MALHEUR AGRICULTURAL
EXPERIMENT STATION

# Alfalfa, Corn, Onions, Grains, Sugar Beets, Miscellaneous Crops, and Potatoes Research

Special Report 832
February 1988

Agricultural Experiment Station
Oregon State University
Corvallis

MALHEUR AGRICULTURAL EXPERIMENT STATION

1987

R E S E A R C H

ALFALFA
CORN
ONIONS
GRAINS
SUGAR BEETS
MISCELLANEOUS CROPS
POTATOES

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Agricultural Experiment Station
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# MALHEUR EXPERIMENT STATION
# OREGON STATE UNIVERSITY
# ONTARIO, OREGON

The Agricultural Experiment Station of Oregon State University was established 100 years ago at Corvallis, Oregon. The Hatch Act of 1887 provided annual funding for agricultural research at Land Grant Universities. The original Oregon experiment station was started in 1888 at Corvallis, on 35 acres and had a single laboratory. Currently, branch experiment stations are located at Aurora, Hood River, Moro, Hermiston, Pendleton, Union, Burns, Redmond, Medford, Klamath Falls, and Ontario.

## Local History

In 1942 local farmers asked Oregon State University to establish a branch experiment station in Malheur County. Money was raised locally to buy the land which was eventually deeded to OSU in the mid-1950's. Research operations began in 1942. Neil Hoffman was the first superintendent of the Malheur Experiment Station from 1946 to 1977.

## Facilities

The Malheur Experiment Station includes 120 acres of row crop land and field equipment appropriate to research on onions, sugar beets, potatoes, small grains, alfalfa seed, and weed control research. Specialized facilities include an onion storage, onion artificial drier, potato storage, potato quality laboratory, and weather station. The potato quality laboratory emphasizes determinations of potato specific gravity and dark-end fry color. Nitrogen analyses are made in the laboratory for wheat and alfalfa research.

## Research Support

The Idaho-Eastern Oregon Onion Committee provides support for onion research project on the station. Projects target onion thrips, weed control, and reduction of *Botrytus* neck rot. Variety evaluations seek new varieties. A study of onions for export addresses how heat treatment before storage or after packing could improve the quality of onions delivered at Pacific rim markets.

The Oregon Potato Commission supports research on potato variety evaluations and on cultural practices to reduce potato "dark-ends." Potato acreage was lost in the Treasure Valley when the 1985 crop suffered a high incidence of "dark-ends." Irrigation studies seek to minimize the dark-end problem by finding ways to reduce plant water stress. Soil management studies are directed at improving water infiltration to keep potato plants at lower levels of moisture stress.

The Nyssa Nampa Sugar Beet Growers Association supports research that includes mildew control, seed emergence, variety evaluations, weed control, and irrigation needs.

Other grower associations providing indispensable support to Malheur Experiment Station research include the Idaho Alfalfa Seed Growers Association, the Mint Growers Association, the Nevada Seed Council, the Oregon Processed Vegetable Commission, and the Oregon Wheat Commission.

## Partnerships

Lynn Jensen and Ben Simko of the Oregon State University Extension Service work closely with Malheur Experiment Station staff on crop production problems. Experiments on onions, potatoes, and alfalfa are designed and evaluated cooperatively.

Faculty at OSU at Corvallis cooperate on the potato variety development program, alfalfa seed management, soybean research, and weed control research. Alvin Mosley leads the potato variety development program. Dan Hane, Steve James, and Ken Rykbost at Hermiston, Redmond, and Klamath Falls round out the statewide potato evaluation teams. Jim Vomocil at OSU is working on soil physical problems that restrict water infiltration related to sugar-end potatoes. Zoe Ann Holmes, an OSU foods and nutrition scientist, cooperates with sugar-end research looking at the reducing sugars, sucrose, and total tuber solids. Bill Stephen conducts entomological research related to alfalfa seed production at Corvallis, at the Malheur Experiment Station, and elsewhere.

Charles Stanger continues to evaluate alternative weed control practices on many Treasure Valley crops. Dr. Stanger's weed control work has the cooperation of many company representatives and grower associations. A goal of weed control research is to find herbicides or herbicide combinations that control weeds without significant crop injury.

The University of Idaho and private industry actively cooperate with several research projects. Joe Pavek of the University of Idaho provides new potato crosses for evaluation in the potato variety development program. Other contributiors are listed below.

Clint

Clinton C. Shock
Superintendent

## CONTRIBUTORS

### MALHEUR COUNTY OFFICE, OSU EXTENSION SERVICE PERSONNEL:

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| Jensen, Lynn | Assistant Professor |
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GROWERS ASSOCIATIONS SUPPORTING RESEARCH

Idaho Alfalfa Seed Growers Association
Idaho-Eastern Oregon Onion Committee
Malheur County Potato Growers
Mint Growers Association
Nevada Seed Council
Nyssa Nampa Beet Growers Association
Oregon Potato Commission
Oregon Processed Vegetable Commission
Oregon Wheat Commission

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# WEATHER REPORT

Charles R. Burnett
Malheur Experiment Station
Oregon State University
Ontario, Oregon, 1987

Observation of air temperature and precipitation at the Malheur Experiment Station began in 1943. Installation of additional equipment in 1948 allowed evaporation and wind measurements, and a recording soil thermometer was added in 1967. Electronic devices acquired in 1985 monitor growing degree days and solar radiation.

Malheur Experiment Station began cooperating with the weather forecasting service of the U.S. Department of Commerce, Environmental Science Service Administration, in 1962. Every day at 8:00 a.m., air and soil temperature extremes and accumulated precipitation for the previous 24 hours are recorded and transmitted to radio station KSRV in Ontario. KSRV conveys this information, along with their daily readings, to the Boise, Idaho, Weather Bureau. Evaporation, wind, and water temperature are also monitored during the irrigation season.

Warm and dry summarize the weather during 1987. Air and soil temperatures exceeded 10-year averages for nine months (Table 6, Figure 1). The year began with the driest winter in 10 years (Table 2) and experienced a 79-day period without rainfall from August 14 to November 1. Total precipitation of 9.81 inches made 1987 the fourth consecutive year with below-average moisture (Table 1).

Wind during the irrigation season followed the pattern established in 1986 and totalled 13,714 miles, well below the 1980 - 1985 totals (Table 3). Evaporation was high all season and totalled a record 62.95 inches.

The 1987 growing season lasted 173 days, two weeks longer than average (Table 4). Temperatures ranged from 2$^{o}$F on January 20 to 99$^{o}$F on five days in July and August (Table 5).

Table 1. Precipitation in inches at the Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Day | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .13 | .16 | | | .29 | | | | | | .10 | .09 | |
| 2 | .52 | T | | | .07 | | .57 | | | | .02 | .16 | |
| 3 | | .06 | T | | | | | | | | .01 | .39 | |
| 4 | .05 | | | | | | | | | | | | |
| 5 | | | | | | T | | | | | | T | |
| 6 | | | .18 | | | | | | | | | .02 | |
| 7 | | | .47 | | | T | | | | | | .04 | |
| 8 | | | | | | .09 | | | | | | | |
| 9 | T | | | T | | .37 | | | | | T | .19 | |
| 10 | T | T | | | T | .06 | | | | | .25 | .23 | |
| 11 | | | .05 | T | | | | | | | .02 | .02 | |
| 12 | | T | .02 | T | | .16 | | | | | .35 | | |
| 13 | | .26 | .16 | | | | | T | | | .25 | | |
| 14 | .04 | .17 | | | | | | .60 | | | .15 | | |
| 15 | T | T | .08 | | | T | | | | | T | | |
| 16 | | .09 | | | .29 | .11 | T | | | | | | |
| 17 | | | | | | .10 | | | | | | | |
| 18 | | T | .40 | | | .01 | | | | | | | |
| 19 | | | .01 | | | .06 | | | | | | | |
| 20 | | | | | | | | | | | | | |
| 21 | | | | | | | | | | | T | .01 | |
| 22 | | | | | | T | T | | | | | | |
| 23 | | .03 | | | | | T | | | | .02 | | |
| 24 | .06 | | | | T | | | | | | | | |
| 25 | .27 | | | | | | | | | | .23 | | |
| 26 | .15 | | | | .10 | | | | | | | | |
| 27 | | | T | | .61 | | | | | | | | |
| 28 | .02 | | | | T | | | | | | | .07 | |
| 29 | | | | .06 | | | | | | | | .12 | |
| 30 | | | | .02 | | | | | | | | .12 | |
| 31 | | | | | T | | | | | | | | |
| 1987 Total | 1.24 | .77 | 1.37 | .08 | 1.36 | .96 | .57 | .60 | 0 | 0 | 1.40 | 1.46 | 9.81 |
| 10-Year Average | 1.27 | 1.38 | 1.40 | .85 | .92 | .84 | .36 | .50 | .68 | .62 | 1.26 | 1.70 | 11.79 |
| 30-Year Average | 1.32 | 1.03 | .98 | .69 | .86 | .77 | .24 | .52 | .64 | .63 | 1.25 | 1.41 | 10.34 |

Table 2. Fall and winter precipitation - October through March for 1977 - 1987 at the Malheur Experiment Station, OSU, Ontario, Oregon.

| Month | 1977 -78 | 1978 -79 | 1979 -80 | 1980 -81 | 1981 -82 | 1982 -83 | 1983 -84 | 1984 -85 | 1985 -86 | 1986 -87 | 30 Year Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | inches | | | | | | | | | | |
| October | .18 | .01 | 1.21 | .17 | .93 | 2.06 | .33 | .63 | .71 | .12 | .66 |
| November | 1.85 | .61 | 1.18 | .84 | 2.76 | .91 | 2.08 | 1.59 | 1.05 | .22 | 1.22 |
| December | 1.81 | .72 | .97 | 1.73 | 3.53 | 3.08 | 3.57 | .84 | .92 | .22 | 1.41 |
| January | 2.33 | 1.93 | 1.28 | 1.07 | 1.73 | 1.46 | .58 | .11 | .96 | 1.24 | 1.32 |
| February | 1.70 | 1.82 | 1.50 | 1.35 | 1.83 | 1.48 | .72 | .36 | 2.29 | .77 | 1.03 |
| Total | 7.87 | 5.09 | 6.14 | 5.16 | 10.78 | 8.99 | 7.28 | 3.53 | 5.93 | 2.57 | 5.65 |
| March | .53 | .85 | 1.54 | 1.85 | .68 | 3.73 | 1.36 | .89 | 1.24 | 1.37 | .98 |
| Total | 8.40 | 5.94 | 7.68 | 7.01 | 11.46 | 12.72 | 8.64 | 4.42 | 7.17 | 3.94 | 6.65 |

Table 3. Evaporation in inches from a free water surface and total wind mileage immediately above the evaporation pan for the seven-month period comprising the irrigation season for 1978-1987. Malheur Experiment Station, OSU, Ontario, Oregon.

| Month | | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 40 Year Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Wind and Evaporation | | | | | | | | | | |
| | | miles/inches | | | | | | | | | | |
| April | W[1] | 1856 | 1806 | 2808 | 2634 | 3164 | 3030 | 4405 | 2823 | 2308 | 2354 | 2070 |
| | E[2] | 4.03 | 6.20 | 6.90 | 5.95 | 6.19 | 5.46 | 7.14 | 7.22 | 5.80 | 8.13 | 5.43 |
| May | W | 3444 | 2826 | 2693 | 3523 | 3632 | 3073 | 3425 | 2734 | 2321 | 2432 | 1811 |
| | E | 7.61 | * | 6.56 | 8.64 | 9.85 | 8.99 | 7.61 | 8.93 | 8.31 | 9.55 | 7.27 |
| June | W | 1173 | 2180 | 2153 | 2250 | 2275 | 2707 | 2985 | 2492 | 1789 | 1898 | 1419 |
| | E | 8.90 | * | 8.40 | 8.31 | 9.32 | 10.23 | 9.64 | 10.86 | 10.91 | 9.51 | 8.59 |
| July | W | 1909 | 1934 | 2130 | 1976 | 2092 | 2284 | 2152 | 2111 | 2130 | 2161 | 1344 |
| | E | 11.51 | 11.44 | 10.64 | 11.76 | 9.74 | 10.60 | 11.69 | 12.68 | 12.00 | 11.46 | 10.91 |
| August | W | 918 | 1476 | 2687 | 1859 | 2005 | 1829 | 2147 | 2430 | 1740 | 1938 | 1218 |
| | E | 9.25 | 9.09 | 11.45 | 11.87 | 10.56 | 9.55 | 11.39 | 10.58 | 11.61 | 11.08 | 9.30 |
| September | W | 1593 | 1853 | 1749 | 1855 | 2488 | 2717 | 2351 | 2268 | 1413 | 1620 | 1147 |
| | E | 5.23 | 8.82 | 5.59 | 7.77 | 6.68 | 8.59 | 7.13 | 5.73 | 5.05 | 8.30 | 5.87 |
| October | W | 1601 | 2468 | 1998 | 1907 | 2244 | 2102 | 2290 | 2237 | 1544 | 1311 | 1155 |
| | E | 3.94 | 4.04 | 3.80 | 3.31 | 4.05 | 4.26 | 3.89 | 3.47 | 3.95 | 4.92 | 2.83 |
| Total | W | 13494 | 14543 | 16218 | 16004 | 17900 | 17742 | 19755 | 17095 | 13245 | 13714 | 10178 |
| | E | 50.47 | | 53.34 | 57.61 | 56.39 | 57.68 | 58.49 | 59.47 | 57.63 | 62.95 | 50.10 |

* Evaporation pan being repaired.

[1] W = Wind (mileage per month).

[2] E = Evaporation (inches per month).

Table 4. Dates of latest frosts in the spring and earliest frosts in the fall at the Malheur Experiment Station, OSU, Ontario, Oregon, 1958-87.

| Year | Latest Frost in Spring Date | Temp-°F | First Frost in Fall Date | Temp-°F | Frost-Free Period Days |
|---|---|---|---|---|---|
| 1958 | Apr 27 | 31 | Oct 21 | 25 | 176 |
| 1959 | May 3 | 30 | Oct 26 | 28 | 175 |
| 1960 | May 22 | 27 | Oct 13 | 27 | 143 |
| 1961 | May 5 | 31 | Sept 22 | 30 | 139 |
| 1962 | Apr 30 | 26 | Oct 18 | 30 | 170 |
| 1963 | Apr 21 | 28 | Oct 26 | 27 | 187 |
| 1964 | May 4 | 28 | Oct 4 | 32 | 152 |
| 1965 | May 5 | 30 | Sept 17 | 30 | 134 |
| 1966 | May 23 | 31 | Oct 10 | 29 | 139 |
| 1967 | May 11 | 32 | Oct 16 | 31 | 158 |
| 1968 | May 6 | 30 | Oct 3 | 31 | 149 |
| 1969 | Apr 30 | 28 | Oct 5 | 30 | 157 |
| 1970 | May 11 | 27 | Sept 25 | 30 | 136 |
| 1971 | Apr 8 | 28 | Sept 18 | 30 | 162 |
| 1972 | May 1 | 30 | Sept 26 | 30 | 146 |
| 1973 | May 11 | 31 | Oct 3 | 31 | 144 |
| 1974 | May 18 | 30 | Oct 6 | 27 | 140 |
| 1975 | May 25 | 27 | Oct 24 | 23 | 151 |
| 1976 | Apr 29* | 33 | Oct 5 | 32 | 158 |
| 1977 | Apr 20 | 29 | Oct 8 | 29 | 170 |
| 1978 | Apr 23 | 31 | Oct 14 | 30 | 173 |
| 1979 | Apr 19 | 32 | Oct 28 | 32 | 191 |
| 1980 | Apr 13 | 32 | Oct 17 | 28 | 186 |
| 1981 | Apr 14 | 27 | Oct 4 | 30 | 172 |
| 1982 | May 5 | 30 | Oct 5 | 32 | 152 |
| 1983 | Apr 27 | 31 | Sept 20 | 29 | 145 |
| 1984 | May 7 | 31 | Sept 25 | 26 | 140 |
| 1985 | May 13 | 32 | Sept 29 | 25 | 138 |
| 1986 | May 23 | 32 | Oct 12 | 25 | 142 |
| 1987 | Apr 21 | 29 | Oct 11 | 28 | 173 |
| 30 Yr Avg | May 4 | 30 | Oct 7 | 29 | 157 |

*On June 26, 1976, a severe killing frost in other areas around the valley shortened the growing season to 100 days.

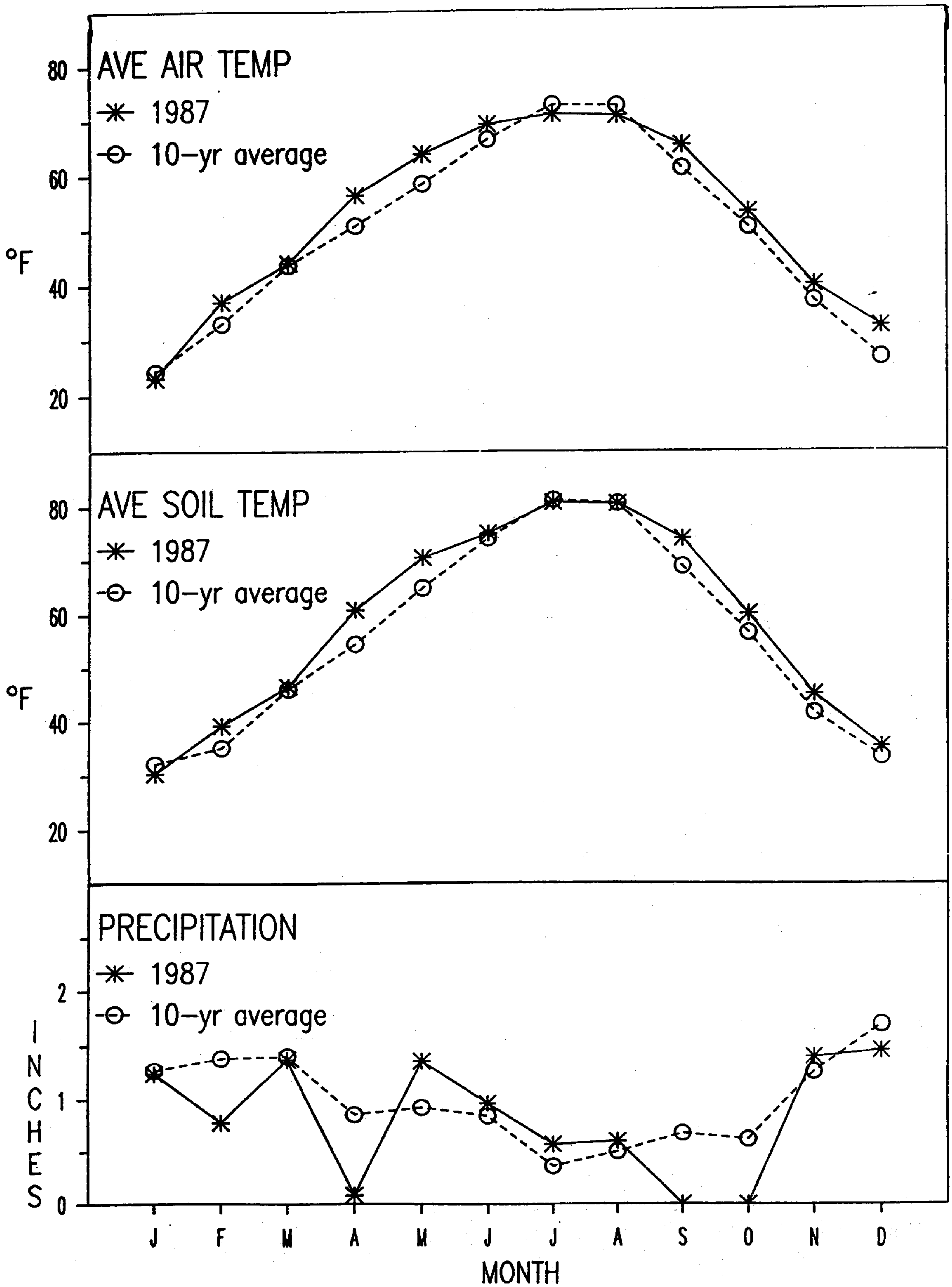
Table 5. Summary of weather recorded at the Malheur Experiment Station, OSU, Ontario, Oregon 1983-1987.

| Event | 1983 | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|---|
| Total Precipitation (inches) | 16.87 | 9.49 | 7.89 | 8.64 | 9.81 |
| Total Snowfall (inches) | 35.10 | 12.5 | 33.4 | 13.0 | 15.5 |
| First Snow in Fall | Nov 22 | Nov 27 | Nov 9 | Dec 19 | Nov 25 |
| Coldest Day of the Year | Dec 23, 24, & 25<br>-10°F | Jan 18, 19, & 20<br>-11°F | Feb 4<br>-17°F | Jan 7<br>-2°F | Jan 20<br>2°F |
| Hottest Day of the Year | Aug 8<br>104°F | July 26<br>103°F | July 21 & 28<br>102°F | Aug 10<br>101°F | July 15, 16, 27, & 28<br>Aug 10<br>99°F |
| Days 0°F or Below | 8 | 10 | 36 | 5 | 0 |
| Days 32°F or Below | 94 | 160 | 165 | 132 | 139 |
| Days 100°F or Above | 3 | 2 | 6 | 6 | 0 |
| Days 90°F or Above | 33 | 51 | 47 | 62 | 59 |
| Last Killing Frost in Spring | Apr 27<br>31°F | May 7<br>31°F | May 13<br>32°F | May 23<br>32°F | April 21<br>29°F |
| First Killing Frost in Fall | Sept 20<br>29°F | Sept 25<br>26°F | Sept 29<br>25°F | Oct 12<br>25°F | Oct 11<br>28°F |
| Days Frost-Free Growing Season | 146 | 140 | 139 | 142 | 173 |
| Number of Clear Days | 114 | 119 | 143 | 154 | 171 |
| Number of Partly Cloudy Days | 175 | 167 | 162 | 153 | 147 |
| Number of Cloudy Days | 75 | 80 | 60 | 58 | 47 |
| Greatest Amount of Snow on the Ground at One Time (date & inches) | 15"<br>Dec 31 | 11"<br>Jan 1 | 10"<br>Feb 2 | 10"<br>Jan 5-9 | 6"<br>Jan 2 |
| Dates of Severe Wind Storms | None | May 30 | June 19, July 29, & Aug 18 | None | June 16 |

Table 6. Average maximum, average minimum, and mean air and four-inch soil temperatures for 1987, and multi-year mean air and soil temperatures at the Malheur Experiment Station, OSU, Ontario, Oregon.

| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | - - - - - - - | - - - - - | - - - - | Average Air Temperatures, °F | | | | | - - - | - - - - | - - - - | - - - - |
| Maximum | 31.9 | 45.9 | 55.2 | 72.8 | 77.8 | 84.4 | 86.9 | 88.3 | 84.2 | 71.6 | 49.6 | 40.6 |
| Minimum | 14.4 | 28.1 | 32.9 | 39.9 | 49.9 | 54.1 | 55.5 | 53.4 | 46.5 | 34.6 | 30.0 | 23.8 |
| 1987 Mean | 23.1 | 37.0 | 44.0 | 56.4 | 63.9 | 69.3 | 71.2 | 70.9 | 65.4 | 53.1 | 39.8 | 32.2 |
| 10 Year Mean | 24.2 | 33.0 | 43.6 | 50.8 | 58.5 | 66.5 | 72.9 | 72.7 | 61.2 | 50.3 | 36.9 | 26.5 |
| 45 Year Mean | 26.7 | 34.7 | 42.4 | 50.6 | 59.0 | 66.9 | 74.6 | 72.5 | 62.6 | 50.7 | 38.1 | 29.6 |
| | - - - - - - - | - - - - - | - - - - | Average Soil Temperatures °F | | | | | - - - | - - - - | - - - - | - - - - |
| Maximum | 30.5 | 42.5 | 51.5 | 68.4 | 78.3 | 83.0 | 88.2 | 87.6 | 81.0 | 65.7 | 47.3 | 36.1 |
| Minimum | 30.0 | 35.9 | 41.5 | 53.2 | 62.7 | 66.9 | 73.4 | 73.3 | 67.0 | 54.4 | 42.4 | 34.1 |
| 1987 Mean | 30.3 | 39.2 | 46.5 | 60.8 | 70.5 | 75.0 | 80.8 | 80.5 | 74.0 | 60.0 | 44.9 | 35.1 |
| 10 Year Mean | 32.1 | 35.1 | 46.0 | 54.5 | 64.9 | 74.1 | 81.2 | 80.6 | 68.8 | 56.5 | 41.4 | 33.1 |
| 21 Year Mean | 32.0 | 35.9 | 45.3 | 54.6 | 66.2 | 75.1 | 82.5 | 81.1 | 69.9 | 55.3 | 41.1 | 33.4 |

Figure 1. Monthly averages of air and four-inch soil temperatures and precipitation for 1987 compared with 10-year averages. Malheur Experiment Station, OSU, Ontario, Oregon.



# FIVE YEAR ALFALFA FORAGE YIELD STUDY, 1983-1987

Charles Burnett and Ben Simko

Malheur Experiment Station, Oregon State University
Malheur County Office, Extension Service
Ontario, Oregon, 1987

## Purpose

Alfalfa forage yields vary with variety, cultural practices, and weather. The performance of a specific variety depends upon its adaptation to local environmental conditions and its degree of resistance to locally occurring diseases and pests. The purpose of this trial was to identify those varieties which yield well in the Treasure Valley.

## Cultural Practices

An alfalfa forage yield trial was planted on September 14, 1982, and harvested for five years until it was disked up on November 23, 1987. Plots were hand-seeded at the rate of 15.6 pounds per acre on an Owyhee silt loam soil. On March 10, 1983, the entries Emeraude and Armor were replanted due to inadequate stands.

A wheat crop preceded the trial. Five hundred pounds of $P_2O_5$ and 60 pounds of N per acre were plowed down with the stubble before seedbed preparation. No further fertilizer was applied during the course of the experiment. Irrigation water was applied through corrugates on 30-inch centers. Generally 12-hour irrigations occurred the day after each cutting and again two and one-half weeks later.

The alfalfa was managed on a four-cutting-per-season schedule. Harvests coincided with plant growth stages between late bud and 10 percent bloom. Weeds were initially controlled by a broadcast spray application of one pound active ingredient 2, 4-DB plus one-half pound active ingredient Fusilade with one quart activated oil per acre in March 1983. An annual broadcast spray application of one pound active ingredient Velpar per acre in the fall or winter controlled weeds in the established alfalfa. Insects were generally not controlled.

## Experimental Procedures

Nine public and twenty-one private alfalfa varieties and brands were arranged in a randomized complete block experimental design with four replications.

Each 5- by 20-foot alfalfa plot was separated from neighboring plots by 30-inch bare soil alleys. In 1983 entire plots were harvested with a sickle bar mower and weighed to determine yields. Beginning in 1984 yields were determined by harvesting a 3-foot by 20-foot strip centered in each plot to eliminate yield exaggeration due to border effects.

In 1983 and 1984 moisture percentages for yield calculation were determined from forage samples from each plot. Analysis of moisture data from several harvests revealed no correlation between percent moisture and variety, block, row, or hour of harvest. Beginning in 1985, therefore, twelve plots located at regular intervals within the trial were sampled as they were harvested. The average moisture percentage from these samples was used to calculate yields from all plots.

## Disease and Insect Pest Observations

Over the course of the trial several opportunities arose to evaluate the entries' reactions to diseases and insects. Reactions to downy mildew (*Peronospora trifoliorum*) among entries in May 1983 ranged from moderately susceptible to resistant (Table 1). During an August 1984 infestation of spotted alfalfa aphids (*Therioaphis maculata* (Buckton)) the alfalfa varieties demonstrated distinct differences in severity of damage. Counts of pea aphids did not differ among varieties in June 1985. Low incidences of alfalfa mosaic virus, verticillium wilt (*Verticillium albo-atrum*), and sclerotinia wilt (*Sclerotinia trifoliorum*) occurred throughout the trial. Table 6 presents disease and insect resistance information obtained from PNW 244 "Selecting Alfalfa Varieties for the Pacific Northwest" and the Certified Alfalfa Seed Council publication "1987 Alfalfa Varieties."

Stem nematodes (*Ditylenchus dipsaci*) were first noted in 1984 in minor infestations involving 13 of the alfalfa entries (Table 2). By spring of the third season stem nematode infestations were observed in all entries and occupied one-half of the plot area of the suseptible variety Baker. In March 1986 as much as 80 percent of the plot area of some alfalfa varieties showed symptoms of stem nematode infestation.

Linear regression of that season's data indicates that a stem nematode infestation of 67 percent would reduce seasonal yield by one ton per acre. Though a warm spring reduced symptom expression in 1987, stem nematode infestations were observed to increase in some varieties while remaining stable in others.

## Results and Discussion

Five-year forage yields adjusted to 12 percent moisture averaged 49.4 tons per acre (Table 3). One-third of the entries did not yield significantly less than the high yield of 53.4 tons per acre. Large equipment compaction and harvest losses were minimal compared to typical commercial operations. Irrigation the day after harvest allowed regrowth to commence immediately. Moderately winter-hardy entries tended to grow earlier in the spring and regrow faster after harvests and therefore out-yield winter-hardy entries.

First-season yields averaged 13.0 tons per acre. These very high yields were partially due to border effect, but the alfalfa was very vigorous and yields were noticeably higher than in subsequent seasons. In 1984 spotted alfalfa aphids reduced third-cutting yields of susceptible varieties. Second-cutting yields were low in 1985.

Contributing factors probably included water stress and an infestation of pea aphids. The 1986 average yield of 9.4 tons per acre was a respectable fourth-season performance even though stem nematodes reduced yields of susceptible entries (Table 5). Warm spring weather in 1987 allowed an early first harvest, but seasonal yields averaged one ton per acre below 1986 yields. This yield reduction corresponded with noticeable stand reduction and weed encroachment during the trial's fifth season.

Table 1. Response of alfalfa varieties and brands to Downy Mildew (Peronospora trifoliorum) and Spotted Alfalfa Aphid (Therioaphis maculata). Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Entry | Downy Mildew[1] Infection Rating | Downy Mildew Published Resistance Level[3] | Spotted Alfalfa Aphid[2] Infestation Rating | Spotted Alfalfa Aphid Published Resistance Level |
|---|---|---|---|---|
| Apollo II | 3.6 | LR | 4 | MR |
| Armor | 3.5 | - | 3 | - |
| H-103 | 3.5 | LR | 5 | MR |
| GT-55 (IH-101) | 4.8 | LR | 5 | MR |
| WL 316 | 4.3 | - | 4 | R |
| WL 312 | 3.9 | LR | 5 | R |
| Seagull | 3.6 | MR | 5 | R |
| Pioneer 532 | 4.5 | MR | 5 | HR |
| Pioneer 526 | 4.5 | MR | 5 | HR |
| Pioneer 545 | 2.9 | R | 5 | R |
| RS 209 | 3.4 | LR | 4 | LR |
| Dekalb 120 | 3.8 | - | 1 | S |
| IOSG 8010 | 3.5 | - | 1 | - |
| IOSG 8020 | 4.5 | - | 1 | - |
| Emeraude | 3.8 | MR | 1 | - |
| Classic | 3.6 | - | 3 | LR |
| Hi-phy | 4.3 | - | 3 | S |
| Vancor | 3.5 | MR | 2 | S |
| Trumpetor | 4.1 | MR | 2 | LR |
| Greenway 360 II (Greenway 360) | 4.3 | - | 3 | MR |
| Lahontan | 1.8 | S | 5 | MR |
| Agate | 3.4 | - | 1 | - |
| Baker | 2.6 | LR | 5 | R |
| Perry | 3.3 | MR | 3 | MR |
| Riley | 2.6 | MR | 5 | HR |
| Wrangler (NS 79) | 2.3 | - | 5 | HR |
| NS 82 | 2.8 | - | 5 | - |
| Vernema | 3.8 | - | 3 | MR |
| W-37 | 4.6 | - | 1 | - |

[1] Evaluated by Dr. R. Romanko, University of Idaho, 5/20/83 such that 1 = susceptible and 5 = resistant.

[2] Evaluated 8/3/84 such that 1 = severe crop damage and 5 = no crop damage.

[3] From PNW 244 "Selecting Alfalfa Varieties for the Pacific Northwest" and the Certified Alfalfa Seed Council publication "1987 Alfalfa Varieties."

Table 2. Response of alfalfa varieties and brands to Alfalfa Stem Nematode (<u>Ditylenchus dipsaci</u>). Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Entry | % Plot Area Infested | | | | Published |
|---|---|---|---|---|---|
| | 1984 | 1985 | 1986 | 1987 | Resistance leve |
| Apollo II | 0 | 18 | 60 | 53 | MR |
| Armor | .2 | 18 | 65 | 63 | - |
| H-103 | 0 | 10 | 25 | 45 | MR |
| GT-55 (IH-101) | 0 | 10 | 18 | 25 | MR |
| WL 316 | 0 | 5 | 15 | 30 | MR |
| WL 312 | .8 | 30 | 50 | 48 | MR |
| Seagull | 0 | 11 | 45 | 60 | MR |
| Pioneer 532 | 1.7 | 20 | 58 | 68 | - |
| Pioneer 526 | .9 | 21 | 83 | 83 | - |
| Pioneer 545 | .4 | 10 | 40 | 63 | MR |
| RS 209 | 0 | 13 | 55 | 55 | S |
| Dekalb 120 | .1 | 16 | 33 | 65 | R |
| IOSG 8010 | .3 | 18 | 30 | 53 | - |
| IOSG 8020 | 0 | 18 | 28 | 43 | - |
| Emeraude | 0 | 11 | 13 | 28 | - |
| Classic | 0 | 19 | 43 | 70 | - |
| Hi-phy | .4 | 21 | 55 | 80 | - |
| Vancor | 0 | 10 | 35 | 48 | R |
| Trumpetor | 0 | 16 | 35 | 48 | R |
| Greenway 360 II (Greenway 360) | .1 | 11 | 40 | 50 | LR |
| Lahontan | 0 | 5 | 3 | 13 | R |
| Agate | 1.2 | 19 | 68 | 70 | LR |
| Baker | 14.1 | 49 | 83 | 83 | - |
| Perry | .3 | 9 | 20 | 65 | - |
| Riley | 0 | 15 | 70 | 83 | LR |
| Wrangler (NS 79) | 0 | 13 | 50 | 85 | - |
| NS 82 | 0 | 8 | 63 | 88 | - |
| Vernema | .1 | 11 | 5 | 18 | R |
| W-37 | 0 | 13 | 8 | 30 | - |
| Mean | .7 | 15 | 40 | 54 | |

Table 3. Seasonal forage yields at 12 percent moisture for 1983 through 1987 for 29 alfalfa varieties and brands, Malheur Experiment Station, OSU, Ontario, Oregon.

| | Harvest Season | | | | | |
|---|---|---|---|---|---|---|
| | 1983 | 1984 | 1985 | 1986 | 1987 | Total[1] |
| Variety | Tons/Acre | | | | | |
| Apollo II* | 13.5 | 10.5 | 8.3 | 9.8 | 8.7 | 50.8 |
| Armor* | 13.7 | 10.2 | 8.2 | 9.8 | 8.7 | 50.6 |
| H-103 | 13.4 | 10.5 | 9.0 | 10.4 | 9.1 | 52.2 |
| GT-55 (IH-101) | 13.5 | 10.4 | 8.7 | 10.6 | 10.2 | 53.4 |
| WL 316* | 13.3 | 11.2 | 8.1 | 10.2 | 9.1 | 51.9 |
| WL 312 | 14.2 | 9.9 | 8.3 | 9.9 | 9.0 | 51.4 |
| Seagull | 13.2 | 11.2 | 9.2 | 9.8 | 8.5 | 51.8 |
| Pioneer 532* | 13.1 | 10.6 | 7.9 | 8.5 | 7.5 | 47.6 |
| Pioneer 526* | 12.9 | 10.6 | 8.3 | 8.2 | 7.8 | 47.7 |
| Pioneer 545* | 13.2 | 10.9 | 8.5 | 9.9 | 8.4 | 50.8 |
| RS 209 | 13.6 | 10.2 | 8.6 | 9.7 | 8.8 | 50.9 |
| Dekalb 120* | 13.8 | 10.6 | 8.1 | 9.2 | 8.3 | 50.1 |
| IOSG 8010 | 14.1 | 10.2 | 7.6 | 8.9 | 8.0 | 48.9 |
| IOSG 8020 | 12.1 | 9.6 | 7.3 | 9.0 | 8.5 | 46.5 |
| Emeraude | 10.0 | 10.4 | 7.8 | 8.4 | 8.2 | 44.8 |
| Classic* | 13.7 | 10.6 | 8.2 | 9.3 | 7.9 | 49.7 |
| Hi-phy* | 13.6 | 10.7 | 8.1 | 9.4 | 7.7 | 49.4 |
| Vancor* | 13.1 | 9.6 | 7.8 | 9.2 | 8.7 | 48.5 |
| Trumpetor* | 13.0 | 10.4 | 8.0 | 9.4 | 9.2 | 49.9 |
| Greenway 360II (Greenway 360) | 14.0 | 11.5 | 8.6 | 10.0 | 8.9 | 52.9 |
| Lahontan* | 11.6 | 10.6 | 8.7 | 10.3 | 9.1 | 50.2 |
| Agate* | 12.0 | 9.2 | 7.7 | 8.9 | 8.1 | 45.8 |
| Baker* | 11.6 | 10.3 | 7.9 | 8.0 | 7.7 | 45.5 |
| Perry* | 13.7 | 9.8 | 8.3 | 9.4 | 7.8 | 49.0 |
| Riley* | 12.5 | 11.0 | 7.9 | 8.3 | 7.2 | 46.7 |
| Wrangler*(NS 79) | 12.4 | 10.4 | 8.7 | 9.2 | 7.3 | 47.9 |
| NS 82 | 12.0 | 10.3 | 9.2 | 9.0 | 7.7 | 48.1 |
| Vernema* | 13.2 | 10.3 | 8.3 | 9.9 | 9.3 | 51.0 |
| W-37 | 12.7 | 8.9 | 6.8 | 8.7 | 9.3 | 46.5 |
| Mean | 13.0 | 10.4 | 8.2 | 9.4 | 8.5 | 49.4 |
| LSD (.05) | 1.3 | .6 | .9 | .9 | .9 | 2.7 |
| (.01) | 1.7 | .8 | 1.0 | 1.0 | 1.1 | 3.6 |
| CV (%) | 6.8 | 4.1 | 7.5 | 6.6 | 7.2 | 3.9 |

*Approved for certification by the Alfalfa Variety Review Board.

1 Five-year total yields of the top 10 performing entries do not differ significantly from the highest-yielding alfalfa, GT-55, at the 5% level of confidence.

Table 4. Forage yields of 29 alfalfa varieties and brands as a percent of Lahontan's yield for 1983 through 1987. Malheur Experiment Station, OSU, Ontario, Oregon.

| | Harvest Season | | | | | |
|---|---|---|---|---|---|---|
| | 1983 | 1984 | 1985 | 1986 | 1987 | Total[1] |
| Variety | % Lahontan | | | | | |
| Apollo II* | 117 | 99 | 95 | 95 | 96 | 101 |
| Armor* | 118 | 96 | 94 | 95 | 96 | 101 |
| H-103 | 115 | 99 | 103 | 101 | 100 | 104 |
| GT-55 (IH-101) | 117 | 98 | 100 | 103 | 112 | 106 |
| WL 316* | 115 | 106 | 93 | 99 | 100 | 103 |
| WL 312 | 123 | 93 | 95 | 96 | 99 | 102 |
| Seagull | 114 | 106 | 106 | 95 | 93 | 103 |
| Pioneer 532* | 113 | 100 | 91 | 83 | 82 | 95 |
| Pioneer 526* | 112 | 100 | 95 | 80 | 86 | 95 |
| Pioneer 545* | 114 | 103 | 98 | 96 | 92 | 101 |
| RS 209 | 118 | 96 | 99 | 94 | 97 | 101 |
| Dekalb 120* | 119 | 100 | 93 | 89 | 91 | 100 |
| IOSG 8010 | 122 | 96 | 87 | 86 | 88 | 97 |
| IOSG 8020 | 105 | 91 | 84 | 87 | 93 | 93 |
| Emeraude | 86 | 98 | 90 | 82 | 90 | 89 |
| Classic* | 118 | 100 | 94 | 90 | 87 | 99 |
| Hi-phy* | 117 | 101 | 93 | 91 | 85 | 98 |
| Vancor* | 113 | 91 | 90 | 89 | 96 | 97 |
| Trumpetor* | 112 | 98 | 92 | 91 | 101 | 99 |
| Greenway 360II (Greenway 360) | 121 | 108 | 99 | 97 | 98 | 105 |
| Lahontan* | 100 | 100 | 100 | 100 | 100 | 100 |
| Agate* | 104 | 87 | 89 | 86 | 89 | 91 |
| Baker* | 100 | 97 | 91 | 78 | 85 | 91 |
| Perry* | 118 | 92 | 95 | 91 | 86 | 98 |
| Riley* | 108 | 104 | 91 | 81 | 79 | 93 |
| Wrangler*(NS 79) | 107 | 98 | 100 | 89 | 80 | 95 |
| NS 82 | 104 | 97 | 106 | 87 | 85 | 96 |
| Vernema* | 114 | 97 | 95 | 96 | 102 | 102 |
| W-37 | 110 | 84 | 78 | 84 | 102 | 93 |
| Mean | 112 | 98 | 94 | 91 | 93 | 98 |
| LSD (.05) | 11 | 6 | 10 | 9 | 10 | 5 |
| (.01) | 15 | 8 | 11 | 10 | 12 | 7 |

*Approved for certification by the Alfalfa Variety Review Board.

1 Five-year total yields of the top 10 performing entries do not differ significantly from the highest-yielding alfalfa, GT-55, at the 5% level of confidence.

Table 5. Alfalfa forage yields at 12 percent moisture during 1987. Malheur Experiment Station, OSU, Ontario, Oregon.

| | Harvest Date | | | | |
|---|---|---|---|---|---|
| Variety | May 12 | June 23 | July 22 | Sept. 4 | Total |
| | Tons/Acre | | | | |
| Apollo II | 2.8 | 2.4 | 1.8 | 1.8 | 8.7 |
| Armor | 2.8 | 2.4 | 1.8 | 1.8 | 8.7 |
| H-103 | 2.8 | 2.5 | 1.9 | 1.9 | 9.1 |
| GT-55 (IH-101) | 3.2 | 2.8 | 2.1 | 2.0 | 10.2 |
| WL 316 | 2.8 | 2.6 | 2.0 | 1.8 | 9.1 |
| WL 312 | 2.8 | 2.5 | 1.9 | 1.9 | 9.0 |
| Seagull | 2.5 | 2.3 | 1.9 | 1.9 | 8.5 |
| Pioneer 532 | 2.5 | 1.9 | 1.6 | 1.6 | 7.5 |
| Pioneer 526 | 2.6 | 1.9 | 1.6 | 1.7 | 7.8 |
| Pioneer 545 | 2.6 | 2.2 | 1.8 | 1.8 | 8.4 |
| RS 209 | 2.8 | 2.3 | 1.8 | 1.8 | 8.8 |
| Dekalb 120 | 2.7 | 2.2 | 1.7 | 1.7 | 8.3 |
| IOSG 8010 | 2.5 | 2.3 | 1.6 | 1.6 | 8.0 |
| IOSG 8020 | 2.8 | 2.6 | 1.8 | 1.4 | 8.5 |
| Emeraude | 2.5 | 2.4 | 1.8 | 1.5 | 8.2 |
| Classic | 2.5 | 2.1 | 1.7 | 1.7 | 7.9 |
| Hi-phy | 2.5 | 1.9 | 1.7 | 1.6 | 7.7 |
| Vancor | 2.8 | 2.4 | 1.7 | 1.8 | 8.7 |
| Trumpetor | 2.9 | 2.7 | 1.8 | 1.8 | 9.2 |
| Greenway 360II (Greenway 360) | 2.7 | 2.5 | 1.9 | 1.8 | 8.9 |
| Lahontan | 2.5 | 2.5 | 2.1 | 2.0 | 9.1 |
| Agate | 2.7 | 2.2 | 1.6 | 1.6 | 8.1 |
| Baker | 2.5 | 1.9 | 1.5 | 1.8 | 7.7 |
| Perry | 2.5 | 2.0 | 1.6 | 1.7 | 7.8 |
| Riley | 2.4 | 1.7 | 1.4 | 1.6 | 7.2 |
| Wrangler (NS 79) | 2.3 | 1.9 | 1.6 | 1.6 | 7.3 |
| NS 82 | 2.5 | 1.8 | 1.5 | 1.8 | 7.7 |
| Vernema | 2.8 | 2.7 | 2.0 | 1.9 | 9.3 |
| W-37 | 3.0 | 2.9 | 1.9 | 1.5 | 9.3 |
| Mean | 2.7 | 2.3 | 1.8 | 1.8 | 8.5 |
| LSD (.05)* | .4 | .3 | .2 | .2 | .9 |
| (.01)* | .5 | .5 | .2 | .2 | 1.1 |
| CV (%) | 9.9 | 10.6 | 6.4 | 6.3 | 7.2 |

* Variety differences in forage yield are highly significant for all harvests.

Table 6. Published disease and insect resistance levels for alfalfa varieties and brands planted at the Malheur Experiment Station 1983 - 1987, OSU, Ontario, Oregon, 1987.

| Seed Source | Variety | Release Year | WH | BW | FW | VW | PRR | AN | DM | AW | PA | SAA | LH | RKN | SN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Public | | | | | | | | | | | | | | | |
| NV/USDA | Lahontan* | 54 | MH | MR | LR | S | LR | | S | S | LR | MR | R | S | R |
| MN/USDA | Agate* | 72 | H | HR | HR | | R | MR | | | LR | | | S | LR |
| NE/USDA | Baker* | 76 | H | HR | R | S | S | LR | LR | LR | HR | R | R | | |
| NE/USDA | Perry* | 79 | H | R | R | S | LR | LR | MR | LR | R | MR | MR | | |
| KS/USDA | Riley* | 77 | H | HR | R | LR | S | MR | MR | S | HR | HR | R | S | LR |
| NE/USDA | Wrangler* | | H | R | R | LR | | LR | | | HR | HR | | | |
| NE/USDA | NS 82 P2 Syn2 | | H | | | | | | | | | | | | |
| WA/USDA | Vernema* | 81 | MH | MR | | MR | LR | S | | | | MR | | | R |
| WA/USDA | W-37 | | MH | S | | R | MR | LR | | | | | | | |
| Private | | | | | | | | | | | | | | | |
| NAPB | Apollo II* | 81 | MH | R | R | MR | HR | MR | LR | | MR | MR | MR | | MR |
| NAPB | Armor* | 81 | MH | R | R | S | R | MR | | | MR | | MR | | |
| Ferry Morse | H 103 | | H | R | R | LR | R | R | LR | | MR | MR | | LR | MR |
| Ferry Morse | GT-55 (IH 101) | 82 | MH | R | MR | MR | R | R | LR | | MR | MR | LR | MR | LR |
| Waterman Loomis | WL 316* | 81 | MH | MR | R | R | MR | HR | | | R | R | | | MR |
| Waterman Loomis | WL 312 | 78 | MH | R | HR | LR | MR | LR | LR | | R | R | | | MR |
| Green Thumb | Seagull | | MH | R | MR | S | R | MR | MR | LR | R | R | S | S | MR |
| Pioneer | 532* | 79 | H | HR | R | | LR | LR | MR | | R | HR | | LR | |
| Pioneer | 526* | 81 | H | HR | MR | | LR | LR | MR | | R | HR | LR | | |
| Pioneer | 545* | 77 | H | R | MR | | R | LR | R | | S | R | LR | LR | MR |
| Dekalb/Ramsey | RS 209 | | H | R | R | | R | R | LR | | R | LR | | S | S |
| Dekalb/Ramsey | Dekalb 120* | 78 | H | HR | R | | R | LR | | | R | S | LR | | R |
| ID-OR Seed Grw. | IOSG 8010 | | | | | | | | | | | | | | |
| ID-OR Seed Grw. | IOSG 8020 | | | | | | | | | | | | | | |
| Shield Seed Co. | Emeraude | 62 | MH | | | | | | MR | S | MR | | | | |
| FFR Coop. | Classic* | 78 | MH | R | R | S | LR | LR | | | | S | MR | | |
| FFR Coop. | Hi-phy* | 78 | MH | HR | HR | S | MR | S | | | | LR | LR | MR | |
| Northrup-King | Vancor* | 80 | H | HR | R | S | MR | R | MR | LR | MR | S | S | | R |
| Northrup-King | Trumpetor* | 81 | MH | MR | HR | MR | LR | R | MR | S | MR | LR | | | R |
| Greenway Seed | Greenway 360 II (Greenway 360) | 81 | | R | MR | LR | R | R | | LR | MR | MR | | | LR |

*Information confirmed by the National Alfalfa Variety Review Board.

WH = Winter Hardiness, BW = Bacterial Wilt, FW = Fusarium Wilt, VW = Verticillium Wilt, PRR = Phytophthora Root Rot, AH = Anthracnose, DM = Downy Mildew, AW = Alfalfa Weevil, PA = Pea Aphid, SAA = Spotted Alfalfa Aphid, LH = Leaf Hopper, RKN = Root Knot Nematode, SN = Stem Nematode.

VH = Very Hardy, H = Hardy, MH = Moderately Hardy, MNH = Moderately Non-Hardy.

Disease and Insect Resistance: 51% = HR (Highly Resistant), 31-50% = R (Resistant), 15-30% = MR (Mode rately Resistant), 6-14% = LR (Low Resistance), 5% = S (Susceptible).

# EXPERIMENTAL DESICCANTS FOR USE IN ALFALFA SEED PRODUCTION

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## Justification

Alfalfa seed harvest is difficult when leaves and stems are green. Seed producers seek to limit green foliage by minimizing irrigations before harvest. Fall rain can delay harvest, stimulate alfalfa regrowth, and result in seed pod dehiscence. Desiccants hasten drying of the plants and allow greater recovery of seed. Fall rains can cause considerable seed loss and prolonged vegetative growth of seed alfalfa.

Dinitro compounds such as Dinoseb, Contac, and Sinox are no longer permitted for use as desiccants. Inexpensive alternative desiccants are urgently needed to replace the dinitro compounds.

## Objective

The objectives of the experiment were to test alternative desiccants for use before harvesting alfalfa seed and to see how crop moisture affects harvesting speed.

