S105
E55
no. 816
cop. 2

MALHEUR AGRICULTURAL EXPERIMENT STATION

Potato, Onion, and Sugar Beet Research

FEB 1988
LIBRARY
OREGON STATE
UNIVERSITY

Special Report 816
February 1988

Agricultural Experiment Station
Oregon State University
Corvallis

MALHEUR AGRICULTURAL EXPERIMENT STATION

Potato, Onion, and Sugar Beet Research

Special Report 816, February 1988

Standage Farms

Agricultural Experiment Station
Oregon State University, Corvallis

CONTENTS

CONTRIBUTORS

MALHEUR COUNTY OFFICE, O.S.U. EXTENSION SERVICE PERSONNEL:

Jensen, Lynn	Assistant Professor
Simko, Ben	Associate Professor

MALHEUR EXPERIMENT STATION:

Bradshaw, Pamela	Secretary
Burnett, Charles R.	Research Assistant
Eldridge, Eric	Graduate Student
Ishida, Joey	Biological Technician
Kee, Mary Jo	Secretary
Kolding, Mathias F.	Senior Instructor
Shock, Clinton C.	Superintendent and Associate Professor
Stanger, Charles E.	Professor of Crop Science
Stieber, Tim	Research Assistant
Swisher, Jerry	Farm Foreman

OREGON STATE UNIVERSITY, CORVALLIS, AND OTHER STATIONS;

Appleby, Arnold	Professor, Dept. of Crop Science
Broich, Steve	Research Associate
Burrill, Larry	Weed Control Specialist
Hane, Dan	Research Assistant (Hermiston)
Holmes, Zoe Ann	Professor, Dept. of Foods and Nutrition
Kronstad, Warren	Professor, Dept. of Crop Science
James, Steven R.	Research Assistant (Redmond)
Maxwell, Jerry	Research Assistant (Klamath Falls)
Mosley, Alvin R.	Associate Professor, Dept of Crop Science
Stephen, William	Professor, Dept. of Entomology
Verhoeven, Mary	Instructor, Dept. of Crop Science
Vomocil, James	Professor, Dept of Soil Science
Wernz, James	Research Associate and Manager of the Plant Analysis Laboratory
Willnow, Jeff	Student

UNIVERSITY OF IDAHO:

Pavek, Joe	Research Geneticist

OTHER PERSONNEL COOPERATING ON SPECIAL PROJECTS;

Burnett, Denise	Agriculture Research Technician, Ore-Ida Foods, Inc., Ontario, Oregon
Burr, Jim	Private Crop Consultant, Ontario, Oregon
Lewis, Mike	Manager of Agriculture Services, Ore-Ida Foods, Inc., Ontario, Oregon

McKinney, Mark	Manager of Raw Products Ore-Ida Foods, Inc., Ontario, Oregon
Zalewski, James D.	Senior Manager of Agricultural Research, Ore-Ida Foods, Inc., Ontario, Oregon
Gardner, Bronson	Product Technical Manager Standard Oil Engineered Materials Solon, Ohio
Futter, Herb	District Conservationist Ontario, Oregon
Perry, Bob	Soil Conservationist Ontario, Oregon
Hobson, Joe	Cooperating Farmer
Peterson, Robert	Cooperating Farmer
Tipton, Dick	Cooperating Farmer
Okuda, Min	Cooperating Farmer
Beck, Richard	Beck Precision Planters Nyssa, Oregon
Vogt, Glenn	J. R. Simplot Company

GROWERS ASSOCIATIONS SUPPORTING RESEARCH

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

POTATO DARK-END RESEARCH, 1986

Clinton C. Shock, Lynn Jensen, Tim Stieber,
Eric Eldredge, and Jim Zalewski

Malheur Experiment Station, Oregon State University
Malheur County Office, O.S.U. Extension Service
Agricultural Research Department, Ore-Ida Foods, Ontario

Introduction

The Treasure Valley has an agricultural resource-based economy. Economic development of this economy involves stimulating the production of high-value crops and of increasing the number of industries that process agriculural raw materials. Industry converts farm products into a higher value form, thus providing income and employment. A good example of the type of crop we would like to stimulate is the potato.