## Procedures

Desiccants were applied to alfalfa on June 26, 1987, to screen products and product combinations for use in the fall. A total of 16 desiccant treatments were applied to alfalfa in a vegetative state (Table 1). Products were sprayed using a bicycle sprayer with 45 pounds per square inch pressure and 30 gallons per acre spray volume.

Desiccants were applied September 4 to a mature crop of seed alfalfa using a backpack sprayer, pressure of 45 pounds per square inch, and 30 gallons per acre spray volume (Table 3).

Both experiments were laid out in randomized complete block designs. The preliminary trial had three replicates and the September trial had four replicates. Plot size was 30 by 10 feet. Whole plants were cut two inches above ground immediately proceeding the applications and every two or three days after desiccant application. Each plant sample was weighed fresh, then dried at 70°C for 48 hours to determine the percent water. Subjective evaluations of 0 to 10 were made of crop drying four days after desiccant application.

Seeds from the September desiccant plots were harvested from the center of each plot (120 $ft^2$) using a Wintersteiger small plot harvester to determine if desiccants affect seed quality. The elapsed time necessary to harvest each plot was recorded to see how crop moisture affects harvesting speed.

## Results and Discussion

In the preliminary trial, Dinoseb plus diesel, all combinations of Des-I-Cate and N-Tac were the least effective treatments, whether evaluated by visual observation (Table 1) or by plant water content (Table 2). Diquat was slightly less effective when applied in the afternoon than in the evening.

Diquat and Diquat combinations were among the most rapid and effective desiccants in drying the mature alfalfa seed crop in September (Table 4). Diquat and Diquat mixtures were more efficient than the Dinitro compounds.

Desiccants showed differing patterns of drying. Most of the drying by N-Tac occurred during the first two days. In contrast, Ignite had dried the crop little after two days but dryness continued to improve during the observation period.

Crop water content was not related to seed recovery. The greater the amount of water content in the alfalfa plants, the greater time was necessary to harvest the crop (Table 5). Subjective evaluations of crop dryness were also related to the speed of harvest, the drier alfalfa being faster to harvest.

## Conclusions

Diquat plus Paraquat (not registered) and Diquat plus Enhancer were among the most effective desiccant treatments for alfalfa seed. Diquat tended to be more effective when applied in the evening than in the afternoon. Dinitro compounds at previously registered rates were not superior to Diquat or Diquat mixtures. Alfalfa crop moisture significantly slowed harvesting.

## Acknowledgments

Alfalfa seed crop desiccation research was supported in 1987 by the Nevada Seed Council. Robert and Kelly Peterson provided the experimental site used for the September experiment.

Table 1. Visual ratings of foliar drying of alfalfa June 30, 1987. Desiccants were applied June 26, 1987, at the Malheur Experiment Station, OSU, Ontario, Oregon.

| | | | | Visual Drying Index[1] | | | |
|---|---|---|---|---|---|---|---|
| | | | | Replicate | | | |
| Treatments | Desiccants | Rate | Time of Application | 1 | 2 | 3 | Ave. |
| | | | | - - - - 0-10 - - - | | | |
| 1 | Dinoseb + Diesel | 1.5 qt + 10 gal | Afternoon | 3 | 3 | 4 | 3.3 |
| 2 | Contac + Morac | 3 qt + 1 qt | Afternoon | 9 | 8 | 9 | 8.7 |
| 3 | Sinox + Morac | 3 qt + 1 qt | Afternoon | 9 | 9 | 9 | 9 |
| 4 | Des-I-Cate + Morac | 4 qt + 2 qt | Early Morning | 2 | 3 | 3 | 2.7 |
| 5 | Des-I-Cate + Enhancer | 4 qt + 1 qt | Early Morning | 2 | 3 | 3 | 2.7 |
| 6 | Des-I-Cate + Addit | 4 qt + 6 qt | Early Morning | 4 | 3 | 3 | 3.3 |
| 7 | Ignite | 4 qt | Afternoon | 7 | 5 | 6 | 6 |
| 8 | Diquat + X-77 | 1 qt + 8 oz | Evening | 8 | 7 | 8 | 7.7 |
| 9 | Paraquat + X-77 | 1 qt + 8 oz | Evening | 7 | 7 | 8 | 7.3 |
| 10 | Diquat + Paraquat + X-77 | 1 qt + 1/2 qt + 8 oz | Evening | 9 | 8 | 7 | 8 |
| 11 | Diquat + X-77 | 1.5 qt + 8 oz | Evening | 9 | 9 | 8 | 8.7 |
| 12 | Diquat + X-77 | 1 qt + 8 oz | Afternoon | 7 | 8 | 6 | 7 |
| 13 | Diquat + Enhancer | 1 qt + 1 qt | Evening | 8 | 8 | 8 | 8 |
| 14 | Diquat + Addit | 1 qt + 2 qt | Evening | 7 | 7 | 7 | 7 |
| 15 | Diquat + R900XC | 1 qt + 1 qt | Evening | 6 | 6 | 7 | 6.3 |
| 16 | N-Tac (Enquik) | 10 gal | Afternoon | 3 | 4 | 4 | 3.7 |
| 17 | Check (Control) | | None | 0 | 0 | 0 | 0 |
| | LSD(05) | | | | | | 1.0 |

1. 0 = no impact, 10 = totally desiccated.

Table 2. Moisture retained by alfalfa forage 3, 5, and 7 days after desiccant application on June 26, 1987, Malheur Experiment Station, OSU, Ontario, Oregon.

| | | | | Percent Moisture After | | |
|---|---|---|---|---|---|---|
| Treatments | Desiccants | Rate | Time of Application | 3 Days | 5 Days | 7 Days |
| | | | | - - - - - | % | - - - - - |
| 1 | Dinoseb + Diesel | 1.5 qt + 10 gal | Afternoon | 76 | 75 | 73 |
| 2 | Contac + Morac | 3 qt + 1 qt | Afternoon | 69 | 66 | 64 |
| 3 | Sinox + Morac | 3 qt + 1 qt | Afternoon | 66 | 65 | 59 |
| 4 | Des-I-Cate + Morac | 4 qt + 2 qt | Early Morning | 78 | 76 | 75 |
| 5 | Des-I-Cate + Enhancer | 4 qt + 1 qt | Early Morning | 79 | 76 | 76 |
| 6 | Des-I-Cate + Addit | 4 qt + 6 qt | Early Morning | 78 | 77 | 76 |
| 7 | Ignite | 4 qt | Afternoon | 75 | 71 | 67 |
| 8 | Diquat + X-77 | 1 qt + 8 oz | Evening | 68 | 65 | 59 |
| 9 | Paraquat + X-77 | 1 qt + 8 oz | Evening | 70 | 68 | 66 |
| 10 | Diquat + Paraquat + X-77 | 1 qt + 1/2 qt + 8 oz | Evening | 64 | 59 | 54 |
| 11 | Diquat + X-77 | 1.5 qt + 8 oz | Evening | 64 | 58 | 52 |
| 12 | Diquat + X-77 | 1 qt + 8 oz | Afternoon | 69 | 68 | 62 |
| 13 | Diquat + Enhancer | 1 qt + 1 qt | Evening | 66 | 67 | 60 |
| 14 | Diquat + Addit | 1 qt + 2 qt | Evening | 69 | 68 | 64 |
| 15 | Diquat + R900XC | 1 qt + 1 qt | Evening | 69 | 71 | 67 |
| 16 | N-Tac (Enquik) | 10 gal | Afternoon | 74 | 72 | 71 |
| 17 | Check (Control) | | None | 79 | 76 | 77 |
| | LSD(05) | | | | | 4.8 |

Table 3. Desiccants applied September 4, 1987, to an alfalfa seed crop at Bob Peterson Farm, Ontario Oregon.

| Treatments | Desiccants | Rate | Product per Plot | Time of Application |
|---|---|---|---|---|
| 1 | Dinoseb + Diesel | 1.5 qt + 10 gal | 9.8 ml + 260 ml | Afternoon |
| 2 | Contac + Morac | 3 qt + 1 qt | 19.6 ml + 6.5 ml | Afternoon |
| 3 | Sinox + Morac | 3 qt + 1 qt | 19.6 ml + 6.5 ml | Afternoon |
| 4 | Des-I-Cate + Morac | 4 qt + 2 qt | 26 ml + 13 ml | Early Morning |
| 5 | Ignite | 4 qt | 26 ml | Afternoon |
| 6 | Diquat + X-77 | 1 qt + 8 oz | 6.5 ml + 0.8 ml | Evening |
| 7 | Paraquat + X-77 | 1 qt + 8 oz | 6.5 ml + 0.8 ml | Evening |
| 8 | Diquat + Paraquat + X-77 | 1 qt + 1/2 qt + 8 oz | 6.5 ml + 3.3 ml + 0.8 ml | Evening |
| 9 | Diquat + X-77 | 1.5 qt + 8 oz | 9.8 ml + 0.8 ml | Evening |
| 10 | Diquat + Enhancer | 1 qt + 1 qt | 6.5 ml + 6.5 ml | Evening |
| 11 | Diquat + Spodnam | 1 qt + 1/2 qt | 6.5 ml + 3.3 ml | Evening |
| 12 | N-Tac (Enquik) | 20 gal | 520 ml + 0.8 ml | Afternoon |
| 13 | Check (Control) | | none | None |

Table 4. The effects of desiccants on the moisture content of Riley alfalfa plant tops. The alfalfa plants contained 62.9 percent moisture when desiccants were applied September 4, 1987, on the Robert Peterson Farm, Oregon Slope, Ontario, Oregon.

| Treatments | Desiccants | Rate | Days after application 2 | 4 | 6 |
|---|---|---|---|---|---|
| | | | Plant water content | | |
| | | | - - - - - - % - - - - - | | |
| 1 | Dinoseb + Diesel | 1.5 qt + 10 gal | 51.8 | 48.6 | 46.8 |
| 2 | Contac + Morac | 3 qt + 1 qt | 50.8 | 47.5 | 45.4 |
| 3 | Sinox + Morac | 3 qt + 1 qt | 50.5 | 48.4 | 47.3 |
| 4 | Des-I-Cate + Morac | 4 qt + 2 qt | 58.6 | 53.6 | 49.0 |
| 5 | Ignite | 4 qt | 59.3 | 47.7 | 46.4 |
| 6 | Diquat + X-77 | 1 qt + 8 oz | 49.2 | 50.3 | 43.1 |
| 7 | Paraquat + X-77 | 1 qt + 8 oz | 55.8 | 51.4 | 47.5 |
| 8 | Diquat + Paraquat + X-77 | 1 qt + 1/2 qt + 8 oz | 50.2 | 41.7 | 40.7 |
| 9 | Diquat + X-77 | 1.5 qt + 8 oz | 53.5 | 45.6 | 42.9 |
| 10 | Diquat + Enhancer | 1 qt + 1 qt | 48.7 | 42.8 | 40.9 |
| 11 | Diquat + Spodnam | 1 qt + 1/2 qt | 52.7 | 47.4 | 44.5 |
| 12 | N-Tac (Enquik) | 20 gal | 50.5 | 50.7 | 49.6 |
| 13 | Check (Control) | | 62.7 | 58.6 | 61.3 |
| | LSD(05) | | | | 6.6 |

Table 5. Correlation between the time necessary to harvest the alfalfa treated with various desiccants and moisture content of alfalfa forage the day before harvest or the subjective evaluations of crop dryness three days before harvest. Robert Peterson Farm, Oregon Slope, Ontario, Oregon, 1987.

| Treatments | Desiccants | Rate | Sept 8 Subjective Evaluation of Desiccation | Sept 10 Plant Water Content | Sept 11 Time to Harvest Plot |
|---|---|---|---|---|---|
| | | | 0 - 10 | % | sec |
| 1 | Dinoseb + Diesel | 1.5 qt + 10 gal | 6.8 | 46.8 | 233 |
| 2 | Contac + Morac | 3 qt + 1 qt | 7.5 | 45.4 | 154 |
| 3 | Sinox + Morac | 3 qt + 1 qt | 7.5 | 47.3 | 144 |
| 4 | Des-I-Cate + Morac | 4 qt + 2 qt | 5.8 | 49.0 | 250 |
| 5 | Ignite | 4 qt | 6.0 | 46.4 | 185 |
| 6 | Diquat + X-77 | 1 qt + 8 oz | 8.5 | 43.1 | 134 |
| 7 | Paraquat + X-77 | 1 qt + 8 oz | 8.0 | 47.5 | 134 |
| 8 | Diquat + Paraquat + X-77 | 1 qt + 1/2 qt + 8 oz | 9.0 | 40.7 | 165 |
| 9 | Diquat + X-77 | 1.5 qt + 8 oz | 8.8 | 42.9 | 167 |
| 10 | Diquat + Enhancer | 1 qt + 1 qt | 8.5 | 40.9 | 155 |
| 11 | Diquat + Spodnam | 1 qt + 1/2 qt | 8.8 | 44.5 | 177 |
| 12 | N-Tac (Enquik) | 20 gal | 6.3 | 49.6 | 158 |
| 13 | Check (Control) | | 0.3 | 61.3 | 378 |
| | Correlation with time to harvest | | -.44 | +.38 | |
| | Significant[1] | | ** | ** | |
| | LSD(05) | | 1.2 | 6.6 | |

[1] ** Significant at P = .01.

# EVALUATION OF SUPERSWEET CORN VARIETIES FOR THE TREASURE VALLEY

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## Objective

This project screened supersweet corn lines to identify locally adapted hybrids with superior agronomic and processing qualities.

## Introduction

New sweet corn types provide a market opportunity for the expansion of sweet corn cultivation in Oregon. Until recently, supersweet corn lines have demonstrated serious inadequacies in plant stand establishment, uniformity of maturity, lodging resistance, ear uniformity, and processing quality.

## Cultural Practices

Twenty-four supersweet corn hybrids were evaluated for plant stand establishment, uniformity of maturity, lodging resistance, ear uniformity, and processing quality. In a separate trial three supersweet lines were harvested on five different dates over a two-week period to monitor changes in yield and quality with advancing harvest dates. The trials were located on an Owyhee silt loam. One hundred pounds of $P_2O_5$ per acre were plowed down in November 1986 following harvest of the preceeding crop of sugar beets. After the field was roller packed, Dual 8E at the rate of 3 1/2 pounds ai/ac was broadcast sprayed for weed control and incorporated with an S-tined cultivator. The field was fall-bedded on 30-inch centers. The trial area was irrigated on April 25.

The variety trial was planted on May 8, two days after the beds were pulled down to moist soil with a spike-toothed harrow. The four-bed by 20-foot plots were overplanted by 75 percent and thinned to 29,000 plants per acre on June 1 and 2. On June 4 the trial was sidedressed with 162 lbs N/ac as ammonium nitrate.

The date of harvest trial was similiarly planted on May 22, thinned on June 10, and sidedressed with 173 lbs N/ac as ammonium nitrate on June 24.

## Procedures

The supersweet variety trial included the 24 entries (Table 1) in a randomized complete block experimental design with four replications. Silking dates were recorded for all entries and used to project harvest dates. Three days before each variety's estimated harvest date, 12 ears were sampled for moisture determination in order to schedule harvest for each variety at optimum maturity.

Primary ears were picked from the center 15 feet of the two center rows in the early morning. The ears were counted, weighed, husked, and weighed again to determine yield and husking percentage. Twenty-five average ears were measured for length, maximum diameter, diameter six inches from the base, and number of kernel rows. The ears were then visually evaluated for quality and maturity. Three ears from each plot were forwarded to Ore Ida's analytical laboratory for moisture determination and sugar analysis.

Fifteen of the entries were considered inadequate in some respect and were not frozen. Fifty ear samples of the remaining nine varieties were blanched and frozen to be thawed for evaluation at a later date (Table 1).

The date-of-harvest trial consisted of three supersweet lines arranged in a randomized complete block experiment with four replications. Two of the supersweet hybrids, XPH 2606 and GSS 3376, were also in the variety trial. The third, FMX 85, is a Ferry Morse variety that was entered in a similiar variety trial in 1986.

The observed silking dates of the three varieties were used to project optimum harvest date and harvests were begun several days before that date. Twenty-four ears were picked from the center two rows of a four-bed by 20-foot plot of each variety on five dates over two weeks. The ears from each plot were weighed with and without husks to determine ear weight. Three ears from each of the first two replications were combined into one sample and three ears from each of the second two replications were combined into a second sample. These two samples were forwarded to the Ore-Ida analytical laboratory for moisture determination and sugar analysis. The remaining ears were frozen for future cooking and evaluation.

## Results and Discussion

The major quality problems encountered were poor fill, curving or irregular kernel rows, and short ears. Immature ears contributed to the B and cull categories to a lesser extent. Two entries, 85-3157A and 85-3158B, lodged extensively before harvest (Table 2). Nine varieties yielded in excess of 10 tons per acre (Table 2). Another group of nine varieties had adequate appearance and uniformity to warrent freezing and storing ears for quality determinations (Table 1).

Sugar content increased as moisture declined for the entries in the date of harvest trial (Table 3). The range of sugar and water content which is acceptable for processing will be determined when the frozen samples are cooked and evaluated. Adequate sugar content was maintained for over one week.

Varieties such as Asgrow XPH2606, Rogers Brothers GSS3376, and Abbott and Cobb SS7700 demonstrate the successes in improving supersweet corn yields and quality in recent years.

## Acknowledgments

Ore-Ida Foods contributed personnel and facilities to both experiments.


Table 1. Sources of supersweet corn varieties at the Malheur Experiment Station, OSU, in 1987.

| ENTRY # | SEED COMPANY | VARIETY | SAMPLES FROZEN |
|---|---|---|---|
| 1 | ASGROW | XPH 2606 | * |
| 2 | | XPH 2671 | |
| 3 | | XPH 2623 | |
| 4 | | XPH 2670 | |
| 5 | ABBOTT & COBB | SS 7700 | * |
| 6 | | SS 7600 | |
| 7 | CROOKHAM | CRISP 'N' SWEET 710 (LOT A) | * |
| 8 | SUN SEEDS | SUNEX 2574 | * |
| 9 | HARRIS-MORAN | HMX 6399S | |
| 10 | | HMX 4379S | |
| 11 | | HMX 7371S | * |
| 12 | | HMX 7372S | |
| 13 | | HMX 5384S | |
| 14 | ILLINOIS FOUNDATION | SCH 5429 | |
| 15 | | SCH 5288 16R | |
| 16 | | SCH 4055 | * |
| 17 | MUSSER | 85-3157A sh2 | |
| 18 | | 85-3154 sh2 | |
| 19 | | 85-3158B sh2 | |
| 20 | | 85-3161 sh2 | * |
| 21 | ROGERS BROTHERS | GSS 3376 | * |
| 22 | HARRIS-MORAN | PINNACLE | * |
| 23 | ASGROW | XPH 2672 | |
| 24 | SUN SEEDS | SUNEX 2609 | |

* Frozen for future cooking and evaluation.

Table 2. Yield and quality of supersweet corn varieties for 1987 and of Golden Jubilee for 1985-1987, Malheur Experiment Station, OSU, Ontario, Oregon.

| Variety | Days to Harvest | Emergence | Yield | Ears/T | Ear Length | Max. Diameter | Kernel Rows | Taper[1] | Maturity Index[2] | Quality A's | Quality B's | Quality Culls | Final Moisture | Sucrose |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | % | T/A | | inches | inches | # | inches | | % | % | % | % | % |
| 1. XPH 2606 | 94 | 79.3 | 10.5 | 2562 | 7.75 | 1.86 | 17 | 0.25 | 2.94 | 81.0 | 9.0 | 10.0 | 75.5 | 9.5 |
| 2. XPH 2671 | 95 | 84.2 | 9.2 | 3123 | 7.15 | 1.84 | 16 | 0.38 | 3.01 | 57.5 | 36.3 | 6.0 | 75.0 | 9.1 |
| 3. XPH 2623 | 87 | 82.1 | 12.2 | 2314 | 8.66 | 1.88 | 13 | 0.24 | 2.90 | 90.0 | 3.3 | 6.7 | 77.0 | 5.3 |
| 4. XPH 2670 | 94 | 76.6 | 10.9 | 2766 | 8.19 | 1.82 | 17 | 0.27 | 2.92 | 67.7 | 19.2 | 13.1 | 74.0 | 9.7 |
| 5. SS 7700 | 96 | 82.4 | 9.7 | 2892 | 8.04 | 1.87 | 18 | 0.33 | 2.90 | 71.0 | 22.0 | 7.0 | 75.9 | 8.2 |
| 6. SS 7600 | 95 | 89.8 | 7.9 | 3232 | 7.60 | 1.87 | 16 | 0.37 | 2.87 | 56.0 | 19.5 | 24.5 | 76.5 | 7.5 |
| 7. C°N'S 710 | 91 | 79.0 | 10.2 | 2557 | 8.10 | 1.85 | 17 | 0.29 | 2.97 | 66.0 | 16.0 | 18.0 | 77.4 | 8.7 |
| 8. SUNEX 2574 | 94 | 69.8 | 10.9 | 2509 | 6.77 | 2.07 | 17 | 0.50 | 2.87 | 72.0 | 7.0 | 21.0 | 77.2 | 10.1 |
| 9. HMX 6399S | 96 | 84.4 | 9.6 | 2798 | 8.50 | 1.84 | 16 | 0.21 | 2.92 | 76.0 | 14.0 | 10.0 | 76.5 | 8.0 |
| 10. HMX 4379S | 96 | 55.5 | 6.8 | 3277 | 8.27 | 1.76 | 18 | 0.26 | 2.78 | 55.5 | 28.3 | 16.3 | 75.2 | 8.8 |
| 11. HMX 7371S | 92 | 74.2 | 10.5 | 2406 | 8.04 | 1.96 | 16 | 0.28 | 2.92 | 82.0 | 11.0 | 7.0 | NA | NA |
| 12. HMX 7372S | 91 | 66.5 | 8.8 | 2632 | 7.88 | 1.85 | 17 | 0.36 | 2.89 | 63.5 | 12.1 | 24.4 | 76.6 | 10.1 |
| 13. HMX 5384S | 92 | 80.1 | 11.6 | 2758 | 7.55 | 1.77 | 16 | 0.25 | 2.92 | 56.0 | 33.0 | 8.0 | NA | NA |
| 14. SCH 5429 | 90 | 75.2 | 9.2 | 3089 | 7.81 | 1.83 | 16 | 0.32 | 2.88 | 76.1 | 10.3 | 13.7 | 76.9 | 9.2 |
| 15. SCH 5288 | 90 | 78.0 | 9.5 | 3058 | 7.96 | 1.77 | 16 | 0.35 | 2.86 | 74.2 | 10.8 | 15.0 | 76.5 | 8.9 |
| 16. SCH 4055 | 91 | 79.0 | 11.4 | 2503 | 7.70 | 1.85 | 17 | 0.34 | 3.07 | 78.0 | 11.0 | 11.0 | 76.6 | 9.1 |
| 17. 85-3157A | 92 | 81.0 | 6.8 | 3077 | 7.33 | 1.76 | 15 | 0.32 | 2.85 | 50.0 | 30.0 | 20.0 | NA | NA |
| 18. 85-3154 | 94 | 66.4 | 7.5 | 2791 | 7.57 | 1.88 | 16 | 0.29 | 3.04 | 51.0 | 25.0 | 24.0 | 75.0 | 8.6 |
| 19. 85-3158B | 92 | 88.4 | 5.8 | 3266 | 7.44 | 1.76 | 16 | 0.30 | 2.94 | 46.0 | 22.0 | 22.0 | NA | NA |
| 20. 85-3161 | 91 | 86.7 | 9.7 | 2496 | 7.75 | 1.91 | 16 | 0.40 | 3.07 | 78.0 | 1.0 | 21.0 | 75.5 | 10.6 |
| 21. GSS 3376 | 94 | 82.3 | 11.1 | 2625 | 7.99 | 1.87 | 17 | 0.28 | 2.99 | 89.0 | 6.0 | 5.0 | 77.7 | 9.7 |
| 22. PINNACLE | 89 | 79.9 | 8.9 | 2451 | 9.07 | 1.81 | 15 | 0.15 | 2.92 | 94.0 | 1.0 | 5.0 | 76.6 | 9.3 |
| 23. XPH 2672 | 95 | 91.5 | 9.2 | 3302 | 7.57 | 1.81 | 16 | 0.34 | 2.98 | 53.0 | 23.0 | 24.3 | 75.6 | 8.6 |
| 24. SUNEX 2609 | 95 | 71.1 | 9.0 | 3010 | 7.56 | 1.83 | 17 | 0.34 | 2.95 | 77.0 | 7.0 | 16.0 | 76.4 | 8.1 |
| Mean | 93 | 78.4 | 9.4 | | 7.84 | 1.84 | 16 | 0.31 | 2.93 | 69.3 | 15.6 | 14.5 | 76.2 | 8.9 |
| LSD (.05) | | 4.8 | 1.3 | | 0.25 | 0.04 | 1 | 0.05 | 0.14 | 12.2 | 10.1 | 10.0 | | |
| CV (%) | | 4.3 | 9.8 | | 2.2 | 1.7 | 2.4 | 11.2 | 3.3 | 12.4 | 45.7 | 48.9 | | |
| Golden Jubilee | 100 | | 10.4 | | 8.10 | 1.93 | 17 | .31 | 2.94 | 91.6 | 3.1 | 5.4 | 70.4 | 2.6 |

The data presented are averages of four replications. [1] Taper refers to the difference between maximum ear diameter and diameter six inches from the base.
[2] The maturity index ranges from one to four as maturity advances, with three referring to the optimum stage for harvest.

Table 3. Yield and quality of three supersweet corn varieties with advancing harvest date. Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Variety | Season Length: Harvest Date | Season Length: Days After Planting | Season Length: Water Content* | Relative Ear Weight | Sugar Content: Dextrose | Sugar Content: Sucrose |
|---|---|---|---|---|---|---|
| | | days | % | % | - - - - - - % | - - - - - - |
| XPH 2606 | 8/19 | 90 | 78.2 | 100 | 0.75 | 8.2 |
| | 8/21 | 92 | 75.9 | 101 | 0.90 | 9.1 |
| | 8/24 | 95 | 74.7 | 108 | 0.60 | 9.1 |
| | 8/27 | 98 | 74.2 | 115 | - | - |
| | 9/1 | 102 | 73.8 | - | 0.65 | 7.5 |
| GSS 3376 | 8/19 | 90 | 79.9 | 100 | 1.18 | 7.6 |
| | 8/21 | 92 | 77.4 | 107 | 1.50 | 8.5 |
| | 8/24 | 95 | 75.0 | 118 | 0.68 | 10.0 |
| | 8/27 | 98 | 74.1 | 128 | - | - |
| | 9/1 | 102 | 73.8 | - | 0.70 | 9.6 |
| FMX 85 | 8/19 | 90 | 83.1 | 100 | 1.62 | 5.8 |
| | 8/21 | 92 | 80.7 | 106 | 0.94 | 8.4 |
| | 8/24 | 95 | 78.5 | 125 | 0.65 | 8.8 |
| | 8/27 | 98 | 76.5 | 129 | - | - |
| | 9/1 | 102 | 75.0 | - | 0.55 | 9.5 |
| G. Jubilee≠ | 9/1 | - | 70.4 | - | 0.72 | 2.6 |

≠ Obtained from a commercial field and presented for sugar and percent water comparison.

* G. Jubilee at 70% water and supersweet corn at 77-78% water are considered ideal for harvesting.

# EARLY ESTABLISHMENT OF GOLDEN JUBILEE SWEET CORN AND DEPENDABLE STAND ESTABLISHMENT OF SUPERSWEET CORN

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## Objective

Various cultural practices were evaluated to achieve early establishment and harvest of Golden Jubilee sweet corn and to establish uniform stands of supersweet corn.

## Introduction

Acreage of sweet corn in Malheur County is limited by the processing plant capacity and by the earliest corn harvest date. Early planting of sweet corn in cool soil contributes to slow and erratic emergence. Supersweet corn, a potential crop for local processing, is plagued by erratic emergence even under good field conditions due to the high sugar, low starch nature of its endosperm. Erratic emergence leads to non-uniform plant stands resulting in variability in crop quality, maturity, and yield.

The improvement of factors critical to early corn growth is necessary to achieve uniform stands of supersweet corn and early planted sweet corn. To investigate these factors, three corn emergence experiments were conducted in 1987, one with Golden Jubilee sweet corn and two with supersweet corn lines.

## Cultural Practices

The trials were located adjacently on 30-inch beds on an Owyhee silt loam. One hundred pounds of $P_2O_5$ per acre were plowed down in November 1986 following harvest of the preceeding crop of sugar beets. After the field was roller packed, Dual 8E at the rate of 3 1/2 pounds ai/ac was broadcast sprayed for weed control and incorporated with an S-tined cultivator. The field was then fall bedded.

The beds for the Jubilee trial were pulled down to moist soil with a spike-toothed harrow on April 15, 1987, and the trial was planted on April 22. The corn was cultivated on May 13 and sidedressed with 173 lbs N/ac from ammonium nitrate on May 19.

The supersweet trial area was irrigated on April 25 and the beds were dragged off on May 6. Both trials were planted on May 8 and sidedressed with 162 lbs N/ac as ammonium nitrate on June 4.

## Procedures

In the Golden Jubilee trial, seed treatments included a standard fungicide/insecticide mixture, the fungicides Thiram and Ridomil used alone, and no seed treatment (Table 1). Two treatments entailed 25 and 50 pounds of phosphate per acre banded 3 1/2 inches below the seed row. Some seed was coated with a suspension of 16 grams of Viterra Agri-gel, a product of the Nepera Chemical Company, in two liters of water before planting. The gel coating may create a microclimate around each seed favorable to early germination and emergence.

The PAM treatment consisted of pouring 23g polyacrylimide suspended in one gallon of water on the soil surface above the seed row for 25 feet to reduce crusting. The final treatment entailed covering beds with 21-inch-wide strips of 2 mil plastic to increase soil temperatures.

The trial was established in a randomized complete block design with four replications. Plots were four beds wide by 22 feet long, separated by 3-foot alleys. The corn was overplanted by 40 percent and thinned to 29,000 plants per acre on May 18. Emerged plants were counted on April 28, 29, and 30 and May 2. Grain moisture was evaluated on July 29 by drying subsamples of kernels taken from 10 ear samples in each plot.

One supersweet trial evaluated the effect of various seed treatments on the emergence of the Crookham variety Crisp N' Sweet 710. The treatments included a standard fungicide mixture, Thiram, Captan, and Ridomil only, and no seed treatment (Table 2). Grain moisture was determined on August 7.

The other supersweet trial evaluated the emergence of the Asgrow line XPH2606 under various cultural practices. Treatments coinciding with those in the Jubilee trial included two rates of sidedressed phosphate, surface-banded polyacrylimide, and a standard seed treatment. Plastic row covers were not used due to warm soil and air temperatures. The two gel treatments entailed "priming" the seed by soaking in water for two days before adding gel and planting. One of these treatments included 200 ppm phosphate in the gel. Seed was screened to segregate small seed and large seed for the final two treatments.

Both supersweet trials consisted of plots four beds wide by 20 feet long in a randomized complete block experimental design with five replications. All plots were overplanted by 40 percent and thinned to 29,000 plants per acre. Emerged plants were counted every other day from May 12 through May 18.

## Results

Two of the treatments evaluated in the Golden Jubilee trial accelerated initial emergence compared to the standard check. Plastic row covers accelerated emergence but did not increase the final percentage of emerged plants. Gel coating the seed accelerated emergence and resulted in a significantly higher percentage of emerged plants. The other treatments all slowed emergence and the higher rate of banded phosphate significantly decreased the final plant stand. No significant differences in grain moisture were detected among the various treatments at harvest (Table 1).

While none of the treatments significantly altered the rate of emergence of Crisp N' Sweet 710, both the seed with no treatment and the seed treated only with Ridomil resulted in significantly fewer plants emerging. Harvest maturity did not vary significantly among the treatments (Table 2).

Among the cultural factors applied to XPH 2606, only large seed resulted in significantly higher emergence than the check treatment. All other treatments slowed emergence and the two gel treatments also decreased percent emergence (Table 3).

## Discussion

Warm weather and the absence of a soil-cooling irrigation immediately after planting probably reduced differences in emergence among treatments. Plastic row cover and gel-coated seed both show promise for increasing the rate and extent of emergence. The two-day "priming" procedure used with the gel treatment on XPH2606 was clearly inappropriate. A shorter "priming" period may be feasible. Planting large seed proved to be a relatively simple and inexpensive method to improve emergence for supersweet lines.

The relatively poor performance of seed treated with single fungicides substantiates the common practice of treating seed with a mixture of several fungicides and an insecticide. The anti-crusting properties of polyacrylimide remain untested as weather conditions conducive to crusting did not occur. Warm soil conditions increased availability of soil phosphate and may have negated any benefits of the banded phosphate treatments. Some of the negative effects of the phosphate treatments were probably due to a loss of seed bed moisture when the soil was disturbed during sidedressing. The reduction in emergence with the higher rate of phosphate in the Golden Jubilee trial suggests that fertilizer salts provided a negative osmotic factor.

Table 1. Emergence and harvest maturity of Golden Jubilee sweet corn planted April 22 with nine different planting treatments, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Seed Treatment | Soil Treatment | Sweet Corn Emergence By Date April 28 | April 29 | April 30 | May 2 | Harvest Maturity Grain Moisture July 29 |
|---|---|---|---|---|---|---|
| | | % | | | | % |
| 1. Standard ≠ | | 11.2 | 68.2 | 84.8 | 84.8 | 74.8 |
| 2. Thiram | | 3.1 | 44.3 | 85.1 | 90.5 | 75.1 |
| 3. Ridomil | | 1.5 | 37.7 | 80.9 | 86.4 | 75.7 |
| 4. None | | 2.4 | 38.4 | 76.2 | 83.9 | 74.7 |
| 5. Standard with gel | | 24.3 | 76.1 | 89.9 | 94.1 | 75.2 |
| 6. Standard + | PAM on soil surface | 3.8 | 65.1 | 83.1 | 87.5 | 75.5 |
| 7. Standard + | 25 lbs/ac phosphate | 0.9 | 27.8 | 59.6 | 79.4 | 75.2 |
| 8. Standard + | 50 lbs/ac phosphate | 0.4 | 27.0 | 65.2 | 71.5 | 75.2 |
| 9. Standard + | Plastic row cover | 30.3 | 62.3 | 72.7 | 79.8 | 76.8 |
| LSD (.05) | | 6.2 | 14.6 | 15.8 | 8.8 | ns |

≠Captan, Vitavax, Thiram, and Lorsban.

Table 2. Emergence and relative maturity of supersweet corn* with different seed treatments planted May 8, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Seed Treatment | Emergence By Date May 13 | May 14 | May 16 | May 18 | Harvest Maturity Grain Moisture August 7 |
|---|---|---|---|---|---|
| | - - - - - | - - - - | % - - - - | - - - - - | % |
| 1. None | 5.2 | 42.4 | 72.7 | 74.9 | 79.2 |
| 2. Standard ≠ | 4.0 | 56.0 | 80.6 | 82.3 | 80.0 |
| 3. Thiram | 9.2 | 51.2 | 76.8 | 79.5 | 80.5 |
| 4. Captan | 6.5 | 44.8 | 77.1 | 82.3 | 80.1 |
| 5. Ridomil | 6.0 | 47.3 | 75.7 | 77.7 | 80.3 |
| LSD (.05) | ns | ns | 4.5 | 4.2 | ns |

≠ Captan (43%), Thiram (43%), Difolatan (39%), Apron (35%).
* Crisp N' Sweet 710 variety of Crookham Seed Company.

Table 3. Emergence of supersweet corn* given different treatments at planting (May 8), Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Additional Seed or Soil Treatment** | Emergence by Date May 12 | May 14 | May 16 | May 18 |
|---|---|---|---|---|
| | - - - - - | - - - - | % - - - - | - - - - - |
| 1. None (Standard seed treatment) | 6.6 | 34.7 | 70.6 | 73.4 |
| 2. 2 days in gel before planting | 1.5 | 8.5 | 35.1 | 37.7 |
| 3. 2 days in gel plus phosphate | 1.0 | 5.2 | 33.0 | 32.9 |
| 4. Polyacrylimide | 4.1 | 24.1 | 67.3 | 73.1 |
| 5. Phosphate, 25 lbs/ac banded | 2.8 | 26.6 | 69.6 | 76.9 |
| 6. Phosphate, 50 lbs/ac banded | 3.5 | 25.9 | 71.7 | 74.5 |
| 7. Undersized seed (.078g)*** | 2.0 | 22.2 | 65.3 | 68.0 |
| 8. Oversized seed (.106g)*** | 4.3 | 36.4 | 77.2 | 81.2 |
| LSD (.05) | 2.6 | 7.8 | 7.6 | 7.5 |

* Asgrow experimental line XPH 2606.
** All seed had been comercially treated with Captan, Thiram, and Captafol.
*** Average seed weight was 0.092 g/seed.

ONION VARIETY TRIALS

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## Purpose

Commercial and semi-commercial varieties of yellow, white, and red onions were compared for maturity date, bulb yields, bulb size, and for bulb shape and storage quality. Seed was received for testing from eight companies: American Takii, Asgrow, Crookham, Ferry Morse, Harris Moran, Nickerson Zwaan, Petoseed, and Sunseeds. The objective of the trial was to compare the performance of onion varieties.

## Procedures

The onions were planted on April 9 and 10 in silt loam soil with 1.5 percent organic matter and a pH of 7.0. Corn and grain had been grown in the field in 1985 and 1986 respectively. The wheat stubble was shredded and the field was deep-chiseled, disced, irrigated, and moldboard-plowed in the fall. One hundred pounds per acre of $P_2O_4$ and fifty lbs N/ac was broadcast before plowing. The field was not tilled in the fall after plowing.

Forty-nine varieties were planted in plots two rows wide and 25 feet long. Each variety was replicated five times. Seed for each row was prepacked using enough seed for a planting rate of 12 viable seeds per foot of row. Onions were planted with 12-inch cone-seeders mounted on a John Deere Model 71 flexi-planter unit equipped with disc openers.

The onions were watered by furrow irrigation immediately after planting to assure adequate soil moisture for uniform seed germination and seedling growth.

On June 2, 40 lbs N/ac as anhydrous ammonia was applied in the water during furrow irrigation. The onions were hand-thinned on June 11-13 to a population of four plants per linear foot of row. Two hundred lbs/ac nitrogen ammonium nitrate was sidedressed on June 16 by shanking on each side of all rows planted on single-row beds.

Ammo insecticide for thrip control was applied at the rate of four ounces per acre during each aerial application on June 21, July 22, and August 10.

Rovral fungicide was broadcast applied at the rate of 0.75 pounds ai/ac on August 18. The fungicide was applied following an August 13 hail storm which caused severe damage to the onion foliage.

Maturity ratings were recorded on August 4, 14, 24, and on September 1 and 8. Numerical ratings given were based on percent of bulbs with tops fallen over.

The onion bulbs were lifted on September 11, topped and bagged on September 22 and 23, and put in storage on September 25 and 26. They remained in storage until graded on January 11 and 12. The onion bulbs were graded according to diameter of bulbs. Sizes were 1 1/2- to 2 1/4-inch (small), 2 1/4- to 3-inch (medium), 3- to 4-inch (jumbo), and larger than 4-inch (colossal). Split bulbs were classed as number two's. The bulbs infected by Botrytis were weighed to determine percent storage rot and then graded for size. Weights for each size class were used to calculate total onion yields. The storage rot data are reported as average neck rot and potential neck rot. The average neck rot data is the mean of observed neck rot from five replications. Potential neck rot is the percent rot from a single replication where the greatest amount of neck rot occurred.

## Results

Each variety is listed by company furnishing the seed and listed in decending order according to total yield. Bulb yields were good this year, even when hail damage was taken into consideration. Spring growth was slower than normal, but maturity ratings are close to normal for varieties in prior trials. The onions stored very well with low incidence of neck rot among all varieties. The greatest amount of neck rot occurred with late-maturing lines such as Durango and Avalanche.

Average bulb yields were 586 cwt per acre with 27 percent colossal-sized bulbs and 50 percent jumbos. Overall percent number two's was 8.5 percent and the average percent neck rot for all varieties was 1.2 percent.

Early maturing varieties included Yula, XPH-3373, Norstar, Redman, Bronze Reserve, MOX-2610, Olathe, Golden Cascade, Bullring, and Magnum. Eighty percent of the tops were down in these varieties on September 8. Varieties with less than 21 percent of their tops down by September 8 included Armanda, XPH-83N128, Dai Maru, Celebrity, Bronze Wonder, White Delight, White Keeper, Sunex 490-2, Durango, Sunre 615-4, Valdez, Avalanche, Blanco Duro, and Carmen. Tops of these varieties remained green when lifted on September 11. Very few onions bolted in 1987.

Statistical data are included in the tables and should be considered when comparisons are made between varieties for yield performance. Differences greater than the LSD values should exist before a single variety is considered superior to another.

Table 1. Yield and quality of onions in the 1987 variety trial, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Company | Variety | Yield Rank | Yield Total | Average Neck rot | Potential Neck rot | Yield by Market Grade +4 inch | | 3-4 inch | | 2 1/4-3 inch | | 1 1/2-2 1/4 inch | | 2's | Maturity Ratings 8/4 | 8/14 | 8/24 | 9/1 | 9/8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | cwt/ac | % | % | cwt/ac | % | cwt/ac | % | cwt/ac | % | cwt/ac | % | cwt/ac | 0 - 100 % | | | | |
| Amer. Takii | T-355 | 43 | 448 | 0 | 0 | 2 | 0.5 | 348 | 78 | 88 | 20.0 | 8 | 0.2 | 3 | 0 | 10 | 28 | 45 | 62 |
| | Norstar | 46 | 421 | 0.9 | 2.5 | 12 | 3 | 287 | 68 | 111 | 26.4 | 11 | 2.6 | 0 | 64 | 84 | 98 | 99 | 100 |
| Asgrow | Armanda | 9 | 679 | 0.5 | 1.8 | 326 | 48 | 290 | 43 | 18 | 3 | 3 | 0.4 | 42 | 0 | 3 | 7 | 7 | 17 |
| | Vega | 15 | 643 | 0.5 | 1.9 | 226 | 35 | 368 | 57 | 28 | 4 | 3 | 0.5 | 17 | 0 | 3 | 12 | 22 | 32 |
| | XPH-3326 | 19 | 616 | 1.6 | 3.2 | 201 | 32 | 371 | 60 | 29 | 5 | 4 | 0.7 | 12 | 1 | 29 | 43 | 56 | 68 |
| | Maya | 21 | 612 | 0.5 | 1.8 | 151 | 25 | 419 | 68 | 24 | 4 | 2 | 0.3 | 17 | 1 | 34 | 50 | 57 | 70 |
| | Yula | 31 | 576 | 1.6 | 4.3 | 224 | 39 | 289 | 50 | 23 | 4 | 2 | 0.4 | 39 | 8 | 54 | 71 | 81 | 82 |
| | XPH-3373 | 35 | 571 | 0.7 | 2.9 | 99 | 17 | 422 | 74 | 33 | 6 | 3 | 0.5 | 13 | 3 | 38 | 62 | 66 | 87 |
| Crookham | XPH-83N128 | 1 | 731 | 3.4 | 5.3 | 488 | 67 | 225 | 31 | 6 | 0.8 | 1 | 0.2 | 11 | 0 | 0 | 3 | 3 | 3 |
| | Amber Sweet | 3 | 714 | 1.0 | 2.8 | 343 | 48 | 310 | 43 | 10 | 1.4 | 2 | 0.3 | 51 | 0 | 14 | 21 | 21 | 34 |
| | Dai Maru | 4 | 712 | 6.7 | 25.8 | 324 | 46 | 325 | 46 | 35 | 4.9 | 4 | 0.6 | 25 | 0 | 4 | 9 | 10 | 11 |
| | Ringmaker | 6 | 708 | 0.4 | 1.1 | 291 | 41 | 341 | 48 | 21 | 3.0 | 2 | 0.3 | 53 | 0 | 26 | 48 | 51 | 60 |
| | Celebrity | 8 | 685 | 3.2 | 7.6 | 267 | 39 | 351 | 51 | 19 | 2.8 | 3 | 0.5 | 46 | 0 | 4 | 6 | 9 | 9 |
| | Big Mac | 16 | 638 | 0 | 0 | 201 | 32 | 348 | 54 | 25 | 3.9 | 4 | 0.6 | 63 | 1 | 6 | 19 | 19 | 33 |
| | Bronze Wonder | 20 | 614 | 0.7 | 1.8 | 160 | 26 | 382 | 62 | 25 | 4.1 | 3 | 0.5 | 45 | 0 | 3 | 9 | 9 | 9 |
| | Early Shipper | 26 | 586 | 0.4 | 1.4 | 133 | 23 | 364 | 62 | 27 | 4.6 | 5 | 0.9 | 57 | 0 | 7 | 17 | 17 | 26 |
| | White Keeper | 33 | 573 | 0.7 | 1.4 | 96 | 16 | 392 | 68 | 22 | 3.8 | 3 | 0.5 | 61 | 0 | 5 | 14 | 14 | 21 |
| | Foxy | 36 | 561 | 2.1 | 8.1 | 96 | 17 | 412 | 73 | 33 | 5.9 | 3 | 0.5 | 18 | 0 | 25 | 36 | 42 | 58 |
| | White Delight | 38 | 533 | 0.6 | 2.2 | 45 | 8 | 396 | 74 | 32 | 6.0 | 3 | 0.6 | 58 | 0 | 2 | 4 | 4 | 8 |
| | Hybrid Red Baron | 41 | 466 | 0.2 | 0.3 | 6 | 1 | 381 | 82 | 61 | 13.0 | 6 | 0.2 | 13 | 0 | 16 | 30 | 42 | 60 |
| Ferry Morse | FMX 70 W6 | 17 | 636 | 0.2 | 0.8 | 238 | 37 | 363 | 57 | 23 | 3.6 | 2 | 0.3 | 10 | 0 | 15 | 30 | 30 | 43 |
| | Bullseye | 34 | 572 | 0 | 0 | 96 | 17 | 446 | 78 | 28 | 4.9 | 2 | 0.3 | 0 | 0 | 8 | 14 | 26 | 44 |
| | Redman | 40 | 497 | 1.2 | 4.6 | 30 | 6 | 378 | 76 | 51 | 10.3 | 4 | 0.8 | 33 | 1 | 31 | 56 | 68 | 83 |
| | Bronze Reserve | 45 | 440 | 0 | 0 | 311 | 71 | 101 | 23 | 27 | 6.1 | 1 | 0.2 | 1 | 7 | 61 | 75 | 86 | 96 |
| Harris Moran | MOX 1008 | 13 | 647 | 0.9 | 2.5 | 215 | 33 | 380 | 59 | 16 | 2.4 | 3 | 0.5 | 32 | 0 | 8 | 21 | 24 | 41 |
| | MOX 1029 | 14 | 647 | 0.5 | 0.9 | 209 | 32 | 391 | 60 | 21 | 3.2 | 2 | 0.3 | 24 | 0 | 12 | 24 | 24 | 24 |
| | MOX 2610 | 42 | 459 | 0.2 | 1.1 | 12 | 26 | 343 | 75 | 92 | 20.0 | 6 | 1.3 | 5 | 60 | 97 | 98 | 99 | 100 |

TABLE 1 CONTINUED ON THE NEXT PAGE

TABLE 1 CONTINUED

| Company | Variety | Yield Rank | Yield Total | Average Neck rot | Potential Neck rot | Yield by Market Grade: +4 inch | | 3-4 inch | | 2 1/4-3 inch | | 1 1/2-2 1/4 inch | | 2's | Maturity Ratings: 8/4 | 8/14 | 8/24 | 9/1 | 9/8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | cwt/ac | % | % | cwt/ac | % | cwt/ac | % | cwt/ac | % | cwt/ac | % | cwt/ac | 0 - 100 % | | | | |
| Nick. Zwaan | NIZ 230090 | 32 | 576 | 0.4 | 1.5 | 87 | 15 | 363 | 63 | 32 | 5.5 | 2 | 0.4 | 92 | 1 | 11 | 18 | 27 | 27 |
| | NIZ 230100 | 47 | 410 | 0.3 | 0.5 | 21 | 5 | 228 | 56 | 101 | 25 | 16 | 0.4 | 44 | 21 | 50 | 67 | 71 | 71 |
| | Olathe | 48 | 386 | 0 | 0 | 14 | 4 | 220 | 57 | 124 | 32 | 19 | 4.9 | 7 | 29 | 87 | 91 | 96 | 98 |
| | NIZ 238357 | 49 | 373 | 6.2 | 13.3 | 40 | 11 | 157 | 42 | 93 | 25 | 22 | 5.9 | 61 | 8 | 31 | 40 | 52 | 52 |
| Petoseed | PSR 51386 | 12 | 649 | 0.3 | 1.1 | 181 | 28 | 447 | 69 | 15 | 2 | 1 | 0.2 | 6 | 0 | 0 | 9 | 11 | 39 |
| | PSX 1183 | 29 | 580 | 0.6 | 3.7 | 117 | 20 | 420 | 72 | 31 | 5 | 2 | 0.3 | 10 | 3 | 36 | 44 | 65 | 66 |
| | PSX 1383 | 37 | 540 | 0 | 0 | 64 | 12 | 389 | 72 | 46 | 9 | 3 | 0.6 | 39 | 0 | 5 | 22 | 23 | 56 |
| Sunseeds | Sunex 490-2 | 2 | 715 | 0.6 | 2.3 | 398 | 56 | 299 | 42 | 13 | 2 | 1 | 0.2 | 3 | 0 | 4 | 10 | 10 | 16 |
| | Durango | 5 | 708 | 6.4 | 22.0 | 415 | 59 | 256 | 36 | 11 | 2 | 3 | 0.4 | 23 | 0 | 2 | 8 | 11 | 11 |
| | Sunre 615-4 | 7 | 691 | 1.3 | 5.9 | 361 | 52 | 297 | 43 | 18 | 3 | 2 | 0.3 | 14 | 0 | 2 | 4 | 5 | 7 |
| | Winner | 10 | 676 | 0.3 | 0.7 | 314 | 46 | 336 | 49 | 15 | 2 | 2 | 0.3 | 10 | 0 | 21 | 37 | 37 | 43 |
| | Valdez | 11 | 675 | 4.0 | 14.7 | 307 | 45 | 338 | 50 | 17 | 3 | 2 | 0.2 | 12 | 0 | 4 | 10 | 12 | 12 |
| | Avalanche | 18 | 622 | 8.8 | 23.3 | 190 | 30 | 382 | 61 | 18 | 3 | 3 | 0.5 | 30 | 0 | 3 | 3 | 3 | 3 |
| | Sunre 1684 | 22 | 611 | 0.6 | 1.3 | 159 | 26 | 425 | 70 | 21 | 3 | 2 | 0.3 | 3 | 0 | 6 | 12 | 12 | 27 |
| | Golden Cascade | 23 | 598 | 0 | 0 | 182 | 30 | 377 | 63 | 33 | 6 | 5 | 0.8 | 2 | 5 | 58 | 69 | 77 | 87 |
| | Bullring | 24 | 596 | 0.2 | 0.6 | 128 | 21 | 431 | 72 | 33 | 6 | 3 | 0.5 | 2 | 2 | 66 | 85 | 87 | 93 |
| | Blanco Duro | 25 | 587 | 0.7 | 1.7 | 126 | 21 | 410 | 70 | 32 | 5 | 5 | 0.8 | 15 | 0 | 4 | 13 | 13 | 15 |
| | Magnium | 27 | 585 | 0.3 | 0.9 | 142 | 24 | 397 | 68 | 38 | 6 | 4 | 0.7 | 4 | 2 | 37 | 57 | 77 | 89 |
| | Cima | 28 | 584 | 0 | 0 | 117 | 20 | 386 | 66 | 35 | 6 | 10 | 0.2 | 37 | 1 | 9 | 17 | 20 | 38 |
| | Valiant | 30 | 579 | 0.2 | 0.6 | 111 | 19 | 414 | 72 | 48 | 8 | 4 | 0.7 | 3 | 0 | 3 | 6 | 17 | 33 |
| | Tango | 39 | 518 | 0 | 0 | 11 | 2 | 402 | 78 | 85 | 16 | 6 | 1.1 | 13 | 1 | 6 | 22 | 28 | 35 |
| | Carmen | 44 | 445 | 0.7 | 3.1 | 10 | 2 | 307 | 69 | 103 | 2 | 5 | 1.1 | 21 | 0 | 1 | 2 | 3 | 7 |
| | LSD .05 | | 54 | | | 53 | | 55 | | 19 | | 8 | | 21 | | | | | |
| | Mean | | 586 | 1.2 | | 163 | | 353 | | 40 | | 5 | | 24 | | | | | |
| | CV (%) | | 3.3 | | | 11.7 | | 5.6 | | 17.2 | | 58.8 | | 30.5 | | | | | |

Table 2. Two-year average from onion variety trials (1986 and 1987), Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Company | Variety | Total Yield | Average Neck rot | Potential Neck rot | YIELD BY MARKET GRADE: +4 inch | | 3-4 inch | | 2 1/4-3 inch | | 2's | Maturity Ratings 8/15 | 9/1 | 9/8 | Bolting |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | cwt/ac | % | % | cwt/ac | % | cwt/ac | % | cwt/ac | % | cwt/ac | 0 - 100 % | | | % |
| Asgrow | Armanda | 711 | 1.7 | 4.5 | 405 | 56 | 281 | 39 | 17 | 3 | 40 | 4 | 19 | 38 | .6 |
| | Vega | 693 | .8 | 2.1 | 319 | 45 | 342 | 50 | 22 | 3 | 25 | 3 | 26 | 43 | .7 |
| | Maya | 627 | .6 | 1.5 | 206 | 36 | 399 | 63 | 24 | 4 | 15 | 29 | 63 | 76 | 0 |
| | Yula | 615 | 2.0 | 3.8 | 253 | 41 | 320 | 52 | 28 | 4 | 35 | 54 | 84 | 86 | 0 |
| Crookham | XPH 83N128 | 805 | 4.5 | 10.4 | 596 | 74 | 194 | 25 | 10 | 1 | 20 | 1 | 9 | 17 | .6 |
| | Sweet Amber | 754 | 2.0 | 4.6 | 433 | 57 | 286 | 38 | 9 | 1 | 64 | 12 | 40 | 52 | .2 |
| | Dai Maru | 744 | 5.1 | 15.1 | 431 | 58 | 278 | 38 | 22 | 3 | 20 | 4 | 20 | 34 | .3 |
| | Ringmaker | 739 | .8 | 1.8 | 374 | 50 | 320 | 44 | 17 | 3 | 59 | 20 | 49 | 64 | .4 |
| | Celebrity | 734 | 2.9 | 6.4 | 397 | 53 | 292 | 41 | 21 | 3 | 51 | 4 | 17 | 32 | .4 |
| | Big Mac | 667 | .4 | .7 | 292 | 43 | 326 | 49 | 22 | 3 | 58 | 7 | 28 | 49 | .2 |
| | White Keeper | 577 | 2.3 | 5.7 | 124 | 21 | 393 | 68 | 28 | 5 | 52 | 6 | 31 | 43 | .2 |
| | White Delight | 548 | 1.9 | 3.5 | 104 | 18 | 380 | 70 | 35 | 7 | 45 | 4 | 17 | 33 | .2 |
| Ferry Morse | FMX 70W6 | 674 | .7 | 1.5 | 311 | 46 | 339 | 51 | 18 | 3 | 10 | 14 | 38 | 58 | .8 |
| | Bullseye | 613 | .5 | .9 | 175 | 28 | 414 | 68 | 24 | 4 | 3 | 7 | 29 | 50 | 1.5 |
| | Redman | 543 | 1.4 | 4.6 | 91 | 16 | 395 | 73 | 39 | 7 | 22 | 19 | 50 | 73 | .2 |
| Hars. Moran | MOX 1008 | 613 | 1.0 | 2.5 | 187 | 31 | 381 | 63 | 27 | 4 | 45 | 9 | 31 | 52 | 0 |
| Petoseed | PSX 1183 | 628 | .8 | 3.2 | 181 | 29 | 414 | 67 | 24 | 4 | 9 | 40 | 66 | 75 | .4 |
| | PSX 1383 | 592 | .3 | .6 | 132 | 22 | 397 | 68 | 34 | 5 | 28 | 6 | 33 | 61 | .1 |
| Sunseeds | Durango | 759 | 6.5 | 22.1 | 476 | 62 | 265 | 35 | 12 | 2 | 24 | 2 | 23 | 23 | 1.4 |
| | Sunre 615-4 | 754 | 2.0 | 5.8 | 486 | 64 | 246 | 34 | 15 | 2 | 16 | 1 | 8 | 16 | 1.6 |
| | Valdex | 727 | 3.1 | 9.4 | 422 | 57 | 285 | 40 | 14 | 3 | 13 | 3 | 17 | 29 | 1.0 |
| | Winner | 702 | 1.1 | 1.5 | 365 | 51 | 317 | 45 | 21 | 3 | 7 | 17 | 48 | 59 | .8 |
| | Avalanche | 684 | 18.8 | 42.4 | 285 | 41 | 369 | 54 | 15 | 3 | 35 | 3 | 15 | 27 | 1.3 |
| | Golden Cascade | 644 | .5 | 1.0 | 275 | 41 | 345 | 54 | 27 | 5 | 4 | 43 | 70 | 82 | .1 |
| | Magnum | 632 | .9 | 1.6 | 260 | 39 | 354 | 56 | 26 | 4 | 6 | 29 | 69 | 85 | 0 |
| | Blanco Duro | 611 | 3.2 | 6.0 | 158 | 26 | 417 | 69 | 26 | 4 | 10 | 4 | 24 | 38 | .8 |
| | Valiant | 591 | 1.0 | 1.9 | 139 | 21 | 400 | 67 | 46 | 7 | 11 | 4 | 29 | 50 | 0 |
| | Tango | 522 | .8 | 1.3 | 37 | 7 | 403 | 77 | 73 | 14 | 8 | 22 | 45 | 56 | 0 |
| | Carmen | 460 | 1.0 | 2.9 | 38 | 7 | 336 | 72 | 85 | 8 | 19 | 3 | 18 | 30 | 0 |

Table 3. Three-year average from onion variety trials (1985, 1986, and 1987), Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Company | Variety | Total Yield | Average Neck rot | Potential Neck rot | YIELD BY MARKET GRADE +4 inch | | 3-4 inch | | 2 1/4-3 inch | | 2's | Maturity Ratings 8/15 | 9/1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | cwt/ac | % | % | cwt/ac | % | cwt/ac | % | cwt/ac | % | cwt/ac | 0 - 100 % | |
| Asgrow | Armanda | 710 | 1.9 | 4.7 | 391 | 55 | 286 | 40 | 16 | 2 | 43 | 14 | 35 |
| | Vega | 685 | .7 | 1.7 | 305 | 44 | 341 | 50 | 23 | 3 | 26 | 18 | 41 |
| | Maya | 631 | .7 | 1.5 | 227 | 36 | 379 | 60 | 23 | 4 | 23 | 35 | 66 |
| | Yula | 600 | 2.4 | 5.8 | 246 | 42 | 294 | 49 | 26 | 5 | 46 | 58 | 83 |
| Crookham | XPH 83N128 | 771 | 3.2 | 5.1 | 544 | 71 | 190 | 25 | 10 | 2 | 31 | 7 | 24 |
| | Dai Maru | 762 | 3.7 | 10.9 | 421 | 56 | 288 | 38 | 24 | 3 | 33 | 13 | 36 |
| | Celebrity | 742 | 2.2 | 4.7 | 384 | 51 | 310 | 42 | 22 | 3 | 43 | 11 | 32 |
| | Ringmaker | 721 | .6 | 1.7 | 339 | 47 | 330 | 46 | 22 | 3 | 49 | 31 | 57 |
| | Big Mac | 674 | .5 | 1.0 | 306 | 45 | 309 | 46 | 20 | 3 | 58 | 14 | 40 |
| | White Delight | 578 | 1.5 | 4.9 | 124 | 21 | 375 | 66 | 38 | 7 | 51 | 16 | 34 |
| | White Keeper | 555 | 2.0 | 3.4 | 112 | 20 | 381 | 69 | 35 | 7 | 40 | 19 | 45 |
| Ferry Morse | FMX 70 W6 | 677 | .9 | 1.9 | 298 | 44 | 354 | 52 | 16 | 3 | 13 | 20 | 48 |
| | Bullseye | 609 | .5 | 1.2 | 172 | 28 | 410 | 67 | 25 | 4 | 3 | 23 | 45 |
| | Redman | 538 | 1.2 | 3.8 | 81 | 15 | 401 | 77 | 42 | 7 | 17 | 26 | 58 |
| Hars. Moran | MOX 1008 | 586 | 1.6 | 4.4 | 147 | 25 | 374 | 65 | 32 | 6 | 51 | 26 | 47 |
| Sunseeds | Durango | 764 | 4.9 | 15.5 | 444 | 58 | 296 | 39 | 13 | 2 | 22 | 11 | 36 |
| | Valdez | 745 | 2.3 | 6.7 | 445 | 59 | 274 | 37 | 14 | 2 | 16 | 8 | 28 |
| | Avalanche | 717 | 15.0 | 36.9 | 321 | 44 | 359 | 50 | 17 | 2 | 33 | 4 | 23 |
| | Winner | 697 | 1.4 | 3.2 | 335 | 48 | 341 | 49 | 20 | 3 | 7 | 24 | 55 |
| | Golden Cascade | 647 | .5 | 1.2 | 259 | 39 | 360 | 56 | 26 | 4 | 7 | 48 | 73 |
| | Magnum | 641 | .9 | 1.5 | 240 | 37 | 377 | 59 | 27 | 4 | 8 | 35 | 72 |
| | Blanco Duro | 626 | 2.5 | 4.5 | 181 | 28 | 407 | 65 | 28 | 4 | 9 | 11 | 37 |
| | Valiant | 599 | .9 | 1.9 | 162 | 27 | 393 | 66 | 41 | 7 | 3 | 20 | 45 |
| | Tango | 525 | .8 | 1.6 | 36 | 6 | 418 | 79 | 64 | 15 | 6 | 31 | 57 |
| | Carmen | 459 | 1.3 | 4.0 | 36 | 8 | 334 | 73 | 83 | 11 | 20 | 12 | 36 |

# ARTFICIAL DRYING OF ONIONS TO IMPROVE STORAGE QUALITY

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## Purpose

Onion losses to rot are a problem in commercial storage. Trials were continued to compare different drying temperatures and drying times to identify optimum drying conditions to minimize losses to rot.

## Summary

Six different varieties of sweet spanish onions were compared for yield and storage quality after artificial drying and storage. Durango, Valdez, Dai Maru, and Avalanche yielded more total weight and colossal-sized bulbs than Golden Cascade and White Keeper. The average percent neck rot for Valdez, Durango, and Dai Maru in the control treatment was 18.6 percent. Less storage rot (average 7.4 percent) occurred with varieties Valdez, Durango, and Dai Maru when artifically dried for 20 minutes at 125°F. Average percent rot occurring in storage was less than 4.6 percent for Golden Cascade and White Keeper, and artifically drying these varieties did not significantly improve storage quality. Severe injury occurred to bulbs of Valdez, Durango, Avalanche, and Dai Maru when dried for 80 minutes at 150°F. Moisture losses from bulbs during drying was very low-ranging from an average of 0.039 percent when bulbs were dried at 100°F for 10 minutes to 0.323 percent at 150°F for 80 minutes. The greatest moisture loss (0.426 percent) occurred with Avalanche dried at 150°F for 80 minutes.

## Introduction

Trials were conducted from 1984 to 1986 to evaluate the interaction between varieties, maturity, and harvest dates on onion yields and storage quality. Each year, onions from several varieties with different maturity dates were compared for bulb yield and storage quality when harvested on different dates and dried by electric and propane heat before storage. Each year, significant increases in bulb yields were measured for each variety when harvest date was delayed through September. Yield increases were caused by increases in bulb size (higher percent of Jumbo and Colossal sized bulbs). Yield increases were greatest among late-maturing lines such as Avalanche, Valdez, and Dai Maru. Late-maturing lines are more susceptible to fungal infection and rot during a long storage period. Artificial drying in 1984, 1985, and 1986 resulted in a significant reduction in neck rot during storage and in an increased yield of marketable onions. Drying temperatures and drying periods were not varied during trials conducted in 1984 and 1985 but temperatures and drying times varied in trials conducted during 1986. Trials in 1987 sought to repeat the timed temperature treatments of 1986 while collecting data on bulb moisture loss and temperature.

## Materials and Methods

Six varieties of onions (Golden Cascade, White Keeper, Valdez, Durango, Dai Maru, and Avalanche) were planted April 9 and 10 as strip plots four rows wide and 600 feet long. Planting rates were in excess of desired plant populations and onions were hand-thinned to a spacing of approximately four plants per linear foot of row on June 6 and 8.

One hundred pounds $P_2O_5$ and 60 lbs N/ac as ammonium nitrate were applied broadcast and plowed down in the fall of 1986 behind a wheat crop. Anhydrous ammonia was injected in the irrigation water to apply 40 lbs N/ac on June 2. The onions were sidedressed on June 17 with 200 lbs N/ac as ammonium nitrate.

The onions were watered by furrow irrigation. Thrips were controlled with three applications (June 21, July 22, and August 10) of Ammo at a rate of four ounces of material each application.

The onions (bulbs and tops) were severely damaged by hail which occurred on August 13. No fungicides were applied after the hail storm.

Bulbs were lifted on September 28, followed by topping on October 5 and 6. Twenty-five-foot sections, two rows wide at five areas from strip plantings of each variety, were harvested. The onions were transported from the field in burlap bags. Drying was started on October 8 and continued through October 21. Drying treatments included three drying temperatures (100, 125, and 150$^{o}$F) and four drying times (10, 20, 40, and 80 minutes). Weight loss during drying was calculated by weighing the trays of bulbs immediately before and after drying. At the end of the drying period the onions were placed in burlap bags and stored until January 13. On January 13 and 14 the onions were graded. Grade size included Colossal (> 4 inch), Jumbo (3-4 inch), Medium (2 1/4- 3-inch), Small (1 1/2- 2 1/4-inch), Two's and storage neck rot. For each drying temperature, thermistor probes were placed in the air space between the bulbs, at the top of the bulb where it joined the neck, and 0.2 inch, 0.6 inch and 1 inch deep into the sides of the bulbs. The temperatures were monitored every minute from the time the onions were placed into the drier up to 80 minutes. The data was recorded on an Omnidata datalogger with 20 channels so that four replicates of the five temperature locations could be recorded simultaneously and averaged.

## Results

Bulb yields between varieties differed significantly in size and cwts per acre as a result of varietial difference (Table 1). Top growth of late maturing lines continued through September while early varieties had drying tops laying on the ground. Valdez and Durango produced the highest yields 860 cwt/acre with the highest colossal-sized bulb yield, 704 cwt/acre. Golden Cascade was the earliest variety but still yielded 739 cwt per acre with 463 cwt per acre colossal bulbs. White Keeper yielded least of the six varieties evaluated, 625 cwt per acre. Onions were subject to damage during handling because they were "bald," lacking outer dry skins.

Percent moisture lost from bulbs during drying increased uniformily with exposure time and drying temperature for all varieties (Table 2). Percent moisture losses ranged from a low of .038 when bulbs were dried for 10 minutes at 100°F to a high of 0.32 at 150°F for 80 minutes. Actual moisture losses from bulbs are quite insignificant and benefits from drying may be from heat killing Botrytis fungus rather than from actual drying of the bulb.

Maximum tissue temperature in the onion neck area ranging from 82° to 109°F during drying treatments was associated with the least amount of storage rot. Temperatures below 82°F did not generate sufficient heat to improve storate quality and temperatures higher than 109°F injured the bulb (Table 4).

Drying onion bulbs with artificial heat before winter storage reduced the total storage rot for varieties Avalanche, Valdez, Durango, and Dai Maru when these varieties were dried for 20, 40, and 80 minutes at 125°F (Table 3). The percent rot was greatest for these varieties and rot was reduced for all drying times above 20 minutes at 125°F. Less total rot occurred with Golden Cascade and White Keeper (4.3 and 6.6 percent) and a benefit from drying was not measured for these varieties. Damage to onion bulbs occurred when temperatures were held at 150°F for 80 minutes (Table 3). Avalanche and Durango were more sensitive to the higher temperature and exposure time than were the other four varieties. Golden Cascade was more tolerant to drying at high temperatures.

## Conclusions

Three years of data showed that bulb yields increased significantly from bulb enlargement when growth was allowed through September. The greatest yield increases were noted with late-maturing varieties such as Avalanche, Valdez, Dai Maru, and Durango. Yield increases were still significant with the early maturing varieties Golden Cascade and White Keeper. Bulbs continue to grow and increase in size even though tops have fallen over and as long as the tops remain green.

Data obtained from four years of study showed that onion bulbs dried by artificial heat store with less neck rot at the end of storage than non-heat dried bulbs. Preliminary data from 1987 studies indicated that improved storage quality related to temperatures generated in the neck tissue during drying rather than moisture losses from bulbs.

Although it was not measured, it was observed that onions artifically dried had skins that were drier with better color compared to skins of non-dried bulbs. Presumably drier bulbs would be better preserved for shipment and more appealing to customers at the marketplace.

Further drying studies correlating drying times and temperatures with temperatures generated in the neck tissue for optimum storage conditions are needed. Treatments should be concentrated on late-maturing varieties with a high potential for neck rot. Conditions can be identified for commercial onion drying. In addition, costs of drying onion bulbs should be estimated and compared to returns expected from drying onion bulbs.

Table 1. Yield of six onion varieties used in the artificial drying study, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Variety | Yield by Market Grade | | | | Total Yield |
|---|---|---|---|---|---|
| | Small < 2 1/4" | Medium 2 1/4-3" | Jumbo 3-4" | Colossal > 4" | |
| | cwt/ac | | | | |
| Golden Cascade | 1 | 12 | 263 | 463 | 739 |
| White Keeper | 1 | 18 | 410 | 196 | 625 |
| Valdez | 1 | 5 | 150 | 704 | 860 |
| Durango | 1 | 7 | 157 | 704 | 869 |
| Avalanche | 1 | 8 | 195 | 593 | 797 |
| Dai Maru | 0 | 15 | 227 | 516 | 758 |
| Mean | 1 | 11 | 234 | 529 | 775 |
| LSD(05) | ns | 6 | 36 | 70 | 41 |

Table 2. Percent weight loss from onions dried at $100^{\circ}$F, $125^{\circ}$F, and $150^{\circ}$F for 10, 20, 40 and 80 minutes, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Variety | Drying Temperatures | | | | | | | | | | | | LSD(.05) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | --- $100^{\circ}$F --- | | | | --- $125^{\circ}$F --- | | | | --- $150^{\circ}$F --- | | | | |
| | Minutes | | | | Minutes | | | | Minutes | | | | |
| | 10 | 20 | 40 | 80 | 10 | 20 | 40 | 80 | 10 | 20 | 40 | 80 | |
| Golden Cascade | .041 | .049 | .074 | .130 | .056 | .061 | .106 | .178 | .062 | .081 | .147 | .288 | .049 |
| White Keeper | .029 | .035 | .063 | .106 | .047 | .063 | .098 | .161 | .061 | .079 | .163 | .242 | .040 |
| Valdez | .042 | .040 | .060 | .119 | .048 | .058 | .089 | .153 | .039 | .073 | .211 | .238 | .050 |
| Durango | .038 | .044 | .073 | .118 | .042 | .057 | .096 | .139 | .052 | .086 | .199 | .274 | .059 |
| Avalanche | .039 | .070 | .110 | .181 | .055 | .068 | .128 | .213 | .066 | .133 | .187 | .426 | .076 |
| Dai Maru | .049 | .063 | .132 | .205 | .055 | .088 | .137 | .212 | .071 | .125 | .176 | .401 | .077 |

Table 3. Percent total rot from onions dried at 100°F, 125°F, and 150°F for 10, 20, 40, and 80 minutes, Malheur Experiment Station, OSU, Ontario, Oregon, 1988.

| Variety | Drying Temperatures: 100°F, Minutes 10 | 100°F 20 | 100°F 40 | 100°F 80 | 125°F, Minutes 10 | 125°F 20 | 125°F 40 | 125°F 80 | 150°F, Minutes 10 | 150°F 20 | 150°F 40 | 150°F 80 | Check |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Golden Cascade | 9.92 | 5.76 | 2.81 | 4.99 | 2.69 | 5.04 | 3.71 | 2.23 | 4.34 | 3.13 | 8.55 | 10.71 | 4.31 |
| White Keeper | 7.01 | 4.36 | 5.34 | 6.45 | 9.94 | 13.21 | 4.00 | 7.49 | 9.18 | 14.33 | 10.82 | 28.22 | 6.67 |
| Valdez | 14.82 | 17.41 | 5.35 | 8.77 | 21.34 | 7.24 | 10.01 | 3.32 | 16.34 | 3.84 | 16.05 | 58.41 | 14.78 |
| Durango | 16.26 | 25.13 | 11.19 | 9.85 | 10.72 | 6.57 | 11.10 | 17.94 | 14.82 | 4.13 | 9.46 | 84.39 | 23.61 |
| Avalanche | 14.72 | 9.67 | 3.94 | 6.06 | 7.77 | 7.10 | 5.64 | 8.90 | 10.22 | 4.70 | 22.83 | 90.15 | 10.83 |
| Dai Maru | 22.22 | 14.09 | 17.29 | 12.96 | 3.78 | 7.79 | 4.39 | 9.96 | 14.52 | 9.39 | 21.90 | 74.92 | 13.33 |
| Average | 14.16 | 12.70 | 7.65 | 8.18 | 9.37 | 7.79 | 6.48 | 8.30 | 11.57 | 6.59 | 14.94 | 57.8 | 12.26 |

Table 4. Air and onion neck temperatures over time when onions are artifically dried at 100°F, 125°F, and 150°F. Reported temperatures are for the air passing between bulbs and for the onion tissue in the middle of the neck at the junction with the bulb. Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| | Drying Temperatures | | | | | |
|---|---|---|---|---|---|---|
| | 100°F | | 125°F | | 150°F | |
| Elapsed Time | Air | Onion Neck | Air | Onion Neck | Air | Onion Neck |
| | °F | | | | | |
| 0 | 84.6 | 47.7 | 80.4 | 51.2 | 116.9 | 52.6 |
| 2 | 92.4 | 51.9 | 111.3 | 56.8 | 140.5 | 59.2 |
| 5 | 93.5 | 56.6 | 117.5 | 63.5 | 143.9 | 68.8 |
| 10 | 93.0 | 61.9 | 118.4 | 72.2 | 144.1 | 80.3 |
| 20 | 94.4 | 69.0 | 118.9 | 82.5 | 143.7 | 90.6 |
| 30 | 95.7 | 74.0 | 119.1 | 89.7 | 143.7 | 105.3 |
| 40 | 94.4 | 77.8 | 121.4 | 95.2 | 145.5 | 112.7 |
| 60 | 97.0 | 83.9 | 120.7 | 102.8 | 145.8 | 123.3 |
| 80 | 97.4 | 87.8 | 123.7 | 109.0 | 147.0 | 130.4 |

# USE OF ROVRAL TO REDUCE ONION NECK ROT

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## Purpose

Rovral fungicide was evaluated to study possible effects on the incidence of Botrytus neck rot in onions.

## Summary

Two late-maturing varieties of onions, Durango and Avalanche, were grown to test Rovral fungicide. The two varieties were chosen because of their susceptibility to Botytus neck rot. Plots were either left untreated or received four applications of Rovral or Rovral plus Nu-Film-P. Untreated onions had only 1.4 percent rot after four months storage. Avalanche was more subject to rot than Durango. Rovral plus Nu-Film-P reduced rot to 0.2 percent. Onion yields (698 cwt/ac, 98.4 percent jumbo or larger) were unaffected by the fungicide applications.

## Introduction

Previous experiments at the Malheur Experiment Station have shown that late-maturing onion varieties have high-yield potential. Late-maturing varieties may encounter cool wet weather and poor curing conditions at harvest. Poorly cured onions are more subject to storage rot, in particular Botrytus neck rot.

## Materials and Methods

Durango and Avalanche onions were planted April 9, 1987, in four row plots with 22 inches between the rows. The seeding rate was about two and one-half pounds per acre and plants were thinned to four per foot June 6. Each experimental plot was 25 feet long by four rows wide.

The soil was fertilized with 100 pounds of phosphate per acre (44 lbs P/ac) and 60 lbs N/ac in the fall of 1986. Forty lbs N/ac was water-run June 2 as anhydrous ammonia. Ammonium nitrate was sidedressed June 16 to apply an additional 200 lbs N/ac. Thrips were controlled by aerial application of Ammo at four ounces per acre June 21, July 22, and August 10.

Onions were untreated with fungicides or received 1.5 pounds Rovral (50 percent wetable powder) four times at two-week intervals (August 3, August 14, August 31, and September 15). Rovral was applied alone or with Nu-Film-P at eight ounces per acre. Product was sprayed at 40 psi and 30 gallons of water per acre. Fungicide treatments were replicated five times on each variety.

Onions were lifted September 15, and topped, bagged, and placed in storage September 22. Only the onions from 20 feet of the two center rows were bagged for evaluation after storage. On January 14, 1988 onions were removed from storage and sorted by market grade and storage rot.

## Results

Onion growing conditions in 1987 were favorable for the crop, with the exception of a severe hail storm the evening of August 13 that shredded the foliage. The second Rovral application was advanced to August 14 because of the hail. Onion tops and bulbs grew little after the hail. Yields of Durango were 735 cwt per acre and Avalanche were 683 cwt per acre in spite of the hail (Table 1).

Weather was drier and warmer than normal at harvest. Onions may have cured further than what could usually be expected. The incidence of neck rot was only 0.6 percent for Durango and 1.6 percent for Avalanche. Rovral alone did not reduce rot during storage in this study. Onions that received four applications of Rovral plus Nu-Film-P had only 0.2 percent storage rot (less rot at a probability of 94 percent). Rovral in either formulation had no significant positive or negative effects on yields.

The promising results of Rovral plus Nu-Film-P suggest that this combination should be tested another year when the conditions may be more conducive to storage rot.

Table 1. The effect of Rovral fungicide on two varieties of onions grown at Ontario and stored for four months, Malheur Experiment Station, OSU, Ontario, Oregon, 1988.

| Treatment | Yield by Market Grade | | | | | Total Jumbo > 3" diameter | | Defective Onions | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Small < 2 1/4" | Medium 2 1/4-3" | Jumbo 3-4" | Colossal >4" | Total | | | No 2 | Rot | |
| | - - - - - - | - - - - - - | cwt/ac | - - - - - - | - - - - - - | cwt/ac | % | cwt/ac | cwt/ac | % |
| Fungicide | | | | | | | | | | |
| 1. No fungicide | 1.2 | 13 | 231 | 460 | 706 | 692 | 98.0 | 59 | 10 | 1.4 |
| 2. Rovral | 0.7 | 8 | 229 | 491 | 729 | 720 | 98.8 | 42 | 12 | 1.7 |
| 3. Rovral + Nu-Film-P | 0 | 11 | 232 | 449 | 693 | 682 | 98.4 | 54 | 2 | 0.2 |
| LSD(05) | ns | 3≠ | ns | ns | ns | ns | 0.4 | 12 | 8≠ | 1.1≠ |
| Variety | | | | | | | | | | |
| 1. Durango | 0.4 | 11 | 219 | 505 | 735 | 724 | 98.5 | 45 | 5 | 0.6 |
| 2. Avalanche | 1.0 | 11 | 242 | 429 | 683 | 671 | 98.3 | 58 | 11 | 1.6 |
| LSD(05) | ns | ns | 20 | 33 | 30 | 39 | ns | 10 | 6≠ | 0.9≠ |

≠LSD (10) and significant at only 6-9 percent.

# ESTABLISHMENT OF ACTION THRESHOLDS FOR ONION THRIPS

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## Objective

Experiments were conducted to evaluate the influence of thrip populations on onion yields and to compare insecticide for thrip control.

## Procedures

For the threshold studies, Vega onions were planted on April 10 at the Parma Research and Extension Center and on April 21 at the Oregon State University Malheur Experiment Station, Oregon, in single rows on 42-inch raised beds. At the Parma station, plots were four rows by 20 feet and at the Malheur station the plots were six rows by 25 feet. At both locations, plots were replicated four times in a randomized complete block design.

Onions at the Malheur station were thinned to approximately one plant per three inches. Onions at the Parma station were sprinkler-irrigated as needed and the Malheur station plots were furrow-irrigated approximately every six days or as needed. At Parma, all rows in each plot were treated, while at the Malheur station only the four inside rows were treated. Cypermethrin (Ammo 2.5EC) at 0.08 lb ai/A was used in all treatments to control thrips and was applied using a $CO_2$ pressurized sprayer delivering 38 gal water/acre at 35 psi. The onion plants were hail-damaged at the Malheur station on August 13 and all plots were sprayed with chlorothalonil fungicide on August 14.

At Malheur, onions were lifted on September 15, then topped and bagged on September 19. At Parma, onions were lifted on September 24 and topped September 28. Yields, including US Number Two's and rot, were determined by weighing 15 feet of onions from each of the middle two rows at the Malheur Station and 10 feet of onions from the middle two rows at the Parma station. While US Number Two's and rot were recorded, they were not significant and were not included in the report.

The threshold experiment had two parts. Sprays were applied incrementally every 10 days, either increasing or decreasing the number of treatments, to vary population levels of thrips for different time intervals during the season. An untreated control was included for each experimental part. Counts at both locations were made on 6/3, 6/12,/6/24, 7/2, 7/14, and 7/24 by examining 10 plants from the inner two rows per plot for thrips. On 8/24, 8/31, and 9/8 only five plants were examined. Counts were terminated at the Parma station on 8/5 because the thrips population had declined essentially to zero.

In the thrips foliar insecticide spray trials, Bronze Wonder onions were planted on April 10, at the Parma station, in offset double rows on 42-inch raised beds. Plots were four rows by 25 feet replicated four times in a randomized complete block design. All treatments were applied July 29 as described above. No counts were made until the day treatments were applied. Post-spray counts were made at 24 hours and seven days. All thrips counts were made by examining 10 plants randomly selected from the two middle rows.

## Results and Discussion

No phytotoxicity was noted in any of the treatments, regardless of the number of sprays. The predominant species of thrips present at both locations was the onion thrips, *Thrips tabaci* (Lindeman), and not the Western flower thrips, *Frankliniella occidentalis* (Pergande).

### Threshold Study

Analysis of variance and regression of date, thrips numbers, and number of treatments on yield indicated no apparent correlation between thrips numbers and yield or number of treatments and yield (Tables 1 and 2). Thrips had no apparent influence on onion market grades (Tables 3 and 4). There was a slightly higher correlation between date of application and yield, but it was not statistically significant. The thrips infestation at the Malheur station was quite heavy; on some plants counts were 200 to 300 thrips. Because the thrips infestation was heavier and lasted longer at Malheur, more sprays were required than at the Parma station. While thrips damage was readily apparent on those plots that were not sprayed regularly, all of the tops went down at about the same time, regardless of the number of treatments. Even after the hail damage, new growth was readily apparent in all treatments.

Yields from both locations varied considerably. While the thrips populations were lower at the Parma location than the Malheur location, the yields were lower as well.

The intent of these experiments was to establish threshold levels for onion thrips. From these data, it is not possible to do so. It would appear that irrigation and cultural practices may affect yield as much, if not more, than thrips damage. It will be necessary to repeat these experiments and impose the effect of irrigation practices on the spray schedule, as well as numbers of thrips at various stages of plant growth.

### Foliar Control of Onion Thrips

Most insecticides controlled onion thrips and statistically significant differences are apparent (Table 5). There were less-apparent differences in control at the seven-day count. Methyl parathion and Guthion, both widely used insecticides for thrips control, allowed a greater increase in thrips numbers than did the other insecticides after seven days. These data are consistent with past years' experiments and may indicate a trend towards resistance in thrips populations to the organophosphate insecticides. Yields were not taken in this particular trial.

Table 1. Onion thrip populations and onion yield for threshold studies conducted at University of Idaho, Research and Extension Center, Parma, Idaho, 1987.

| Treatment | Mean Number of Thrips/Plant | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Count Dates[a] | | | | | | | Yield[b] (cwt/A) |
| | 6/3 | 6/12 | 6/24 | 7/26 | 7/14 | 7/24 | 8/5 | |
| 7 Sprays | *0 | *0 | *0.1 | *0.5 | *0.5 | *1.2 | *0.6 | 708.8 a |
| 6 Sprays | 0 | *0.1 | *0.4 | *0.4 | *0.7 | *0.6 | *0.7 | 638.1 a |
| 5 Sprays | 0 | 0.4 | *2.3 | *0.9 | *0.8 | *1.1 | *0.6 | 665.2 a |
| 4 Sprays | 0 | 0.4 | 9.8 | *1.9 | *1.0 | *2.2 | *0.4 | 677.7 a |
| 3 Sprays | 0.1 | 0.2 | 6.2 | 11.8 | *7.2 | *1.2 | *0.6 | 648.1 a |
| 2 Sprays | 0 | 0.3 | 6.7 | 8.2 | 37.8 | *16.3 | *0.6 | 617.9 a |
| Untreated Control | 0 | 0.4 | 11.9 | 11.2 | 33.3 | 25.8 | 20.8 | 645.3 a |
| 1 Spray | *0 | 0.2 | 6.4 | 12.1 | 33.8 | 21.0 | 11.1 | 603.9 a |
| 2 Sprays | *0 | *0.1 | 1.6 | 5.2 | 28.5 | 21.4 | 11.4 | 630.4 a |
| 3 Sprays | *0 | *0.1 | *0.2 | 2.2 | 26.3 | 25.7 | 13.1 | 693.2 a |
| 4 Sprays | *0 | *0.1 | *0.1 | *0.5 | 15.0 | 28.3 | 15.1 | 631.3 a |
| 5 Sprays | *0 | *0 | *0.1 | *0.2 | *0.8 | 3.4 | 13.7 | 606.4 a |
| 7 Sprays | *0 | *0.1 | *0.1 | *0.4 | *0.6 | *2.2 | *0.3 | 661.2 a |
| Untreated Control | 0.1 | 0.5 | 7.4 | 7.9 | 27.1 | 17.4 | 16.5 | 623.8 a |

a * Indicates plot was sprayed the day before that count.
b Number followed by same letter not significantly different by DMRT (P = 0.05).

Table 2. Onion thrip populations and onion yield for threshold studies conducted at Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| | Mean Number of Thrips/Plant Count Dates[a] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatment | 6/3 | 6/12 | 6/24 | 7/26 | 7/14 | 7/24 | 8/5 | 8/24 | 8/31 | 9/8 | Yield[b] (cwt/A) |
| 10 Sprays | *0 | *0.2 | *0.5 | *2.2 | *2.3 | *3.2 | *2.8 | *31.5 | *12.4 | *2.1 | 986 a |
| 9 Sprays | 0.1 | *0.3 | *0.5 | *2.2 | *2.0 | *3.2 | *2.4 | *52.2 | *6.5 | *1.6 | 1016 a |
| 8 Sprays | 0.2 | 0.9 | *6.0 | *2.0 | *1.5 | *3.6 | *3.4 | *33.3 | *11.8 | *0.9 | 1071 a |
| 7 Sprays | 0.2 | 0.6 | 14.2 | *9.8 | *1.3 | *2.8 | *2.7 | *48.1 | *15.7 | *2.1 | 806 a |
| 6 Sprays | 0.2 | 0.8 | 18.2 | 23.0 | *18.1 | *7.8 | *2.0 | *26.0 | *15.3 | *0.5 | 833 a |
| 5 Sprays | 0.1 | 0.7 | 15.1 | 24.4 | 35.0 | *13.8 | *1.9 | *50.3 | *17.1 | *0.5 | 840 a |
| Untreated Control | 0 | 0.9 | 17.5 | 24.4 | 30.3 | 37.1 | 68.2 | 59.2 | 16.5 | 35.5 | 992 a |
| 1 Spray | *0 | 0.4 | 13.2 | 21.3 | 31.4 | 40.9 | 26.0 | 51.6 | 69.0 | 19.3 | 864 a |
| 2 Sprays | *0 | *0.3 | 7.8 | 21.7 | 29.6 | 39.4 | 78.1 | 31.4 | 30.2 | 11.1 | 801 a |
| 3 Sprays | *0 | *0.4 | *0.5 | 7.6 | 19.8 | 45.8 | 59.5 | 130.9 | 41.5 | 19.9 | 938 a |
| 4 Sprays | *0 | *0.4 | *0.5 | *2.0 | 8.4 | 40.1 | 73.3 | 73.8 | 53.8 | 27.1 | 840 a |
| 5 Sprays | *0 | *0.2 | *1.4 | *1.6 | *1.6 | 11.3 | 50.4 | 48.3 | 78.8 | 22.3 | 918 a |
| 10 Sprays | *0 | *0 | *0.7 | *3.2 | *1.6 | *2.4 | *2.9 | *23.3 | *22.3 | *0.5 | 940 a |
| Untreated Control | 0.2 | 1.1 | 20.1 | 24.2 | 53.4 | 28.2 | 74.5 | 51.3 | 21.1 | 13.3 | 958 a |

a * Indicates plot was sprayed the day before that count. Counts on 24 and 31 Aug and 8 Sept were taken 7 days post spray.

b Number followed by same letter not significantly different by DMRT (P = 0.05).

Table 3. Onion yield by size for various spray treatments from onion thrip threshold studies at University of Idaho, Research and Extension Center, Parma, Idaho, 1987.

| Treatment | Small | Medium | Jumbo | Collos | Total Yield |
|---|---|---|---|---|---|
| | - - - - - - - - - - - | cwt/ac | - - - - - - - - - - - | | |
| 7 sprays | 34.5 a | 165.5 | 472.0 a | 36.7 a | 708.8 a |
| 4 sprays | 24.3 a | 146.9 a | 480.1 a | 26.5 a | 677.7 a |
| 5 sprays | 31.7 a | 171.4 a | 414.1 a | 47.9 a | 665.2 a |
| 3 sprays | 33.3 a | 168.3 a | 391.7 a | 54.8 a | 648.1 a |
| 0 sprays | 24.3 | 180.2 a | 407.9 a | 33.0 a | 645.3 a |
| 6 sprays | 34.5 a | 165.5 a | 423.5 a | 14.6 a | 638.1 a |
| 2 sprays | 32.4 a | 164.0 a | 384.9 a | 31.7 a | 617.9 a |
| | | | | | |
| 3 sprays | 34.9 a | 157.1 a | 468.0 a | 33.3 a | 693.2 a |
| 6 sprays | 32.1 ab | 179.2 a | 412.3 ab | 37.7 a | 661.2 a |
| 4 sprays | 22.4 b | 162.7 a | 410.7 ab | 35.5 a | 631.3 a |
| 2 sprays | 33.6 a | 205.0 a | 361.2 b | 30.5 a | 630.4 a |
| 0 spray | 31.7 ab | 206.3 a | 353.8 b | 32.1 a | 623.8 a |
| 5 sprays | 33.0 ab | 163.4 a | 381.5 ab | 28.6 a | 606.4 a |
| 1 spray | 32.1 ab | 196.3 a | 364.7 a | 10.9 a | 603.9 a |

a Number followed by same letter not significantly different by DMRT (P = 0.05).

Table 4. Onion yield by size for various spray treatments from onion thrip threshold studies at Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Treatment | Small | Medium | Jumbo | Collos | Total Yield |
|---|---|---|---|---|---|
| | cwt/ac | | | | |
| 8 sprays | 8.1 | 107.8 | 508.1 | 447.2 | 1071.2 |
| 9 sprays | 39.5 | 109.9 | 544.6 | 321.6 | 1015.6 |
| 0 sprays | 0 | 65.4 | 542.6 | 383.9 | 991.8 |
| 10 sprays | 3.8 | 47.8 | 473.0 | 461.7 | 986.3 |
| 5 sprays | 0 | 65.0 | 462.8 | 312.5 | 840.3 |
| 6 sprays | 0 | 60.5 | 400.0 | 372.3 | 832.7 |
| 7 sprays | 0 | 60.4 | 398.4 | 347.4 | 806.2 |
| 3 sprays | 0 | 53.9 | 383.5 | 500.5 | 937.9 |
| 10 sprays | 1.0 | 32.1 | 453.2 | 453.8 | 940.1 |
| 5 sprays | 0 | 44.6 | 505.0 | 368.8 | 918.4 |
| 1 spray | 0 | 48.8 | 512.6 | 302.6 | 864.0 |
| 0 spray | 0 | 61.4 | 455.6 | 342.9 | 859.9 |
| 4 sprays | 0 | 52.2 | 426.4 | 361.3 | 839.9 |
| 2 sprays | 2.5 | 50.2 | 444.6 | 304.0 | 801.3 |

a Total yield does not include US Number Two's and rot yields.

Table 5. Onion thrips control using foliar applied insecticide sprays, University of Idaho, Research and Extension Center, Parma, Idaho, 1987.

| | Mean number of thrips/10 plants | | | | |
|---|---|---|---|---|---|
| Treatment | Pre-Count 7/29 | Post-Count 7/30 | Mean-Percent Control | 7-day Count 8/5 | Mean[b] Percent Control |
| Baythroid 2EC 0.025 | 11.9 | 2.6 | 78.8 a | 2.2 | 85.9 a |
| Capture 2EC 0.06 | 17.9 | 5.9 | 56.0 ab | 8.5 | 45.5 ab |
| Cymbush 3E 0.06 | 17.7 | 8.2 | 52.9 ab | 7.2 | 53.9 ab |
| Cymbush 3E 0.08 | 10.6 | 4.8 | 50.6 ab | 3.4 | 78.2 a |
| Ammo 2.5EC 0.08 | 18.5 | 6.3 | 48.8 ab | 5.5 | 64.7 a |
| Vydate L 2EC 0.5 | 9.8 | 4.5 | 47.4 ab | 9.6 | 38.5 |
| Methyl Parathion 4E 0.5 | 13.7 | 6.2 | 45.6 ab | 19.4 | +24.4 c |
| Ammo 2.5 EC 0.06 | 18.0 | 8.7 | 35.7 abc | 8.8 | 43.6 ab |
| Guthion 2S 0.5 | 14.4 | 10.0 | 2.2 bc | 19.5 | +25.0 c |
| Untreated Check | 11.4 | 11.2 | 0.0 c | 15.6 | 0.0 bc |

a Number followed by same letter not significantly different by DMRT "Duncan's mean range test" (P = 0.05).

b Initial mean percent control compared to pre-spray count. Seven-day mean percent control compared to the untreated check.

# EVALUATION OF EXPERIMENTAL SMALL GRAINS FOR THE TREASURE VALLEY

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Lines selected and derived from wheat, barley, and triticale populations created from crosses at the Hermiston Agricultural Research and Extension Center and at the Crop Science Department at Corvallis are systematically chosen for testing at the Malheur Experiment Station. The testing procedures range from observing a short row to conducting comprehensive replicated trials. Observations and results from the more complex trials provide objective data about a line's potential value. This data either refutes or supports the cereal breeder's experience and ability to pick lines with the highest probability of success.

## Purpose

The new cereal lines are brought to the Malheur Experiment Station to facilitate selection of new cereal varieties for Oregon cereal growers. This report summarizes data from the 16 Treasure Valley experiments conducted in 1987 to assist plant breeders in their decisions about which lines to discard.

## Procedures

Fall-seeded trials are planted in mid-October, and the spring trials in late March. Trials entail either randomized complete blocks with three to six replications or single observation rows or plots. The four-row plots are 4 feet by 15 feet. They are bordered and divided by V-shaped rills and consist of two 14-inch-wide raised beds with two rows planted 10 inches apart on each bed. A four-row double-disc opener research drill mounted on a small tractor is used to seed the trials. The V-shaped rills or furrows are cleaned and reopened by a set of "slicks" mounted on the drill. Harvesting is completed with a small-plot combine.

## Winter Nursery Cultural Practices

The winter small grain nursery was planted in field D-2A on October 16, 1986. One hundred pounds of $P_2O_5$ as granular triple superphosphate were broadcasted following the removal of the preceding onion crop and plowed into the soil prior to seeding. Weeds were controlled by a single application of Brominal ME-4 at one pint per acre on April 7, 1987. On April 30, 1987, the nursery was top-dressed with ammonium nitrate and ammonium sulfate. The wheat received 170 pounds of nitrogen and 100 pounds of sulfur per acre and the barley received 127 pounds of nitrogen and 40 pounds of sulfur per acre. Irrigation water was applied in alternating rows during eight 12-hour "runs." The winter nursery was combined on July 24 through 28.

## Spring Nursery Cultural Practices

The spring small-grain nursery was planted in field B-8A on April 10, 1987. Sixty pounds of N plus 100 pounds of $P_2O_5$ per acre from ammonium nitrate and granular triple superphosphate were broadcasted following the removal of the preceding corn silage crop and plowed into the soil during November 1986. Weeds were controlled by a single application of Brominal ME-4 at one pint per acre on May 4, 1987. The plots were top-dressed with 47 pounds of nitrogen per acre as ammonium nitrate on May 26. The wheat and barley plots received nine and eight irrigations, respectively. Each irrigation entailed a 12-hour set in alternate corrugates. Barley harvest was completed August 5 and the wheat was combined on August 10.

## Results and Discussions

Several winter barley trials were planted, but severe early lodging precluded harvest. As a result, the 1988 barley plots are larger single plots, eight rows wide and 30 feet long.

Eastern Oregon Winter Wheat (Table 1). This trial is grown at several locations each year and contains advanced white wheat selections as well as the more popular white winter wheats grown in Oregon.

McDermid was released by Oregon State University in the early 1970's. It rapidly replaced Nugaines in the Treasure Valley due to its larger diameter stems, bigger kernels, and better milling and baking characteristics. It was one of the first soft white varieties from crosses of tall, high-yielding European types with the Pacific Northwest semi-dwarf germplasm.

Stephens, which replaced McDermid in the early 1980's, is now the predominant soft white winter wheat variety grown in Oregon. Reduced lodging, better yields, a tolerance to lower culm and root diseases, and superb quality contributed towards grower acceptance. The wheat industry's dependence on this single variety makes it vulnerable to widespread yield reductions due to diseases or environmental factors. Stephens has the best five-year yield averages (Table 1).

Hill is a taller variety which has gained acceptance in areas where winter survival is crucial. Unfortunately, those areas may include the zones where dwarf smut is a problem. Hill is very susceptible to dwarf smut infections. Conversations with growers have revealed a perception that Hill outperforms resistant varieties even when suffering yield and quality reductions due to dwarf smut. Hill has a good five-year yield record at the Malheur Experiment Station, but appears to lodge more than Stephens in large fields.

Malcolm, a recent release from Oregon State University, has a little smaller head than Stephens, but appears to produce more heads per acre. Consequently, in some trials it has a better yield record than Stephens. For example, when averaged across the three 1987 locations in the Eastern Oregon White Wheat trial, Malcolm averaged 131 bushels per acre compared to Stephens at 126. In 1986 Malcolm averaged 126 compared to Stephens at 129 bushels per acre at the same three locations.

Though Malcolm's grain yield compares favorably to Stephens, its primary strength is that it is from a different genetic background. The background captured within the variety gives it a different gene complex for resistance to stripe rust and cold hardiness. What does that mean to growers? It means that the wheat crop's vulnerability due to the widespread use of Stephens is reduced, and the probability for consistent production is increased.

The other named varieties in this trial are Dusty, Lewjain, and Daws, which were released by Washington State University. Dusty, the most recent one, is similar to Stephens and is establishing an acceptable yield pattern along the Columbia River. It has a very good level of cold hardiness, but is not as cold hardy as Lewjain and Daws.

Lewjain, which has excellent resistance to smuts, is a very appropriate candidate for growers to use where smuts are a potential problem.

Daws, on the other hand, is not resistant to dwarf smut and generally yields 10 to 15 percent less than the previously mentioned varieties.

Three of the experimental entries, numbers 5, 9, and 15, are of special interest. FW75336-103, Entry 5, Yamhill/McDermid/2/Triticum spelta/3/Suwon 92/Roedel/4/NB68513/Hyslop/2/Backa, is a line selected from the long-term root rot-BYDV screening complex near Hermiston. In trials conducted at 14 Oregon locations from 1985 through 1987 it averaged 108.6 bushels per acre while Stephens averaged 106.5. It was entered in the regional winter wheat nursery in 1987.

Entry 9, FW81454-301, Daws/SM-4/2/McDermid/SM-11, is a line from the effort to breed a dwarf smut resistant variety. It is in its second year of regional testing.

Entry 15, FW81464-333, Stephens*2/SM-4, had the best overall yield average in the 1987 Eastern Oregon White Wheat trials and is ranked as promising in the quality trials. FW81464-333 is slated for the regional trials beginning with 1989.