The potato has high productivity and can provide an adequate return per acre. The potato has been successfully industrialized in the Treasure Valley. We have numerous processing plants and these processing plants produce a wide variety of products. The major industrialized product is frozen french fried potatoes. In the fall of 1985, the potato harvest presented processors with a problem of crisis proportions. Potato quality was insufficient to satisfy consumer demand because of an the internal defect called sugar-ends or dark-ends.

What are sugar-ends? When a potato plant suffers moisture and temperature stress during the growth of the tuber a sugar-end can develop. A sugar-end potato from our region typically has more sugars in the stem end than in the rest of the potato. When the potato strips are fried at 375°F. for 2 1/2 minutes, the end with the greater sugars, the part of the potato strip near the stem end of the potato, develops a dark color which is unacceptable for the fast food industry and other industrial food service consumers.

Potatoes as a raw material for industry must meet the quality specifications of sugar-ends. If quality specifications are not met producers will lose potato acreage and cash income, industries will lose sales, and communities will lose jobs.

Approaches to Solve Sugar-Ends

The sugar-ends problem can be addressed with two basic approaches. The first approach is to find cultural practices which will minimize stress on the potato plant and thereby avoid the development of sugar-ends. The second approach is to find potato germplasm which will be able to tolerate the environmental stress that would provoke sugar-ends in another more susceptible variety.

I. VARIETY DEVELOPMENT

No current variety is satisfactory in solving the sugar-end problem. Varieties that have a high degree of susceptibility to sugar-ends are unacceptable. Varieties with low indices of sugar-ends have some secondary negative attribute that eliminates or severely limits their use as a cultivar to replace Russet Burbank. Growers and industry will not accept a potato cultivar that has a high incidence of shatter bruise, hollow heart, black spot, sprouting in storage, low specific gravities, or low yields.

Variety evaluation methods in Oregon have been accelerated to increase the probabilities of success. Nearly 100,000 new progeny from crosses can be examined each year. Early generation materials, including single hills and preliminary trials, are now evaluated in their first year for tolerance to sugar-ends. Several germplasm selections show tolerance to sugar-ends and provide hope that a variety that not only tolerates sugar-ends but has acceptable performance in all other aspects will be found.

Variety development is a long-term solution. In addition to the potato breeding program, the industry needs immediate solutions to the problem to bridge the time when these improved varieties become available.

II. CULTURAL PRACTICES

Many potato cultural practice experiments were conducted in 1986 at and around the Malheur Experiment Station. Cultural practice experiments included studies on the effect of delaying the onset of irrigation, the comparison of furrow irrigation with sprinkler irrigation, and the effect of straw mulch on sprinkler- and furrow-irrigated potatoes. Other experiments examined the effects of the timing of stress on the development of sugar-ends, such as the particular periods during the year when potatoes were prone to produce sugar-ends. Studies were conducted to study the temperature of the crop canopy to determine to what extent sugar-end potatoes can be predicted based on the temperature of the canopy and calculated levels of moisture stress. Furthermore, irrigation treatments were evaluated to see how they changed soil temperatures in the potato beds.

Procedures

Each experiment was conducted using normal cultural practices used by growers. Potatoes were planted 10 inches apart on 36-inch beds.

Experimental treatments for all studies were replicated four times. Each plot had its own gated pipe or sprinklers. Plots were 105 to 120 feet long and two to four rows wide. Only the potatoes out of the middle of each plot were harvested. Neutron probe tubes were located in every plot. Soil water was monitored twice a week. Potatoes were irrigated when the neutron probe counts showed between 2.6 and 2.2 inches per foot of water.

Potato sugar-ends are often evaluated against a USDA color chart. The person who is taking the center fry strips then judges the color at about a half-inch from the stem end of the potato against the USDA color chart. The evaluation of potato fry color against the color chart is a rather subjective decision. The stem end fry color of the potatoes in these experiments was determined using a photovolt reflectance meter available in the Ag Research labs of Ore-Ida. The photovolt reflectance meter was calibrated to take light reflectance observations of each potato from every plot in the same way. The darker the french fry, the less light is reflected back into the meter. The lighter the french fry, the more light is reflected back. The first method used to get exactly a half-inch from the end of the potato was to cut a slab lengthwise through the whole potato. After frying, there is a change in color from the stem end to the bud or the growing point end of each potato, a gradation from the darkest end to the lightest end. A center strip cut through the potato may not catch the darkest part of the potato. The second method was to cut a half-inch piece off the stem end of the potato, fry it, and measure the reflectance. The two methods resulted in reflectance values which were practically identical for any two samples of potatoes.