Eastern Oregon BYDV Winter Wheat (Table 2). Entries 2 through 17 are selections from a cross of two wheats which are very tolerant to Barley Yellow Dwarf Virus (BYDV). FW771595-21F, the female parent, is a poor milling quality soft red winter wheat selection from a complex cross. The male parent is the hard red spring wheat selection 879/4 developed at Novi Sad, Yugoslavia. It was observed to have exceptional tolerance to BYDV, and possibly to Aster Yellows, in India. It was first used as a parent in Oregon's breeding program in 1982. After several years of recurrent selection the better lines were entered into the 1987 Eastern Oregon BYDV Winter Wheat Trial planted at four locations. Two of the locations near Hermiston had very severe take-all, septorea nodorum, and Xanthomonas bacteria infections. Grain yields within the four locations ranged from 15 to

166 bushels per acre. Average yields across locations ranged from 70 to 99 bushels per acre for entries seven and two respectively. The Malheur Experiment Station grain yields ranged from 124 to 166 bushels per acre. Most test weights were satisfactory. Straw strength was good as only three lines partially lodged.

Ontario Winter Wheat Selections Table 3). Seventeen wheat lines were kept from 60 plant plots grown at the Malheur Experiment Station in 1986. In 1987 the 17 were tested near Hermiston, Boardman, and on the Malheur Experiment Station. There are three types of crosses. Entries One through Seven are selections from the FW82150 crosses, Al Fong/3/Excelsior/2/Rb/Hyslop, in an attempt to select the earliness of Al Fong and still retain the high level of Barley Yellow Dwarf Virus tolerance of the Excelsior/2/Rb/Hyslop cross. Their 1987 grain yields, which ranged from 145 to 164 bushels per acre at Ontario, were satisfactory. They are, however, several days later maturing than Malcolm, and bushel weights are one to two pounds less than desired. Entries Eight and Nine are an attempt to combine the root disease tolerance of FW741037 with the good quality of CP04. Both Eight and Nine were discarded because of poor seed quality. The Stephens/2/Pillan/Cerco cross within FW82178 selections was made to combine Pillan's BYDV tolerance and Cerco's Cercosporella resistance with the quality of Stephens. The FW82178 selections are very promising. Entries 12 through 17 were included in the 1988 trials because of kernel quality, earliness, grain yield, bushel weight, and stiff straw.

Corvallis Elite Winter Wheat (Table 4). The Corvallis elite winter wheats are new to the Ontario station. Their pedigrees represent an excellent variation of high-yielding germplasm that reflects the priority effort to develop diverse varieties for Oregon growers. Two lines, CW8723 and CW8726, are especially interesting; CW8723 because of its earliness and high yield, and CW8726 because the high yield of the late-maturing Nord Desprez (ND) and Vilmorin 53 (Vil 53) is successfully transferred to this line with mid-season maturity.

White Winter Wheat Selection Trial Table 5). Attempts within Project 0396 to develop dwarf wheat lines with good yields have been unsatisfactory. Usually the dwarf types had high rates of sterility or had shriveled seed. The types reported in Table 5 are probably two-gene dwarfs. The yields of the lines selected for further testing are excellent for the 24-inch plant height. Now the plan is to pick the best lines and use them as parents, or release them as varieties to growers in very high fertility sites where lodging is a problem.

Ontario Individual Wheat Plant Plots (Table 6). In this trial 72 plant plots were evaluated for potential adaptation to the flood irrigation system. Red and white wheats with good tolerance to BYDV and root diseases at Hermiston were used as parents. Forty lines were selected for 1988 preliminary yield trials.

Tri-State Hard Red Winter Wheat (Table 7). This nursery is a cooperative nursery including the breeding programs of Idaho, Washington, and Oregon. Only the Idaho lines were tested since the Idaho participant was the only one submitting lines in time for planting. These lines are good quality hard red winter types and have satisfactory baking and milling characteristics. They represent a significant advance in developing short-stature hard red winters for high-production sites.

Hermiston Preliminary Hard Red Winter Wheat (Table 8). The preliminary hard red wheats in this trial are better quality wheats than previously tested. Their grain yields, however, are not as high as the check, FW771595G309.

Corvallis Source Spring Wheat (Table 9). The entries in this trial are introduction spring wheats. The grain yields are generally similiar to McKay and Borah yields. Several lines are promising.

Eastern Oregon Spring Barley (Table 10). Entry number Seven, FB78444-006, is the most outstanding line in the trial. Its four-year yield average of 147 bushels per acre is 13 bushels higher than the highest-yielding named barley, Lindy. FB78444-006 is being purified for breeders seed production and for increase for regional trials. Karla (6-row), Kris (2-row), and Morex (6-row) are approved for general production of malting barley. Cougbar is a dual purpose type, but requires additional malting quality testing before it may gain general acceptance as a malt type. Lindy and Steptoe are very similar feed types which lodge readily in high-production sites. Micah and Columbia are short stiff-strawed feed varieties suitable for irrigation.

Spring Barley Seeding Rate Trial (Table 11). The experimental line FB78444-006 and Micah were seeded at 35, 70, and 105 pounds per acre. Micah yielded the same across seeding rates but had lower test weights as seeding rates increased. FB78444-006 had the lowest yield and lowest test weight at 35 pounds per acre. Lodging tended to increase as seeding rates increased. The results of this trial were not statistically significant.

Eastern Oregon Spring Triticale (Table 12). Four triticales were compared with a wheat and a spring durum. Grain yields were in the same range as one expects from spring wheats. Yields ranged from 95 bushels per acre for Nutricale to 130 bushels per acre for the Grace selection. The bushel weights of 52 and 53 pounds were typical for spring seeded triticale.

Corvallis Spring Barley Trial (Table 13). Experimental lines tested in this trial have passed preliminary malting evaluations. Three entries exceeded the highest-yielding check, Steptoe. Only two did not yield as well as the malting varieties Morex and Klages. Lodging within the experiment was higher than desirable.

Eastern Oregon BYDV Winter Barley (Table 14). Fifteen new winter barley plant plot selections from the 1986 Hermiston BYDV screening nursery and three checks were tested in this trial at four locations. Three were near Hermiston and defined as early, mid, and late 1986 fall planting dates.

The early date was planted August 28 in the BYDV test area. The mid date was on September 8 in a location where wheat was grown in

1985 and spring barley was grown in 1986. High populations (greater than 100 per foot of row) of viruliferous aphids infected the early and mid seeding dates. Common root rot of barley was prevalent in the mid and late seedings. The experimental site on the Ken Taghan farm near Willow Creek was planted October 10.

Entries number Six and 10, both selections from the complex cross of Luther/Hiproly/2/NE 76138/3/FB763167 (entry #2) were the two most stable lines at all four locations, and had the highest average yields. Hesk's yields confirm past observations about that variety. It has a moderate tolerance to BYDV, but is moderately susceptible to the root rots. The check, FB763167-H6001, is more tolerant to root rots than Hesk and is an entry in the regional nursery. The third check, FB77796-H6001, is an early maturing selection from Ohio barley 67-23 times Lakeland from Michigan. It is a candidate for release for growers who have shallow soils and desire an early maturing type. Though grain yields at Willow Creek are very satisfactory, low bushel weights and percents plump may reflect either the unfavorable higher than 1 percent sodium, or the unfavorable calcium:phosphorus ratio of 201:1 reported in the soil test results.

Eastern Oregon Spring Barley (Table 15). This test was conducted in the same field near Willow Creek as the previous test, and has the same entries as the test grown on the Malheur Experiment Station (Table 10). Yields ranged from 90 to 138 bushels per acre for Robust and Steptoe, respectively. Bushel weights were excellent and none of the entries lodged.

Eastern Oregon Winter Triticale (Table 16). This yield test was also conducted in the same field near Willow Creek. The results from the soil tests were somewhat different. The pH in this test was 7.8 versus 7.4 at the Eastern Oregon BYDV winter barley site. The calcium:sodium ratio was more favorable, but the calcium:phosphorus ratio was less favorable at 614:1 versus 201:1. Grain yields were not spectacular for the triticale. Four triticale lines yielded 17 or more bushels per acre than Stephens.

Table 1. Eastern Oregon Winter Wheat: a five-year yield summary plus the date of heading, test weight, plant height, and lodging percent of white winter wheats in a 1987 yield trial at the Malheur Experiment Station, OSU, Ontario, Oregon.

| Entry | Name | YIELD 1983 | 1984 | 1985 | 1986 | 1987 | Average | Date 50% Headed | Test Weight | Plant Height | Lodging |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | bu/ac | | | | | | | lbs/bu | inches | % |
| 1 | McDermid | 129 | 117 | 133 | 143 | 139 | 132* | 5/17 | 61 | 35 | 10 |
| 2 | Stephens | 163 | 150 | 137 | 138 | 159 | 149 | 5/13 | 61 | 34 | 10 |
| 3 | Hill | 163 | 144 | 120 | 131 | 140 | 140 | 5/17 | 61 | 38 | 10 |
| 4 | Malcolm | 159 | 130 | 120 | 123 | 149 | 136 | 5/12 | 58 | 37 | 0 |
| 5 | FW73577-715 | 134 | 94 | 115 | 138 | 130 | 122 | 5/18 | 57 | 37 | 50 |
| 6 | FW75336-103 | | | 140 | 120 | 158 | 139 | 5/15 | 57 | 36 | 10 |
| 7 | FW771697G19 | | | 121 | 144 | 142 | 136 | 5/17 | 61 | 36 | 40 |
| 8 | FW81463-307 | | | 134 | 146 | 156 | 145 | 5/14 | 58 | 36 | 60 |
| 9 | FW81454-301 | | | | 129 | 162 | 145 | 5/12 | 59 | 35 | 20 |
| 10 | FW82178-B5018 | | | | 134 | 158 | 146 | 5/13 | 59 | 36 | 10 |
| 11 | Dusty | | | | 132 | 155 | 143 | 5/13 | 62 | 37 | 0 |
| 12 | Lewjain | | | | | 157 | 157 | 5/13 | 59 | 37 | 0 |
| 13 | FW82167-307 | | | | | 158 | 158 | 5/13 | 59 | 37 | 0 |
| 14 | FW82169-318 | | | | | 154 | 154 | 5/13 | 59 | 38 | 0 |
| 15 | FW81464-333 | | | | | 158 | 158 | 5/15 | 60 | 36 | 10 |
| 16 | FW82202-324 | | | | | 128 | 128 | 5/18 | 58 | 37 | 30 |
| 17 | FW82176-302 | | | | | 160 | 160 | 5/16 | 60 | 35 | 40 |
| 18 | Daws | | | | | 136 | 136 | 5/17 | 59 | 39 | 0 |

* Stephens averages not listed are: 1984 through 1987 = 146 bushels per acre
1985 through 1987 = 145 bushels per acre
1986 through 1987 = 148 bushels per acre

Table 2. Eastern Oregon BYDV Winter Wheat: grain yield, date of 50 percent heading, test weight, plant height, and lodging percent of Barley Yellow Dwarf Virus tolerant selections tested in a 1987 yield trial at the Malheur Experiment Station, OSU, Ontario, Oregon.

| Entry | Name | Yield | Date 50% Headed | Test Weight | Plant Height | Lodging |
|---|---|---|---|---|---|---|
| | | bu/ac | | lbs/bu | inches | % |
| 1 | FW75336 H6001 | 166 | 5/13 | 58 | 36 | 0 |
| 2 | FW83242-004* | 154 | 5/17 | 58 | 37 | 20 |
| 3 | FW83242-006 | 150 | 5/08 | 58 | 31 | 0 |
| 4 | FW83242-007 | 148 | 5/12 | 55 | 26 | 0 |
| 5 | FW83242-009 | 154 | 5/08 | 57 | 29 | 0 |
| 6 | FW83242-010 | 162 | 5/08 | 61 | 28 | 0 |
| 7 | FW83242-014 | 124 | 5/14 | 60 | 36 | 0 |
| 8 | FW83242-029 | 142 | 5/16 | 60 | 34 | 0 |
| 9 | FW83242-030 | 158 | 5/13 | 60 | 31 | 0 |
| 10 | FW83242-032 | 143 | 5/15 | 60 | 41 | 0 |
| 11 | FW83242-034 | 146 | 5/12 | 60 | 30 | 0 |
| 12 | FW83242-036 | 150 | 5/13 | 59 | 42 | 0 |
| 13 | FW83242-038 | 149 | 5/11 | 62 | 32 | 0 |
| 14 | FW83242-040 | 158 | 5/17 | 60 | 36 | 10 |
| 15 | FW83242-041 | 154 | 5/11 | 60 | 32 | 10 |
| 16 | FW83242-048 | 156 | 5/06 | 61 | 29 | 0 |
| 17 | FW83242-051 | 147 | 5/16 | 61 | 36 | 0 |
| 18 | FW83242-054 | 141 | 5/13 | 62 | 34 | 0 |

*2 FW83242-004. The pedigree for the FW83242 series is FW771595-21F/NS 879-4.

Table 3. Ontario Winter Wheat Selections: grain yield, date of 50 percent heading, plant height, test weight, and percent lodging of early generation winter wheat selections tested near Hermiston and Boardman in 1986, and near Ontario, Oregon in 1986 and 1987.

| Entry | Name | YIELD Hermiston | YIELD Boardman | YIELD Ontario 1986 | YIELD Ontario 1987 | YIELD Average | Date 50% Headed | Test Weight | Plant Height | Lodging |
|---|---|---|---|---|---|---|---|---|---|---|
| | | bu/ac | bu/ac | bu/ac | bu/ac | bu/ac | | lbs/bu | inches | % |
| 1 | FW83150-05003 | 104 | 104 | 135 | 156 | 125 | 5/16 | 57 | 35 | 30 |
| 2 | FW83150-05004 | 110 | 118 | 131 | 157 | 129 | 5/17 | 59 | 34 | 40 |
| 3 | FW83150-05005 | 125 | 106 | 137 | 161 | 132 | 5/14 | 60 | 32 | 10 |
| 4 | FW83150-05007 | 118 | 122 | 135 | 158 | 133 | 5/16 | 58 | 34 | 40 |
| 5 | FW83150-05008 | 111 | 121 | 131 | 164 | 132 | 5/16 | 59 | 35 | 50 |
| 6 | FW83150-05014 | 106 | 112 | 135 | 145 | 124 | 5/17 | 58 | 36 | 70 |
| 7 | FW83150-05018 | 118 | 113 | 145 | 152 | 132 | 5/16 | 57 | 35 | 70 |
| 8 | FW83228-05019 | 114 | 113 | 133 | 145 | 126 | 5/17 | 59 | 35 | 0 |
| 9 | FW83228-05041 | 126 | 121 | 134 | 149 | 132 | 5/18 | 57 | 37 | 20 |
| 10 | FW82178-B5006 | 118 | 120 | 146 | 172 | 139 | 5/12 | 60 | 36 | 0 |
| 11 | FW82178-B5009 | 118 | 106 | 110 | 168 | 125 | 5/13 | 60 | 36 | 0 |
| 12 | FW82178-B5011 | 120 | 113 | 134 | 176 | 136 | 5/11 | 60 | 37 | 0 |
| 13 | FW82178-B5021 | 137 | 121 | 142 | 170 | 142 | 5/11 | 60 | 35 | 0 |
| 14 | FW82178-B5025 | 126 | 120 | 140 | 171 | 139 | 5/13 | 60 | 36 | 0 |
| 15 | F282178-B5023 | 134 | 125 | 132 | 170 | 140 | 5/12 | 60 | 36 | 0 |
| 16 | F282178-B5024 | 118 | 120 | 134 | 170 | 135 | 5/12 | 59 | 36 | 0 |
| 17 | FW82178-B5026 | 128 | 127 | 131 | 171 | 139 | 5/11 | 60 | 37 | 0 |
| 18 | Malcolm | 122 | 126 | 144* | 156 | 137 | 5/13 | 58 | 38 | 0 |

* Malcolm yield from adjacent trial in 1987.

Table 4. Corvallis Elite Winter Wheat: grain yeild, date of 50 percent heading, pounds per bushel, plant height, and percent lodging of advanced generation winter wheats submitted by the Corvallis cereal improvement project and tested in a 1987 trial grown at the Malheur Experiment Station, OSU, Ontario, Oregon.

| Entry | Name | Pedigree | Yield | Date 50% Headed | Test Weight | Plant Height | Lodging |
|---|---|---|---|---|---|---|---|
| | | | bu/ac | | lbs/bu | inches | % |
| 1 | CW8723 | 6720/Ciano/Inia/2/Rfn | 151 | 5/09 | 60 | 35 | 0 |
| 2 | CW8724 | 6720-11/Mda 38/Wrm | 148 | 5/13 | 58 | 38 | 30 |
| 3 | CW8725 | Hys/Cer/2/Ymh/Hys | 128 | 5/17 | 58 | 35 | 50 |
| 4 | CW8726 | ND/P-101/3/Vil 53/N 10B/HS | 172 | 5/13 | 57 | 40 | 0 |
| 5 | CW830166 | V6707/BNN | 146 | 5/12 | 60 | 32 | 0 |
| 6 | CW830211 | Rmn/Torim | 164 | 5/12 | 63 | 34 | 0 |
| 7 | CW830801 | Cleo/Pch//ZZ | 138 | 5/12 | 55 | 33 | 0 |
| 8 | CW832665 | 6210/Bjy//4/TJB259//Mhm/3/G11/Nar | 130 | 5/18 | 58 | 39 | 30 |
| 9 | CW832784 | Cleo/Pck//ZZ/4/Avc/3/DJ/Bez//Wa 5204 | 141 | 5/09 | 58 | 33 | 10 |
| 10 | CW833032 | Hys/T2484-35T-2t-1t | 138 | 5/17 | 57 | 37 | 40 |
| 11 | CW873053 | ND/P-101/2/Smb/Hn IV | 125 | 5/17 | 60 | 37 | 60 |
| 12 | CW833103 | Rdl/SW7107/2/ND/VG9144 | 124 | 5/17 | 59 | 36 | 40 |
| 13 | CW833313 | Ymh/2/Ymh/Hys | 134 | 5/21 | 61 | 40 | 60 |
| 14 | CW833646 | Cerco/2/Ymh/Hys | 143 | 5/17 | 59 | 37 | 60 |
| 15 | CW833649 | Cerco/2/Ymh/Hys | 143 | 5/16 | 59 | 38 | 40 |
| 16 | CW833725 | TJB 842-12919/Spn | 130 | 5/16 | 59 | 37 | 40 |
| 17 | CW833765 | 6720-11/2/Mda 38/Wrm | 146 | 5/13 | 59 | 38 | 20 |
| 18 | CW834686 | Spn/2/Ymh/Hys | 153 | 5/18 | 60 | 35 | 50 |
| 19 | Stephens* | | 159 | 5/13 | 61 | 35 | 10 |

* Stephens from an adjacent trial.

Table 5. White Winter Wheat Selection Trial: grain yield, date 50 percent headed, plant height, and lodging percent of short-stature F-4 generation selections grown and selected at the Malheur Experiment Station, OSU, Ontario, Oregon.

| Entry | Name | Yield | Date 50% Headed | Plant Height | Lodging |
|---|---|---|---|---|---|
| | | bu/ac | | inches | % |
| 1 | FW82271-07016* | 125 | 5/25 | 24 | 0 |
| 2 | FW82271-07017 | 120 | 5/25 | 24 | 0 |
| 3 | FW82271-07018 | 116 | 5/25 | 24 | 0 |
| 4 | FW82271-07020 | 121 | 5/25 | 24 | 0 |
| 5 | FW82271-07021 | 129 | 5/25 | 24 | 0 |
| 6 | FW82271-07023 | 129 | 5/25 | 24 | 0 |
| 7 | FW82271-07027 | 124 | 5/25 | 24 | 0 |
| 8 | FW82271-07033 | 141 | 5/25 | 24 | 0 |
| 9 | FW82271-07034 | 129 | 5/25 | 24 | 0 |
| 10 | FW82271-07035 | 127 | 5/25 | 24 | 0 |
| 11 | FW82271-07039 | 129 | 5/25 | 24 | 0 |
| 12 | FW82271-07041 | 129 | 5/25 | 24 | 0 |
| 13 | FW82271-07051 | 123 | 5/25 | 24 | 0 |
| 14 | FW82271-07052 | 148 | 5/25 | 24 | 0 |
| 15 | FW82271-07058 | 123 | 5/25 | 24 | 0 |
| 16 | FW82271-07059 | 124 | 5/25 | 24 | 0 |
| 17 | FW82271-07063 | 122 | 5/25 | 24 | 0 |
| 18 | FW82271-07071 | 119 | 5/25 | 24 | 0 |

* The pedigree for the FW82271 - selections is FW73830-06/2/Rb/2* 1523/Dc.

Table 6. Ontario individual wheat plant plots: grain yield, lodging percent, and kernel color of selections advanced to replicated yield trials and grown in 1987 at the Malheur Experiment Station, OSU, Ontario, Oregon.

| Entry | Name | Yield | Lodging | Seed Coat Color | Entry | Name | Yield | Lodging | Seed Coat Color |
|---|---|---|---|---|---|---|---|---|---|
| | | bu/ac | % | | | | bu/ac | % | |
| 1 | FW83057-07002 | 125 | 60 | red | 21 | FW83057-07003 | 123 | 40 | mixed |
| 2 | FW83057-07005 | 122 | 60 | white | 22 | FW83057-07007 | 109 | 70 | red |
| 3 | FW83120-07002 | 129 | 0 | white | 23 | FW83120-07003 | 117 | 0 | red |
| 4 | FW83120-07010 | 124 | 10 | mixed | 24 | FW83120-07012 | 129 | 50 | white |
| 5 | FW83120-07014 | 112 | 40 | white | 25 | FW83120-07019 | 113 | 40 | red |
| 6 | FW83120-07024 | 115 | 10 | red | 26 | FW83120-07026 | 120 | 10 | mixed |
| 7 | FW83120-07030 | 117 | 0 | red | 27 | FW83120-07031 | 106 | 10 | mixed |
| 8 | FW83126-07001 | 126 | 70 | red | 28 | FW83126-07002 | 127 | 80 | red |
| 9 | FW83126-07005 | 129 | 60 | white | 29 | FW83126-07006 | 141 | 40 | white |
| 10 | FW83126-07008 | 126 | 30 | white | 30 | FW83126-07009 | 138 | 70 | mixed |
| 11 | FW83126-07012 | 146 | 30 | white | 31 | FW83126-07015 | 134 | 0 | white |
| 12 | FW83130-07004 | 169 | 0 | mixed | 32 | FW83130-07014 | 158 | 50 | white |
| 13 | FW83232-07001 | 132 | 0 | red | 33 | FW83232-07002 | 131 | 0 | red |
| 14 | FW83232-07003 | 125 | 10 | red | 34 | FW83232-07005 | 137 | 0 | red |
| 15 | FW83232-07006 | 136 | 0 | red | 35 | FW83232-07007 | 138 | 0 | red |
| 16 | FW83236-07013 | 119 | 50 | white | 36 | FW83236-07016 | 119 | 60 | red |
| 17 | FW83236-07017 | 107 | 70 | red | 37 | FW83270-07001 | 122 | 30 | white |
| 18 | F283290-07001 | 145 | 60 | white | 38 | FW83272-07002 | 138 | 30 | mixed |
| 19 | FW83290-07002 | 157 | 50 | white | 39 | FW83290-07007 | 130 | 0 | white |
| 20 | FW83290-07008 | 163 | 10 | white | 40 | FW83290-07001 | 151 | 0 | white |

Table 7. Tri-state hard red winter wheat nursery: grain yield from 1986 and 1987, date of 50 percent heading, test weight, plant height, and percent lodged of red winter wheats tested in a 1987 trial at the Malheur Experiment Station, OSU, Ontario, Oregon.

| Entry | Name | ---- YIELD ---- 1986 | 1987 | Average | Date 50% Headed | Test Weight | Plant Height | Lodging |
|---|---|---|---|---|---|---|---|---|
| | | ---- bu/ac | | ----- | | lbs/bu | inches | % |
| 1 | NEELY | 119 | 119 | 119 | 5/09 | 60 | 35 | 0 |
| 2 | STEPHENS | 140 | 149 | 145 | 5/13 | 58 | 38 | 30 |
| 3 | ID 301 | 126 | 128 | 127 | 5/17 | 58 | 35 | 50 |
| 4 | ID 323 | 133 | 130 | 131 | 5/13 | 57 | 40 | 0 |
| 5 | ID 326 | 128 | 144 | 136 | 5/12 | 60 | 32 | 0 |
| 6 | ID 339 | | 127 | 127 | 5/12 | 63 | 34 | 0 |
| 7 | ID 355 | | 131 | 131 | 5/12 | 55 | 33 | 0 |
| 8 | ID 356 | | 142 | 142 | 5/18 | 58 | 39 | 30 |
| 9 | ID 357 | | 127 | 127 | 5/09 | 58 | 33 | 10 |
| 10 | ID 358 | | 142 | 142 | 5/17 | 57 | 37 | 40 |
| 11 | ID 359 | | 142 | 142 | 5/17 | 60 | 37 | 60 |
| 12 | ID 360 | | 149 | 149 | 5/17 | 59 | 36 | 40 |
| 13 | ID 361 | | 147 | 147 | 5/21 | 61 | 40 | 60 |
| 14 | ID 362 | | 131 | 131 | 5/17 | 59 | 37 | 60 |
| 15 | ID 364 | | 139 | 139 | 5/16 | 59 | 38 | 40 |

Table 8. Hermiston preliminary hard red winter wheat: grain yield, date of 50 percent heading, plant height, test weight, and percent lodged of preliminary hard red winter wheat selections tested in 1987 at the Malheur Experiment Station, OSU, Ontario, Oregon.

| Entry | Name | Yield | Date 50% Headed | Test Weight | Plant Height | Lodging |
|---|---|---|---|---|---|---|
| | | bu/ac | | lbs/bu | inches | % |
| 1 | FW771595G309 | 153 | 5/17 | 58 | 33 | 0 |
| 2 | FW81464-342 | 142 | 5/16 | 60 | 33 | 50 |
| 3 | FW82164-305 | 141 | 5/17 | 56 | 33 | 30 |
| 4 | CERCO | 131 | 5/16 | 60 | 33 | 0 |
| 5 | PROFIT 75 | 136 | 5/15 | 59 | 37 | 0 |
| 6 | FW741595G02 | 112 | 5/16 | 56 | 33 | 0 |
| 7 | FW81463-315 | 148 | 5/12 | 61 | 34 | 30 |
| 8 | FW84030-B6033 | 139 | 5/14 | 58 | 36 | 0 |
| 9 | FW84048-B6003 | 126 | 5/20 | 60 | 42 | 0 |
| 10 | FW84053-B6002 | 138 | 5/16 | 59 | 36 | 0 |
| 11 | FW84053-B6016 | 141 | 5/11 | 59 | 32 | 0 |
| 12 | FW84053-B6021 | 130 | 5/13 | 58 | 33 | 0 |
| 13 | FW84053-B6029 | 134 | 5/17 | 56 | 34 | 0 |
| 14 | F284068-B6054 | 132 | 5/11 | 60 | 37 | 0 |
| 15 | FW84064-B6016 | 146 | 5/10 | 61 | 36 | 0 |
| 16 | FW84069-B6040 | 133 | 5/11 | 61 | 36 | 0 |
| 17 | FW84073-B6002 | 116 | 5/16 | 61 | 37 | 0 |
| 18 | TSN B-2 | 134 | 5/14 | 60 | 34 | 0 |

Table 9. Corvallis source spring wheat: a three-year yield summary, plus date of 50 percent heading, plant height, test weight, and percent lodged of elite spring wheats submitted from the Corvallis-based cereal improvement project and tested in a 1987 trial at the Malheur Experiment Station, OSU, Ontario, Oregon.

| Entry | Name | YIELD 1985 | YIELD 1986 | YIELD 1987 | YIELD Average | Date 50% Headed | Test Weight | Plant Height | Lodging |
|---|---|---|---|---|---|---|---|---|---|
| | | bu/ac | | | | | lbs/bu | inches | % |
| 1 | ORSW 8508 (Tanager) | 89 | 86 | 104 | 93 | 6/02 | 63 | 32 | 20 |
| 2 | ORSW 8509 (Veery) | 87 | 94 | 117 | 99 | 6/08 | 61 | 27 | 10 |
| 3 | ORSW 8510 (Minivet) | 81 | 87 | 107 | 92 | 6/06 | 62 | 30 | 0 |
| 4 | ORSW 8511 | 89 | 99 | 123 | 104 | 6/09 | 62 | 31 | 0 |
| 5 | BOW | 93 | 93 | 114 | 100 | 6/03 | 64 | 28 | 0 |
| 6 | ORSW 8518 (Gen 81) | 80 | 98 | 124 | 101 | 6/08 | 62 | 30 | 10 |
| 7 | ALP850015 (Buck Pucara) | | 84 | 109 | 96 | 6/04 | 63 | 34 | 30 |
| 8 | ALP850016 (Buck Mapuche) | | 84 | 110 | 97 | 6/03 | 62 | 31 | 20 |
| 9 | ALP850017 | | 79 | 101 | 90 | 6/04 | 63 | 29 | 10 |
| 10 | ALP850020 | | 81 | 105 | 93 | 6/10 | 63 | 33 | 10 |
| 11 | MCKAY | | 98 | 114 | 106 | 6/08 | 60 | 34 | 10 |
| 12 | BORAH | | | 111 | 111 | 6/06 | 60 | 32 | 30 |
| 13 | TITMOUSE | | | 90 | 90 | 6/03 | 62 | 28 | 20 |
| 14 | 906 R | | | 104 | 104 | 5/01 | 61 | 27 | 20 |
| 15 | ORSW 8413 | | | 119 | 119 | 6/10 | 62 | 33 | 0 |
| 16 | ORSW 8415 | | | 112 | 112 | 6/08 | 63 | 33 | 0 |
| 17 | ORSW 8416 | | | 119 | 119 | 6/09 | 63 | 34 | 10 |
| 18 | ORSW 8418 | | | 106 | 106 | 6/02 | 64 | 31 | 0 |

Table 10. Eastern Oregon spring barley: a five-year grain yield comparison for the years an entry was grown, plus the date of 50 percent heading, plant height, test weight, and percent lodged of spring barleys grown in trials at the Malheur Experiment Station, OSU, Ontario, Oregon.

| Entry | Name | 1983 | 1984 | 1985 | 1986 | 1987 | Average | Date 50% Headed | Test Weight | Plant Height | Lodging |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | - - - - - - - - - - - - | - - - - - | YIELD | - - - - - | - - - - - - - - - - - - | | | | | |
| | | bu/ac | | | | | | | lbs/bu | inches | % |
| 1 | KARLA | 116 | 110 | 134 | 138 | 130 | 126 | 6/07 | 46 | 37 | 40 |
| 2 | KRIS | 119 | 93 | 100 | 138 | 122 | 114 | 6/10 | 50 | 34 | 60 |
| 3 | MICAH | 113 | 116 | 121 | 110 | 137 | 119 | 6/10 | 47 | 32 | 20 |
| 4 | COLUMBIA | | 139 | 137 | 128 | 136 | 135 | 6/10 | 47 | 33 | 20 |
| 5 | FB78444-004 | | 157 | 131 | 138 | 128 | 138 | 6/10 | 46 | 33 | 40 |
| 6 | FB78444-005 | | 152 | 130 | 138 | 120 | 135 | 6/12 | 47 | 34 | 30 |
| 7 | FB78444-006 | | 166 | 150 | 142 | 130 | 147 | 6/12 | 46 | 33 | 0 |
| 8 | LINDY | | 145 | 117 | 148 | 123 | 133 | 6/04 | 45 | 29 | 80 |
| 9 | COUGBAR | | | | 142 | 120 | 131 | 6/09 | 47 | 38 | 70 |
| 10 | HAZEN | | | | 139 | 119 | 129 | 6/06 | 47 | 37 | 70 |
| 11 | ANDRE | | | | 142 | 125 | 133 | 6/09 | 47 | 33 | 90 |
| 12 | LEWIS | | | | 130 | 128 | 129 | 6/10 | 41 | 36 | 50 |
| 13 | ROBUST | | | | | 118 | 118 | 6/05 | 42 | 35 | 90 |
| 14 | MOREX | | | | | 111 | 111 | 6/05 | 48 | 34 | 80 |
| 15 | STEPTOE | | | | | 132 | 132 | 6/04 | 45 | 29 | 80 |
| 16 | FB84982 | | | | | 115 | 115 | 6/04 | 53 | 29 | 80 |
| 17 | FB871501 | | | | | 100 | 100 | 5/29 | 51 | 22 | 90 |
| 18 | FB871502 | | | | | 123 | 123 | 5/29 | 47 | 28 | 90 |

Table 11. Spring barley seeding rate trial: grain yields, date of 50 percent heading, test weight, plant height, and percent lodged of two spring barleys seeded at 35, 70, and 105 pounds per acre in a 1987 trial at the Malheur Experiment Station, OSU, Ontario, Oregon.

| Entry | Name | Seeding Rate | Yield | Date 50% Headed | Test Weight | Plant Height | Lodging |
|---|---|---|---|---|---|---|---|
| | | lbs/ac | bu/ac | | lbs/bu | inches | % |
| 1 | MICAH | 35 | 125 | 6/10 | 47 | 28 | 10 |
| 2 | MICAH | 70 | 121 | 6/09 | 45 | 29 | 23 |
| 3 | MICAH | 105 | 123 | 6/08 | 44 | 28 | 28 |
| 4 | FB78444-006 | 35 | 118 | 6/11 | 44 | 32 | 13 |
| 5 | FB78444-006 | 70 | 130 | 6/11 | 45 | 32 | 13 |
| 6 | FB78444-006 | 105 | 132 | 6/10 | 45 | 33 | 15 |

Table 12. Eastern Oregon spring triticale: grain yield, date of 50 percent heading, test weight, plant height, and percent lodged of spring seeded triticale grown in a 1987 trial at the Malheur Experiment Station, OSU, Ontario, Oregon.

| Entry | Name | Yield | Date 50% Headed | Test Weight | Plant Height | Lodging |
|---|---|---|---|---|---|---|
| | | bu/ac | | lbs/bu | inches | % |
| 1 | NUTRICALE | 95 | 6/09 | 52 | 48 | 70 |
| 2 | GRACE SELECTION (private) | 130 | 6/10 | 52 | 46 | 40 |
| 3 | KARL | 116 | 6/03 | 53 | 36 | 0 |
| 4 | KRAMER | 116 | 6/06 | 52 | 38 | 30 |
| 5 | YAVEROS (wheat) | 118 | 6/06 | 64 | 30 | 40 |
| 6 | CARCUMIN (durum) | 108 | 6/06 | 60 | 29 | 60 |

Table 13. Corvallis spring barley trial, a two-year yield summary, date of 50 percent heading, test weight, plant height, and percent lodged of elite spring barleys submitted from the Corvallis-based cereal improvement project and tested in 1987 at the Malheur Experiment Station, OSU, Ontario, Oregon.

| Entry | Name | YIELD 1986 | YIELD 1987 | YIELD Average | Date 50% Headed | Test Weight | Plant Height | Lodging |
|---|---|---|---|---|---|---|---|---|
| | | | | | | lbs/bu | inches | % |
| 1 | ORSM 8616 | 116 | 127 | 121 | 6/08 | 45 | 29 | 10 |
| 2 | ORSM 8618 | 125 | 126 | 125 | 6/10 | 48 | 26 | 30 |
| 3 | ORSM 8619 | 136 | 124 | 130 | 6/10 | 47 | 32 | 80 |
| 4 | ORSM 8622 | 125 | 127 | 126 | 6/08 | 50 | 29 | 70 |
| 5 | ORSM 8623 | 107 | 107 | 107 | 5/30 | 48 | 21 | 80 |
| 6 | ORSM 8624 | 113 | 129 | 121 | 6/03 | 51 | 25 | 20 |
| 7 | ORSM 8625 | 108 | 120 | 114 | 6/03 | 46 | 23 | 70 |
| 8 | ORSM 8626 | 117 | 128 | 122 | 6/07 | 49 | 29 | 20 |
| 9 | STEPTOE | | 134 | 134 | 6/04 | 43 | 27 | 70 |
| 10 | KLAGES | | 120 | 120 | 6/10 | 49 | 34 | 70 |
| 11 | ADVANCE | | 102 | 102 | 6/28 | 42 | 30 | 90 |
| 12 | MOREX | | 125 | 125 | 6/03 | 46 | 32 | 90 |
| 13 | ANDRE | | 111 | 111 | 6/10 | 49 | 32 | 80 |
| 14 | OR 8408 | | 138 | 138 | 6/11 | 50 | 32 | 70 |
| 15 | SM 8411 | | 135 | 135 | 6/12 | 51 | 34 | 20 |
| 16 | SM 8413 | | 119 | 119 | 6/11 | 49 | 25 | 40 |
| 17 | SM 8423 | | 117 | 117 | 6/10 | 43 | 29 | 30 |
| 18 | SM 8424 | | 126 | 126 | 6/10 | 46 | 26 | 10 |
| 19 | SM 2860351 | | 90 | 90 | 6/01 | 44 | 20 | 90 |
| 20 | SM 2860352 | | 120 | 120 | 6/05 | 46 | 25 | 80 |
| 21 | SM 2860355 | | 128 | 128 | 6/08 | 49 | 30 | 40 |
| 22 | SM 2860357 | | 138 | 138 | 6/09 | 51 | 31 | 20 |
| 23 | SM 2860356 | | 130 | 130 | 6/08 | 48 | 28 | 20 |
| 24 | SM 2860254 | | 133 | 133 | 6/12 | 49 | 31 | 0 |

Table 14. Eastern Oregon BYDV winter barley: grain yields, average date of 50 percent heading, test weight, plant height, percent lodged, and percent plump kernels remaining on a 6/64 by 1/2 inch slotted screen from three 1987 yield trials grown near Hermiston which were planted (early) August 28, (mid) September 10, (late) September 30, 1986, and one grown near Willow Creek in Malheur County, Oregon.

| | | - - - - - - - Y I E L D - - - - - - - - - | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | - - - - Hermiston - - - | | | Willow | | Date 50% | Test | Plant | | |
| Entry | Name | Early | Mid | Late | Creek | Average | Headed | Weight | Height | Lodging | Plumps |
| | | - - - - - - - - - - bu/ac - - - - - - - - - | | | | | | lbs/bu | inches | % | % |
| 1 | HESK | 113 | 65 | 97 | 180 | 114 | 5/02 | 44 | 30 | 3 | 28 |
| 2 | FB76316-H6001 | 95 | 100 | 110 | 158 | 116 | 5/03 | 44 | 30 | 3 | 50 |
| 3 | FB77796-H6001 | 82 | 89 | 89 | 136 | 114 | 4/30 | 47 | 35 | 0 | 39 |
| 4 | FB84221-B6004 | 125 | 60 | 89 | 142 | 94 | 5/09 | 44 | 29 | 30 | 43 |
| 5 | FB84261-B6033 | 108 | 71 | 83 | 173 | 109 | 5/05 | 46 | 31 | 3 | 36 |
| 6 | FB84261-B6036 | 131 | 102 | 118 | 164 | 129 | 5/05 | 45 | 31 | 5 | 42 |
| 7 | FB84320-B6051 | 101 | 81 | 112 | 165 | 115 | 5/08 | 45 | 36 | 8 | 63 |
| 8 | FB84338-B6019 | 77 | 69 | 108 | 166 | 105 | 5/10 | 45 | 27 | 2 | 58 |
| 9 | FB84359-B6043 | 75 | 73 | 114 | 165 | 107 | 5/08 | 43 | 30 | 18 | 74 |
| 10 | FB84261-B6005 | 134 | 106 | 108 | 163 | 128 | 5/04 | 46 | 31 | 18 | 47 |
| 11 | FB84359-B6010 | 94 | 68 | 115 | 152 | 107 | 5/05 | 44 | 34 | 20 | 57 |
| 12 | FB84359-B6014 | 76 | 72 | 123 | 165 | 109 | 5/08 | 43 | 34 | 10 | 39 |
| 13 | FB84320-B6015 | 75 | 69 | 90 | 136 | 93 | 5/07 | 43 | 34 | 18 | 58 |
| 14 | FB84370-B6003 | 54 | 69 | 97 | 168 | 97 | 5/07 | 44 | 30 | 15 | 48 |
| 15 | FB84370-B6004 | 113 | 82 | 85 | 177 | 114 | 5/06 | 45 | 36 | 20 | 32 |
| 16 | FB84370-B6008 | 81 | 56 | 88 | 153 | 95 | 5/09 | 45 | 36 | 22 | 38 |
| 17 | FB84370-B6016 | 110 | 61 | 109 | 175 | 114 | 5/09 | 42 | 32 | 12 | 40 |
| 18 | FB84391-B6003 | 68 | 49 | 98 | 160 | 94 | 5/09 | 47 | 29 | 2 | 12 |

Table 15. Eastern Oregon spring barley: grain yield, test weight, and percent lodged of spring seeded barleys grown in a 1987 yield trial near Willow Creek, Oregon.

| Entry | Name | - - - - Y I E L D - - - - | | Test Weight | Lodging |
|---|---|---|---|---|---|
| | | bu/ac | lbs/ac | lbs/bu | % |
| 1 | COLUMBIA | 122 | 5858 | 49.3 | 0 |
| 2 | COUGBAR | 115 | 5516 | 50.7 | 0 |
| 3 | LINDY | 128 | 6135 | 49.7 | 0 |
| 4 | HAZEN | 115 | 5528 | 50.1 | 0 |
| 5 | MICAH | 120 | 5744 | 50.4 | 0 |
| 6 | STEPTOE | 138 | 6614 | 50.5 | 0 |
| 7 | LEWIS | 123 | 5916 | 47.7 | 0 |
| 8 | ROBUST | 90 | 4342 | 51.2 | 0 |
| 9 | FB78444-004 | 120 | 5759 | 47.2 | 0 |
| 10 | MOREX | 114 | 5474 | 51.4 | 0 |
| 11 | ANDRE | 119 | 5702 | 51.1 | 0 |
| 12 | KARLA | 112 | 5391 | 48.3 | 0 |
| 13 | FB78444-006 | 117 | 5602 | 47.4 | 0 |
| 14 | FB78444-005 | 129 | 6191 | 49.0 | 0 |
| 15 | KRIS | 119 | 5694 | 53.1 | 0 |
| 16 | FB84982 | 93 | 4444 | 48.0 | 0 |
| 17 | FB871501 | 120 | 5769 | 50.6 | 0 |
| 18 | FB871502 | 119 | 5736 | 52.8 | 0 |

Table 16. Eastern Oregon winter triticale: grain yield, test weight, and percent lodged of fall-seeded triticale grown in a 1987 trial near Willow Creek, Oregon.

| Entry | Name | - - - - Y I E L D - - - - | | Test Weight | Lodging |
|---|---|---|---|---|---|
| | | bu/ac | lbs/ac | lbs/bu | % |
| 1 | FT80061 BL002 | 70 | 4200 | 55.7 | 0 |
| 2 | B81-456-S4003 | 88 | 5280 | 51.0 | 0 |
| 3 | FT87814 | 96 | 5760 | 55.2 | 0 |
| 4 | M84-7715 | 90 | 5400 | 55.3 | 0 |
| 5 | FT R5-001 | 94 | 5640 | 51.8 | 0 |
| 6 | B81-456-S4001 | 98 | 5880 | 52.6 | 0 |
| 7 | B81-918-S4001 | 78 | 4680 | 54.4 | 0 |
| 8 | FT85009 | 94 | 5640 | 52.7 | 0 |
| 9 | FT85007 | 102 | 6120 | 54.2 | 0 |
| 10 | B81-531-S4005 | 86 | 5160 | 51.8 | 0 |
| 11 | B81-456-S4002 | 116 | 6960 | 52.3 | 0 |
| 12 | B81-531-S4003 | 85 | 5100 | 56.0 | 0 |
| 13 | B81-531-S4004 | 85 | 5100 | 56.3 | 0 |
| 14 | B81-531-S4006 | 85 | 5100 | 55.0 | 0 |
| 15 | M79-6621-S4002 | 87 | 5220 | 50.3 | 0 |
| 16 | M81-3305-S4001 | 108 | 6480 | 54.3 | 0 |
| 17 | M81-3305-S4003 | 118 | 7080 | 58.8 | 0 |
| 18 | STEPHENS | 85 | 5100 | 61.0 | 0 |

# REGIONAL SMALL GRAIN NURSERIES IN 1987

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Personnel from the USDA-ARS coordinate an array of small grain trials which are replicated throughout the western United States. Regional nurseries grown at Malheur Experiment Station in 1987 included winter barley, spring barley, white winter wheat, and spring wheat.

## Purpose

The regional nurseries provide an opportunity to evaluate the most promising cultivars in the West under the conditions found at each cooperating site.

## Procedures

The regional nurseries were arranged in randomized complete blocks with four replications. Experimental and cultural practices were detailed in the preceding report, "Evaluation of Experimental Small Grains for the Treasure Valley." Yields and lodging were evaluated for all replications. The other data presented were collected from the first replication only.

## Results and Discussion

Entries in the Western Regional Winter Barley Nursery grew rapidly during the warm spring of 1987 and began to fall down before heading. By mid-June the winter barleys' stems were broken over at the soil surface, resulting in low yields of shriveled grain. Due to early severe lodging the winter barley trials were not harvested.

Lodging was also extensive in the Western Regional White Winter Wheat Nursery. The lodging occurred late in the season and apparently did not reduce yields or test weights (Table 1). Four entries, ID 329, ID 330, ORFW 301, and ORCW 8519, had excellent two-year performance records. Relative to Stephens these lines had higher yields, less lodging, and equal or higher test weights. Dusty, the recent Washington release, remains competitive with Stephens after four years of testing. Dusty's average performance compares to that of Stephens with four bushels per acre lower yield, one-half pound per bushel lower test weight, and equal lodging. Two of Washington's entries in this trial will be released as varieties. WA 7163, which has a common head type and a respectable four-year record, has been named Madsen. WA 7166 will be released as Hyak. Hyak is a club wheat and does not seem to be adapted to the Treasure Valley.

Many of the new spring barley cultivars in the Western Regional Spring Barley Nursery performed very well. Eighteen of the entries have higher average yields than Steptoe over the same growing seasons

(Table 2). The six-row feed barley, OR 8408, averaged a 12-bushel-per-acre yield advantage, 1.4 pounds-per-bushel higher test weight, and 10 percent less lodging relative to Steptoe. The two-row malting barleys, BA 280529 and ID 910740, also averaged higher yields and test weights and less lodging than Steptoe over three years.

Penawawa, a recent release from the Washington program, continued to perform well compared to Owens in the 1987 Western Regional Spring Wheat Nursery (Table 3). Averaged over four years Penawawa has yielded 110 bushels per acre compared to Owens' 106 and has lodged 13 percent compared to 25 percent for Owens. Their average test weights were equal at 62 pounds per bushel. Over the same period another Washington release, Spillman, averaged 104 bushels per acre and lodged only 8 percent; however, Spillman's average test weight was two pounds per bushel lighter. Several other entries also look promising but require a few more years of evaluation.

Table 1. Western Regional White Winter Wheat Nursery: a four-year grain yield summary and the 1987 observations for test weight, plant height, heading date, and percent lodging at the Malheur Experiment Station, OSU, Ontario, Oregon.

| | Yield | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Selection | 1984 bu/ac | 1985 bu/ac | 1986 bu/ac | 1987 bu/ac | Avg bu/ac | Percent Stephens[1] | Test Weight lbs/bu | Plant Height Inches | Date 50% Headed | Lodging % |
| CI 1442 (Kharkof) | 62 | 89 | 83 | 106 | 85 | 60 | 61 | 41 | 5/14 | 73 |
| CI 11755 (Elgin) | 64 | 103 | 102 | 86 | 89 | 63 | 58 | 40 | 5/13 | 68 |
| CI 13740 (Moro) | 81 | 100 | 101 | 89 | 93 | 66 | 54 | 40 | 5/12 | 83 |
| CI 13968 (Nugaines) | 65 | 127 | 128 | 127 | 112 | 80 | 58 | 34 | 5/17 | 60 |
| CI 17596 (Stephens) | 134 | 144 | 142 | 142 | 141 | 100 | 58 | 35 | 5/15 | 50 |
| CI 17917 (Tres) | 72 | 110 | 112 | 105 | 100 | 71 | 58 | 37 | 5/13 | 78 |
| PI 486429 (Dusty) | 126 | 135 | 142 | 143 | 137 | 98 | 57 | 36 | 5/15 | 50 |
| OR 7996 (Oveson) | 106 | 110 | 114 | 119 | 112 | 80 | 61 | 42 | 5/16 | 35 |
| ORCW 8314 | 127 | 131 | 143 | 129 | 133 | 95 | 56 | 43 | 5/18 | 65 |
| WA 7163 | 125 | 128 | 128 | 137 | 130 | 93 | 61 | 35 | 5/17 | 33 |
| WA 7166 | 82 | 101 | 113 | 119 | 104 | 74 | 56 | 34 | 5/10 | 60 |
| WA 7216 | | 109 | 133 | 116 | 119 | 83 | 56 | 39 | 5/17 | 85 |
| WA 7217 | | 106 | 112 | 110 | 109 | 76 | 57 | 38 | 5/17 | 68 |
| ORCW 8421 | | 118 | 135 | 142 | 132 | 93 | 58 | 38 | 5/18 | 58 |
| OR 8270 | | 126 | 130 | 137 | 131 | 92 | 56 | 37 | 5/12 | 25 |
| ORCW 8416 | | | 133 | 136 | 135 | 95 | 58 | 38 | 5/18 | 30 |
| ORCW 8519 | | | 135 | 157 | 146 | 103 | 60 | 38 | 5/14 | 35 |
| ORCW 8517 | | | 114 | 118 | 116 | 82 | 59 | 39 | 5/13 | 13 |
| ID 329 | | | 138 | 163 | 151 | 106 | 60 | 37 | 5/8 | 10 |
| ID 330 | | | 147 | 158 | 153 | 108 | 58 | 40 | 5/13 | 20 |
| WA 7432 | | | 110 | 101 | 106 | 75 | 52 | 33 | 5/21 | 83 |
| WA 7433 | | | 120 | 135 | 128 | 90 | 56 | 34 | 5/18 | 25 |
| WA 7435 | | | 117 | 115 | 116 | 82 | 57 | 33 | 5/18 | 70 |
| WA 7437 | | | 124 | 119 | 122 | 86 | 57 | 35 | 5/14 | 55 |
| OR 843 | | | 138 | 140 | 139 | 98 | 59 | 37 | 5/13 | 40 |
| OR 842 | | | 133 | 140 | 137 | 96 | 59 | 38 | 5/12 | 58 |
| OR 845 | | | 134 | 144 | 139 | 98 | 60 | 35 | 5/12 | 18 |
| ORFW 301 | | | 145 | 150 | 148 | 104 | 58 | 36 | 5/11 | 28 |
| ORCW 8521 | | | | 143 | 143 | 101 | 60 | 44 | 5/13 | 13 |
| ORCW 8522 | | | | 144 | 144 | 101 | 62 | 42 | 5/9 | 15 |
| ORF 75336 | | | | 150 | 150 | 106 | 58 | 38 | 5/13 | 33 |
| WA 7528 | | | | 100 | 100 | 70 | 56 | 34 | 5/16 | 55 |
| WA 7529 | | | | 126 | 126 | 89 | 57 | 39 | 5/18 | 90 |
| WA 7526 | | | | 114 | 114 | 80 | 56 | 39 | 5/16 | 70 |
| WA 7527 | | | | 105 | 105 | 74 | 56 | 41 | 5/16 | 63 |
| Mean | | | | 128 | | | | | | |
| LSD (.05) | | | | 16 | | | | | | |
| CV (%) | | | | 9.0 | | | | | | |

Yield differences among varieties are highly significant.

[1] Yield comparisons for the same years grown.

Table 2. Western Regional Spring Barley Nursery; a four-year grain yield summary and the 1987 observations for test weight, plant height, heading date, percent lodging and percent plumps at the Malheur Experiment Station, OSU, Ontario, Oregon.

| Selection | Yield 1984 bu/ac | Yield 1985 bu/ac | Yield 1986 bu/ac | Yield 1987 bu/ac | Yield Avg bu/ac | Percent Steptoe[1] | Test Weight lbs/bu | Plant Height Inches | Date 50% Headed | Lodging % | Plumps[2] % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CI 936 (Trebi) | 104 | 77 | 120 | 112 | 103 | 87 | 44 | 35 | 6/5 | 85 | 69 |
| CI 15229 (Steptoe) | 128 | 101 | 140 | 107 | 119 | 100 | 44 | 34 | 6/5 | 83 | 75 |
| CI 15478 (Klages) | 100 | 94 | 134 | 110 | 110 | 92 | 49 | 33 | 6/12 | 75 | 80 |
| CI 15773 (Morex) | 111 | 84 | 119 | 124 | 110 | 92 | 49 | 33 | 6/5 | 80 | 75 |
| BA 280529 | | 91 | 145 | 118 | 118 | 102 | 50 | 33 | 6/12 | 53 | 91 |
| BA 814038 | | 88 | 143 | 121 | 117 | 101 | 48 | 34 | 6/10 | 78 | 87 |
| ID 910740 | | 90 | 142 | 122 | 118 | 102 | 50 | 32 | 6/8 | 73 | 76 |
| MT 81161 | | 89 | 113 | 126 | 109 | 94 | 51 | 29 | 6/8 | 73 | 93 |
| MT 81616 | | 93 | 131 | 110 | 111 | 96 | 46 | 32 | 6/10 | 73 | 81 |
| OR 8408 | | 98 | 148 | 138 | 128 | 110 | 46 | 36 | 6/5 | 68 | 68 |
| BA 680761 | | | 127 | 131 | 129 | 104 | 46 | 34 | 6/8 | 55 | 81 |
| ID 223222 | | | 145 | 109 | 127 | 103 | 47 | 28 | 6/9 | 48 | 75 |
| MT 81143 | | | 135 | 133 | 134 | 109 | 51 | 35 | 6/8 | 68 | 82 |
| MT 81502 | | | 128 | 120 | 124 | 100 | 50 | 32 | 6/9 | 88 | 77 |
| ND 7691 | | | 150 | 121 | 136 | 110 | 51 | 33 | 6/6 | 75 | 91 |
| OR 8432 | | | 132 | 115 | 124 | 100 | 47 | 24 | 6/10 | 55 | 81 |
| PB 29 (Heavyweight) | | | 142 | 109 | 126 | 102 | 52 | 33 | 6/10 | 70 | 87 |
| VD 403582 | | | 135 | 126 | 131 | 106 | 49 | 29 | 6/5 | 58 | 88 |
| WA 870780 | | | 152 | 131 | 142 | 115 | 43 | 33 | 6/8 | 60 | 77 |
| BA 280350 | | | | 105 | 105 | 98 | 47 | 26 | 6/10 | 83 | 71 |
| PB 265 | | | | 103 | 103 | 96 | 47 | 32 | 6/10 | 68 | 88 |
| SF 8623 | | | | 121 | 121 | 113 | 44 | 33 | 6/7 | 75 | 89 |
| SM 8618 | | | | 118 | 118 | 110 | 48 | 27 | 6/10 | 50 | 74 |
| UT 1848 | | | | 136 | 136 | 127 | 44 | 33 | 6/8 | 55 | 90 |
| UT 2793 | | | | 150 | 150 | 140 | 43 | 35 | 6/5 | 65 | 85 |
| UT 2780 | | | | 135 | 135 | 126 | 45 | 37 | 6/8 | 35 | 92 |
| WA 701883 | | | | 120 | 120 | 112 | 50 | 37 | 6/9 | 70 | 88 |
| WA 877178 | | | | 125 | 125 | 117 | 50 | 33 | 6/9 | 73 | 88 |
| WA 102178 | | | | 98 | 98 | 92 | 45 | 34 | 6/9 | 78 | 62 |
| WP 85350 (Sprinter) | | | | 81 | 81 | 76 | 47 | 32 | 6/14 | 73 | 77 |
| Mean | | | | 119 | | | | | | | |
| LSD (.05) | | | | 20 | | | | | | | |
| CV (%) | | | | 12.3 | | | | | | | |

Yield differences among varieties are highly significant.
[1] Yield comparisons for the same years grown.
[2] Percent of sample remaining on 6/64" x 1/2" slotted screen.

Table 3. Western Regional Spring Wheat Nursery: a four-year grain yield summary and the 1987 observations of test weight, plant height, heading date, and percent lodging at the Malheur Experiment Station, OSU, Ontario, Oregon.

| Selection | Class[1] | Yield 1984 bu/ac | Yield 1985 bu/ac | Yield 1986 bu/ac | Yield 1987 bu/ac | Yield Avg bu/ac | Percent Federation[2] | Test Weight lbs/bu | Plant Height Inches | Date 50% Headed | Lodging % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CI 17903 (McKay) | H | 102 | 89 | 98 | 119 | 102 | 116 | 61 | 37 | 6/10 | 0 |
| WA 6831 (Edwall) | S | 93 | 99 | 101 | 111 | 101 | 115 | 59 | 35 | 6/9 | 13 |
| CI 4734 (Federation) | S | 92 | 70 | 96 | 95 | 88 | 100 | 59 | 41 | 6/17 | 45 |
| CI 17904 (Owens) | S | 108 | 87 | 106 | 123 | 106 | 120 | 62 | 31 | 6/6 | 48 |
| WA 6920 (Penawawa) | S | 109 | 104 | 103 | 124 | 110 | 125 | 63 | 33 | 6/9 | 20 |
| WA 7075 (Spillman) | H | 104 | 103 | 96 | 111 | 104 | 118 | 60 | 35 | 6/9 | 10 |
| WA 7183 (Wakonz) | S | 105 | 71 | 99 | 119 | 99 | 113 | 61 | 35 | 6/14 | 0 |
| ORS 8418 | H | | 74 | 88 | 110 | 91 | 105 | 63 | 31 | 6/3 | 15 |
| OR 8508 | H | | | 84 | 109 | 97 | 102 | 63 | 32 | 6/5 | 30 |
| WA 7328 | H | | | 85 | 104 | 95 | 99 | 59 | 36 | 6/10 | 7 |
| WA 7326 | H | | | 92 | 104 | 98 | 103 | 61 | 34 | 6/10 | 14 |
| WA 7176 | S | | | 99 | 117 | 108 | 113 | 60 | 35 | 6/13 | 30 |
| WA 7492 | S | | | 106 | 115 | 111 | 116 | 60 | 34 | 6/10 | 10 |
| UT 402265 | H | | | 102 | 111 | 107 | 112 | 60 | 38 | 6/14 | 48 |
| ID 303 | H | | | 94 | 99 | 97 | 102 | 60 | 34 | 6/10 | 3 |
| ID 312 | S | | | 99 | 115 | 107 | 112 | 62 | 31 | 6/5 | 28 |
| ID 315 | S | | | 104 | 122 | 113 | 118 | 60 | 32 | 6/7 | 53 |
| ID 319 | S | | | 101 | 117 | 109 | 114 | 60 | 31 | 6/4 | 20 |
| UT 461941 | H | | | | 109 | 109 | 115 | 60 | 35 | 6/10 | 40 |
| UT 1111 | H | | | | 113 | 113 | 119 | 59 | 35 | 6/11 | 33 |
| UT 1821 | H | | | | 108 | 108 | 114 | 61 | 37 | 6/11 | 28 |
| UT 2171 | H | | | | 117 | 117 | 123 | 60 | 38 | 6/9 | 25 |
| UT 2506 | H | | | | 101 | 101 | 106 | 57 | 35 | 6/14 | 45 |
| ORS 8509 | H | | | | 113 | 113 | 119 | 62 | 31 | 6/7 | 0 |
| ORS 8510 | H | | | | 103 | 103 | 108 | 62 | 32 | - | 3 |
| ORS 8511 | H | | | | 124 | 124 | 131 | 62 | 32 | - | 15 |
| ORS 8422 | H | | | | 100 | 100 | 105 | 62 | 31 | - | 5 |
| ORS 8512 | H | | | | 113 | 113 | 119 | 64 | 27 | - | 0 |
| WA 7496 | S | | | | 107 | 107 | 113 | 58 | 27 | - | 3 |
| ID 307 | H | | | | 106 | 106 | 112 | 62 | 31 | - | 30 |
| ID 341 | H | | | | 109 | 109 | 115 | 60 | 34 | - | 0 |
| ID 365 | H | | | | 101 | 101 | 106 | 60 | 31 | - | 43 |
| ID 366 | H | | | | 109 | 109 | 115 | 60 | 37 | - | 53 |
| ID 348 | S | | | | 116 | 116 | 122 | 61 | 32 | - | 13 |
| ID 372 | S | | | | 133 | 133 | 140 | 62 | 33 | - | 35 |
| ID 373 | S | | | | 114 | 114 | 120 | 62 | 35 | - | 0 |
| Mean | | | | | 112 | | | | | | |
| LSD (.05) | | | | | 10 | | | | | | |
| CV (%) | | | | | 6.2 | | | | | | |

Yield differences among varieties are highly significant.

[1] S = soft white, H = hard red.

[2] Yield comparisons for the same years grown.

# LOCAL SPRING SMALL GRAIN TRIALS

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Ontario, Oregon, 1987

Even though soft white winter wheats dominate the small grain acreage in the Treasure Valley, crop rotations, fall weather conditions, and various other factors necessitate some use of spring wheats and barleys.

## Purpose

The local trials evaluate spring wheat and barley cultivors that are not entered in the other nuseries but have potential for the Treasure Valley.

## Procedures

The local trials were arranged in randomized complete block experimental designs. The wheat trial had four replications and the barley trial had five replications in 1987. Experimental and cultural practices were presented in the preceding report, "Evaluation of Experimental Small Grains for the Treasure Valley."

## Results and Discussion

Steptoe remained the top yielder among the released varieties in the Local Spring Barley Trial (Table 1). The similiar variety, Lindy, has averaged seven bushels per acre lower yields and one pound per bushel lower test weights over the last four years. During the same period Columbia's average yield was 11 bushels per acre below Steptoe and Columbia's test weight equaled that of Lindy. Columbia's local popularity is due to its lodging resistance. Averaged over four seasons Columbia has lodged 4 percent compared to approximately 50 percent for Steptoe and Lindy. Premier is a two-row malting barley with a higher three-year yield average than Steptoe in the regional nursery.

The new soft white variety, Treasure, was the highest yielding released variety for the second year in the Local Spring Wheat Trial (Table 2). Two-year averages place Treasure eight bushels per acre above Owens in yield, equal to Owens in test weight, and 12 percent below Owens in lodging. Breeders and foundation seed will be available from Idaho for the spring of 1989. Owen's reported lodging of 5 percent in 1987 was uncharacteristically low. Two-year average yields, test weights, and percent lodging were virtually equal for Bliss and Owens. Bliss can normally be expected to lodge less than Owens, however. Copper is a promising hard red spring wheat from the Idaho breeding program that tends to have higher yields but lower protein than Westbred 906R, the dominant hard red spring wheat in Idaho.

Table 1. 1987 Local Spring Barley Trial; A four-year yield summary and the 1987 observations for test weight, plant height, heading date, and percent lodging at the Malheur Experiment Station, OSU, Ontario, Oregon.

| Selection | Yield 1984 | Yield 1985 | Yield 1986 | Yield 1987 | Yield Avg. | Percent Steptoe[1] | Test Weight | Plant Height | Date 50% Headed | Lodging |
|---|---|---|---|---|---|---|---|---|---|---|
| | bu/ac | | | | | | lbs/bu | inches | | % |
| UT 1505 | | | | 149 | 149 | 101 | 46 | 32 | 6/8 | 34 |
| Steptoe | 146 | 116 | 146 | 148 | 139 | 100 | 47 | 35 | 6/4 | 62 |
| Lindy | 120 | 115 | 145 | 148 | 132 | 95 | 47 | 28 | 6/4 | 62 |
| Premier | | | | 143 | 143 | 97 | 52 | 30 | 6/10 | 40 |
| Columbia | 134 | 108 | 129 | 141 | 128 | 92 | 48 | 31 | 6/11 | 4 |
| ID 917019 | | | | 137 | 137 | 93 | 49 | 31 | 6/10 | 30 |
| Micah | | | 113 | 130 | 122 | 83 | 50 | 29 | 6/10 | 22 |
| Fiesta | | | | 114 | 114 | 77 | 48 | 22 | 5/31 | 12 |
| 84 Ab 897 | | | | 114 | 114 | 77 | 49 | 31 | 6/8 | 52 |
| Mean | | | | 136 | | | | | | |
| LSD (.05) | | | | 9 | | | | | | |
| CV (%) | | | | 5.1 | | | | | | |

Variety yield differences are highly significant.

[1] Yield comparisons for the same years grown.

Table 2. 1987 Local Spring Wheat Trial; A two-year yield summary and the 1987 observations for test weight, percent protein, plant height, heading date, and percent lodging at the Malheur Experiment Station, OSU, Ontario, Oregon.

| Selection | Class[1] | Yield 1986 | Yield 1987 | Yield Avg. | Percent Owens[2] | Test Weight | Protein[3] | Height | Date 50% Headed | Lodging |
|---|---|---|---|---|---|---|---|---|---|---|
| | | bu/ac | bu/ac | bu/ac | | lbs/bu | % | inches | | % |
| ORS 8501 | S | | 130 | 130 | 105 | 62 | 12.7 | 32 | 6/5 | 33 |
| ID 286 | S | 108 | 129 | 119 | 109 | 62 | 13.0 | 35 | 6/8 | 50 |
| Treasure | S | 106 | 127 | 117 | 107 | 61 | 12.0 | 32 | 6/9 | 10 |
| Owens | S | 94 | 124 | 109 | 100 | 60 | 12.6 | 36 | 6/15 | 5 |
| ID 266 | S | 100 | 119 | 110 | 101 | 62 | 12.8 | 32 | 6/6 | 40 |
| ID 18151 | S | | 118 | 118 | 95 | 60 | 12.4 | 33 | 6/11 | 28 |
| Bliss | S | 100 | 116 | 108 | 99 | 61 | 12.7 | 33 | 6/7 | 40 |
| ID 368 | H | | 114 | 114 | 92 | 60 | 15.1 | 32 | 6/10 | 20 |
| ID 367 | H | | 112 | 112 | 90 | 60 | 15.0 | 34 | 6/9 | 30 |
| Copper | H | 94 | 109 | 102 | 94 | 62 | 16.0 | 34 | 6/4 | 30 |
| Yecora Rojo | H | | 108 | 108 | 87 | 61 | 15.0 | 25 | 6/2 | 0 |
| Mean | | | 119 | | | | | | | |
| LSD (.05) | | | 10 | | | | | | | |
| CV (%) | | | 6.2 | | | | | | | |

Variety yield differences are highly significant.
[1] S = soft white, H = hard red.
[2] Yield comparisons for the same years grown.
[3] By Dr. Donald Sunderman, et al. Aberdeen, Idaho.

# HARD RED WHEAT PRODUCTION IN THE TREASURE VALLEY, 1987

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Oregon State University
Ontario, Oregon, 1987
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## Objective

The purpose of this project was to develop information on cultivar performance and cultural practices which would allow economic production of hard red wheat in the Treasure Valley.

Hard red winter wheat lines from the Midwest, Oregon, Washington, and Idaho were compared with the soft white winter wheat, Stephens. Comparisons included grain yield, grain quality, biomass production, and nitrogen utilization.

Rates and timing of nitrogen applications were varied to study the response of yield, grain protein, and nitrogen and biomass relationships. Grain yield and protein were correlated with flag leaf nitrogen, biomass nitrogen, and nitrogen applications at flowering to develop data bases for predicting fertilization requirements.

## Introduction

A successful hard red wheat variety must produce high yields of grain with adequate protein. High yields require both an adequate biological yield and a favorable harvest index. Biological yield refers to total biomass, or all plant growth above the soil surface. Harvest index is the ratio of grain yield to biological yield. A key factor in producing a high yield is the efficiency with which a plant can take up nitrogen from the soil. Adequate grain protein requires efficient nitrogen transfer from the foliage to the grain. Nitrogen uptake and translocation to the grain vary among cultivars.

Rates and timing of nitrogen applications are crucial cultural factors influencing hard red wheat production. Early season nitrogen fertilization must stimulate adequate vegetative development for high yields while avoiding luxuriant growth that is prone to lodging. A second nitrogen application near flowering stimulates the formation of adequate grain protein for successful marketing.

## Cultural Practices

In mid-October the field was ripped twice and 100 pounds of $P_2O_5$ per acre as calcium phosphate were plowed down. Gypsum at the rate of 750 lbs/ac was broadcast on the soil after seedbed preparation to prevent soil crusting the following spring. The trial was seeded on an Owyhee silt loam on October 27, 1986, at the approximate rate of 90 pounds seed per acre with six inches between drill strips.

Soil analysis in early March revealed 49 lbs/ac of $NO_3$-N in the top two feet. On April 7, 1987, the trial was broadcast sprayed with one pint of Brominal ME4 per acre for weed control. The first irrigation occurred on April 22 and was followed by six more irrigations through the season. Each irrigation entailed a 12- to 24-hour set in alternate furrows. The trial was harvested with a small plot combine on July 29.

## Experimental Design

The hard red wheats under investigation were Arkan, a popular midwestern variety, Batum from Washington, and the experimental lines ID 323 from Idaho, and ORCR 8511 from Oregon. Stephens was included to compare a soft white variety with the hard reds.

Spring nitrogen treatments consisted of 0, 100, or 200 lbs/ac top dressed on the appropriate plots on March 17. Each plot received either 0 or 50 lbs N/ac at flowering.

Six foot by 18 foot plots were arranged in a randomized complete block experimental design with four replications. Treatments comprised a three-way factorial of variety, spring nitrogen applications, and nitrogen applied at flowering.

## Experimental Procedures

Ammonium nitrate at appropriate rates was topdressed on the northern 15 feet of the plots on March 17. Three-foot alleys were mowed through the southern ends of the plots before flowering in mid-May.

Flag leaf and biomass samples were taken and nitrogen was topdressed as each variety reached anthesis (pollen shed). Flag leaves were randomly collected throughout each plot and analyzed for nitrogen. Biomass sampling entailed sickling a three-foot-wide by two-foot-long area centered at the north end of each plot. The foliage was dried, weighed, and analyzed for nitrogen. Plots were then topdressed with ammonium nitrate.

Shortly before harvest the northern three feet of the plots were mowed to remove irregularities created by biomass sampling at anthesis. Four-foot by 12-foot strips from the centers of the resulting 6-foot by 12-foot plots were harvested. The grain was weighed, bushel-weighed, and grain samples were sent to Steve Broich for protein and hardness determination. Plants from within the remaining one-foot-wide strips on the plots' perimeters were dried and weighed. The grain was then threshed out of these plants and weighed to determine harvest indicies.

## Results

Arkan flowered on May 14, a week ahead of any other wheat in the trial, and produced significantly less biomass at flowering than the other wheats (Table 1). ID 323, which flowered on May 21, and Batum, which flowered on May 27, produced the most biomass.

Spring-applied nitrogen did not influence biomass yields at flowering, but did affect nitrogen percentage in the biomass (Table 2). Batum incorporated a higher percentage of nitrogen in its biomass than did the other wheats. Stephens and ORCR 8511 had intermediate biomass nitrogen concentrations while ID 323 and Arkan contained relatively low percentage of biomass nitrogen. Only Arkan did not increase the nitrogen content of its biomass as spring-applied nitrogen increased from 100 to 200 pounds.

Batum, with a high yield of nitrogen rich biomass, contained the most total nitrogen at flowering (Table 3). ID 323 had a high yield of biomass with a low nitrogen percentage, resulting in moderate total nitrogen. The moderate biomass yields and nitrogen concentrations of Stephens and ORCR 8511 were similar to the total nitrogen levels of ID 323. Arkan accumulated a relatively low level of total nitrogen by flowering due to a low yield of biomass with a low nitrogen percentage.

Arkan produced almost four tons of vegetative material per acre after flowering, compared to approximately two tons for Batum and ID 323. Stephens and ORCR 8511 were intermediate in vegetative growth after flowering.

The soft white wheat, Stephens, yielded more grain than the hard red wheats while ID 323 yielded significantly below the other hard reds (Table 4). Grain yields did not vary significantly with nitrogen applications. Test weights decreased significantly as applied nitrogen increased (Table 5). Both of these trends may be partially due to increased lodging at the higher fertilization rates (Table 6).

Lodging also appeared to decrease total biological yields at harvest. Because lodging was related to applied nitrogen it may have obscured the nitrogen effects on biological yield. Stephens had a significantly higher biological yield than all of the hard red wheats except Arkan (Table 7).

Stephens had the highest harvest index of 0.41 and ID 323 had the lowest of 0.33 (Table 8). The varieties were very different in their ratios of grain yield to plant biomass at anthesis. Arkan had the highest ratio followed by Stephens, ORCR 8511, Batum, and ID 323 (Table 9).

Nitrogen fertilization at flowering enhanced grain protein by 1.0, 0.7, and 0.2 percent respectively for wheat that had received 0, 100, and 200 lbs N/ac in the early spring (Figure 1, Table 10). Nitrogen applications at flowering were more effective at increasing grain protein than March 17 applications.

Total nitrogen in the grain is directly related to grain protein and grain yield. Batum's average increase of 19 pounds of grain nitrogen per acre with the addition of 50 pounds of nitrogen per acre at flowering suggests that Batum continued to take up soil nitrogen efficiently after flowering (Table 11). Conversely, Arkan's relatively low average increase of 10 pounds of grain nitrogen with the addition of 50 pounds of nitrogen at flowering suggests that it took up less soil nitrogen after flowering. ID 323 responded to fertilization at flowering with the same grain nitrogen increase as Arkan. Grain nitrogen increases due to nitrogen applications at flowering were slightly higher for ORCR 8511 and Stephens than for Arkan. Grain hardness of the hard red wheats was acceptable and did not vary with N fertilization (Table 12).

Percent nitrogen in flag leaves at flowering may indicate the current nitrogen status of the wheat plant. Flag leaf N is potentially a diagnostic tool for determining late-season N fertilizer requirements (Figures 2 and 3, Table 13). When flag leaf nitrogen content approached 5 percent, there was little grain protein response to N fertilization at flowering. Critical flag leaf nitrogen levels to insure adequate grain protein varied among cultivars (Figure 4).

An alternative diagnostic tool for plant nitrogen status at flowering is whole-plant nitrogen content. Grain protein can be predicted from biomass N at flowering for hard red and soft white winter wheat (Figures 5 and 6). Hard red winter wheat grain protein responses to late-season N application may vary not only by plant N status but by hard red winter wheat genotype (Figure 7).

The relationship between biomass nitrogen concentration and flag leaf nitrogen concentration at flowering also varied with variety. Batum had the highest biomass nitrogen level and the lowest flag leaf nitrogen level at flowering, while Arkan had the lowest biomass level and highest flag leaf nitrogen level. Relative nitrogen levels in biomass and flag leaves were consistent for ID 323 and Stephens.

Soft white winter wheat with 50 lbs N/ac added at flowering or with 239 pounds or more N/ac in the biomass at flowering produced grain with more than 10 percent protein. Stephens wheat had less than 10 percent protein in the grain when there was less than 200 pounds of nitrogen per acre in the biomass at anthesis, when there was less than 2.7 percent N in the biomass at anthesis, and when there was less than 4.5 percent N in the flag leaves at anthesis. These values may prove useful in producing high yields of low-protein soft white winter wheat in intensely managed irrigated fields of the Treasure Valley.

## Discussion

There appears to be some potential for improving hard red wheat by combining the best attributes typified by these varieties through plant breeding. Hard red wheat genotypes need to combine high biological yield, high harvest index, reasonable plant N uptake, and efficient transfer of plant N to grain N. These four attributes are not all present in a single variety.

## Conclusions

Flag leaf nitrogen concentrations at anthesis appear to predict grain protein levels. Use of flag leaf sampling to determine nitrogen application rates at flowering may require an index specific to the wheat variety being grown. Nitrogen in the biomass at flowering may be as useful an indicator of nitrogen needs for protein formation as flag leaf nitrogen levels. Hard red winter wheat grain protein above 12 percent is a realizable goal that can be assured by plant sampling followed by late-season N fertilization.

Table 1. Effect of spring-applied nitrogen on the biomass yield of five winter wheat varieties at flowering, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| | Biomass at Flowering | | | |
|---|---|---|---|---|
| | Spring Applied Nitrogen (lbs/ac) | | | |
| Variety | 0 | 100 | 200 | Mean |
| | - - - - tons/ac - - - - - | | | |
| Stephens | 4.2 | 4.2 | 4.1 | 4.2 |
| Batum | 4.6 | 4.5 | 4.5 | 4.5 |
| Arkan | 3.3 | 3.3 | 3.4 | 3.3 |
| ID 323 | 4.3 | 4.4 | 4.4 | 4.4 |
| ORC 8511 | 4.1 | 4.1 | 4.2 | 4.1 |
| Mean | 4.1 | 4.1 | 4.1 | |

| | All Entries | Hard Reds Only |
|---|---|---|
| LSD(.05) between varieties: | .3 | .2 |
| between fertility treatments: | NS | NS |
| between varieties X fertility treatments: | NS | NS |

Table 2. Effect of spring-applied nitrogen on the percent nitrogen in the biomass of five winter wheat varieties at flowering, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| | Biomass Nitrogen Concentration at Flowering | | | |
|---|---|---|---|---|
| | Spring Applied Nitrogen (lbs/ac) | | | |
| Variety | 0 | 100 | 200 | Mean |
| | - - - - - - % N - - - - - - | | | |
| Stephens | 2.1 | 2.9 | 3.1 | 2.7 |
| Batum | 2.0 | 3.0 | 3.3 | 2.8 |
| Arkan | 2.3 | 2.6 | 2.6 | 2.5 |
| ID 323 | 2.2 | 2.4 | 2.9 | 2.5 |
| ORCR 8511 | 2.3 | 2.8 | 3.1 | 2.7 |
| Mean | 2.2 | 2.7 | 3.0 | |

| | All Entries | Hard Reds Only |
|---|---|---|
| LSD(.05) between varieties: | .1 | .2 |
| between fertility treatments: | .2 | .3 |
| between varieties X fertility treatments: | .3 | .5 |

Table 3. Effect of spring-applied nitrogen on the total nitrogen in the biomass of five winter wheat varieties at flowering, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Total Biomass Nitrogen at Flowering | | | | |
|---|---|---|---|---|
| | Spring Applied Nitrogen (lbs/ac) | | | |
| Variety | 0 | 100 | 200 | Mean |
| | - - - - - lbs N/ac - - - - - | | | |
| Stephens | 182 | 239 | 262 | 228 |
| Batum | 185 | 266 | 294 | 248 |
| Arkan | 149 | 171 | 180 | 167 |
| ID 323 | 193 | 212 | 255 | 220 |
| ORCR 8511 | 192 | 234 | 262 | 229 |
| Mean | 180 | 224 | 251 | |

| | All Entries |
|---|---|
| LSD(.05) between varieties: | 16 |
| between fertility treatments: | 12 |
| between varieties X fertility treatments: | NS |

Table 4. Grain yield of five winter wheat varieties in response to six nitrogen fertilization treatments, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Grain Yields | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Spring & Flowering Nitrogen Applications (lbs/acre) | | | | | | |
| Variety | 0 + 0 | 0 + 50 | 100 + 0 | 100 + 50 | 200 + 0 | 200 + 50 | Mean |
| | - - - - - bu*/acre - - - - - | | | | | | |
| Stephens | 147 | 156 | 161 | 161 | 155 | 155 | 156 |
| Batum | 126 | 137 | 126 | 121 | 106 | 115 | 122 |
| Arkan | 126 | 133 | 137 | 138 | 148 | 134 | 136 |
| ID 323 | 108 | 109 | 104 | 111 | 101 | 96 | 105 |
| ORCR 8511 | 128 | 134 | 131 | 131 | 124 | 132 | 130 |
| Mean | 127 | 134 | 132 | 132 | 127 | 126 | |

| | | All Entries | Hard Reds Only |
|---|---|---|---|
| LSD(.05) | Between varieties: | 17 | 8 |
| | Between fertility treatments: | NS | NS |
| | Between varieties X fertility treatments: | NS | NS |

* based on 60 lbs/bu.

Table 5. Test weight of five winter wheat varieties in response to six nitrogen fertilization treatments, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| | Test Weight | | | | | | |
|---|---|---|---|---|---|---|---|
| | Spring + Flowering Nitrogen Applications (lbs/ac) | | | | | | |
| Variety | 0 + 0 | 0 + 50 | 100 + 0 | 100 + 50 | 200 + 0 | 200 + 50 | Mean |
| | lbs/bu | | | | | | |
| Stephens | 58.7 | 59.4 | 58.1 | 57.5 | 57.8 | 57.6 | 58.2 |
| Batum | 58.7 | 59.5 | 58.3 | 58.8 | 56.3 | 56.6 | 58.0 |
| Arkan | 60.5 | 61.1 | 61.0 | 61.2 | 60.9 | 60.9 | 60.9 |
| ID 323 | 61.0 | 61.4 | 60.8 | 61.6 | 60.6 | 60.0 | 60.9 |
| ORC 8511 | 61.5 | 61.8 | 60.1 | 60.4 | 60.1 | 60.7 | 60.8 |
| Mean | 60.1 | 61.0 | 59.7 | 59.9 | 59.1 | 59.2 | |

| | All Entries | Hard Reds Only |
|---|---|---|
| LSD(.05) between varieties: | .6 | .5 |
| between fertility treatments: | .6 | .6 |
| between varieties X fertility treatments: | NS | .8 |

Table 6. Lodging of five winter wheat varieties in response to six nitrogen fertilization treatments, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| | Lodging | | | | | | |
|---|---|---|---|---|---|---|---|
| | Spring + Flowering Nitrogen Applications (lbs/ac) | | | | | | |
| Variety | 0 + 0 | 0 + 50 | 100 + 0 | 100 + 50 | 200 + 0 | 200 + 50 | Mean |
| | % Lodging | | | | | | |
| Stephens | 1 | 20 | 9 | 10 | 5 | 9 | 9 |
| Batum | 8 | 16 | 40 | 61 | 45 | 62 | 39 |
| Arkan | 4 | 5 | 5 | 13 | 18 | 24 | 12 |
| ID 323 | 25 | 44 | 59 | 40 | 74 | 65 | 51 |
| ORCR 8511 | 4 | 3 | 42 | 66 | 54 | 32 | 34 |
| Mean | 8 | 18 | 31 | 38 | 39 | 38 | |

| | All Entries |
|---|---|
| LSD(.05) between varieties: | 14 |
| between fertility treatments: | 15 |
| between varieties X fertility treatments: | NS |

Table 7. Total biological yield (grain plus stubble) of five winter wheat varieties in response to six nitrogen fertilization treatments, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| | Total Biological Yield | | | | | | |
|---|---|---|---|---|---|---|---|
| | Spring + Flowering Nitrogen Applications (lbs/ac) | | | | | | |
| Variety | 0 + 0 | 0 + 50 | 100 + 0 | 100 + 50 | 200 + 0 | 200 + 50 | Mean |
| | tons/ac | | | | | | |
| Stephens | 10.8 | 11.5 | 12.2 | 12.3 | 11.6 | 11.0 | 11.6 |
| Batum | 10.0 | 11.6 | 9.9 | 11.0 | 8.8 | 8.9 | 10.0 |
| Arkan | 10.9 | 11.0 | 10.2 | 11.5 | 12.4 | 11.1 | 11.2 |
| ID 323 | 10.4 | 10.1 | 9.4 | 9.8 | 8.7 | 9.0 | 9.6 |
| ORC 8511 | 10.6 | 11.0 | 10.8 | 11.1 | 10.4 | 10.0 | 10.7 |
| Mean | 10.5 | 11.0 | 10.5 | 11.1 | 10.4 | 10.0 | |

| | All Entries |
|---|---|
| LSD(.05) between varieties: | .9 |
| between fertility treatments: | NS |
| between varieties X fertility treatments: | NS |

Table 8. Harvest index for five winter wheat varieties in response to six nitrogen fertilization treatments, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| | Harvest Index | | | | | | |
|---|---|---|---|---|---|---|---|
| | Spring + Flowering Nitrogen Applications (lbs/ac) | | | | | | |
| Variety | 0 + 0 | 0 + 50 | 100 + 0 | 100 + 50 | 200 + 0 | 200 + 50 | Mean |
| | Harvest Index | | | | | | |
| Stephens | .41 | .41 | .40 | .39 | .40 | .42 | .41 |
| Batum | .38 | .36 | .38 | .36 | .36 | .39 | .37 |
| Arkan | .35 | .37 | .40 | .36 | .37 | .36 | .37 |
| ID 323 | .31 | .33 | .33 | .34 | .35 | .32 | .33 |
| ORCR 8511 | .36 | .37 | .36 | .36 | .36 | .40 | .37 |
| Mean | .36 | .37 | .37 | .36 | .37 | .38 | |

| | All Entries |
|---|---|
| LSD(.05) between varieties: | .02 |
| between fertility treatments: | NS |
| between varieties X fertility treatments: | NS |

Table 9. Effect of spring-applied nitrogen on the ratio of grain yield to plant biomass at anthesis for five winter wheats, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Ratio of Grain Yield to Biomass at Anthesis | | | | |
|---|---|---|---|---|
| | Spring Applied Nitrogen (lbs/ac) | | | |
| Variety | 0 | 100 | 200 | Mean |
| | - - - - - - harvest ratio - - - - - - - - | | | |
| Stephens | 1.08 | 1.17 | 1.14 | 1.14 |
| Batum | .85 | .86 | .74 | .82 |
| Arkan | 1.18 | 1.27 | 1.27 | 1.24 |
| ID 323 | .75 | .13 | .66 | .72 |
| ORC 8511 | .96 | .96 | .92 | .95 |
| Mean | .96 | 1.00 | .95 | |

| | All Entries |
|---|---|
| LSD(.05) between varieties: | .09 |
| between fertility treatments: | NS |
| between varieties X fertility treatments: | NS |

Table 10. Grain protein of five winter wheat varieties in response to six nitrogen fertilization treatments, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Grain Protein | | | | | | | |
|---|---|---|---|---|---|---|---|
| | - - - - - - Spring + Flowering Nitrogen Applications (lbs/ac) - - - - - - - | | | | | | |
| Variety | 0 + 0 | 0 + 50 | 100 + 0 | 100 + 50 | 200 + 0 | 200 + 50 | Mean |
| | - - - - - - - - - - - - - - - - - - % Protein - - - - - - - - - - - - - - - - - - | | | | | | |
| Stephens | 9.1 | 10.3 | 10.3 | 11.0 | 11.0 | 11.4 | 10.5 |
| Batum | 10.1 | 11.0 | 11.0 | 11.9 | 11.8 | 12.1 | 11.3 |
| Arkan | 10.7 | 11.4 | 11.0 | 11.9 | 11.9 | 12.2 | 11.5 |
| ID 323 | 10.1 | 11.5 | 11.5 | 11.8 | 12.0 | 12.2 | 11.5 |
| ORCR 8511 | 10.5 | 11.6 | 11.8 | 12.4 | 12.2 | 12.1 | 11.8 |
| Mean | 10.4 | 11.4 | 11.3 | 12.0 | 12.0 | 12.2 | |

| | All Entries | Hard Reds Only |
|---|---|---|
| LSD(.05) between varieties: | .5 | NS |
| between fertility treatments: | .5 | .5 |
| between varieties X fertility treatments: | NS | NS |

Table 11. Total nitrogen in the grain of five winter wheat varieties in response to six nitrogen fertilization treatments, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| | Total Nitrogen in the Grain | | | | | | |
|---|---|---|---|---|---|---|---|
| | Spring + Flowering Nitrogen Applications (lbs/ac) | | | | | | |
| Variety | 0 + 0 | 0 + 50 | 100 + 0 | 100 + 50 | 200 + 0 | 200 + 50 | Mean |
| | lbs N/ac | | | | | | |
| Stephens | 139 | 164 | 170 | 181 | 175 | 180 | 168 |
| Batum | 132 | 153 | 141 | 159 | 127 | 143 | 143 |
| Arkan | 138 | 157 | 154 | 168 | 169 | 168 | 159 |
| ID 323 | 112 | 127 | 122 | 134 | 117 | 120 | 122 |
| ORC 8511 | 138 | 159 | 158 | 167 | 155 | 163 | 157 |
| Mean | 132 | 152 | 149 | 162 | 150 | 155 | |

| | All Entries |
|---|---|
| LSD(.05) between varieties: | 11 |
| between fertility treatments: | 11 |
| between varieties X fertility treatments: | NS |

Table 12. Grain hardness of five winter wheat varieties in response to six nitrogen fertilization treatments, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| | Grain Hardness | | | | | | |
|---|---|---|---|---|---|---|---|
| | Spring + Flowering Nitrogen Applications (lbs/ac) | | | | | | |
| Variety | 0 + 0 | 0 + 50 | 100 + 0 | 100 + 50 | 200 + 0 | 200 + 50 | Mean |
| | Grain Hardness | | | | | | |
| Stephens | 42 | 33 | 21 | 20 | 26 | 20 | 27 |
| Batum | 71 | 84 | 79 | 86 | 76 | 76 | 79 |
| Arkan | 69 | 70 | 65 | 74 | 72 | 68 | 70 |
| ID 323 | 80 | 84 | 81 | 80 | 81 | 84 | 82 |
| ORCR 8511 | 88 | 92 | 84 | 84 | 85 | 85 | 87 |
| Mean | 77 | 83 | 77 | 81 | 79 | 78 | |

| | All Entries | Hard Reds Only |
|---|---|---|
| LSD(.05) between varieties: | 6 | 4 |
| between fertility treatments: | NS | NS |
| between varieties X fertility treatments: | NS | NS |

Table 13. Effect of spring-applied nitrogen on the nitrogen concentration of flag leaves at anthesis for five winter wheat varieties, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| | Flag Leaf Nitrogen Concentration | | | |
|---|---|---|---|---|
| | Spring Applied Nitrogen (lbs/ac) | | | |
| Variety | 0 | 100 | 200 | Mean |
| | - - - - - - % N - - - - - - - | | | |
| Stephens | 4.4 | 4.9 | 5.2 | 4.8 |
| Batum | 3.8 | 4.7 | 5.0 | 4.5 |
| Arkan | 4.7 | 5.2 | 5.1 | 5.0 |
| ID 323 | 4.2 | 4.7 | 5.0 | 4.6 |
| ORC 8511 | 4.0 | 4.8 | 5.0 | 4.6 |
| Mean | 4.2 | 4.9 | 5.1 | |

| | All Entries | Hard Reds Only |
|---|---|---|
| LSD(.05) between varieties: | .2 | .3 |
| between fertility treatments: | .3 | .2 |
| between varieties X fertility treatments: | NS | NS |

Figure 1. The effect of nitrogen fertilization in mid-March and at anthesis on the grain protein of hard red and soft white winter wheat, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1987.

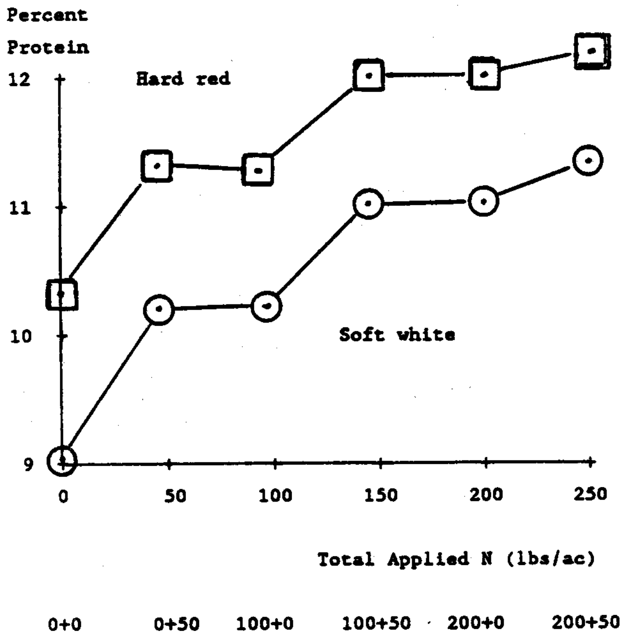



Figure 2. Effects of flag leaf N concentration at anthesis and nitrogen fertilization at anthesis on the grain protein of hard red winter wheat, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1987.

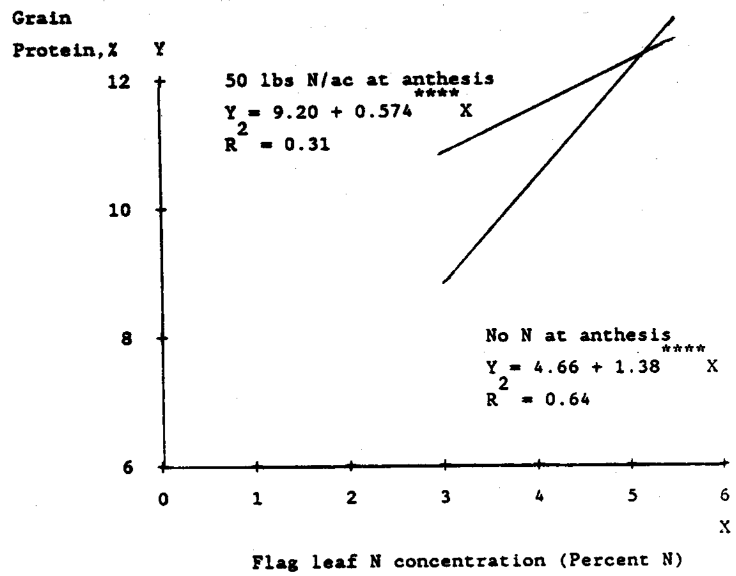



Figure 3. Effects of flag leaf N concentration at anthesis and nitrogen fertilization at anthesis on the grain protein of soft white winter wheat, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1987.

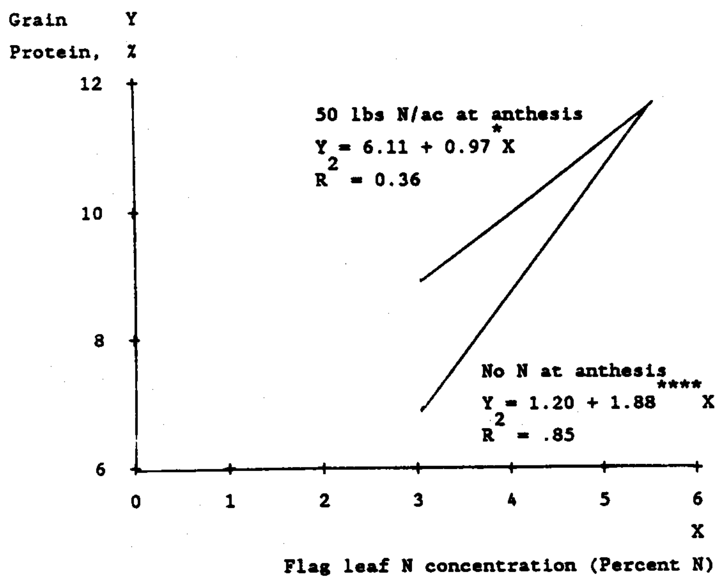



Figure 4. Effects of Flag leaf N concentration at anthesis and nitrogen fertilization at anthesis on the grain protein of three hard red winter wheat genotypes, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1987.

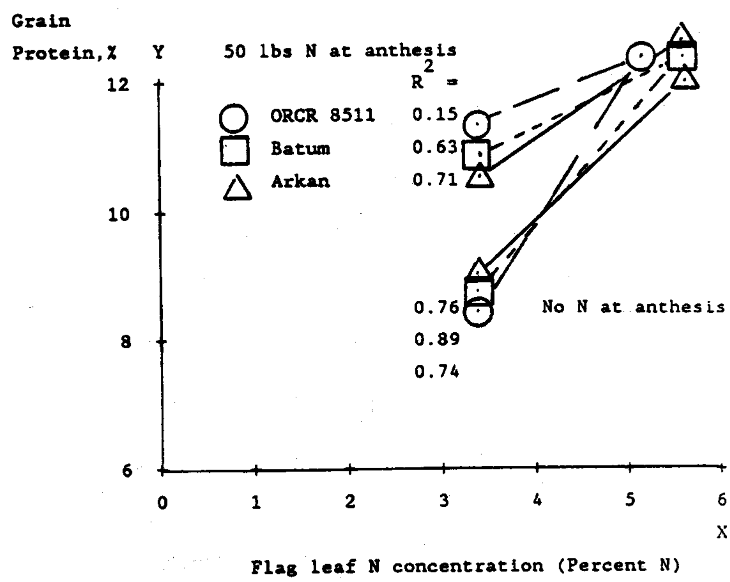


Figure 5. Effects of biomass N concentration at anthesis and nitrogen fertilization at anthesis on the grain protein of hard red winter wheat, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1987.

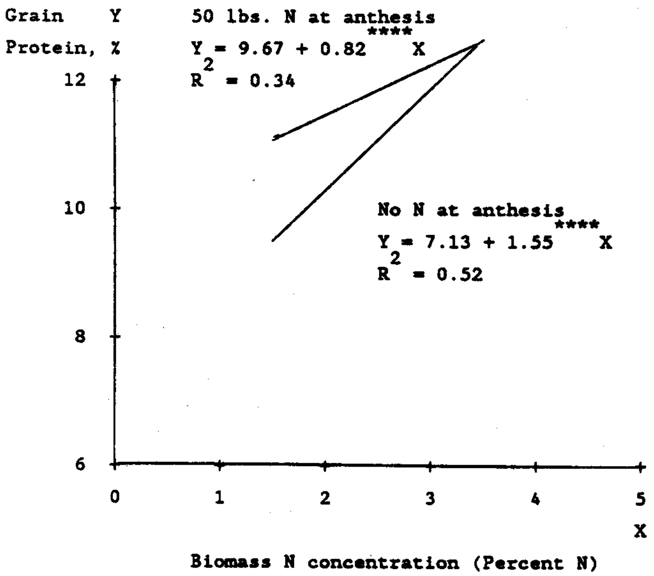



Figure 6. Effects of biomass N concentration at anthesis and nitrogen fertilization at anthesis on the grain protein of soft white winter wheat, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1987.

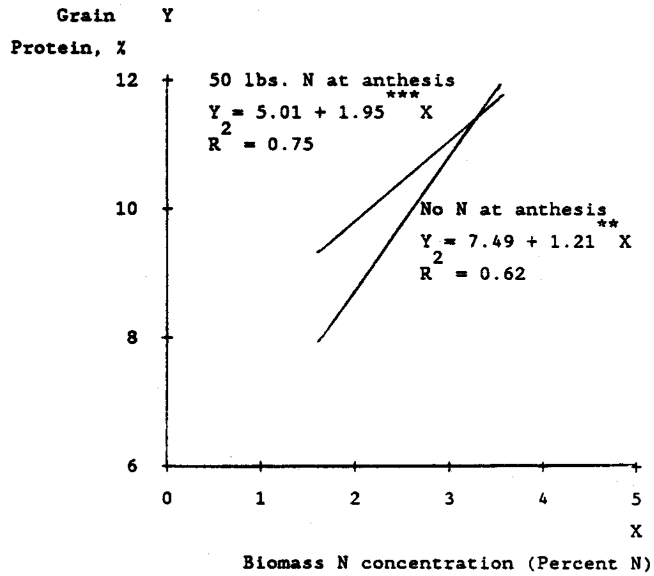
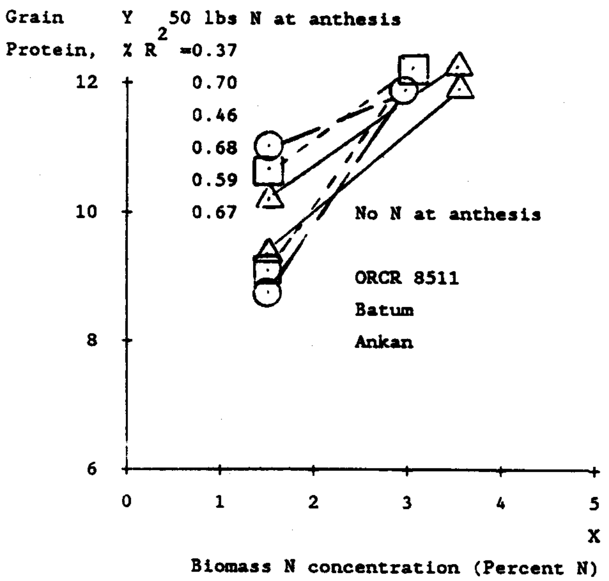



Figure 7. Effects of biomass N concentration at anthesis and nitrogen fertilization at anthesis on the grain protein of three hard red winter wheat genotypes, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1987.



# SUGAR BEET VARIETY TESTING RESULTS

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Ontario, Oregon, 1987

## Purpose

Commercial varieties and experimental lines of sugar beets were evaluated to identify lines for superior sugar yields and root quality. A joint seed advisory committee evaluates the accumulative performance data for the varieties and recommends all varieties ranking above minimum requirements for planting in Malheur County and Idaho.

## Procedures

Seventeen commercial varieties and 23 experimental lines of sugar beets were evaluated in trials conducted at the Malheur Experiment Station. Seed for evaluation was received from American Crystal, Betaseed, Holly, Mono-Hy, Western, and TASCO companies. The sugar beets were planted on Owyhee silt loam soil where onions and Stephans wheat, respectively, were planted the previous two years. Soil pH is 7.3 and the soil organic matter is 1.2 percent. The field was plowed in the fall of 1986. One hundred pounds of phosphate and 60 pounds N were applied as a broadcast treatment before plowing. An additional 150 pounds of ammonium nitrate was sidedressed after thinning. Two lbs ai/ac of Nortron and 1.5 lbs ai/ac of Hoelon were broadcast and incorporated preplant by a spike-tooth harrow.

The commercial varieties and experimental lines were planted in separate trials. Commercial checks were planted with experimental lines for comparison purposes. Each entry was replicated eight times and arranged in a complete randomized block experimental design. Each plot was four rows wide and 23 feet long with 4-foot alleyways between the ends of each plot. Approximately 12 viable seeds per foot of row were planted. The seed was planted on April 16-17 with a cone-seeder mounted on a John Deere model 71 flexi-planter equipped with disc openers. After planting, the sugar beets were furrowed and surface-irrigated to assure moisture for uniform seed germination and seedling emergence.

The sugar beets were hand-thinned during the last week of May. Spacing between plants was approximately eight inches. In mid-July, just before the last cultivation, one lb ai/ac Bayleton was applied broadcast with a ground sprayer. Another Bayleton application was aerial-applied at 0.5 pounds active ingredient per acre during mid-August. One lb ai/ac Orthene was applied with the last application of Bayleton for the control of loopers. Powdered sulfur was aerial-applied at 30 lbs/ac on August 5 to aid in control of powdery mildew.

The sugar beets were harvested on October 23-28. The foliage was removed by rubber flail beater and the crowns clipped with floating scalping knives. The roots from the two center rows of each four-row plot were dug with a single-row wheel-type lifter harvester and roots in each 23 feet of row were weighed to calculate root yields. A sample of seven beets was taken from each of the harvested rows and sent to the Amalgamated research laboratory to be analyzed for percent sucrose and conductivity readings as a measure of root purity.

## Results

The sugar beet trial suffered hail damage on August 13. Approximately 50 percent of the foliage was removed by the hail and the remaining leaves and petioles were damaged.

Varieties (Table 1 and 2) have been grouped by seed companies. Each variety is ranked within each company's group by yield of recoverable sugar per acre. The data was analyzed statistically for LSD value at .05 percent level of significance, coefficient of variation, P values, and means for all evaluated parameters except curley-top ratings.

Yield of recoverable sugar from commercial varieties ranged from a high of 6.7 tons of sugar per acre to a low of 5.5 tons per acre, with a variety mean of 6.3 tons per acre. Six varieties had sugar yields equal to or greater than the mean. Of these six varieties WS-PM9 produced a sugar yield significantly greater than the mean (Table 1).

Yields of recoverable sugar for entries in the experimental trial ranged from 6.9 to 5.8 tons per acre with an entry mean of 6.3 tons of sugar per acre. Eight of the 24 bins tested had sugar yields above the trial mean. Six lines had sugar yields significantly better than the mean (Table 2).

Root yields were lower this year compared to previous years; but percent sucrose was extremely high this year and conductivity readings were lower. With the higher percent sucrose, the extraction percentage yields of recoverable sugar were generally high.

Table 1. Sugar, root yields, and quality evaluations of 17 commercial varieties of sugar beets, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Company | Variety | Root Yield | Sucrose | Conductivity | Extraction | Recoverable Sugar | Curley Top Ratings |
|---|---|---|---|---|---|---|---|
| | | tons/ac | % | | % | tons/ac | 0-9 |
| American Crystal | ACH-177 | 40.90 | 18.23 | 753 | 86.19 | 6.424 | 5.5 |
| | ACH-173 | 42.29 | 17.39 | 727 | 86.44 | 6.351 | 4.1 |
| | ACH-31 | 42.02 | 17.23 | 783 | 85.67 | 6.200 | 4.8 |
| | ACH-184 | 38.19 | 17.29 | 735 | 86.32 | 5.693 | |
| | ACH-139 | 37.34 | 17.17 | 742 | 86.21 | 5.529 | |
| Betaseed | 8654 | 44.23 | 16.89 | 850 | 84.71 | 6.325 | 4.7 |
| | 8555 | 43.65 | 17.02 | 854 | 84.67 | 6.290 | 4.5 |
| | 8428 | 41.46 | 17.28 | 848 | 84.80 | 6.077 | 4.7 |
| Holly | HH-39 | 43.56 | 16.81 | 794 | 85.46 | 6.254 | 5.4 |
| Mono-Hy | R2 | 43.09 | 16.47 | 844 | 84.74 | 6.012 | 5.5 |
| | R1 | 41.68 | 16.88 | 794 | 85.47 | 6.009 | 5.3 |
| | RH83 | 41.34 | 16.61 | 836 | 84.88 | 5.830 | 5.6 |
| | 55 | 40.74 | 16.79 | 859 | 84.59 | 5.786 | 5.5 |
| TASCO | WS-PM9 | 47.21 | 16.59 | 778 | 85.64 | 6.706 | 4.2 |
| | WS-88 | 44.74 | 17.06 | 796 | 85.46 | 6.530 | 4.2 |
| | WS-76 | 42.76 | 16.94 | 826 | 85.05 | 6.161 | 4.4 |
| Western | Hybrid 8 | 41.47 | 17.20 | 701 | 86.76 | 6.193 | 4.4 |
| LSD .05 | | 1.95 | 0.408 | 48 | 0.675 | 0.323 | |
| P-Value | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | |
| CV (s/mean) | | 4.57 | 2.42 | 6.11 | 0.79 | 5.195 | |
| Mean | | 43.13 | 17.07 | 796 | 85.47 | 6.290 | |

1 = no incidence of curly-top, 9 - plants killed from curly-top virus infection.

Table 2. Sugar, root yields, and quality evaluations of 28 experimental varieties of sugar beets, Malheur Experiment Station OSU, Ontario, Oregon, 1987.

| Company | Variety | Root Yield | Sucrose | Conductivity | Extraction | Recoverable Sugar | Curley Top Ratings[1] |
|---|---|---|---|---|---|---|---|
| | | tons/ac | % | | % | tons/ac | 0-9 |
| American Crystal | C86-166 | 42.19 | 17.47 | 771 | 85.85 | 6.324 | 4.3 |
| | C86-237 | 39.88 | 18.12 | 767 | 86.00 | 6.220 | 5.6 |
| | C85-87 | 42.84 | 16.87 | 838 | 84.87 | 6.126 | 4.5 |
| | C85-453 | 37.70 | 18.27 | 663 | 87.39 | 6.016 | 5.5 |
| | C85-98 | 39.66 | 17.41 | 726 | 86.45 | 5.967 | 3.7 |
| | 31 | 39.57 | 17.48 | 738 | 86.30 | 5.965 | 4.8 |
| | C86-243 | 38.49 | 17.42 | 748 | 86.16 | 5.783 | 5.4 |
| Betaseed | 3G5567 | 46.65 | 17.24 | 834 | 84.98 | 6.824 | 5.1 |
| | 5BC6214 | 46.23 | 16.92 | 803 | 85.35 | 6.679 | 5.2 |
| | 4BG5600 | 43.44 | 17.33 | 769 | 85.86 | 6.463 | 5.3 |
| | 9527 | 44.87 | 16.86 | 882 | 84.27 | 6.369 | 5.3 |
| | 8654 | 42.53 | 17.09 | 820 | 85.16 | 6.190 | 4.7 |
| Holly | 85C141-07 | 42.48 | 17.44 | 719 | 86.55 | 6.409 | 5.1 |
| | HH-48 | 41.92 | 17.07 | 753 | 86.05 | 6.158 | 5.8 |
| | HH-39 | 42.05 | 17.03 | 768 | 85.84 | 6.144 | 5.4 |
| | HH-42 | 40.77 | 17.13 | 760 | 85.97 | 6.004 | 5.2 |
| | 85T144-014 | 41.33 | 16.51 | 774 | 85.70 | 5.839 | 5.3 |
| Mono-Hy | 2905 | 45.50 | 16.90 | 855 | 84.65 | 6.509 | 5.9 |
| | 176 | 43.72 | 17.09 | 692 | 86.87 | 6.489 | 4.2 |
| | 3003 | 42.35 | 17.30 | 808 | 85.34 | 6.255 | 5.9 |
| | 2906 | 42.05 | 17.35 | 842 | 84.88 | 6.191 | 6.0 |
| | 55 | 42.29 | 16.82 | 846 | 84.77 | 6.022 | 5.5 |
| TASCO | E5044 | 45.32 | 17.91 | 804 | 85.46 | 6.924 | 4.1 |
| | WS-88 | 45.05 | 17.55 | 761 | 86.01 | 6.797 | 4.2 |
| | E6148 | 45.38 | 17.59 | 839 | 84.95 | 6.785 | 3.7 |
| | E4123 | 46.68 | 16.96 | 872 | 84.43 | 6.685 | 4.9 |
| | E4119 | 43.94 | 17.20 | 764 | 85.92 | 6.496 | 5.0 |
| | E6184 | 42.93 | 17.22 | 799 | 85.45 | 6.315 | 4.4 |
| LSD .05 | | 2.18 | .42 | 57 | 0.81 | 0.320 | |
| P-Value | | .000 | .000 | .000 | .000 | .000 | |
| CV (s/mean) | | 5.17 | 2.48 | 7.34 | 0.96 | 5.126 | |
| Mean | | 42.78 | 17.27 | 786 | 85.96 | 6.320 | |

[1] = no incidence of curly-top, 9 = plants killed from curly-top virus infection.

Table 3. Sugar, root yields, and quality evaluations of 14 commercial varieties of sugar beets averaged over two years, 1986 and 1987, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Company | Variety | Two Year Averages | | | | | |
|---|---|---|---|---|---|---|---|
| | | Root Yield | Sucrose | Conductivity | Extraction | Recoverable Sugar | Curley Top Ratings |
| | | tons/ac | % | | % | tons/ac | 0-9 |
| American Crystal | ACH-173 | 43.1 | 16.8 | 710 | 86.6 | 6.36 | 4.1 |
| | ACH-31 | 42.4 | 16.7 | 779 | 85.7 | 6.04 | 4.9 |
| | ACH-184 | 40.8 | 16.7 | 737 | 86.2 | 5.85 | na |
| | ACH-139 | 40.1 | 16.5 | 751 | 86.0 | 5.68 | na |
| Betaseed | 8654 | 45.8 | 16.3 | 832 | 84.9 | 6.32 | 4.5 |
| | 8555 | 45.6 | 16.3 | 831 | 84.9 | 6.31 | 4.3 |
| Holly | HH-39 | 44.9 | 16.2 | 799 | 85.3 | 6.21 | 5.1 |
| Mono-Hy | R2 | 43.1 | 16.3 | 825 | 85.0 | 6.40 | 5.3 |
| | R1 | 44.1 | 16.4 | 786 | 85.6 | 6.19 | 5.1 |
| | RH83 | 44.1 | 16.2 | 808 | 85.2 | 5.94 | 5.1 |
| | 55 | 44.2 | 16.4 | 825 | 85.0 | 6.16 | 5.2 |
| TASCO | WS-88 | 47.6 | 16.3 | 802 | 85.3 | 6.62 | 4.1 |
| | WS-76 | 45.1 | 16.4 | 824 | 85.0 | 6.29 | 4.2 |
| Western | Hybrid 8 | 43.3 | 16.5 | 700 | 86.7 | 6.18 | 4.3 |
| Averages over all varieties | | 43.9 | 16.4 | 786 | 85.5 | 6.18 | 4.3 |

PREVENTATIVE FUNGICIDE APPLICATION FOR
CONTROL OF POWDERY MILDEW IN SUGAR BEETS

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## Purpose

Several experimental fungicides were compared to a registered standard to evaluate powdery mildew control in sugar beets. Fungicides were applied as early season preventative measures.

## Procedures

The fungicides were applied July 14, 1987, to variety WS-88 sugar beets growing at the Malheur Experiment Station under furrow irrigation. Very little mildew was visible in the trial block at the time of application, although mildew was found in other fields on the station. Spores were likely to be widespread at the time of application.

The fungicides were applied to plots having four 22-inch rows, 40 feet long. A $CO_2$ sprayer with four flat fan 8003 nozzles at 30 PSI applied the chemicals in 30 gallons of water per acre. Each treatment was replicated three times. Most treatments were applied as a band by turning the nozzles parallel with the rows so as to deposit the spray directly downward into the leaf whorl. As a comparison, Bayleton 50WP was applied as a normal broadcast spray, the common commercial practice.

A second application on August 6 was also made on three of the plots by splitting them in half lengthwise to indicate the effect of a sequential broadcast spray. A majority of the leaves had small amounts of mildew visible in the untreated check plots on August 6.

Ratings of diseased mature leaf area (percent MLAD) were taken August 12. Twenty recently mature leaves were randomly selected from the center two rows per replicate. Each leaf was assigned a value of 0 to 100, based upon the amount of mildew area on the top surface of each leaf.

A severe hail storm on August 13 disrupted further evaluation due to defoliation of the plants. Treatments applied on August 7 could not be evaluated.

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[2] Biological Technician and Associate Professor of Oregon State University, Malheur Experiment Station.

## Results

On August 12, mildew had become serious in the untreated check plots, 43 percent MLAD (Table 1). Very good to good control was found from Bayleton 50 WP (registered standard), Bayleton 1.8 EC, and Summit 25DF (formerly KWG 0519), all at eight ounces active ingredient per acre. Both single or split application treatments using the same total amount of chemical reduced mildew.

The Bayleton 1.8 EC did not appear quite as good as the Bayleton 50 WP in terms of control over time, perhaps because the 50 WP acts as more of a "slow-release" material. The 1.8 EC may be better suited for mid-season timing when quick uptake is important.

All of the materials tested at eight and four ounces active ingredient per acre were much less effective at four ounces active ingredient per acre. Folicur appears to be more active than Bayleton at equal rates.

All the experimental fungicides tested in this trial show promise as commercially useful controls for powdery mildew, should they become registered.

Table 1. Powdery mildew ratings taken from sugar beets treated with fungicides, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Fungicide | Rate oz ai/a | Appl. Type | Appl. Date | % MLAD[1] 8/12 | % Contral[2] 8/12 |
|---|---|---|---|---|---|
| 1. Bayleton 50WP | 8 | BC[3] | 7/14 | 8 | 81 |
| 2. Bayleton 50WP | 8 | Band[4] | 7/14 | 5 | 89 |
| 3. Bayleton 50WP | 4 | Band | 7/14 | 14 | 67 |
| 4. Bayleton 50WP plus | 4 | Band | 7/14 | | |
| Bayleton 50WP | 4 | BC | 8/6 | 2 | 96 |
| 5. Bayleton 1.8EC | 8 | Band | 7/14 | 10 | 76 |
| 6. Bayleton 1.8EC | 4 | Band | 7/14 | 17 | 61 |
| 7. Bayleton 1.8EC plus | 4 | Band | 7/14 | | |
| Bayleton 1.8EC | 4 | BC | 8/6 | 3 | 93 |
| 8. Summit 25DF | 8 | Band | 7/14 | 2 | 96 |
| 9. Summit 25DF | 4 | Band | 7/14 | 16 | 63 |
| 10. Summit 25DF plus | 4 | Band | 7/14 | | |
| Summit 25DF | 4 | BC | 8/6 | 3 | 93 |
| 11. Folicur 1.2EC | 4 | Band | 7/14 | 6 | 86 |
| 12. Check (no fungicide) | - | none | - | 43 | 0 |

[1] Mature leaf area diseased: average of 20 leaves from each of three replicates.
[2] Relative to check (Abbot's Formula).
[3] Broadcast spray, 8003 nozzles over row centers.
[4] Band spray into leaf whorl, 8003 nozzles turned parallel to row.

# IRRIGATION SCHEDULING OF SUGAR BEETS

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## Objective

An irrigation study was conducted with sugar beets to determine the usefulness of a Scheduler to schedule irrigations and evaluate crop stress. In years of scarce irrigation water, growers need to know how much water is necessary to produce reasonable yields and when it should be applied. Soil water supply needs to be maintained to the crop during the periods when moisture stress is most closely related to yields.

## Procedures

Betaseed 8654 sugar beets were planted April 21 on an Owyhee silt loam soil at the Malheur Experiment Station. Sugar beets were planted on 22-inch rows. Uniform irrigations were applied April 23, May 7, May 15, and June 9. After June 9, irrigations were based on five criteria (Table 1). The check treatment was irrigated based, on soil water content, when the soil at six-inch depth reached -2 bars water potential. The remaining treatments (2 through 5) were based on crop water stress index (CWSI) as calculated by a SOHIO Scheduler. Each progressive CWSI value represented a higher level of crop stress 1.5, 3.0, 4.5, and 6.0.

Each treatment was replicated four times in a randomized complete block design. Each plot consisted of eight 22-inch rows of beets, 100 feet long. Each plot was fitted with gated pipe and a tail ditch so that it could be irrigated individually. Plots were only irrigated if they reached their irrigation criteria.

Soil moisture at 6 and 18 inches was determined twice a week using Soil Water Mark Sensors. Crop canopy temperature, air temperature above the crop, and air relative humidity were recorded simultaneously twice a week and the CWSI was calculated by the Scheduler.

Standard cultural practices, including weed control and mildew control, were used. The beets were hand-thinned June 2 to one plant every eight inches. The crop was sidedressed June 8 with 150 lbs N/ac as ammonium nitrate. Two central rows of beets from each plot were harvested and evaluated for yield, beet conductivity, percent sucrose, percent recovery, and total recoverable sugar.

## Results and Discussion

The 1987 growing season was very favorable for beet production and sugar yields. Yields in this trial may have been higher except that hail largely defoliated the plants the evening of August 13. Average beet yields ranged from 33.9 to 28.5 tons per acre from the wettest to the driest irrigation treatments (Table 1). Sugar yields ranged from 9,646 to 7,750 pounds per acre of recoverable sugar. Beet conductivity, percent sucrose, and percent recoverable sugar were not affected by the irrigation treatments.

## Effects of Irrigation

Average hours of irrigation varied between the treatments, from 81 hours to 157 hours (Table 2). Beet yields, conductivity, percent sugar, percent recovery , and total recoverable sugar were not related to the total hours of furrow irrigation. Beet yields, $Y_1$ (tons/acre), and total recoverable sugar, $Y_2$ (lbs/acre), were only related to late June irrigation, $X_1$ (hours):

$$Y_1 = 30.5 + 0.109\, X_1 \qquad R^2 = .20 \qquad P = .06$$

$$Y_2 = 8300 + 45.5\, X_1 \qquad R^2 = .39 \qquad P = .006$$

The sugar in the beets at harvest, $Y_3$ (percent), and percent recovery, $Y_4$ (percent), only were related to September irrigation, $X_2$ (hours):

$$Y_3 = 16.2 + 0.058\, X_2 \qquad R^2 = .39 \qquad P = .006$$

$$Y_4 = 84.3 + 0.072\, X_2 \qquad R^2 = .19 \qquad P = .07$$

## Crop Water Stress and Yields

Neither beet tonnage nor sugar yield was related to average June or July CWSI levels. Beet yields, $Y_1$ (tons/acre), and total recoverable sugar, $Y_2$ (lbs/acre), were closely related to average August CWSI values, $X_3$:

$$Y_1 = 34.2 - 2.16\, X_3 \qquad R^2 = .67 \qquad P = .0000$$

$$Y_2 = 9550 - 602\, X_3 \qquad R^2 = .59 \qquad P = .0002$$

The greater the CWSI values measured in August, the lower the sugar yields. Water supplies had to be adequate in August or beet yields and sugar yields were lost. The crop showed considerable tolerance to stress from June 25 to July 30, up to a CWSI value of six during the 1987 season.

## Conclusions

The 1987 trial needs to be repeated to provide reliable recommendations for growers. The 1987 trial results suggest an optimal irrigation strategy to conserve water for sugar beet production on deep well-drained soils with high moisture retentive capacity.

1. Apply adequate water in the spring to establish the crop and fill the soil profile with water.

2. Irrigations during July are not necessary as long as the crop water stress index does not exceed 6.0.

3. Irrigations during August are not necessary as long as the crop water stress index does not exceed 1.0.

4. Irrigation in September may be necessary to improve sugar concentration and to improve the percent recoverable sugar if there are no fall rains.

Although beet and sugar yields in 1987 were not related to July CWSI, the average temperatures in July were not high. August CWSI values closely related to yields, but August temperatures were greater than normal.

Results from one year are unreliable for predicting management systems for a crop. The 1987 sugar beet irrigation results should be approached with caution.

Table 1. Sugar beet yields and quality from the irrigation scheduling trial, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Irrigation Criteria | Beet Yields | Conductivity $\mu\ \Omega$ | Sugar Content | Percent Recovery | Recoverable Sugar |
|---|---|---|---|---|---|
| | t/ac | | % | % | lbs/ac |
| 1. Check | 33.7 | 818 | 16.8 | 85.2 | 9646 |
| 2. CWSI > 1.5 | 32.9 | 829 | 16.9 | 85.1 | 9463 |
| 3. CWSI > 3.0 | 33.9 | 877 | 15.9 | 84.3 | 9116 |
| 4. CWSI > 4.5 | 31.3 | 879 | 16.4 | 84.3 | 8657 |
| 5. CWSI > 6.0 | 28.5 | 861 | 16.2 | 84.5 | 7750 |
| F (regression[1]) | ** | ns | ns | ns | *** |

[1]Regression on August CWSI values.

Table 2. Irrigation water supplied to sugar beets via irrigation scheduling, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| | Month | | | | | |
|---|---|---|---|---|---|---|
| Irrigation Criteria | Planting to June 9 | Late June | July | August | Sept. | Total |
| | irrigation, hours | | | | | |
| 1. Check | 78 | 27 | 15.3 | 24 | 12.7 | 157.0 |
| 2. CWSI > 1.5 | 78 | 27 | 28 | 10.5 | 11.7 | 155.2 |
| 3. CWSI > 3.0 | 78 | 9 | 15.5 | 0 | 0 | 102.5 |
| 4. CWSI > 4.5 | 78 | 6.8 | 11.5 | 1.5 | 0 | 97.8 |
| 5. CWSI > 6.0 | 78 | 0 | 0 | 3 | 0 | 81 |

Table 3. Sugar beet average crop water stress indicies (CWSI) during parts of the growing season, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| | Average[1] CWSI readings | | | |
|---|---|---|---|---|
| Irrigation Criteria | Late June | July | August | All dates |
| 1. Check | 0.88 | 1.65 | 0.15 | 0.84 |
| 2. CWSI > 1.5 | 1.58 | 1.16 | 0.59 | 0.96 |
| 3. CWSI > 3.0 | 0.95 | 1.36 | 0.98 | 1.12 |
| 4. CWSI > 4.5 | 1.11 | 2.02 | 1.39 | 1.59 |
| 5. CWSI > 6.0 | 2.03 | 1.5 | 1.84 | 1.74 |

[1]Averages were based only on days when sugar beets were stressed. Dates when most of the stress index numbers were negative were eliminated from the averages. Negative numbers were encountered with well-watered crops, especially on windy days or after rain.

# A COMPARISON OF FORMULA 132+ AND RV5 WITH AND WITHOUT NUTRIENTS IN PELLETED SUGAR BEET SEED TO RAW SEED FOR EMERGENCE AND SUGAR YIELDS

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## Purpose

This study was continued for the second year to determine if nutrients and other additives contained in the coating material of pelletized sugar beet seed can enhance seedling emergence and growth, reduce seeding disease, and increase sugar yields.

## Procedures

The trial contained five treatments, RV5 + Nutrients, RV5 + Exp. 1, 132B + Nutrients, 132B + Exp. 1 as pelleted seed, and an unpelleted raw seed as a standard check. The seed, either both pelleted or raw, was Tasco WS-99 variety from the same lot.

The seed was planted in an Owyhee silt loam soil. Soil organic matter and pH was 1.2 and 7.3. Winter wheat was grown in the field before planting sugar beets. Seed-bed preparation consisted of moldboard plowing in the fall and field tillage in the spring. One hundred pounds of $P_2O_5$ and 60 pounds of nitrogen were applied as a broadcast application before plowing. An additional 140 pounds of nitrogen was sidedressed after thinning. Two pounds active Nortron and 1.5 pounds active Hoelon per acre were broadcast applied and incorporated with a spike-tooth harrow before planting for weed control.

These five treatments were included with sugar beet varieties planted in the commercial sugar beet variety trial. Each treatment was replicated eight times and arranged at random in blocks and the data analyzed by analysis of variance using a complete randomized block experimental design. Individual treatment plots were four rows wide and 22 feet long. Alley-ways four feet wide separated blocks. An equal number of seeds were prepackaged to plant approximately 12 viable seeds per foot of row.

The seed was planted on April 16-17 and irrigated on April 18 by rill irrigation. Subsequent stand counts were taken 9, 10, 11, 12, and 18 days after planting. Plant counts were taken from six linear feet of the center two rows of each plot planted in light replications. Areas counted from each row were marked and emerged plants were counted from the same section for all counts.

The sugar beets were thinned by hand during the last week of May. Individual sugar beet plants were spaced eight inches apart. In early July, at time of last cultivation, one pound active Bayleton for powdery mildew control was applied using a ground sprayer. A second application of Bayleton was aerial-applied in September at a rate of 0.5 pounds active per acre.

The sugar beets were harvested on October 23-28. The plant foliage was removed with a rubber flail beater and the root crowns clipped by trailing scalper knives. The roots from the two center rows of each four-row plot were lifted with a single-row wheel-type harvester and all roots in each 22-foot row were weighed to calculate root yield per acre. Samples of seven beets were taken from each of the two harvested rows in each plot and analyzed to obtain percent sucrose and conductivity readings. Percent extractable sugar and yield of recoverable sugar per acre was calculated for each seed treatment. Harvested root weights were tared by 5 percent and percent sucrose readings were factored to 95 percent of actual readings when percent extraction and recoverable sugar yields were calculated.

## Results

Soil tilth and irrigation after planting made soil conditions excellent for seed germination and seedling emergence.

Differences in rate of seedling emergence and total plants emerged existed between raw seed and RV5 + Nutrients treatments. The difference between these treatments was great enough to be significant at the 5 percent level for days 10, 12, and final stand. Plants from seed coated with RV5 + Exp.1 were one day slower to emerge than plants from other pelleted seed treatments and the raw seed. Results indicate that seed germination and rate of emergence was not reduced and may be enhanced by additives in the coating material of pelleted sugar beet seed.

Differences in root yields, root quality, or sugar yields did not exist between pelleted and raw seed. Yields and quality were excellent for all treatments with very little variation between treatments within replications as indicated by the C.V. values. Yield responses to initial plant stand are not expected when seed is planted in excess and hand-thinned.

Table 1. Number of sugar beet seedlings emerged from WS-88 variety of seed coated with different additives in the pelleting material. Plant counts began nine days after planting when emergence started. Seedling numbers are an average of counts taken from two, three-foot sections in each of eight replications. Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Seed Treatment | Plant Stand | | | | |
|---|---|---|---|---|---|
| | Day 9 | Day 10 | Day 11 | Day 12 | Day 18 |
| | - - - - - - - - plants / 6 ft row - - - - - - - - - - | | | | |
| RV5 + Nutrients | 35.00 | 45.50 | 47.63 | 47.50 | 48.25 |
| RV5 + Exp. 1 | 24.75 | 41.75 | 45.38 | 45.88 | 46.38 |
| 132 B + Exp. 1 | 34.38 | 41.88 | 44.13 | 44.13 | 44.13 |
| 132 B + Nutrients | 32.00 | 40.25 | 43.88 | 42.63 | 42.25 |
| WS88 (check) | 30.88 | 38.13 | 41.50 | 42.75 | 41.88 |
| LSD.05 | 5.83 | 5.03 | 5.32 | 5.06 | 5.27 |
| CV (%) | 18.11 | 11.84 | 11.68 | 11.10 | 11.55 |
| P value | .0095 | .0715 | 0.232 | 0.247 | 0.0896 |

Table 2. Sugar yields and root quality of WS-88 variety of sugar beet seed coated using different additives in the pelleting material, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Seed Treatments | Root Yield | Sucrose | Conductivity | Extraction | Recoverable Sugar |
|---|---|---|---|---|---|
| | t/a | % | | % | t/a |
| RV5 + Nutrients | 45.56 | 17.21 | 785 | 85.64 | 6.717 |
| RV5 + Exp. 1 | 47.23 | 17.13 | 797 | 85.46 | 6.911 |
| 132 B + Exp. 1 | 46.09 | 16.97 | 826 | 85.05 | 6.655 |
| 132 B + Nutrients | 45.99 | 17.20 | 781 | 85.68 | 6.777 |
| WS88 (check) | 47.37 | 17.18 | 795 | 85.49 | 6.954 |
| LSD.05 | NS | NS | NS | NS | NS |
| CV (%) | 4.17 | 1.685 | 5.42 | 0.70 | 4.56 |
| P value | .2659 | .4688 | .2781 | .2529 | .2815 |

No measurable differences in yields as results of seed treatments.

# EFFECT OF ROW COVERS ON AIR AND SOIL TEMPERATURES

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The advantages of row covers for vegetable and fruit production has been well documented. Most crops exhibit earlier fruiting and larger overall yields when started under protective plant coverings. In addition, row covers offer a degree of protection from frost, some insects and diseases, and high winds. Irrigation demand is also reduced.

The benefits of early fruiting and increased yields under row covers can be attributed to the modified air and soil temperatures under covers. The primary objective of these studies was to study the air and soil temperature regimes under various row covers.

## Material and Methods

An Owyhee silt loam soil typical of the Ontario area was prepared for planting and furrowed out at 22 inches in late March. Tomato seeds were planted every other row with a three-foot within-row spacing. The six-row cover materials listed below were set up over the planted seed March 31 in a complete randomized block design with four replications.

| Treatment | Description |
|---|---|
| 1. Clear plastic, unslitted | 1.1 mil plastic over the row supported by one-gallon, plastic milk jugs filled with water. |
| 2. Clear plastic, slitted | A pre-cut cover supported by #10 wire hoops. (Ken-Bar Inc.) |
| 3. Wallo'Water | An 18-inch-tall cylinder made of 6-mil clear polyethylene plastic. Its two layers are heat-sealed at three-inch intervals, forming 18 vertical pockets which are filled with about three gallons of water. The device is rigid enough to stand by itself, much like a tepee. (Terra Copia, Inc.) |
| 4. Ree may | A spun bonded polyester that doesn't require support hoops. Ree may allows penetration of overhead irrigation water. (Ken-Bar Inc.) |

5. Check — No row cover.

6. White plastic, slitted — Same as #4, only the plastic has white pigment which is 75-80 percent transparent. (Ken-Bar Inc.)

Thermistor probes were placed four inches above the soil and at a depth of two inches in the soil. Starting April 2, air and soil temperatures were recorded every half hour for three weeks on an OmniData datalogger with 20 channels. Temperatures from two replicates of treatments 1, 2, 3, and 6 and one replicate of treatments 4 and 5 were recorded. Seedling survival was evaluated April 24 by counting the surviving seedlings on three hills of all replicates. Plant height was measured May 6. No additional data was recorded.

## Results and Discussion

The OmniData datalogger provided reliable temperature measurements that were essential to measuring row cover effectiveness. All covers increased the air and soil temperatures except white plastic which had a cooling effect on the soil (Table 1, Figures 1 and 2).

Three statistically significant groups for average air and soil temperatures emerged. Average air and soil temperatures under unslitted, clear plastic were warmer than under the slitted clear plastic, the Wallo'Water, and Ree may. The check and slitted white plastic were coolest. The two treatments utilizing a water reservoir to store heat (treatments 1 and 3) had significantly higher average minimum temperatures (Table 1). The Wallo'Waters were the only cover in which the overall minimum air temperature did not drop below 32$^{o}$F (Table 2). Wallo'Waters did not build up excessively high temperatures in their closed position like the unslitted clear plastic (Table 2). Wallo'Waters had the least temperature fluctuation of all the row covers tested (Table 2) and produced the largest plants (Table 3).

Slitted clear plastic, Ree may, and slitted white plastic probably would have performed better had there been a black plastic ground cover as is suggested for optimal temperature and weed control.

Table 1. Average air and soil temperatures under row covers, April 2-21, 1987, Malheur Experiment Station, OSU, Ontario, Oregon.

| Treatment | Average Air* | | | Average Soil** | | |
|---|---|---|---|---|---|---|
| | Av Min | Av Max | Average | Av Min | Av Max | Average |
| | $^{o}F$ | | | | | |
| Clear w/o slits | 46.4 | 100.8 | 73.6 | 52.9 | 78.3 | 65.6 |
| Clear w/ slits | 36.8 | 94.5 | 66.6 | 47.4 | 75.1 | 61.7 |
| Wallo'Waters | 43.5 | 89.8 | 66.9 | 50.2 | 71.6 | 60.6 |
| Reemay | 36.5 | 93.8 | 65.2 | 49.5 | 68.9 | 59.2 |
| Check | 36.0 | 77.7 | 56.8 | 48.3 | 64.9 | 56.6 |
| White w/ slits | 35.7 | 83.6 | 59.7 | 47.4 | 62.9 | 55.2 |
| LSD(.05) | 7.0 | 12.0 | 4.7 | 2.7 | 5.5 | 3.1 |

* Air temperature 4 inches from soil surface.
** Soil temperature at 2-inch depth.

Table 2. Air and Soil temperature extremes under row covers, April 2-21, 1988, Malheur Experiment Station, OSU, Ontario, Oregon.

| Treatment | Air Temperature* | | | Soil Temperature** | | |
|---|---|---|---|---|---|---|
| | Overall Min. | Overall Max. | Average Range | Overall Min. | Overall Max. | Average Range |
| | $^{o}F$ | | | | | |
| Clear w/o slits | 31.9 | 125 | 54.4 | 47.5 | 90.9 | 25.4 |
| Clear w/ slits | 24.2 | 114.3 | 59.8 | 44.2 | 82.8 | 26.8 |
| Wallo'Water | 36.1 | 103.8 | 46.3 | 45.5 | 83.3 | 21.9 |
| Reemay | 26.6 | 106.2 | 57.2 | 45.2 | 77.9 | 19.4 |
| Check | 23.7 | 96.1 | 41.7 | 42.2 | 72.0 | 16.6 |
| White w/ slits | 26.9 | 101.1 | 47.8 | 43.3 | 72.0 | 15.5 |
| LSD(.05) | | | 7.0 | | | 4.2 |

* Air temperature 4 inches from soil surface.
** Soil temperature at 2-inch depth.

Table 3. Effect of row covers on the accumulation of heat units during April and early tomato plant development, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Treatment | Heat Unit Accumulation* | Seedlings Per Hill** | Plant Height*** |
|---|---|---|---|
| | April 2-21 | No. | inches |
| clear w/o slits | 17.7 | 0.6 | 1.7 |
| clear w/ slits | 17.5 | 2.2 | 3.0 |
| Wallo'Water | 17.6 | 2.0 | 7.5 |
| Reemay | 16.8 | 1.2 | 2.4 |
| Check | 13.5 | 0.5 | 1.0 |
| White w/ slits | 15.6 | 2.6 | 2.1 |
| LSD (.05) | 2.2 | 0.7 | 0.4 |

* Heat units equal [daily maximum air temperature (< 86°F) + daily minimum temperature (> 50°F)] /2 - 50.

** Seedlings counted April 24.

*** Plant height measured May 8.

Figure 1. Mean daily air temperatures under row covers, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

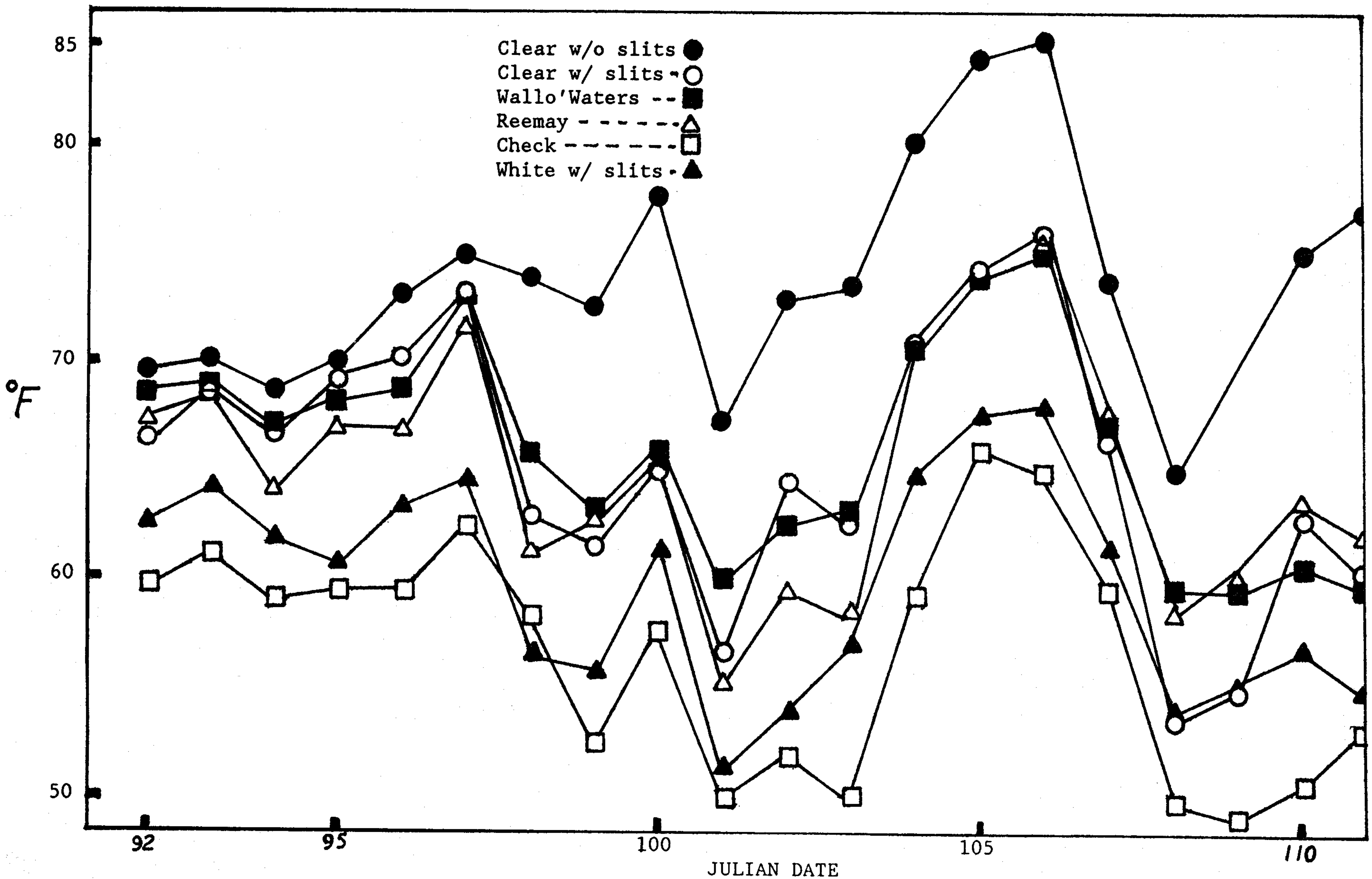
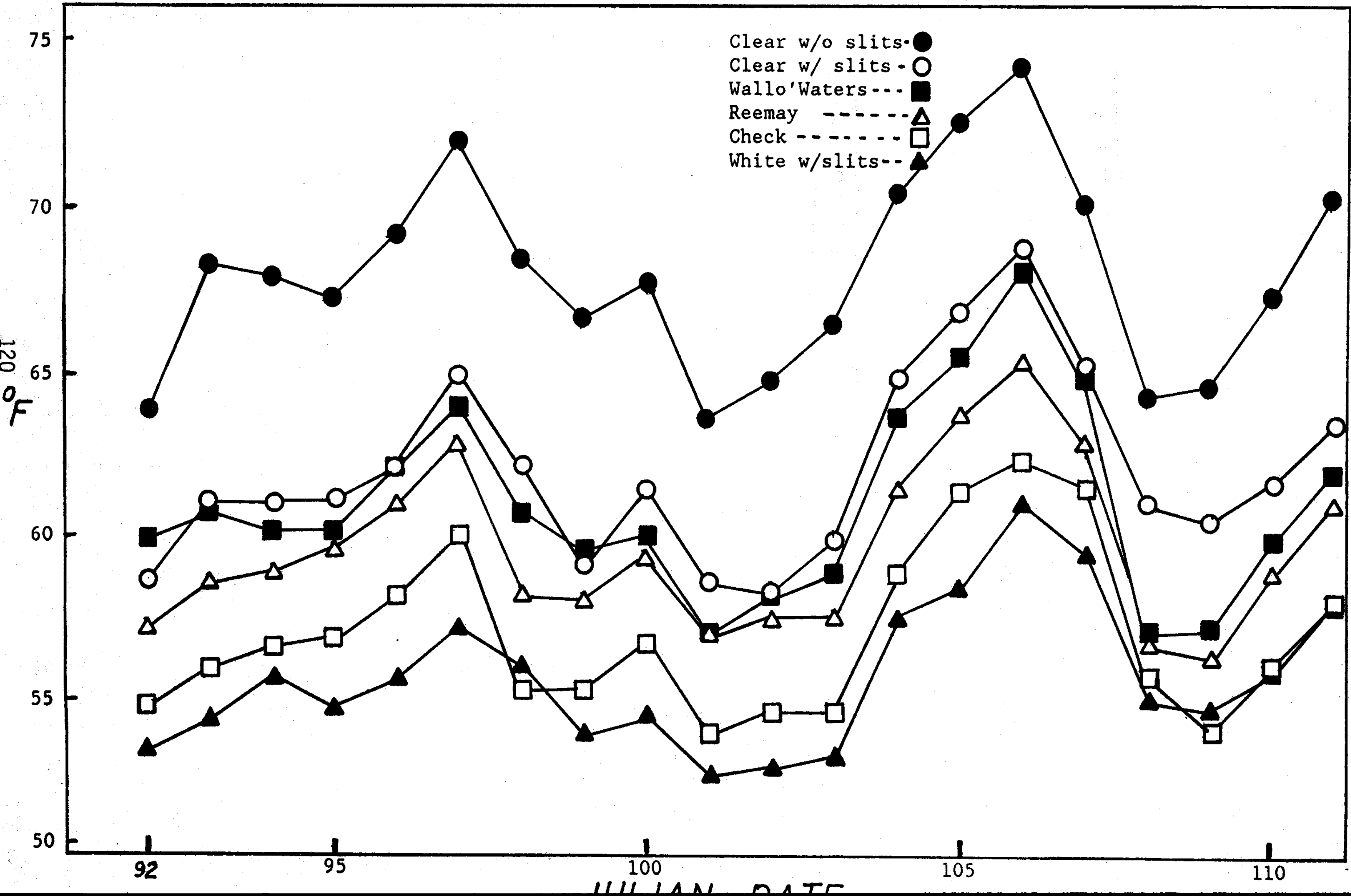


Figure 2. Mean daily soil temperatures at two inch depth for row covers, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.



# EVALUATION OF ATMOMETERS FOR IRRIGATION SCHEDULING IN THE TREASURE VALLEY

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## Introduction

Maintaining soil moisture at optimum levels for crop growth is a constant challenge under irrigated agriculture due to the variable nature of soil moisture depletion. Methods of monitoring soil moisture tend to be impractical and time-consuming. Irrigation scheduling techniques based on evapotranspiration (ET) have been developed but have required climate monitoring and the use of empirical equations. Recent development of reliable, inexpensive, and easy to use atmometers makes available a new irrigation management tool that was evaluated in the Treasure Valley.

## Materials and Methods

Water depletion from the atmometers (a direct estimate of ET) was measured each day directly with a ruler from the change in water level in the sight glass. Atmometer ET was then compared to ET calculated from weather station data for both 1986 and 1987 seasons.

Atmometer performance under field conditions was evaluated by placing the instruments in ongoing potato irrigation studies. These atmometers were measured prior to each sprinkler irrigation. The field was irrigated before soil moisture fell below 65 percent of field capacity. The amount of irrigation water applied was measured with rain gauges. Soil moisture was recorded with neutron probe and water mark sensors (electrical conductivity devices).

Crop coefficients ($K_c$) were used to convert atmometer readings (ET Atmometer) to ET for a potato crop by the following equation: ET atmometer x $K_c$ = ET potato. The correct $K_c$ was obtained by estimating the crop canopy by comparison with photographs of different percentages of canopy cover.

## Result and Discussion

The eight atmometers used in 1987 were easy to use and maintain throughout the season and were much improved over the 1986 model. The instruments water reservoir could supply the Bellani plate (evaporative surface) for at least three weeks and refilling was quick and easy.

The sprinkler irrigation studies where the atmometers were located yielded 481 and 461 cwt/acre of Russet Burbank potatoes in 1986 and 1987 respectively (Table 1). The greater water applications in 1986 resulted in downward pecolation into the second foot of soil. It is not certain whether or not the increased percentage of number-one tubers in 1986 can be attributed to the higher overall application of water. Subsurface soil moisture may have augmented the surface zone and thus provided a more stable growing medium. Yield and quality factors were not correlated to 18-inch soil moisture in 1987. Plots along the sprinkler line which received more water than the check plots had slightly decreased quality in 1986 and slightly increased quality in 1987, but these differences were not statistically significant.

The data suggests that irrigations of shorter duration would have resulted in less percolation in 1986. The data also suggests that more frequent irrigations of shorter duration would have resulted in less plant stress in 1987. More frequent irrigations and a slightly greater seasonal volume of application might also have reduced wind-skip areas. Irrigation with atmometers would have resulted in 1.7 acre inches more applied water over the 1986 and 1987 seasons. Irrigation by weather station ET would have increased water application by 5.3 acre inches, which would probably have been excessive.

It has been observed in the Treasure Valley that consumptive water use by potatoes declines in August and irrigations must be cut back to avoid tuber decay. Atmometer ET did not account for this decline. It was difficult to adjust atmometer readings using crop coefficients based on percent canopy since the decline in water use is not directly correlated to vine senesence. A $K_c$ multiplier of .65 for August readings would have worked in 1986 (Table 2). The 1987 field was damaged in August so water applications were not representative of a normal year (Table 3). Decreased water demand by potatoes needs to be quantified and related to atmometer ET.

Atmometers have been utilized successfully to schedule irrigations in Colorado since 1984. Studies at the Malheur Experiment Station (OSU) in 1986 and 1987 prove atmometers can be a reliable irrigation management tool in the Treasure Valley. Assuming the atmometer can accurately predict potato ET, it is now relatively easy for a grower to calculate irrigation efficiency for either furrow or sprinkler irrigation systems.

Further information regarding atmometers can be obtained from: John Altenhofen, Water Resources Engineer/Irrigation Specialist, Northern Colorado Water Conservancy District, P.O. Box 679, Loveland, Colorado, 80539.

## Acknowledgment

Atmometers were provided by Ore-Ida Foods, Incorporated. Weather station data were collected by Charles Burnett, Research Assistant, Malheur Experiment Station.

Table 1. Summary of potato sprinkler irrigation studies, Malheur Experiment Station, OSU, Ontario, Oregon, 1986 - 1987.

| Year | Applied Irrigation + Rain | Adjusted* Atmometer Depletion | Weather Station* Reference for Potatoes | Average Season Long - - Soil Moisture - - 6" | 18" | Total Yield | # 1 Tubers |
|---|---|---|---|---|---|---|---|
| | - - - - - - - inches | - - - - - - - | | - - - - bars | - - - - | cwt/ac | % |
| 1986 | 20.8 | 22.8 | 25.4 | 0.66 | 0.50 | 481 | 83 |
| 1987 | 18.1 | 19.7 | 24.3 | 0.66 | 0.80 | 461 | 62 |
| Average | 19.5 | 21.2 | 24.8 | 0.66 | 0.65 | 471 | 72 |

* Measurement of total ET from June 1 - August 31.

Table 2. Evaluation of atmometers for potato sprinkler irrigation scheduling, Malheur Experiment Station, OSU, Ontario, Oregon, 1986.

| Irrigation Date | Days Since Last Irrigation | Applied Irrigation + Rain | Adjusted * Atmometer Depletion | ET ref** for Potatoes | ATM/ET ref Ratio |
|---|---|---|---|---|---|
| | | - - - - - - - - | inches | - - - - - - - - - | |
| 1. June 9 | 11 | 1.38 | 1.26 | 1.14 | 1.10 |
| 2. June 13 | 4 | 2.20 | 1.81 | 2.09 | 0.87 |
| 3. June 20 | 7 | 1.39 | .69 | 0.83 | 0.83 |
| 4. June 23 | 3 | 1.38 | 2.12 | 2.03 | 1.04 |
| 5. June 29 | 17 | 2.56 | 3.37 | 4.30 | 0.78 |
| 6. July 15 | 16 | 1.46 | 2.48 | 2.81 | 0.88 |
| 7. July 24 | 9 | 1.18 | 0.99 | 1.39 | 0.71 |
| 8. July 28 | 4 | 1.38 | 1.94 | 2.34 | 0.82 |
| 9. August 3 | 7 | 1.30 | 2.20 | 2.74 | 0.80 |
| 10. August 11 | 8 | 1.38 | 1.85 | 2.42 | 0.76 |
| Total for 10 irrigations | | 14.61 | 18.71 | 22.09 | 0.86 |

* Straight atmometer readings (ET max) adjusted for potatoes using a Kcrop multiplier = 0.9.

** Straight ET reference calculated: ET ref = (Evap pan depletion x 1.1 x Kpan)
ET ref adjusted = ET ref x Kcrop.

Table 3. Evaluation of atmometers for potato sprinkler irrigation scheduling, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Irrigation Date | Days Since Last Irrigation | Canopy Cover | Applied Irrigation + Rain | Adjusted * Atmometer Depletion | Weather Station** Reference for Potato | ATM/ET ref Ratio |
|---|---|---|---|---|---|---|
| | | % | - - - - - | inches | - - - - - | |
| 1. June 26 | 16 | 40 | 1.89 | 1.89 | 1.81 | 1.06 |
| 2. July 01 | 5 | 50 | 1.02 | 1.14 | 1.02 | 1.18 |
| 3. July 10 | 9 | 60 | 1.38 | 1.46 | 2.05 | 0.76 |
| 4. July 16 | 7 | 75 | 1.65 | 1.73 | 2.28 | 0.81 |
| 5. July 22 | 6 | >75 | 1.14 | 0.91 | 1.29 | 0.70 |
| 6. July 29 | 7 | >75 | 1.50 | 1.34 | 1.61 | 0.85 |
| 7. July 31 | 3 | >75 | 0.67 | 0.67 | 1.02 | 0.67 |
| 8. August 06 | 6 | >75 | 0.94 | 1.57 | 1.97 | 0.79 |
| 9. August 12 | 6 | >75 | 0.75 | 1.50 | 2.09 | 0.73 |
| 10. August 20 | 8 | >75 | 2.36*** | 1.46 | 1.93 | 0.76 |
| 11. August 25 | 5 | 50 | 0.51 | 0.94 | 1.14 | 0.79 |
| 12. August 31 | 6 | 50 | 0.51 | 1.06 | 0.79 | 0.87 |
| Total for 13 irrigations | | | 14.32 | 15.67 | 19.00 | AVG 0.83 |

* Straight atmometer readings (ET max) adjusted for potatoes using Kcrop multiplier = 0.9.

** Straight ET reference calculated: ET ref = (Evap pan depletion x 1.1 x Kpan)
ET ref adjusted = ET ref x Kcrop.

*** Includes a 1.18" rain with hail which reduced canopy by approximately 50 percent.

# PRELIMINARY OBSERVATIONS ON SWEET WORMWOOD PRODUCTION IN THE TREASURE VALLEY

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Ontario, Oregon

## Summary

Sweet wormwood, *Artemisia annua*, is a medicinal plant of interest for the production of artemisinin. Artemisinin and related compounds have shown pharmaceutical activity against malaria and other diseases. Sweet wormwood produced the greatest leaf yield over long growing seasons, 410 g per plant in 118 days in 1986 and 378 g per plant in 119 days in 1987.

Although plant height exceeded two meters both years, more than half of the leaf biomass occurred below 120 cm. Older and larger plants consist largely of heavy stem material. Harvest strategies that utilize the entire plant or repeated harvests are indicated.

Plant materials from diverse regions (Argentina, China, Hungary, Romania, Turkey, Yugoslavia, and the USA) all grew well at Ontario. Initial experiments to attempt natural reseeding of the plant stand were successful.

## Introduction

*Artemisia annua* (sweet wormwood) is a member of the compositae family (Bailey, 1949). Other species of the same genus are well known, including *Artemisia tridentata* (sagebrush or big sage) in the western states, *A. dracunculus* (tarragon or estragon) used as a spice, and *A. absinthium* (common wormwood or absinthium) used for the production of certain narcotics.

*Artemisia annua* has long been considered a medicinal herb in China. Artemisinin is found in the leaves and floral parts of the *Artemisia annua*. Dr. Daniel Klayman (1985) of the Walter Reed Army Hospital has shown that artemisinin and its derivatives are active anti-malarial drugs.

Klayman used weedy plant materials found growing spontaneously on the east coast. Preliminary attempts have been made to grow the crop in several parts of the United States. In Washington, D.C., leaf artemisinin contents were greatest during July and August (Acton et al. 1985). Only leaves from the upper parts of the plant were harvested in these studies.

The crop was planted in 1986 and 1987 at the Malheur Experiment Station to make initial observations on its adaptation to the Treasure Valley.

## Materials and Methods

### New Plant Introduction and Spaced Plant Yield Estimates

Seeds of eight *A. annua* selections were planted in greenhouse flats on March 30, 1987. Plants were transplanted to the field into 52-inch rows 30 inches apart on May 4. Water for crop growth and development was applied by furrow irrigation. Rainfall for May 4 to September 14 totaled 3.13 inches.

Soil at the experimental site was an Owyhee silt loam. Soil analysis showed pH 6.9, 1.3 percent organic matter, 12 ppm nitrate, 39 ppm P, 324 ppm K, 1545 ppm Ca, 500 ppm Mg, 158 ppm Na, 1 ppm Zn, 6.7 ppm Fe, 2.2 ppm Mn, 0.4 ppm Cu, 11 ppm sulfate, and 0.4 ppm B. The crop received two applications of 50 lbs N/ac as ammomium nitrate.

Harvests and observations of plant heights were made on August 3, 18, 31, and September 14. Harvests were made by cutting the plants at the ground level and dividing the plant into segments (0 to 20 cm, 20 to 70 cm height, 70 to 120 cm height, and 120 cm and above). All harvested plant material was air-dried indoors and weighed to determine leaf and stem yields. Artemisinin contents from 1987 plant material have not yet been analyzed.

### Spontaneously Reseeded Stand

When the sweet wormwood grown in 1986 was harvested, some branches with seed were left on the stubble. The results of the 1986 planting have been reported previously (Shock and Stieber, 1987). Seed on the stubble was allowed to shatter naturally to reseed a new stand.

The area was furrowed in May and hand-weeded twice in May and June. On May 27, 100 lbs N/ac as ammonium nitrate was broadcast applied. The sweet wormwood was harvested August 3 and evaluated for yield of leaves and stems.

## Results and Discussion

The natural reseeding stand started to germinate February 22 and resulted in hundreds of plants per square foot. Initial growth was very slow due to cold weather. Many plants died during April due to dry soil conditions.

Sweet wormwood was the dominate plant in the naturally reseeded area. Serious weeds included kochia, wheat, and cheese weed.

When the crop was harvested on August 3, it had grown to 252 cm average height in approximately 161 days. Biomass yield consisted of 4.7 tons per hectare of leaves and 12.5 tons per hectare of stems (Table 1).

Areas planted to sweet wormwood could possibly remain in production for several years. Some of the plants must be allowed to naturally reseed themselves. Extra plant debris must be flailed in the winter before spring growth begins. Other inconveniences of naturally reseeding stands include the necessity to maintain irrigation systems and weed control.

## New Plant Introductions

All the introduced lines grew well at Ontario (Table 2). Leaf artemisinin contents are clearly important, and have not been determined.

The Romanian introduction flowered early in August while only the Turkish selection had not flowered by September 14.

## Yield of Spaced Plantings

Biomass yield of *A. annua* increased throughout the growing season to September 14 (Table 3). Leaf yields did not increase after August 31. Leaf distribution shifted to higher in the plant canopy as the season progressed (Table 4).

Biomass had become predominately stems by September 14 (Table 5) and the stem weight became predominate through all levels of the plant canopy.

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Table 1. Yield of Artemisia annua produced by a naturally reseeding stand, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Sample Number | Plant Heights | Leaf Weight | Stem Weight | Total Biomass | Leaf Artemisinin Content | Artemisinin Yield |
|---|---|---|---|---|---|---|
| | cm | $g/m^2$ | $g/m^2$ | $g/m^2$ | mg/g | kg/ha |
| 1 | 236 | 556 | 1430 | 1986 | - | |
| 2 | 285 | 542 | 1381 | 1923 | - | |
| 3 | 225 | 320 | 884 | 1204 | - | |
| 4 | 260 | 471 | 1292 | 1763 | - | |
| Av. | 252 | 472 | 1247 | 1719 | | |
| | | 4720 kg/ha | 12470 kg/ha | 17190 kg/ha | | |

Table 2. Artemisinin concentrations and average plant height of eight Artemisia annua selections transplanted to the field May 2, 1987, Malheur Experiment Station, OSU, Ontario, Oregon.

| Selection | Average Plant Height | | | | Leaf Artemisinin Content | | | |
|---|---|---|---|---|---|---|---|---|
| | August 3 | August 18 | August 31 | September 14 | August 3 | August 18 | August 31 | September 14 |
| | cm | | | | mg/g | | | |
| Argentina | 162 | 186 | 227 | 269 | | | | |
| China (only 1 plant) | 120 | 133 | 140 | 145 | | | | |
| Hungary | 166 | 186 | 204 | 213 | | | | |
| Oregon * | 172 | 200 | 218 | 228 | | | | |
| Romania | 83 | 97 | 144 | 189 | | | | |
| Turkey ≠ | 162 | 196 | 229 | 234 | | | | |
| West Virginia | 180 | 228 | 233 | 209 | | | | |
| Yugoslavia | 154 | 181 | 200 | 207 | | | | |

* Seeds were from plants originally collected from the Washington, D.C., region, now cultivated three generations.

≠Only selection not flowering heavily by September 14.

Table 3. Plant height and total biomass yield of Artemisia annua from four harvest dates, Malheur Experiment Station, OSU, Ontario, Oregon, 1987

| Harvest Date* | Season Length | Plant Height | Total Biomass Yield |
|---|---|---|---|
| | days | cm | tons/acre |
| August 3 | 91 | 178 | 2.69 |
| August 18 | 106 | 200 | 4.31 |
| August 31 | 119 | 236 | 4.76 |
| Sept. 14 | 133 | 228 | 5.64 |
| LSD(.05) | - | 51 | 1.71 |

* Planting date was May 4, 1987.

Table 4. Dry leaf yield of Artemisia annua from four harvest dates. Plants were divided into four parts, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Harvest Date | Season Length | Plant Part by Height - - - cm - - - 0-20 | 20-70 | 70-120 | 120+ | Total | Total |
|---|---|---|---|---|---|---|---|
| | days | - - - - g leaves / plant | | | | - - - - | tons/ac |
| August 3 | 91 | 21 | 70 | 78 | 45 | 214 | 0.95 |
| August 18 | 106 | 15 | 83 | 103 | 79 | 282 | 1.25 |
| August 31 | 119 | 14 | 73 | 129 | 162 | 378 | 1.67 |
| Sept. 14 | 133 | 5 | 63 | 134 | 167 | 369 | 1.63 |
| LSD (.05) | - | 14 | 31 | 61 | 34 | 112 | 0.50 |

Table 5. Dry stem yield of Artemisia annus from four harvest dates. Plants were divided into four parts, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Harvest Date | Season Length | Plant Part by Height (cm) 0-20 | 20-70 | 70-120 | 120+ | Total | Total |
|---|---|---|---|---|---|---|---|
| | days | g/plant | | | | | tons/ac |
| August 3 | 91 | 96 | 172 | 107 | 19 | 394 | 1.75 |
| August 18 | 106 | 156 | 286 | 192 | 58 | 691 | 3.06 |
| August 31 | 119 | 151 | 284 | 247 | 19 | 700 | 3.10 |
| Sept. 14 | 133 | 166 | 275 | 253 | 212 | 906 | 4.01 |
| LSD (.05) | - | 74 | 121 | 97 | 53 | 283 | 1.25 |

Table 6. Shoot yield of Artemisia annua from four harvest dates. Plants were divided into four parts, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Harvest Date | Season Length | Plant Part by Height (cm) 0-20 | 20-70 | 70-120 | 120+ | Total |
|---|---|---|---|---|---|---|
| | days | g/plant | | | | |
| August 3 | 91 | 17 | 242 | 184 | 65 | 608 |
| August 18 | 106 | 71 | 372 | 295 | 136 | 973 |
| August 31 | 119 | 165 | 357 | 376 | 180 | 1245 |
| Sept. 14 | 133 | 170 | 338 | 387 | 379 | 1274 |
| LSD (.05) | - | 79 | 148 | 156 | 64 | 387 |

Table 7. Distribution of Artemisia annua leaves and stems with four harvest dates, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Plant Part Height From Ground | Distribution of Leaves and Stems — Sample Date: August 3 | | August 18 | | August 31 | | Sept. 14 | | F Harvest Date | | LSD (.05) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cm | Leaves | Stems | Leaves | Stems | Leaves | Stems | Leaves | Stems | Leaves | Stems | Leaves | Stems |
| | % | | | | | | | | | | | |
| 120+ | 20 | 4 | 28 | 8 | 43 | 21 | 48 | 25 | **** | **** | 12 | 8 |
| 70-120 | 35 | 26 | 37 | 28 | 34 | 29 | 35 | 27 | ns | ns | - | - |
| 20-70 | 36 | 45 | 30 | 42 | 19 | 33 | 16 | 29 | ** | **** | 11 | 6 |
| 0-20 | 9 | 25 | 5 | 22 | 4 | 17 | 1 | 19 | ** | * | 4 | 5 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | | | | |

# OREGON STATE WIDE SOYBEAN TRIAL AT ONTARIO

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## Objectives

Soybean genotypes belonging to four maturity groups were grown at four Oregon locations to evaluate the potentials and problems of soybean breeding and culture in Oregon. Many lines were newly developed genotypes. The experiment sought to describe the interaction of location on the earliness and yield of the genotypes.

## Introduction

Although the soybean is the leading oilseed crop grown in the United States, it has never been an important crop in Oregon. Most of the soybean research and development has been done in the midwestern and southern states where night temperatures are higher than in most of Oregon. Varieties developed for other areas are not necessarily well-adapted under Oregon conditions.

If the soybean is to become an economic crop in Oregon, varieties specifically adapted to the several climatic conditions found in the different production areas of the state must be found. This may entail a breeding program or at least finding varieties developed in similar cool-night areas. Soybeans usually do best if specifically bred for the region where they are produced.

Because of Oregon's intensive irrigated cropping patterns, soybeans may be economically feasible only at high yields.

Soybeans could supply a high-quality protein source for animal nutrition and a source of vegetable oil for human consumption, both of which are in short supply in the Pacific Northwest.

For a long time it has been considered desirable to introduce soybean production into the Northwest, partially because of its record as a profitable rotational crop. The development of edible or vegetable soybean production might have a greater potential of providing an additional crop for the irrigated lands of the region than would the development of conventional soybean production. Vegetable soybean should be suitable for export to the Orient for human consumption or for domestic use as a feed grain. Vegetable soybean could have a greater market value than conventional soybean, which would be reduced in value if additional large acreage were brought into production. Vegetable soybean has the advantages of conventional soybean, but possibly with higher value and greater versatility.

Soybeans would be valuable as a rotation crop between years when land is planted to higher value crops such as potatoes, onions, sugar beets, sweet corn, vegetable or flower seeds. Soybeans are known to be a soil-improvement crop. The soil tilth is improved by the quantity and quality of soybean residues. If soybean $N_2$-fixation is functioning effectively, reliance on fertilizer N for soybeans is not necessary. In addition, considerable organic N can be added to the soil N supply.

Previous Research at Ontario:

Fitch, Hoffman, and Force (2,3,4,5,6,7) demonstrated that soybean cultivars adapted to Minnesota could yield 50 to 65 bushes per acre per year in Ontario. The most productive lines (such as one that was later named Evans) averaged between 60 to 65 bushels per acre over several years. Furthermore, yields were increased by approximately 20 percent for certain cultivars by decreasing row widths from 20 to 10 inches. By 1972 one line of Minnesota plant materials planted at narrow-row spacings produced an average of 74 bushels per acre. The 74 bushels per acre was then virtually a national record.

Attempts to grow soybeans commercially in the Treasure Valley met with limited success. Growers occasionally attempt soybean production leaving out key cultural practices. Yields are disappointing.

Results of 1985 and 1986 soybean trials conducted at the Malheur Experiment Station were consistent with previous results (8, 9). Some of the same plant materials were included and yielded 60 to 65 bushels per acre when planted on 22-inch rows.

## Procedures and Methods

Four entries from each of four maturity groups (000, 00, 0, and 1) were tested for their dates of flowering and maturity and their seed yield in a replicated yield trial at four locations in Oregon: Ontario, Hermiston, Medford, and Corvallis. Of the four entries in each maturity group, the first was a commercial soybean variety which was used as a standard for each maturity group. The other three were newly developed genotypes with different genetic backgrounds which have performed relatively well in the Willamette Valley. Each experiment was planted as a randomized complete block design with five replicates.

The genotypes included in the experiment were as follows:

| Entry Number | Description | Maturity Group |
|---|---|---|
| 1 | Fiskeby V | 000 |
| 2 | L 4/3 | 000 |
| 3 | Maple Presto/Traff (2004, 753-3-B-3) | 000 |
| 4 | Maple Presto/Traff (2004, 753-3-B-5) | 000 |
| 5 | Mc Call | 00 |
| 6 | Evans x Traff, (ORG-83-117) | 00 |
| 7 | L 4/3 x Hodgson 78, (ORG-83-156) | 00 |
| 8 | Maple Presto x Evans (K357-1-5-4-2) //Traff(2123, x 1133-11-B-4) | 00 |

| | | |
|---|---|---|
| 9 | Evans | 0 |
| 10 | M75-2 x (L6/3 x Hodgson 78), (ORG-83-149) | 0 |
| 11 | Cz-13-2/4*McCall(K452-1)//BC-14-1-13(K738-1-I) | 0 |
| 12 | Evans x Traff (ORG-83-71) | 0 |
| 13 | Hodgson 78 | 1 |
| 14 | L37/6 x Hodgson 78 (ORG-83-159) | 1 |
| 15 | Evans x Traff (ORG-83-72) | 1 |
| 16 | CZ-13-2/4*McCall(K452-2)//BC-14-1-13(K738-1-L) | 1 |

All entries were planted in four-row plots, 20 feet long, with 22 inches between rows. Sixteen feet of each two center rows on each plot was harvested for seed yield.

Weather permitting, the experiment was planted near the same date (May 15) for all locations. Soybeans were inoculated using soil-applied granular inoculants. The seeding rate was 150,000 viable seeds per acre. The seeding rate resulted in about one viable seed every two inches.

Soil fertility was managed so that it was as non-limiting as possible. No nitrogen was added. One hundred pounds of phosphate was plowed down in the fall.

Weeds were controlled by applying two lbs/ac of Dual in the fall and two pints of Treflan preplant in the spring. Soybeans were cultivated one month after planting.

The trial was irrigated as needed so that moisture was non-limiting. Irrigation water was run every 7 to 12 days in every other row for 12-hour durations. Spider mite control was anticipated at Ontario and Hermiston. Before row closure, Kelthane was sprayed on plants to control spider mites, using a directed spray parallel to the ground. Comite was used to control mites after row closure. Lygus bugs were controlled by MSR at Ontario.

Soybeans were harvested with a Wintersteiger Nursery Master combine. Only 16 feet of the two center rows were harvested to minimize border effects. Care was taken to not leave beans from the middle of the plot in the field.

The following observations were made at each site:

1. Plant stands in the center of each plot (2 rows, 16′ long)

2. Date of first flowering, plant height at flowering.

3. Degree of lodging (0-10) - subjective.

4. Propensity to shatter (0-10) - subjective.

5. Insects, diseases, or other limiting factors.

6. Date of maturity, plant height, and number of nodes at maturity and yield.

7. Soybean development stages, according to the method of Fehr et. al. (1).

## Results and Discussion

Soybeans were planted in mid-May at Ontario in both 1986 and 1987. Spider mites were a limiting factor for soybeans produced in 1986 at Ontario.

The 1987 growing season had cooler than normal July weather, followed by hotter and drier than normal August and September weather. There was severe hail on August 13.

### Seed Yield

Yields averaged 47.6 bu/ac in 1986 but only 39.6 bu/ac in 1987, probably reduced by the hail (Table 1). Seed yields ranged from 59.8 bu/ac to 26.1 bu/ac, depending on the genotype and year (Table 1).

### Yield and Maturity Group

Yields at Ontario increase in general with earlier to later maturity groups. Yields increased with maturity group from group 000 through group 0. There was no additional advantage of group 1 over group 0. The yields of maturity groups 00 through 1 was reduced in 1987 due to severe hail August 13 (Table 1).

Individual entries in the maturity groups did not follow the general trends for yield within their respective group. Entry 8 had average yields of 3,586 kg/ha at Ontario. but was one of the earliest maturing varieties (Table 2).

### Maturity and Maturity Group x Location

In general the later-maturing groups required progressively more days to mature (Table 2). An exception to the trend was that the group 1 materials were not much later than the group 0 materials.

Certain entries did not follow the maturity group trends. Some undefined effects are causing varieties to have accelerated or decelerated maturity. For example, McCall of group 00 was early at Ontario (102 days) in 1986 while entry 8 of group 00 was early at Ontario (90 days and 99 days) in both 1986 and 1987.

### Plant Height and Lodging

Plant heights averaged 101 cm and 106 cm at Ontario in 1986 and 1987 respectively (Table 2). Tall plants tended to lodge excessively. Group 000 and one group 00 lines had less lodging problems. Plants specifically bred for Oregon need to be compact and sturdy with no lodging.

## Seed Shatter

When weather is dry at harvest, such as during 1987, seed shatter is excessive (Table 2). Only germplasm with very high resistance to seed shatter is appropriate for soybean production in Oregon.

## Conclusions

Yields of 50 to 60 bushels per acre can be obtained using certain varieties not bred or selected for eastern Oregon conditions. Group 00 and group 0 materials match the available growing season. Plant materials currently available do not have all traits desirable to match Oregon environmental conditions. Plants neeed to be shorter and have stronger stems to reduce lodging. Harvest index was not measured, but the stem-to-seed ratio reflects low harvest indicies. New varieties need to have reduced levels of seed shatter. No breeding program exists to provide plant materials designed for Oregon conditions.

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Table 1. Yield of 16 soybean varieties belonging to four maturity groups in 1986 and 1987, Malheur Experiment Station, OSU, Ontario, Oregon.

| | | Yield | | |
|---|---|---|---|---|
| | Maturity | Year | | |
| Group | Variety | 1986 | 1987 | Average |
| | | - - - - - - - bu/ac | - - - - - | |
| 000 | Fiskeby V | 35.5 | 38.7 | 37.1 |
| 000 | L 4/3 | 40.9 | 27.6 | 34.3 |
| 000 | MP/T (2004, 753-3-B-3) | 44.1 | 51.6 | 47.8 |
| 000 | MP/T (2004, 753-3-B-5) | 39.5 | 43.0 | 41.3 |
| | Avg. | 40.0 | 40.2 | 40.2 |
| 00 | McCall | 54.9 | 42.3 | 48.6 |
| 00 | ORG 83-117 | 41.8 | 38.6 | 40.2 |
| 00 | ORG 83-156 | 31.7 | 27.8 | 29.8 |
| 00 | Maple Presto/Evans(K357-1-5-4-2)// | 59.8 | 46.6 | 52.2 |
| | Traff(2123,X1133-11-B-4) | | | |
| | Avg. | 47.1 | 38.8 | 43.0 |
| 0 | Evans | 50.8 | 49.0 | 49.9 |
| 0 | ORG 83-149 | 50.2 | 41.8 | 46.0 |
| 0 | CZ-13-2/4*McCall(K452-1)// | 51.7 | 31.1 | 41.4 |
| | BC-14-1-13(K738-1-I) | 55.3 | 52.4 | 53.9 |
| 0 | ORG 83-71 | | | |
| | Avg. | 52.0 | 43.6 | 47.8 |
| 1 | Hodgson 78 | 56.0 | 44.8 | 50.4 |
| 1 | ORG 83-159 | 46.9 | 35.1 | 41.0 |
| 1 | ORG 83-72 | 49.6 | 36.4 | 43.0 |
| 1 | CZ-13-2/4*McCall(K452-1)// | 53.3 | 26.1 | 39.7 |
| | BC-14-1-3(K738-1-L) | | | |
| | Avg. | 51.4 | 35.6 | 43.5 |
| | Average by year | 47.6 | 39.6 | 43.6 |
| | LSD (05) Variety = 3.3 bu/ac | | | |
| | LSD (05) Maturity Group = 1.9 bu/ac | | | |

Table 2. Comparative days to flowering and maturity, seed shattering plant height, and lodging of 16 soybean varieties belonging to four maturity groups grown in 1986 and 1987, Malheur Experiment Station, OSU, Ontario, Oregon.

| Maturity Group | Variety or line | Days From Emergence 1986 Flowering | Days From Emergence 1986 Maturity | Days From Emergence 1987 Flowering | Days From Emergence 1987 Maturity | Seed Shatter 1986 | Seed Shatter 1987 | Plant Height 1986 | Plant Height 1987 | Plant Lodging 1986 | Plant Lodging 1987 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | days | | | | % | | cm | | 0 to 10 | |
| 000 | Fiskeby V | 24 | 83 | | 90 | 90 | 100 | 63 | 64 | 0 | 1 |
| 000 | L 4/3 | 30 | 83 | | 93 | 60 | 90 | 78 | 90 | 0 | 1 |
| 000 | MP/T (2004, 753-3-B-3) | 23 | 84 | | 94 | 20 | 80 | 72 | 82 | 0 | 0 |
| 000 | MP/T (2004, 753-3-B-5) | 24 | 82 | | 90 | 2 | 0 | 75 | 85 | 0 | 1 |
| | Avg. | 25 | 83 | | 92 | | | 72 | 80 | | |
| 00 | McCall | 23 | 102 | | 126 | 0 | 0 | 96 | 98 | 0 | 2 |
| 00 | ORG 83-117 | 26 | 110 | | 113 | 10 | 0 | 98 | 115 | 0 | 0 |
| 00 | ORG 83-156 | 26 | 92 | | 101 | 30 | 80 | 86 | 94 | 0 | 2 |
| 00 | Maple Presto/Evans(K357-1-5-4-2)//Traff(2123,X1133-11-B-4) | 26 | 90 | | 99 | 0 | 0 | 93 | 103 | 0 | 1 |
| | Avg. | 25 | 99 | | 110 | | | 93 | 103 | | |
| 0 | Evans | 30 | 110 | | 132 | 0 | 0 | 105 | 141 | 3 | 6 |
| 0 | ORG 83-149 | 26 | 110 | | 126 | 50 | 40 | 97 | 117 | 0 | 2 |
| 0 | CZ-13-2/4*McCall(K452-1)//BC-14-1-13(K738-1-I) | 26 | 92 | | 132 | 0 | 0 | 93 | 98 | 0 | 4 |
| 0 | ORG 83-71 | 24 | 122 | | 132 | 0 | 0 | 105 | 125 | 1 | 6 |
| | Avg. | 27 | 109 | | 131 | | | 100 | 120 | | |
| 1 | Hodgson 78 | 30 | 124 | | 132 | 0 | 0 | 112 | 132 | 1 | 5 |
| 1 | ORG 83-159 | 23 | 122 | | 131 | 0 | 0 | 78 | 120 | 0 | 6 |
| 1 | ORG 83-72 | 29 | 111 | | 122 | 0 | 0 | 100 | 108 | 3 | 6 |
| 1 | CZ-13-2/4*McCall(K452-1)//BC-14-1-3(K738-1-L) | 37 | 111 | | 126 | 0 | 0 | 115 | 125 | 4 | 3 |
| | Avg. | 30 | 117 | | 128 | | | 101 | 121 | | |
| | Overall Average | 27 | 102 | | 115 | 16 | 24 | 92 | 106 | 1 | 3 |

# MELON PERFORMANCE AT ONTARIO

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## Summary

Eleven melon varieties were evaluated in replicated plots in 1987, with an additional 27 varieties evaluated in an unreplicated observation trial on the same field. Several green-fleshed Japanese varieties (A-One, Emerald Jewel, and Honey Brew) had high yields of sweet fruit in the replicated trial. Cantaloupes with reasonable yields of market-grade fruit similar to fruit currently marketed include Mission, Classic, and PSR 10084. Sugar content ranged from 6.2 to 17 percent.

## Materials and Methods

Melons were planted on an Owyhee silt loam a pH of 7.1, 1.5 percent organic matter, 10 ppm nitrate, 12 ppm sulfate, 30 ppm phosphorous, 286 ppm potassium, 1,530 ppm calcium, 515 ppm magnesium, 162 ppm sodium, 4.5 ppm iron, 0.6 ppm zinc, 2.1 ppm manganese, 0.7 ppm copper, and 0.7 ppm boron.

Solonan herbicide was applied at two pounds active ingredient per acre and incorporated in late April along with 50 lbs N/ac as ammonium nitrate and 60 lbs P/ac. An additional 33 and 20 pounds per acre nitrogen were sidedressed as ammonium nitrate on July 8 and 15 respectively. The field was furrowed at 22 inches and the melon varieties were planted May 22 on every fourth row with a three-foot within-row plant spacing. Plots were 27 feet long and 7.3 feet wide. The crop was furrow-irrigated with only one furrow adjacent to the hill receiving water per irrigation. The field received no irrigation after mid-August.

As in 1986, the 1987 trial did not require the use of insecticides or fungicides. A severe hail occurred on August 13 that defoliated the plants and caused fruit skin damage. A preventative insecticide and fungicide treatment (mix of Malthion, Dithane, and Benlate) was applied August 14.

The fruit set of each variety was subjectively evaluated and the number of fruit per plant recorded. Ripe fruit (full vine slip stage) were harvested from each plot from August 24 through September 24 to determine average fruit size and the season length requirement. Yield per acre was calculated using the equation:

$$\frac{\text{Number of fruit set X Average fruit size (lbs)}}{\text{Plot area (acres) X 2000}} = \text{tons/acre}$$

Yields were calculated in this manner because much of the hail-damaged fruit was not worth recovering. Percent sugar content in mature melons was measured using a Baush and Lomb refractometer (Model 39-45-01).

## Results and Discussion

Overall plant development was below optimum in 1987 for two main reasons: 1) slow early season plant growth and 2) August 13 hail which caused partial defoliation during fruit development. The sensitivity of melons to yield-reducing factors such as disease, hail, insects, and cool weather has undoubtedly introduced significant year-to-year variability in these studies.

Honey Brew melon continued as one of the highest-yielding melons (Table 1). Honey Brew is an ivory-fleshed large honey dew type with some cracks (Table 2 and 4). Ambrosia produced excellent yields (Table 1) of soft aromatic fruit (Table 4). Ambrosia is appropriate for home gardens in the Treasure Valley. Ambrosia fruit are too soft for shipping.

Cantaloupe market varieties adapted to Ontario include Mission, Classic, and PSR 10084. These varieties fruit appearances are similar to melons sold in local markets. All three are too late for direct seeding in late May and would have higher yields if transplanted and/or planted under row cover.

Emerald Jewel and A-One were among the most productive green-fleshed varieties (Tables 1 and 4). Many of the green-fleshed melons are widely used in Japan. Green-fleshed varieties with the highest sugar content included Theresa, Prim, and Ivory (Table 3).

Table 1. Yield and fruit size of melon varieties at Malheur Experiment Station, OSU, Ontario, Oregon.

| Variety | Yield 1985 | Yield 1986 | Yield 1987 | Yield Avg | Average Fruit Size 1985 | Average Fruit Size 1986 | Average Fruit Size 1987 |
|---|---|---|---|---|---|---|---|
| | - - - - tons / ac - - - - - - | | | | - - - lbs / fruit - - - | | |
| Earlisweet | 25.3 | 13.2 | 10.1 | 16.2 | 2.7 | 2.5 | 1.7 |
| Ambrosia | 25.6 | 12.1 | 20.9 | 19.5 | 4.7 | 3.7 | 3.6 |
| Classic | 22.0 | 12.1 | 11.9 | 15.3 | 4.5 | 3.6 | 2.7 |
| Mission | 21.4 | 9.6 | 12.6 | 14.5 | 3.4 | 3.2 | 2.4 |
| Honey Brew | - | 23.8 | 25.9 | 24.8 | - | 4.9 | 6.3 |
| Parker 1985 | - | 18.8 | 12.6 | 15.7 | - | 4.1 | 3.0 |
| PSR 10084 | - | 14.3 | 15.9 | 15.1 | - | 4.6 | 4.2 |
| Harvest King | - | 13.7 | 10.0 | 11.9 | - | 3.3 | 2.2 |
| A-One | - | 9.4 | 23.3 | 16.4 | - | 3.3 | 3.4 |
| Golden Makuwa | - | 8.4 | - | - | - | 0.8 | - |
| Emerald Jewel | - | - | 23.4 | - | - | 3.2 | 3.6 |
| Andes | - | | 13.6 | - | - | - | 2.2 |
| LSD (.05) | 4.4 | | 3.1 | | | | |

Table 2. Fruiting characteristics of melon varieties, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Variety | Company | Days to Maturity* | Fruit Set (Subjective) | Sugar |
|---|---|---|---|---|
| | | | (0 - 10) | % |
| Earlisweet | Peto | 108 | 7.8 | 7.1 |
| Ambrosia | Burpee | 112 | 7.7 | 8.3 |
| Classic | Peto | 108 | 5.8 | 8.9 |
| Mission | Asgrow | 112 | 7.0 | 9.4 |
| Honey Brew | Sakata | 120 | 6.0 | 12.3 |
| Parker 1985 | Malheur Exp. Sta. | 112 | 6.0 | 9.4 |
| PSR 10084 | Peto | 108 | 5.8 | 8.8 |
| Harvest King | Sakata | 112 | 6.8 | 12.6 |
| A-One | Sakata | 120 | 8.5 | 10.7 |
| Emerald Jewel | Sakata | 120 | 8.0 | 10.9 |
| Andes | Sakata | 131 | 7.5 | 10.7 |
| LSD (.05) | | | 0.9 | 0.9 |

* May 22 planting date, cool July weather delayed maturity.

Table 3. Melon observation trial results, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Variety | Days to Maturity | Fruit Set | Sugar Content | Average Fruit Size | Yield |
|---|---|---|---|---|---|
| | | 0-10 | % | lbs/fruit | ton/ac |
| **Honey Dew and muskmelons** | | | | | |
| Ambrosia cross (4) | 112 | 9 | 12.2 | 2.3 | 15.8 |
| Bennies Muskmelon (3) | 120 | 3 | 10.7 | 7.5 | 5.8 |
| Gallacium (5) | 108 | 9 | 9.1 | 3.6 | 16.0 |
| Haon (2) | 108 | 9 | 10.1 | 2.3 | 16.4 |
| Hy-Mark (5) | 108 | 8 | 8.9 | 2.1 | 10.2 |
| Ivory | 131 | 4 | 14.7 | 3.8 | 5.9 |
| Japanese melon-1 | 134 | 9 | 15.3 | 2.4 | 14.9 |
| Japanese melon-2 | 120 | 7 | 15.8 | 2.5 | 7.4 |
| Japanese melon-3 | 108 | 5 | 9.8 | 7.1 | 7.8 |
| Juane de Canary (2) | 108 | 7 | 15.8 | 3.6 | 7.5 |
| King Melty | 120 | 6 | 12.5 | 3.8 | 17.6 |
| Parker 86 (4) | 108 | 7 | 10.8 | 4.5 | 15.7 |
| Prim | 134 | 8 | 15.0 | 2.4 | 9.9 |
| Road Runner (5) | 108 | 7 | 8.7 | 3.1 | 11.9 |
| Summet (1) | 112 | 8 | 12.5 | 2.7 | 13.7 |
| Sunrise | 120 | 6 | 8.3 | 3.7 | 11.5 |
| Tam Dew (5) | 112 | 8 | 8.2 | 4.1 | 23.4 |
| Theresa | 131 | 2 | 17.0 | 3.3 | 5.1 |
| Toho Melon | 134 | 8 | 5.4 | 2.0 | 10.6 |
| Takio King | 120 | 8 | 11.9 | 3.0 | 7.5 |
| Top Score (5) | 108 | 8 | 10.0 | 2.6 | 15.7 |
| **Watermelons** | | | | | |
| Japanese watermelon-1 | 108 | 6 | 6.2 | 6.6 | 10.2 |
| Japanese watermelon-2 | 108 | 7 | 9.1 | 9.0 | 10.9 |
| Japanese watermelon-3 | 108 | 9 | 9.5 | 8.4 | 20.4 |
| Japanese watermelon-4 | 105 | 10 | 9.8 | 2.6 | 20.6 |
| Japanese watermelon-5 | 131 | 9 | 11.4 | 2.5 | 19.2 |
| Shimao Mary | 105 | 5 | 10.1 | 6.1 | 16.1 |

Seed Company or Source:

(1) Asgrow
(2) Lockhart
(3) D. Schuster
(4) Malheur Experiment Station
(5) Peto

Table 4. Fruit appearance of melons grown at Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

**Replicated Trial**

| Variety | Flesh Color | Skin Netting | Sutures | Other |
|---|---|---|---|---|
| | | Physical Characteristics | | |
| Earlisweet | orange | medium | medium | yellow sutures at harvest, early bearing |
| Ambrosia | lt orange | light | light | soft aromatic fruit |
| Classic | dk orange | heavy | none | |
| Mission | dk orange | heavy | none | uniform fruit size |
| Honey Brew | lt green | none | none | |
| Parker 85 | lt orange | light | none | some growth cracks |
| PSR 10084 | dk orange | heavy | heavy | pear shaped |
| Harvest King | ivory | heavy | - | |
| A-One | grn-ylw | medium | light | |
| Emerald Jewel | green | medium | none | soft |
| Andes | green | light | none | |
| | | | | soft aromatic fruit |
| **Observation Trial 1987** | | | | |
| Ambrosia cross | orange | medium | medium | |
| Bennies muskmelon | orange | heavy | heavy | large fruit |
| Gallacium | wht-grn | light | light | |
| Haon | lt green | smooth | light | yellow green, striped skin |
| Hy-Mark | orange | medium | none | |
| Ivory | green | none | none | white, smooth |
| Japanese melon-1 | green | medium | none | |
| Japanese melon-2 | lt green | none | light | oblong, green, speckled skin |
| Japanese melon-3 | off wht | heavy | none | |
| Juane de Camary | creme | none | none | oblong, bright yellow skin |
| King Melty | | | | |
| Parker 86 | lt orange | light | none | |
| Prim | grn | medium | none | |
| Road Runner | dk orange | heavy | heavy | |
| Summet | orange | light | heavy | |
| Sunrise | lt orange | light | none | |
| Tam Dew | lt orange | none | light | ivory green skin |
| Theresa | lt green | medium | none | very sweet |
| Toho melon | - | heavy | none | |
| Takio King | | | | |
| Top Score | orange | heavy | none | |
| **Watermelons** | | **Rind** | | |
| Japanese watermelon-1 | white | thin, cracked fruit | | |
| Japanese watermelon-2 | red | thick,irreg | | |
| Japanese watermelon-3 | red | thin | | |
| Japanese watermelon-4 | yellow | thin, most fruit cracked | | |
| Japanese watermelon-5 | ylw-grn | thin | | |
| Shimao Mary | red | thin | | |

# PRELIMINARY OBSERVATIONS ON DRY LIMA BEANS

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Ontario, Oregon, 1987

## Objectives

Seven lima bean varieties were grown to develop preliminary information on the performance of this crop in the Treasure Valley.

## Procedures

Lima bean varieties were planted May 6 at the Malheur Experiment Station (Table 1). Small-seeded varieties were planted at 50 pounds of seed per acre. Large-seeded varieties were planted at 100 pounds of seed per acre. The soil was pre-irrigated before planting. Beans were planted to moisture in 26-inch rows. The planting of each variety was replicated four times. Plot width consisted of only two rows of beans.

Lima beans were irrigated by mistake by farm labor on May 17. Seedling disease followed. Lima beans were replanted May 30.

Analyses indicated that the Owyhee silt loam soil had a pH of 6.9 and 1.4 percent organic matter. Mineral nutrients included 12 ppm nitrate, 39 ppm P, 248 ppm K, 1,545 ppm Ca, 500 ppm Mg, 1 ppm Zn, 6.7 ppm Fe, 2.2 ppm Mn, 0.4 ppm Mn, 0.4 ppm Cu, 11 ppm sulfate, and 0.8 ppm B. The experiment was not fertilized or sprayed during the season.

Lima beans were cut October 1, field dried, and harvested October 5 and 6.

## Results

The irrigation of the lima beans on May 17 promoted fungal attack on the emerging lima bean seedlings. The experiment was replanted on May 30, delaying all stages of crop development. Late planting contributed to the excessively late harvest date.

On August 13 a severe hailstorm largely defoliated the crop. All beans and flowers were lost on the halves of the plants facing northwest, the direction from which the hail fell. Hail probably resulted in significant yield reduction. When plants were harvested, most of the mature pods were on the southeastern quarter of the plant.

Plant yields varied from 750 to 1,780 pounds per acre (Table 1). The yields suggest that under more favorable growing conditions, dry lima beans could be grown in the Treasure Valley.

Table 1. Lima bean yields in 1987, Malheur Experiment Station, OSU, Ontario, Oregon.

| Seed size | Variety | Plant type | Yield |
|---|---|---|---|
| | | | lbs/acre |
| Large seeded | UC 8 | Vine | 1780 |
| | White Ventura N | Vine | 930 |
| | Maria | Bush | 860 |
| | Ventura Bush | Bush | 750 |
| Small seeded | Mezcla | Vine | 1570 |
| | Pat | Vine | 1200 |
| | Henderson | Bush | 770 |
| LSD(05) | | | - |

# OBSERVATION TRIAL ON TOMATO VARIETIES

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## Objectives

Ten tomato varieties were planted in an observation trial for preliminary screening for home and market use.

## Procedures

Tomato seeds were planted in flats in a greenhouse March 26, 1986, and transplanted to the field May 3. Plants were spaced three feet between plants and 44 inches between rows. Twelve plants of each variety were planted without replication.

The soil was an Owyhee silt loam. Before transplanting, two pints of Treflan per acre were applied April 28 and incorporated. Weeds were controlled during the season by hand.

Tomatoes were irrigated on May 3, and at 10-day intervals until the end of July. The last irrigation was in mid-August.

The soil was fertilized before planting with 44 pounds of phosphorus (100 pounds of phosphate) per acre as triple super phosphate and 50 lbs N/ac as ammonium nitrate. The tomato plants were side-dressed on May 24 with 50 lbs N/ac as ammonium sulfate.

## Results and Discussion

Tomatoes were harvested from the first week of August through the first week of October. Yields averaged 23.5 pounds per plant or 46.5 tons per acre (Table 1). Fruit size averaged 0.51 pounds (8.2 ounces) for all fruit from all varieties. The TVG selection had the largest fruit at 1.12 pounds per fruit while University of Idaho's "Parma" variety averaged 0.35 pounds per fruit.

Carmen was the earliest variety, followed by Royal Flush, Carnival, PSM 39079, Celebrity, and Cavalier. Better Boy was a late variety and TVG selection was the latest.

Three people independently evaluated the flavor of the varieties. Celebrity, Carnival, and the TVG selection were chosen among the best flavor by all three. The TVG selection is appropriate only for home garden use because of it's soft skin.

Table 1. Observation trial results of tomato varieties grown at Ontario in 1986. Plants were spaced 3'8" between rows and 3' between plants in the row, Malheur Experiment Station, OSU, Ontario, Oregon.

| Tomato Variety | Company | Fruit Number Per Plant | Yield | Fruit Size |
|---|---|---|---|---|
| | | # | lbs/plant | lbs/fruit |
| 1. Better Boy | - | 48.4 | 25.4 | 0.53 |
| 2. TVG Selection | - | 16.8 | 18.7 | 1.12 |
| 3. Carnival | Peto | 49.2 | 22.1 | 0.45 |
| 4. Parma | Univ. of Idaho | 38.8 | 13.4 | 0.35 |
| 5. Royal Flush | - | 52.1 | 21.6 | 0.41 |
| 6. PSM 39079 | Peto | 73.2 | 32.5 | 0.44 |
| 7. Cavalier | Peto | 48.0 | 23.9 | 0.50 |
| 8. Super Star | Univ. of Idaho | 50.4 | 19.8 | 0.39 |
| 9. Celebrity | Peto | 53.6 | 23.7 | 0.44 |
| 10. Carmen | Peto | 67.4 | 33.7 | 0.50 |
| Average | | 49.8 | 23.5 | 0.51 |

| Comments on Fruit Quality | Vine Size |
|---|---|
| 1. Smooth, scars | large |
| 2. Smooth, some irregular fruit shape, large soft fruit | large |
| 3. Smooth, cracks | compact |
| 4. Smooth, pulpy fruit | compact |
| 5. Smooth, some irregular fruit shape | compact |
| 6. Fruit scared, cracks | compact |
| 7. Smooth, watery and acid fruit | compact |
| 8. Sunburn | compact |
| 9. Smooth, early fruit were large | compact |
| 10. Smooth, regular, cracks | compact |

# IRRIGATION MANAGEMENT TO MINIMIZE DARK-END DEVELOPMENT IN POTATOES

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## Introduction

During the 1985 growing season, potatoes grown in the Treasure Valley were subjected to higher than average heat and moisture stress. At harvest jelly-end tubers were more common than usual. Processed fried potatoes had dark stem-end fry colors.

The sugar-end problem can be reduced through improvements in potato varieties and cultural practices. Improved potato varieties would show a degree of tolerance to the dark-end syndrome. Variety development and selection is a slow but effective process. Improved cultural practices would minimize stress on the potato plant.

## Major Grower Options

Potato producers can choose whether to water their potatoes with sprinkler or furrow irrigation systems. Producers can choose how wet to keep the soil, especially under a sprinkler irrigation system. Management of furrow irrigation can be modified to reduce moisture stress on potato plants during tuber initiation and bulking. Experiments were designed to address grower options.

## Objectives

Irrigation management can be modified to minimize the development of sugar-end tubers.

Experiments were designed to test the effect of varying practices on the development of sugar-ends in Russet Burbank potatoes. Sprinkler irrigation was compared to furrow irrigation both with and without straw mulch. Potatoes were grown in soil that was maintained throughout the season at different soil moisture levels from too wet to very dry. Furrow irrigation was begun at different times. Potatoes were subjected to stress at different times in their development.

## I. Sprinkler vs Furrow Irrigation for the Production of Russet Burbank Potatoes.

### Materials and Methods

Two experiments were conducted in 1986 and two more were conducted in 1987 to compare sprinkler and furrow irrigation systems for the production of Russet Burbank potatoes. Each experiment compared sprinkler- and furrow-irrigated potatoes in four replicates. In addition, the use of straw mulch under both furrow and sprinkler irrigation was tested by the use of 800 pounds of straw placed loosely in the furrows.

Potatoes were planted in April on Owyhee silt loam soils at the Malheur Experiment Station. All plots within a given experiment received the same fertilizer, seed piece spacings, bed width, weed control, and insect control.

Potatoes were harvested in late September from the centers of each plot. The tubers from each plot were graded and the weights were recorded. A sample of the potatoes was stored for quality analysis (specific gravity and fry color).

## Results and Discussion

Potatoes grown under sprinkler irrigation had significant yield advantage in only one of four experiments; however, potatoes grown under sprinkler had better market grade in three of the four experiments. There were fewer Number Two tubers and more Number Ones under sprinklers than under furrow irrigation. Tuber specific gravity was favored by the sprinkler irrigation system in only one of four experiments and the other three experiments showed no significant differences for specific gravity. Fewer dark-ends were found in tubers grown under sprinklers in all four experiments. Average stem-end fry colors were consistently lighter under sprinklers.

Advantages from the use of straw were much more limited than from the use of sprinklers. Straw improved tuber market grade in only two of the four experiments. The greatest improvements in tuber yields and quality were found at the steepest furrow-irrigated site (2.5 percent slope).

## II. How Wet to Keep the Soil Under Sprinkler Irrigation.

Russet Burbank potatoes were grown under a range of season-long soil moisture regimes from slightly too wet, above 65 percent field capacity, to very dry. The experiment was repeated in 1986 and 1987. The objective was to determine the season-long soil moisture level necessary to avoid dark-ends in Russet Burbank potatoes.

## Materials and Methods

The amount of sprinkler irrigation landing on each plot and the soil moisture were monitored. Sprinkler irrigation plus rainfall in the check plots amounted to 25 inches in 1986 and 18 inches in 1987. Rainfall plus irrigation water applied to the drier parts of the field was only about nine inches. Average soil water potential measurements were consistent with the amounts of applied irrigation water.

## Results and Discussion

Potato yields declined from 480 cwt per acre where the soil water potential in the upper six inches of soil averaged -0.2 to -0.5 bars to 320 cwt per acre where the soil water potential averaged -2.0 bars. The yield decline appeared to be linear from -0.7 bars to -2.0 bars. The average soil water potential at 18 inches deep in the bed had no relationship to tuber yields, market grade, or quality in this experiment.

The total Number One tubers declined from 340 cwt per acre to 12 cwt per acre as the average season-long soil water potential at six inches declined from -0.2 to -2.0 bars. As the yields of Number One tubers declined, the yields of Number Two tubers increased. Potato specific gravity and stem-end fry color followed the same general pattern as Number One tubers. With greater moisture stress, specific gravity declined precipitously. Stem-end fry colors were light from soil with -0.2 to -0.5 bars soil water potential. Under drier soil the average color became much darker and the number of dark-ends increased linearly.

Considering only tuber yields, the ideal season-long soil water potential for Russet Burbank would appear to be above -0.7 bars. Considering market grade and tuber quality, the average season-long soil water potential should be wetter than -0.5 bars. The -0.5 bar criteria was consistent with the highest proportion of Number One tubers, highest specific gravity, lightest stem-end fry color, and fewest dark-end tubers. It is critical to minimize soil moisture stress under sprinklers to minimize Russet Burbank dark-end tubers.

## III. Can Furrow Irrigation of Potatoes be Improved?

To reduce potato dark-ends:

A. When should furrow irrigations be started?
B. Where can straw be used to advantage?
C. During which periods of the growing season must the soil remain wet?
D. How should the grower maintain soil moisture?

### A. When Should Furrow Irrigations Start?

Information collected in 1985 and 1986 indicates that early furrow irrigations are detrimental to the potato crop. Potatoes that receive their first irrigation after emergence produced high percentages of Number One tubers and fewer dark-ends. The exact reasons for the better tuber quality with delayed irrigation onset are not known.

Early irrigations lead to sealing up of silt loam soils, making water infiltration more difficult. Neutron probe data show that it is hard to maintain high soil moisture in furrow-irrigated potato beds until the vines go down. Water infiltration rates decline with each successive irrigation until the vines go down.

Ring infiltrometer data showed the same decline with successive irrigations. Early May irrigations apparently make water infiltration more difficult during June tuber set and early tuber bulking. Soil moisture deficiencies during early tuber development have been conclusively tied to dark-end potatoes.

## B. Where Can Straw be Used to Advantage?

The same trials that have compared furrow and sprinkler irrigation systems contained treatments which received straw mulch. Eight hundred pounds per acre of wheat straw was loosely broadcast in the furrows between the potato beds at lay by. The potatoes were laid by one or two weeks after planting.

Straw mulch was associated with improved percent of Number One tubers in two of four experiments under furrow irrigation. At the steepest furrow-irrigated site, straw mulch was associated with higher yields and lighter stem-end fry colors. There were no significant differences observed with or without straw mulch under sprinklers.

The benefits of straw mulch are greatest on steep furrow-irrigated sites. Low rates of wheat straw reduce soil loss and increase water infiltration. The use of straw in the furrows of steep land causes the water to slow and spread out laterally into potato beds. The use of straw mulch on land sloping 2 to 3 percent dramatically improves the use of irrigation water and decreases soil loss.

## C. During Which Periods of the Growing Season Must the Soil Remain Wet?

For environmental stress to cause sugar-end tubers, there must be tubers on the plants. In 1986 and 1987 sporadic heat waves in April through June 1 caused grower concern about sugar-end formation. The early heat came before tuber initiation.

Once tuber initiation begins, the tubers can be damaged if the potato plants suffer excessive moisture and temperature stress. Russet Burbank potatoes planted in the last half of April in Ontario, Oregon, typically start to set tubers sometime during the first week of June. Tuber initiation will vary according to location, planting date, weather, and variety.

### Materials and Methods

During the 1986 and 1987 seasons furrow irrigated Russet Burbank potatoes were grown with adequate and deficient irrigation. The check treatment had adequate soil moisture, at or above 65 percent field capacity, from early June through mid-August. The treatments were specific moisture stress periods in late June, early July, late July, and early August. Plant water stress periods were imposed by allowing the soil moisture level to fall below 65 percent field capacity, to as low as 50 percent field capacity (-1.5 bars) during the interval in question.

### Results and Discussion

Potato plants stressed in late June produced the greatest proportion of Number Two tubers. Potatoes stressed in late June, early July, and early August tended toward greater proportions of dark-ends in 1987. Plants stressed in late June and early August tended to have more dark-ends in 1986.

August is a difficult month to judge irrigation demands of potatoes. If the vines are healthy, water stress leads to early vine death and sugar-end tubers. Water stress of healthy vines in late July and early August leads to reduced yields. If the vines are already dying due to Verticilium wilt, plant water use declines. In early die fields, late-season irrigations facilitate tuber rot.

Soil water should be monitored very carefully from tuber initiation through mid-August. High available soil water needs to be maintained throughout the entire period. An important exception is if the field starts to suffer symptoms of early dying. If fields with early dying symptoms are watered heavily in late July or August, many of the potatoes will rot.

### D. How Should the Grower Maintain Soil Moisture?

Producers have several tools to maintain adequate soil moisture from early June through August or until the vines start to die. Growers have control over furrow irrigation frequency, duration, and inflow rate. Producers are usually knowledgeable about how their fields irrigate. Irrigation frequency, duration, and inflow rate can be varied during the season to meet crop demands.

If irrigation frequency can be maintained as high as possible, fluctuations in stress on the potatoes will be reduced.

## Conclusions

Sprinkler irrigation systems are superior to furrow irrigating for reducing dark-ends. Soil in the beds under sprinklers needs to be maintained at or above -0.5 bars from tuber set until mid-August to minimize the occurrence of dark-ends.

Furrow irrigation systems can be improved in several ways. Early furrow irrigations should be deferred. Low rates of straw mulch applied to the furrows 1) may be beneficial to potatoes, 2) will increase water infiltration, and 3) will decrease soil loss. Benefits of straw are more evident on sites with greater than 2 percent slope. Moisture stress can lead to dark-end tubers from late June to early August. Producers need to vary irrigation frequency, duration, and water inflow rate according to crop needs and the soil's ability to absorb water.

## Acknowledgments

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IRRIGATION STRESSED POTATO VARIETY TRIAL, 1987

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## Objective

The present study was conducted to evaluate the negative effects of late-June moisture stress on various potato lines. The effects of water stress on promosing new potato lines was evaluated in comparison to the Russet Burbank variety.

## Introduction

The potato variety development program in the Pacific Northwest is screening varieties for potential use in processing industries. Variety selection for processing depends as much on internal tuber quality as yield. Yields and quality parameters of all varieties are usually compared under environmental conditions favorable to the crop. Yet the major limitations of the Russet Burbank variety occur when environmental conditions are unfavorable.

Low soil moisture leads to lower plant water status, higher soil temperatures, and higher leaf canopy temperatures. Russet Burbank plants, subjected to a period of moisture stress early in their development, produce defective tubers. External tuber defects include chaining, growth cracks, pointed ends, and knobs. Internal defects include lower specific gravities, higher sugar accumulations, and dark-stem-end fry colors.

## Materials and Methods

Potato varieties were chosen from among the 1986 Oregon Preliminary and Statewide Trials that demonstrated low indices of dark-ends, light fry colors, high specific gravities, and high yields of Number One tubers (Table 5).

### Planting

Potato seed was planted May 2 in 36-inch rows with hills 10 inches apart. Seed had been treated uniformly with Tops fungicide. Seed pieces were planted eight inches deep with 25 seed pieces per plot. Plots were separated using three red potato pieces. The experimental design was a randomized complete block design with four replicates.

### Irrigation Stress

Irrigation stress was imposed by omitting furrow irrigations from June 12 to July 1. The crop had been watered on June 11. Small amounts of rainfall fell from June 12 through June 22, decreasing the duration and extent of water stress (see below).

| Date | | Rainfall inches |
|---|---|---|
| June | 12 | 0.16 |
| | 15 | T |
| | 16 | 0.11 |
| | 17 | 0.10 |
| | 18 | 0.01 |
| | 19 | 0.06 |
| | 22 | T |

June 27 through 30 brought daytime high temperatures of 97, 98, 96, and 96 degrees respectively and afternoon crop wilting.

## Other Cultural Practices

The soil was a Nyssa silt loam characterized by a light white color typical of high free calcium soils. Fall fertilization consisted of 44 lbs P/ac and 50 lbs N/ac. On May 7 the planting was sidedressed with 120 lbs N/ac as ammonium nitrate. Temik was applied at three pounds ai/ac at the time of the nitrogen sidedressing.

Petiole analysis indicated the need for supplemental fertilization. The trial was sprayed by plane with 10 pounds nitrogen, 0.5 pounds of phosphate, and 0.36 pounds of zinc on July 24. July 27 petiole samples indicated nitrogen and phosphate were still deficient. Foliar sprays with 10 pounds nitrogen and 2 pounds phosphate per acre were applied July 29.

On August 13 a hail storm damaged potato crop foliage. Potato plants were sprayed with dithane fungicide August 15 to minimize plant canopy loss. Early vine senesence was evaluated on August 18 and August 31.

## Harvest

Potatoes were dug on September 28 and graded into the following categories: US Number One 10-ounce and larger, US Number One 6 to 10 ounces, US Number One 4 to 6 ounces, US Number Two 10-ounce and larger, US Number Two 4 to 10 ounces, culls (potatoes less than 4 ounces), and rot. A representative sample of potatoes from every plot was evaluated for specific gravity, solids distribution, average fry color, percent dark-end fry color, dextrose content, and sucrose content. Glucose forming potential (GFP) was calculated by dividing the tissue concentration of glucose in moles by the concentration of sucrose in moles.

## Results and Discussion

Plant growth was slower than in many fields on the Malheur Experiment Station. The potatoes were among the first to exhibit nitrogen deficiency through petiole analyses. Nitrogen, zinc, and phosphate shortages were corrected through aerial sprays.

Vine senescence was highly variable depending on variety (Table 1). The line ND01567-2 had 91 percent vine death by August 18 while A80445-1 showed only 3 percent vine death on August 31.

## Harvest and Grading

All tubers were produced under conditions of significant moisture stress. Russet Burbank had the highest total yield and one of the smallest percent of Number One tubers (Table 2). The tuber aberrations of the Number Two tubers was extreme (Table 2).

Other lines that appeared superior to Russet Burbank in minimally stressed 1986 trials showed a range of undesirable attributes when subjected to late June stress (Table 5). The lines A081522-1 and ND01062-1 had 50.5 and 54.2 percent Number Two potatoes. Yields of only ND01567-2 fell to 2.52 cwt/ac. A081195-11, A081216-1, and A082260-8 continued to demonstrate uniformly favorable preformance under severe water-stressed conditions.

The lines A082260-8, A80445-1 and A081216-1 were among the most productive of Nmber One tubers. Among these varieties, 59 to 66 percent of the tubers were Number One's (Table 2).

## Internal Tuber Quality

The varieties in this experiment generally had high specific gravity, high solids, low average fry color, and high dark-end fry color (Table 4). Dextrose ranged from 0.30 percent to 2.18 percent. Sucrose ranged from 1.01 to 3.53 percent. Sucrose and dextrose concentrations were not clearly related to early vine senescence.

Russet Burbank and A081522-1 were among the varieties with the most dark-end fry color formation, 49 and 55 percent respectively. High dark-ends indicies were anticipated for Russet Burbank tubers because of the imposition of severe late June stress. A081394-7 developed 2.18 percent dextrose and 3.53 percent sucrose.

The lines A082260-8, ND01062-1, A081216-1, A081216-1, A081195-11, ND01567-2, A80445-1, A081394-7, A082611-7, A081783-7, and A7411-2 were among those with the lowest indicies of dark-ends 5 to 30 percent (Table 4). Low glucose forming potential (GFP) appeared to be associated with light average fry color and fewer dark-ends (Table 4).

## Future Screening

The experiment demonstrates a suggested screening procedure for tuber dark-end tolerance that could be used in the Oregon Potato Variety Development program before releasing new cultivars for use in processing.

## Conclusions

Potato variety development and selection is a complex procedure. Water-stressed Russet Burbank potatoes were among the worst of the lines tested for dark-ends. Stressed Russet Burbank produced the highest total yields 436 cwt per acre, with only 46.7 percent Number One tubers.

Acknowledgments

Laboratory analyses presented in Table 4 were provided by the J.R. Simplot Company of Caldwell, Idaho. Potato seed was grown by Steve James and handled by Jerry Maxwell of Oregon State University.

Table 1. Vine senesence of 14 varieties of potatoes subjected to moisture stress in late June, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Variety | Vine Senesence | |
|---|---|---|
| | August 18 | August 31 |
| | - - - - - % - - - - - | |
| Russett Burbank | 11 | 66 |
| A081195-11 | 16 | 49 |
| A081216-1 | 4 | 18 |
| A081394-7 | 22 | 18 |
| C008177-2 | 33 | 73 |
| A80445-1 | 8 | 3 |
| A7411-2 | 14 | 8 |
| A081084-2 | 12 | 46 |
| A081522-1 | 6 | 10 |
| A081783-7 | 43 | 70 |
| A082260-8 | 30 | 65 |
| A082611-7 | 15 | 81 |
| ND01062-1 | 9 | 21 |
| ND01567-2 | 91 | 94 |
| F(var) | **** | **** |
| LSD(.05) | 25 | 30 |

Table 2. Yield and market grade of 14 potato varieties subjected to late June moisture stress, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Variety | Yield By Grade | | | | | | | | | | Percent by Grade | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | US Number Ones | | | | US Number Twos | | | | | Total | | |
| | 10+ oz | 6-10 oz | 4-6 oz | Total | 10+ oz | 4-10 oz | Total | Culls | Rot | Yield | Ones | Twos |
| | cwt/acre | | | | | | | | | | % | |
| Russett Burbank | 18 | 120 | 65 | 203 | 20 | 126 | 146 | 85 | 2 | 436 | 46.7 | 33.4 |
| A081195-11 | 13 | 118 | 62 | 193 | 1 | 99 | 100 | 46 | 0 | 339 | 56.9 | 29.8 |
| A081216-1 | 20 | 114 | 54 | 218 | 15 | 77 | 92 | 57 | 2 | 369 | 59.3 | 24.5 |
| A081394-7 | 19 | 97 | 67 | 183 | 14 | 69 | 83 | 68 | 0 | 334 | 54.4 | 25.0 |
| C008177-2 | 19 | 126 | 56 | 200 | 7 | 50 | 57 | 38 | 0 | 296 | 67.2 | 19.8 |
| A80445-1 | 62 | 148 | 23 | 233 | 22 | 77 | 99 | 19 | 4 | 355 | 66.4 | 27.3 |
| A7411-2 | 19 | 113 | 33 | 165 | 72 | 91 | 163 | 29 | 0 | 357 | 46.3 | 45.7 |
| A081084-2 | 40 | 123 | 41 | 204 | 26 | 73 | 99 | 40 | 0 | 343 | 59.1 | 28.6 |
| A081522-1 | 88 | 79 | 8 | 175 | 74 | 114 | 188 | 11 | 1 | 374 | 46.4 | 50.5 |
| A081783-7 | 10 | 128 | 50 | 188 | 16 | 66 | 82 | 47 | 0 | 317 | 59.2 | 25.9 |
| A082260-8 | 21 | 150 | 61 | 232 | 15 | 68 | 83 | 57 | 0 | 372 | 62.1 | 22.4 |
| A082611-7 | 39 | 115 | 34 | 189 | 25 | 83 | 108 | 56 | 0 | 353 | 53.8 | 30.4 |
| ND01062-1 | 23 | 67 | 24 | 114 | 40 | 136 | 176 | 31 | 3 | 325 | 35.2 | 54.2 |
| ND01567-2 | 4 | 89 | 57 | 150 | 3 | 43 | 46 | 55 | 1 | 253 | 59.2 | 18.3 |
| Fvariety | **** | **** | **** | **** | *** | **** | **** | *** | ns | **** | **** | **** |
| LSD (.05) | 28 | 35 | 21 | 46 | 26 | 30 | 38 | 19 | 3.5 | 58 | 9.9 | 5.7 |

Table 3. Subjective evaluation of the appearance of 14 varieties subjected to late June moisture stress, Malheur Experiment Station, OSU, Ontario, Oregon, September 28, 1987.

| Variety | Observations |
|---|---|
| Russett Burbank | Deep eyes, pointed ends, irregular shapes (including bananas, knobs, and dumb bells) growth cracks |
| A081195-11 | Smooth, round, some pear-shaped |
| A081216-1 | Regular shaped, medium russet |
| A081394-7 | Pointed ends tending toward pear-shaped, smooth, regular |
| C008177-2 | A few irregular or knobby |
| A80445-1 | Medium to heavy russet, round, some irregular and water rot |
| A7411-2 | Nice, deep eyes, some irregular, hooked tubers |
| A081084-2 | Ok, growth cracks |
| A081522-1 | Some highly creased, heavy russet, eyes too deep, whopper spuds |
| A081783-7 | Nice pear-shaped, smooth, regular |
| A082260-8 | Nice light russet, round, regular |
| A082611-7 | Regular to pear-shaped, medium russet |
| ND01062-1 | Nice light russet, round, a few deep eyes, some irregular and flat |
| ND01567-2 | Ok, round, smooth, a little rot |

Table 4. Fry color and tuber characteristics of 14 varieties of potatoes subjected to late June moisture stress, Malheur Experiment OSU, Ontario, Oregon, 1987.

| | | Solids Distribution | | | | Fry Color | | Sugar Content | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Variety | Specific Gravity | 16-18 | 18-20 | 20-22 | 22+ | Average USDA | Dark Ends | Dextrose | Sucrose | Glucose Forming Potential |
| | | - - - - - - - % | | | - - - - - - - | 0-4 | % | - - - - mg/g | - - - - | mole/mole |
| Russett Burbank | 1.0960 | - | - | 7 | 93 | 1.8 | 49 | 1.32 | 1.39 | 1.80 |
| A081195-11 | 1.1030 | - | - | - | 100 | 0.4 | 16 | 0.54 | 1.45 | .71 |
| A081216-1 | 1.1065 | - | - | - | 100 | 1.0 | 12 | 0.85 | 1.36 | 1.19 |
| A081394-7 | 1.1149 | - | - | - | 100 | 0.1 | 27 | 2.18 | 3.53 | 1.17 |
| C008177-2 | 1.0872 | 2 | 2 | 22 | 74 | 1.7 | 40 | 1.29 | 1.64 | 1.49 |
| A80445-1 | 1.1049 | - | - | - | 100 | 0.6 | 18 | 0.75 | 1.71 | .83 |
| A7411-2 | 1.1047 | - | - | 7 | 93 | 0.4 | 30 | 0.74 | 1.40 | 1.00 |
| A081084-2 | 1.0992 | - | - | - | 100 | 1.3 | 34 | 1.11 | 1.55 | 1.36 |
| A081522-1 | 1.0961 | - | - | 10 | 90 | 0.9 | 55 | 1.03 | 1.16 | 1.69 |
| A081783-7 | 1.1007 | - | - | - | 100 | 0 | 30 | 0.32 | 1.10 | .55 |
| A082260-8 | 1.0982 | - | - | 3 | 97 | 0.2 | 5 | 0.35 | 1.01 | .66 |
| A082611-7 | 1.0892 | 1 | 4 | 18 | 77 | 0.6 | 28 | 0.76 | 1.53 | .94 |
| ND01062-1 | 1.0976 | - | - | 4 | 96 | 0.3 | 11 | 0.30 | 1.47 | .39 |
| ND01567-2 | 1.0791 | - | 22 | 36 | 42 | 1.3 | 16 | 0.77 | 1.99 | .73 |
| F(var) | **** | | | | | **** | * | | **** | |
| LSD (.05) | 0.0107 | | | | | 0.7 | 25 | - | 0.46 | |

Table 5. Comparison of potato variety preformance in trials with and without moisture stress, Malheur Experiment Station, OSU, Ontario, Oregon.

| | 1986 Trials Without Stress[1] | | | | 1987 Water Stressed Trial | | | |
|---|---|---|---|---|---|---|---|---|
| | Total Yield | Number Ones | Dark Ends | Specific Gravity | Total Yield | Number Ones | Dark Ends | Specific Gravity |
| | cwt/ac | % | % | | cwt/ac | % | % | |
| Russett Burbank | 440 | 74 | 19 | 1.082 | 436 | 47 | 49 | 1.096 |
| A081195-11 | 462 | 76 | 0 | 1.090 | 339 | 57 | 16 | 1.103 |
| A081216-1 | 636 | 78 | 0 | 1.087 | 369 | 59 | 12 | 1.107 |
| A081394-7 | 499 | 83 | 0 | 1.104 | 334 | 54 | 27 | 1.115 |
| C008177-2 | 497 | 78 | 0 | 1.087 | 296 | 67 | 40 | 1.087 |
| A80445-1 | 563 | 86 | 0 | 1.090 | 355 | 66 | 18 | 1.105 |
| A7411-2 | 513 | 72 | 1 | 1.093 | 357 | 46 | 30 | 1.105 |
| A081084-2 | 536 | 71 | 0 | 1.083 | 343 | 59 | 34 | 1.099 |
| A081522-1 | 499 | 73 | 0 | 1.092 | 374 | 46 | 55 | 1.096 |
| A081783-7 | 435 | 75 | 0 | 1.083 | 317 | 59 | 30 | 1.101 |
| A082260-8 | 506 | 58 | 0 | 1.087 | 372 | 62 | 5 | 1.098 |
| A082611-7 | 650 | 68 | 0 | 1.090 | 353 | 54 | 28 | 1.089 |
| ND01062-1 | 480 | 50 | 0 | 1.087 | 325 | 35 | 11 | 1.098 |
| ND01567-2 | 443 | 79 | 0 | 1.075 | 253 | 59 | 16 | 1.079 |

[1] Data for 1986 was mostly taken from Stanger, C.E. and J.K. Ishida, 1987. Potato Variety Trials, Oregon State University, Malheur Experiment Station, Special Report, 816.

# THE EFFECT OF A GRADIENT OF WATER STRESS ON RUSSET BURBANK POTATO STEM-END FRY COLOR

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Ontario, Oregon, 1987

## Objectives

The purpose of the experiment was to determine the critical season-long soil moisture level that should be maintained to minimize dark-ends of Russet Burbank potatoes. The experiment was also used to describe relationships between potato crop water stress index (CWSI) and tuber yields, market grade, specific gravity, and dark-ends.

## Summary

Russet Burbank potatoes were grown on a silt loam soil under a gradient of sprinkler-applied water. The relationships were determined between season-long (June 15 to August 15) soil water potential and tuber yields and quality. Average soil water potentials ranged from -0.2 bars to -2.0 bars at six inches depth. Soil water potentials were highly correlated with yield, percent Number One tubers, percent Number Two tubers, tuber specific gravity, and tuber stem-end fry color. Neither yields nor any tuber quality parameters were correlated with soil water potential at 18 inches depth. Potentials wetter than -0.5 bars during tuber bulking minimized dark stem-end fry colors.

Crop water stress index values were negatively correlated with tuber yield, yield of Number One tubers, and tuber specific gravity. CWSI was positively correlated with increased dark-end tubers and Number Two tubers.

## Procedures

Russet Burbank potatoes were planted April 29, 1987, on an Owyhee silt loam soil on the Malheur Experiment Station. The soil had been bedded for potatoes in the spring after fall plowing of the 1986 wheat stubble. Potato seed was planted 10 inches apart and 9 inches deep on three-foot beds. Potatoes were sidedressed with 120 lbs N/ac as ammonium nitrate and 3 pounds active ingredient per acre of Temik on May 5, 1987.

Treatments were determined by the location of the potato plots in relation to a double line of sprinklers. Treatments ranged from very wet, between the sprinkler lines, to very dry at the edge of the field. The field was irrigated when the next to the wettest plots reached 65 percent field capacity (Table 1). Plots at progressively greater distances from the sprinklers were progressively drier. Sprinkler catch data was collected to determine the amount of sprinkler irrigation on each plot.

Soil moisture was determined at 6-inch and 18-inch depth in every plot using Watermark Soil Moisture Sensors. Soil moisture was also determined in the check plots using a Campbell Nuclear Neutron Probe Model 503.

Soil temperature was recorded at two- and eight-inch depths in the beds of the check treatment and the driest treatment. Potato canopy temperatures, the air temperature, and air relative humidity were recorded simultaneously one meter above each treatment in the afternoon twice a week using a Standard Oil Engineered Materials Scheduler, 1987 model. The Scheduler calculated 1) the difference between the air temperature and crop canopy temperature, 2) the vapor pressure deficit of water in the atmosphere, and 3) the crop water stress index (CWSI). CWSI values were calculated on a scale from zero to ten.

On September 1, potato vine senescence notes was evaluated. On September 22, potatoes were mechanically dug and hand-harvested. Potato yields and market grade were determined by the evaluation of 50 feet of row of potatoes from the center of the plot where soil moisture and CWSI data were collected.

Potatoes were graded into Number One tubers greater than 10 ounces, Number One tubers 6 to 10 ounces, Number One tubers 4 to 6 ounces, Number Two tubers greater than 10 ounces, Number Two tubers 4 to 10 ounces, culls, and rotten tubers. All tubers four ounces and under were considered culls.

A sample was selected and stored for specific gravity and dark-end evaluation. Stem-end color was determined for 20 potatoes from each replicate of every treatment according to the methods of Iritani and Weller (1974) using a Photovolt Reflectance Meter. Lengthwise slabs of potatoes were made 1 3/16 inches wide so that no light from the sensor unit would go off the sides of the potato slab. The sensor unit was centered one-half inch from the center of stem end of the fried potato slab for reflectance readings.

## Results and Discussion

### Tuber Relationships to Average Soil Water Potential

The treatments with decreasing water applications and decreasing soil moisture produced poorer-quality potatoes (Table 2). Yields of Number One tubers decreased from 276 cwt per acre to 61 cwt per acre as the irrigation plus rainfall decreased from 18.9 inches to 9.1 inches and average season-long soil water potential decreased from -0.4 bars to -1.5 bars. Simutaneously the yields of Number Two potatoes increased from 72 cwt per acre to 188 cwt per acre.

The yield and quality were evaluated by regression against the soil water potential at 6 and 18 inches. Soil water at 18 inches had no relationship to tuber yields or any market grade or quality variable. There was a statistically significant linear decline in tuber yield with decreasing average season-long soil water potential (Figure 1). Percent yield by market grade of Number One and Number

Two tubers (Figure 2) was closely related to average season-long soil water potential. Tuber specific quality declined and stem-end fry colors were darker with decreasing soil water potential (Figures 3 and 4).

## Relationship of CWSI to Soil Water Potential

The CWSI values for each day were related to the corresponding soil water potential values. In general the $R^2$ values were not high but the regression coefficients were very highly significant. The relationship of CWSI with soil water potential for July 13, 1987, is presented in Figure 5. The CWSI values were consistently related to soil water potential at the 6-inch depth but showed no relationship to soil water potential at 18-inch depth.

## Relationship Between CWSI and Tuber Yields

Average CWSI values from June 2 to August 6 showed a highly significant negative correlation to tuber yields (Figure 6). As average CWSI values increased from near zero to 4.5, the percent of Number One tubers decreased from 66 percent to 7 percent (Figure 7). The percent of Number Two tubers increased accordingly.

## Relationship Between CWSI and Tuber Quality

Average CWSI values were closely related to tuber specific gravity and tuber stem-end fry color (Figures 8 and 9). Specific gravity decreased from 1.086 to 1.075 over the range of average CWSI values. With higher CWSI values, the average stem-end fry color became darker, and the number of dark-end tubers increased.

## Conclusions

The highest tuber yields were obtained with average season-long soil water potential above -0.7 bars. The highest proportions of Number One tubers, highest specific gravities, and lightest fry colors were observed from areas in the field where the soil water potential averaged above -0.5 bars. Russet Burbank potatoes were very sensitive to soil moisture deficits in producing Number Two potatoes. Under sprinklers, high soil water levels must be maintained for Russet Burbank potatoes to have light stem-end fry colors.

As average CWSI increased, Russet Burbank potato yields, percent Number One tubers, and tuber specific gravity decreased linearly. Russet Burbank tubers grown under higher CWSI values had darker stem-end fry colors.

Soil water potential at 18 inches depth in the soil was not related to tuber yields, quality, or observed CWSI values.

## Literature Cited

Iritani, W. M. and L. Weller. 1974. Objective measurement of french fry color. American Potato Journal 51: 170-173.

Table 1. Water applications to establish a gradient of soil moisture conditions for the production of Russet Burbank potatoes, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Treatment | Water Applied* | Average season-long Soil Potential at 6" | at 18" |
|---|---|---|---|
| | acre/inches | bars | |
| 1. Wettest | 18.9 | -0.41 | - |
| 2. Check (65% FC) | 18.1 | -0.66 | - |
| 3. Progressively Drier | 15.5 | -0.67 | - |
| 4. Progressively Drier | 12.6 | -1.32 | - |
| 5. Driest | 9.1 | -1.47 | - |

*14 irrigations totaling 124 hours for the season, includes 3.2 inches of rainfall.



Table 2. Yield and market grade of Russet Burbank potatoes grown over a gradient of soil moisture conditions, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| | YIELD BY GRADE | | | | | | | | | | Percent by Grade | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | US Number Ones | | | US Number Twos | | | | | Total | | |
| | 10+ oz | 6-10 oz | 4-6 oz | Total | 10+ oz | 4-10 oz | Total | Culls | Rot | Yield | Ones | Twos |
| 1 Wetter | 46 | 135 | 95 | 276 | 15 | 47 | 61 | 100 | 6 | 443 | 62 | 14 |
| 2 Check | 60 | 141 | 72 | 273 | 24 | 49 | 73 | 88 | 6 | 440 | 62 | 16 |
| 3 Drier | 52 | 127 | 76 | 255 | 25 | 57 | 82 | 95 | 10 | 443 | 58 | 19 |
| 5 Drier | 20 | 72 | 50 | 142 | 32 | 100 | 132 | 92 | 1 | 367 | 39 | 36 |
| 5 Driest | 9 | 32 | 20 | 61 | 39 | 149 | 188 | 101 | 33 | 383 | 15 | 50 |
| F(trt) | **** | **** | **** | **** | NS[1] | **** | **** | NS | * | NS[1] | **** | **** |
| LSD (.o5) | 22 | 27 | 20 | 39 | - | 28 | 36 | - | 18 | - | 8 | 8 |

Figure 1. Response of Russet Burbank yields to seasonal average soil moisture, Malheur Experiment Station, OSU, 1987.

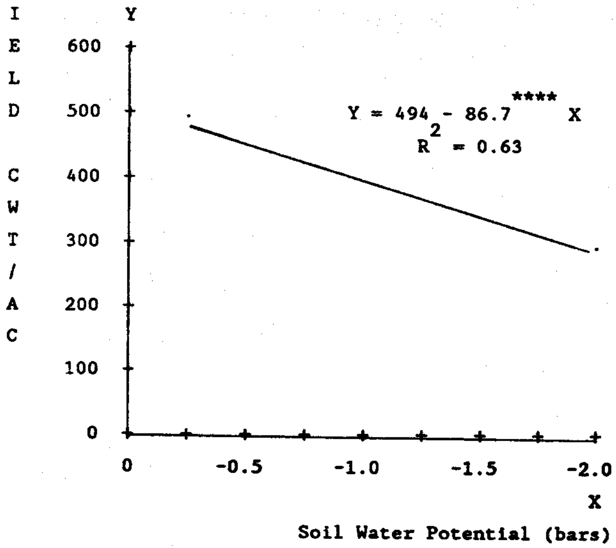



Figure 2. Repsonse of Russet Burbank market grade yields to seasonal average soil moisture, Malheur Experiment Station, OSU, 1987.

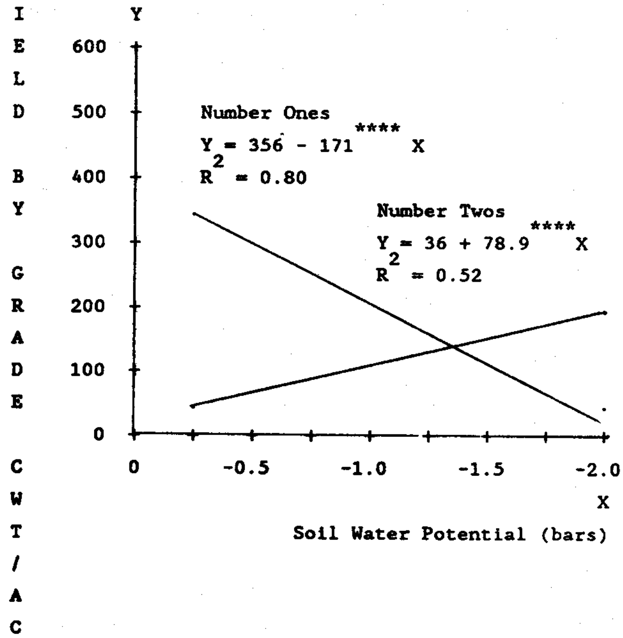



Figure 3. Response of Russet Burbank specific gravity to seasonal average soil moisture, Malheur Experiment Station, OSU, 1987.

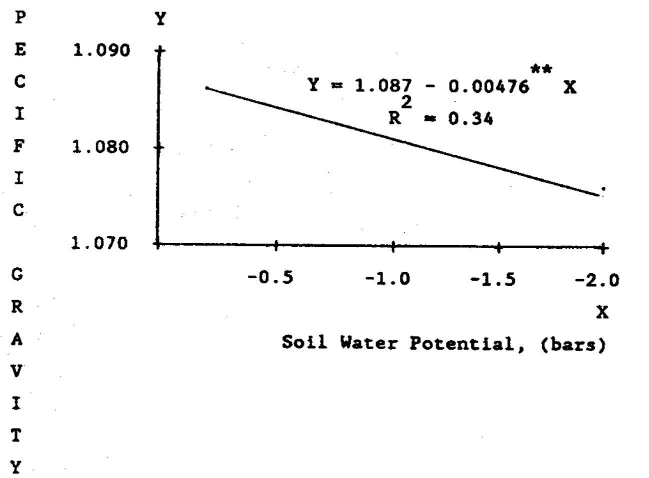



Figure 4. Repsonse of Russet Burbank stem-end fry color (percent reflectance) to seasonal average soil moisture, Malheur Experiment Station, OSU, 1987.

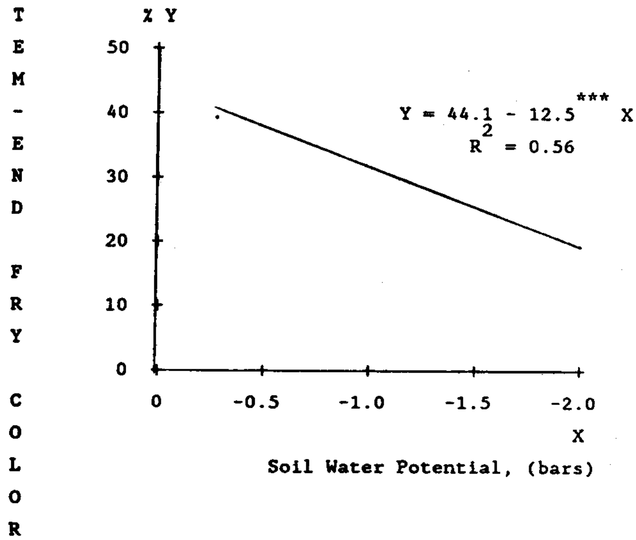



Figure 5. Relationship between soil water potential and Russet Burbank crop water stress index, Malheur Experiment Station, OSU, 7-13-76.

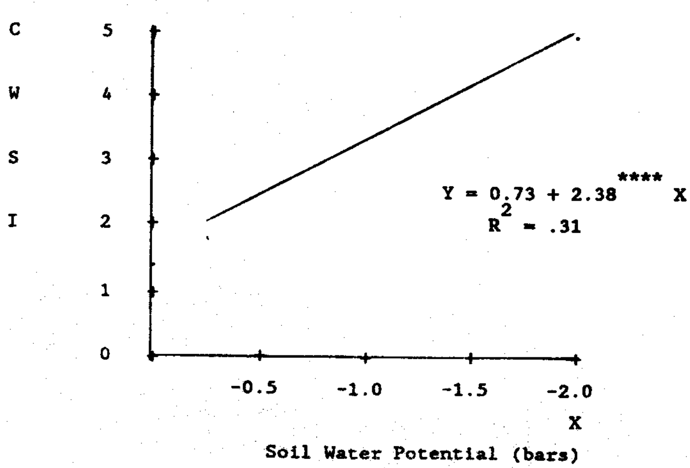


Figure 6. Relationship between Russet Burbank yields and average crop water stress index, Malheur Experiment Station, OSU, 1987.

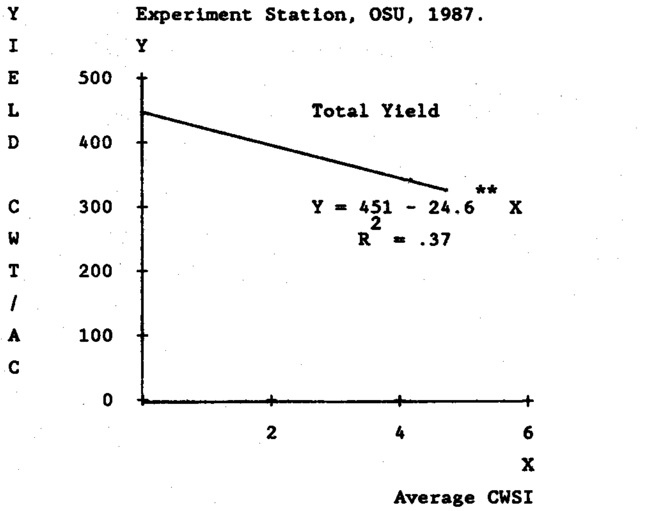



Figure 7. Relationship between Russet Burbank market grade and average crop water stress index, Malheur Experiment Station, OSU, 1987.

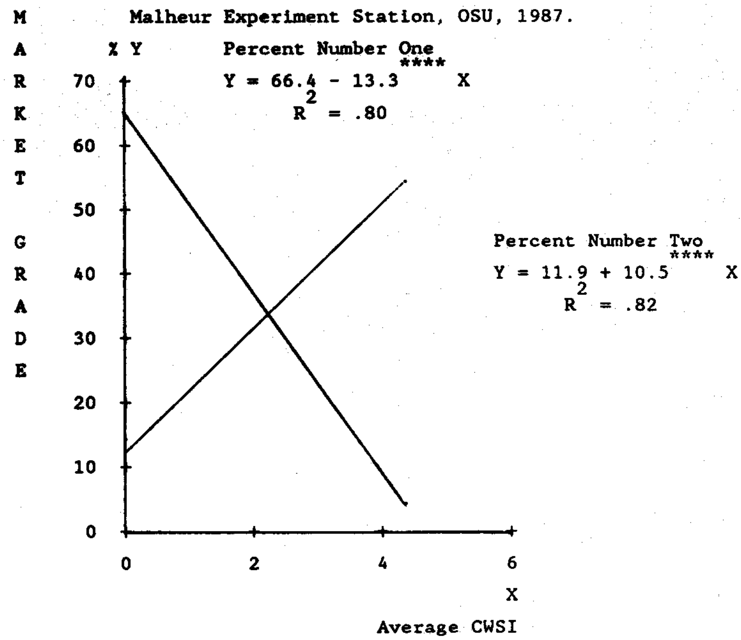



Figure 8. Relationship between Russet Burbank specific gravity and average crop water stress index, Malheur Experiment Station, OSU, 1987.

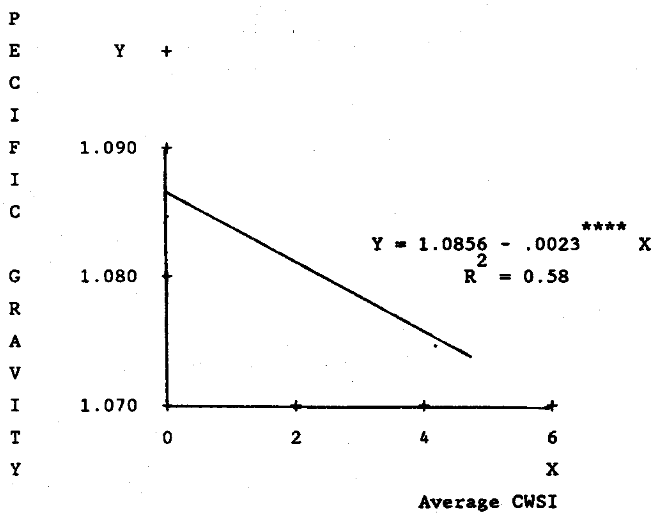
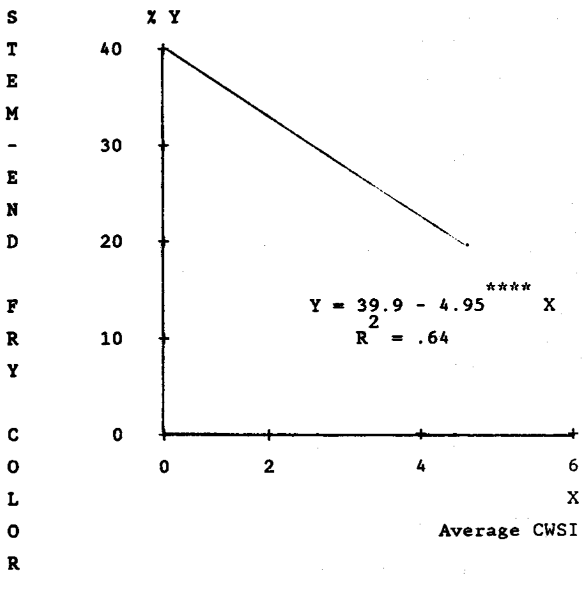



Figure 9. Relationship between Russet Burbank Stem-end fry color (percent reflectance) and average crop water stress index, Malheur Experiment Station, OSU, 1987.



THE EFFECTS OF ANTI-TRANSPIRANT UC 86177
ON RUSSET BURBANK POTATOES

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## Objectives

The anti-transpirant UC 86177 was sprayed on the foliage of stressed Russet Burbank potatoes to evaluate its effect on potato quality.

## Procedures

Russet Burbank potatoes were planted April 29, 1987, on an Owyhee silt loam soil at the Malheur Experiment Station. The soil had a pH of 6.9 and 1.6 percent organic matter. The ground was planted to wheat in 1986 and was fall-plowed. The ground was bedded for potatoes in the spring. Potato seed pieces were planted 10 inches apart and 9 inches deep on three-foot beds. Potatoes were sidedressed with 120 pounds per acre of nitrogen as ammonium nitrate and three pounds active ingredient per acre of Temik on May 5, 1987.

Anti-transpirants were sprayed in two furrow-irrigated experiments. Irrigations for the first experiment were based on crop water stress index values of 1.5 or 4.5. The anti-transpirant was applied or omitted from each treatment. The potatoes watered at a crop water stress index of 1.5 (scale 0 to 10) had considerably less moisture stress during the season than those watered at CWSI = 4.5. In the second experiment, UC86177 was applied to two timed stress treatments, in late June or in early July. Treatments in both experiments were replicated four times.

The anti-transpirant UC 86177 was applied on June 16 and June 30 at a rate of one pound active ingredient per acre. For each 10 g of UC 86177 mixed, 12 ml of a specified adjuvant was added. Sprays were applied at 30 gallons per acre, 45 psi, using a single Tee Jet 8002 nozzle over each treated row of potatoes. Treated plots were one row wide and 25 feet long. Untreated plots were 50 feet long. Each treatment was replicated four times.

Potato canopy temperatures, air temperature, and air relative humidity (RH) were recorded simultaneously one meter above the potatoes in each plot on the afternoon of June 26, 1987, using a 1987 model Standard Oil Engineered Materials Scheduler, 1987 model. The Scheduler calculated: 1) the difference between the air temperature and the crop canopy temperature, 2) the vapor pressure deficit (VPD) of water in the atmosphere, and 3) the crop water stress index (CWSI). CWSI values were calculated on a scale of zero to ten.

Potatoes were harvested on September 18 from the CWSI plots and on September 22 from the timed stressed plots. Potatoes were mechanically dug and hand-harvested. Twenty-five feet of harvest row was recovered in the plots with the anti-transpirant and 50 feet of harvest row was recovered from the untreated plots.

Potatoes were graded into Number One tubers greater than 10 ounces, Number One tubers 6 to 10 ounces, Number One tubers 4 to 6 ounces, Number Two tubers greater than 10 ounces, Number Two tubers 4 to 10 ounces, culls, and rotten tubers. All tubers under four ounces were considered culls.

## Results and Discussion

Tuber set began about June 1. Potato plants in all treatments were severely damaged by hail on August 13.

Phytotoxic effects of the anti-transpirant were noted on June 17 and July 1, one day after each anti-transpirant application. Five to ten percent of the leaves were bronzed and mildly burned. The bronzing was concentrated on the top leaves and did not cause leaf loss.

Crop canopy temperatures and CWSI were generally higher on June 26 for potato plants treated with UC 86177 (Tables 1 and 2). Only the July stress treatments, which had not yet been stressed on June 26 (Table 2), were an exception to the trend of higher temperatures and CWSI with anti-transpirant.

Anti-transpirant applications did not significantly improve potato yields or market grades (Tables 3 and 4). Anti-transpirants on the June-stressed plants were associated with reduction in potato yield (Table 4).

The potatoes in both trials had more moisture stress than optimally irrigated potatoes. Adjacent treatments with minimum stress all season and no anti-transpirant application produced 440 cwt/ac with 62 percent Number One potatoes. No data are available from these experiments to indicate whether anti-transpirants would or would not improve yields or quality of minimally stressed potatoes.

Table 1. Effects of an anti-transpirant and "Scheduler" irrigation treatments on crop canopy temperatures and crop water stress indicies on June 26, 1987. Each data point on the table represents the average of 10 observations, Malheur Experiment Station, OSU, Ontario, Oregon.

| Anti-transpirant application | Irrigation Criteria | Replicate | Crop T | Air T | RH | CWSI | VPD |
|---|---|---|---|---|---|---|---|
| lbs ai/ac | | | °C | °C | % | 0-10 | |
| 0 + 0 | CWSI 1.5 | 1 | 31.1 | 33.6 | 24 | 2.2 | 3.91 |
| | | 2 | 31.2 | 35.1 | 27 | 1.6 | 4.26 |
| | | 3 | 29.4 | 35.8 | 26 | 0.0 | 4.35 |
| | | 4 | 34.8 | 35.7 | 26 | 3.7 | 4.29 |
| | | AV | 31.6 | 35.1 | 25 | 1.9 | 4.20 |
| 1 + 1 | CWSI 1.5 | 1 | 33.1 | 34.5 | 22 | 3.3 | 4.23 |
| | | 2 | 36.1 | 35.6 | 24 | 4.7 | 4.39 |
| | | 3 | 31.6 | 35.7 | 24 | 1.6 | 4.40 |
| | | 4 | 36.3 | 35.6 | 27 | 4.8 | 4.24 |
| | | AV | 34.3 | 35.4 | 24 | 3.6 | 4.32 |
| 0 + 0 | CWSI 4.5 | 1 | 35.9 | 33.6 | 27 | 5.7 | 3.74 |
| | | 2 | 34.3 | 35.7 | 25 | 3.4 | 4.38 |
| | | 3 | 31.2 | 35.5 | 26 | 1.3 | 4.25 |
| | | 4 | 35.7 | 35.4 | 26 | 4.5 | 4.21 |
| | | AV | 34.3 | 35.1 | 26 | 3.7 | 4.17 |
| 1 + 1 | CWSI 4.5 | 1 | 36.7 | 34.3 | 24 | 5.8 | 4.09 |
| | | 2 | 37.7 | 35.4 | 26 | 6.0 | 4.28 |
| | | 3 | 36.3 | 35.5 | 26 | 4.9 | 4.27 |
| | | 4 | 36.9 | 35.6 | 25 | 5.3 | 4.31 |
| | | AV | 36.9 | 35.2 | 25 | 5.5 | 4.24 |

Table 2. Effects of an anti-transpirant and timed irrigation stress treatments on crop canopy temperatures and crop water stress indicies on June 26, 1987. Each data point in the represents the average of 10 observations, Malheur Experiment Station, OSU, Ontario, Oregon.

| Anti-transpirant application | Irrigation Stress Period | Replicate | Crop T | Air T | RH | CWSI | VPD |
|---|---|---|---|---|---|---|---|
| lbs ai/ac | | | °C | °C | % | 0-10 | |
| 0 + 0 | Late June | 1 | 34.5 | 34.3 | 26 | 4.2 | 3.99 |
| | | 2 | 35.8 | 34.8 | 23 | 5.0 | 4.25 |
| | | 3 | 36.7 | 36.2 | 25 | 4.8 | 4.49 |
| | | 4 | 32.1 | 33.6 | 25 | 3.0 | 3.88 |
| | | AV | 34.8 | 34.7 | 25 | 4.3 | 4.15 |
| 1 + 1 | Late June | 1 | 37.1 | 35.4 | 26 | 5.5 | 4.25 |
| | | 2 | 36.8 | 34.9 | 24 | 5.7 | 4.23 |
| | | 3 | 37.2 | 36.0 | 26 | 5.2 | 4.36 |
| | | 4 | 36.3 | 35.7 | 26 | 4.7 | 4.28 |
| | | AV | 36.9 | 35.5 | 26 | 5.3 | 4.28 |
| 0 + 0 | Early July | 1 | 27.7 | 34.7 | 24 | -0.6 | 4.20 |
| | | 2 | 33.3 | 34.8 | 24 | 3.1 | 4.20 |
| | | 3 | 30.8 | 35.8 | 26 | 0.8 | 4.32 |
| | | 4 | 32.6 | 36.0 | 27 | 2.0 | 4.34 |
| | | AV | 31.1 | 35.3 | 25 | 1.3 | 4.27 |
| 1 + 1 | Early July | 1 | 29.9 | 35.1 | 25 | 0.6 | 4.24 |
| | | 2 | 31.4 | 35.0 | 25 | 1.8 | 4.21 |
| | | 3 | 33.7 | 35.5 | 28 | 2.9 | 4.17 |
| | | 4 | 30.6 | 35.1 | 26 | 1.0 | 4.15 |
| | | AV | 31.4 | 35.2 | 26 | 1.6 | 4.19 |

Table 3. Effects of anti-transpirant and "Scheduler" irrigation treatments on potato yields and market grade, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Treatments | | Yield by Grade | | | | | | | | | | Percent by Grade | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | US Number Ones | | | | US Number Twos | | | | | | | |
| Anti-Transpirant | Moisture Stress Level | 10+ oz | 6-10 oz | 4-6 oz | Total | 10+ oz | 4-10 oz | Total | Culls | Rot | Total Yield | Ones | Twos |
| lbs/ac | CWSI | - - - - - - - - - - - - | | | | cwt/acre | | | | | - - - - - - - - - - - - | - - % | - - |
| 0 | 1.5 | 38 | 126 | 61 | 226 | 83 | 137 | 220 | 88 | 8 | 542 | 41 | 41 |
| 1 + 1 | 1.5 | 35 | 116 | 60 | 211 | 43 | 166 | 209 | 82 | 10 | 512 | 42 | 39 |
| 0 | 4.5 | 7 | 33 | 33 | 73 | 36 | 174 | 210 | 84 | 34 | 400 | 18 | 52 |
| 1 + 1 | 4.5 | 8 | 87 | 29 | 124 | 46 | 188 | 234 | 104 | 11 | 473 | 25 | 48 |
| LSD(.10) | CWSI | | | | 89 | | | 60 | | | - | - | - |
| LSD(.05) | CWSI | | | | NS | | | NS | | | NS | 17 | 12 |
| LSD(.05) | Anti-Transpirant | | | | NS | | | NS | | | NS | NS | NS |

Table 4. Effects of an anti-transpirant and timed irrigation stressed treatments on potato yields and market grade, Malheur Experiment Station, OSU, Ontario, Oregon, 1987.

| Treatments | | Yield by Grade | | | | | | | | | | Percent by Grade | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Anti-Transpirant | Moisture Stress Level | US Number Ones | | | | US Number Twos | | | | | Total Yield | | |
| | | 10+ oz | 6-10 oz | 4-6 oz | Total | 10+ oz | 4-10 oz | Total | Culls | Rot | | Ones | Twos |
| lbs/ac | CWSI | - - - - - - - - - - - - - - - - - - - - - - - - - | | | | cwt/acre | - - - - - - - - - - - - - - - - - - - - - - - - | | | | | - - % | - - |
| 0 | June | 12 | 58 | 44 | 114 | 48 | 184 | 232 | 86 | 17 | 449 | 24.6 | 52.0 |
| 1 + 1 | June | 5 | 79 | 29 | 112 | 52 | 117 | 169 | 66 | 6 | 353 | 32.9 | 46.7 |
| 0 | July | 46 | 97 | 65 | 208 | 42 | 128 | 171 | 99 | 5 | 483 | 43.3 | 34.7 |
| 1 + 1 | July | 20 | 128 | 68 | 216 | 30 | 95 | 125 | 68 | 11 | 421 | 51.2 | 29.7 |
| LSD(.05) | Stress Period | | | | 56 | | | NS | | | NS | 14 | 15 |
| LSD(.05) | Anti-Transpirant | | | | NS | | | NS | | | 80 | NS | NS |