A. DELAYED START OF IRRIGATION

Delayed onset of irrigation might result in a plant that is smaller in stature and pre-conditioned to stress. This plant would not be subject to wet soil conditions during early growth, and perhaps it would not be inoculated by disease organisms until a later date. An early stressed plant might senesce later and thereby grow actively later in the growing season. Reduced vine growth, reduced tuber set, and reduced yield were expected in the more extreme treatments. A larger proportion of number-one tubers and a lower percentage of number-two tubers were also anticipated with a delay in the onset of irrigation. We expected to see that the tubers with the later onset of irrigation would have higher specific gravities and possibly lighter dark-end fry colors.

In both 1985 and 1986, experiments were conducted where the onset of irrigation was delayed. Potatoes were irrigated starting eight or nine days after planting, at first emergence, at full emergence, a week after emergence, when the plants were 6 to 8 inches tall, when the plants were 12 to 14 inches tall, or when the plants were near row closure. The later irrigation onset treatments were really quite extreme since the first irrigation did not occur until about mid-June, in spite of the fact that potatoes started to set about June 7 both years.

With delayed irrigation, plant size was reduced in both years. Fewer tubers were set per plant and the total tuber weight by June 26 was lower for delayed irrigation in both years. In 1985, yield decreased if irrigation were delayed by more than 22 days (Table 1). But, in 1986, there was no decline in yields, even if irrigation was delayed into June, in spite of a very severe heat wave at the end of May and the beginning of June (Table 2).

Delayed irrigation was associated with a larger percent of number-one potatoes and fewer number-two potatoes. This same phenomenon was observed in 1986 but the proportion of number-one potatoes was much higher in 1986 than in 1985. Temperature stress was much greater in 1985 than in 1986.

No significant trend occurred in specific gravities with a delay in the onset of irrigation.

Sugar-ends were far less where furrow irrigation was delayed. The greatest number of sugar-ends was found in the treatments that were irrigated earliest both years.

The increase in sugar-ends with early irrigation could be explained by disease organisms infecting these plants and that they were more poorly able to translocate water. Although differences in infection may occur in certain fields, this phenomenon did not occur in the areas that were under this experiment. The vines that were watered earlier did not die down early. Secondly, we could explain the results by the notion that the plants that were watered early had the greater plant top area and, therefore, were more subject to moisture stress and respiration stress when the plant got into trouble. A third explanation for more sugar-ends in early irrigated plots is that the water infiltration rate declines with each successive irrigation and it becomes more difficult to get the soil wet in the early irrigated plots. Plant canopy temperatures and stress indices were measured. The data indicated that the plants were not responding so much to whether or not they had been preconditioned to stress, but that the early irrigated plots actually had drier soil during June than the corresponding treatments where the onset of irrigation was begun later. In fact, more irrigations and more hours of irrigation were necessary later in the season to keep the soil moist in the early irrigated plots.

In June 1986, the soil in the plots which had been watered three or four times was not nearly as moist as the soil in the plots that had been watered just recently for the first time. The plant canopies were cooler where the potatoes had recently been watered for the first time compared to the plant canopies where the soil had been watered three or four times. The plant canopies of the early watered potatoes were about six degrees below environmental temperatures, compared to eight or nine degrees below for potatoes recently watered for the first time. The plants in plots that had not yet been watered had canopy temperatures approximately the same as the surrounding air, suggesting only minimal evaporative cooling.

Small differences in plant canopy temperature have an extremely great importance for a potato. A potato has a photosynthetic maximum of about 70 to 80 degrees Fahrenheit. Above 85 or 90 degrees, photosynthesis drops off very rapidly and respiration of the plant increases rapidly. So small differences in temperature at the upper end of the range can have dramatic consequences for the plant's carbohydrate status.

A probable reason for higher canopy temperatures in these early irrigated plants was that the soil moisture was not as high as in the plots that had just recently been irrigated for the first time. Early irrigation leads to reduced rates of infiltration, drier soil during June, and added moisture stress on the plants.

B. REDUCED WATER INFILTRATION RATES

Ring infiltrometers were mounted in the rows of the date-of-first-irrigation experiment to see what the effect of the past history of irrigation would be on the infiltration rate. Ring infiltrometers were mounted in furrows which had received four, three, or no irrigations. Double rings were maintained with water for a period of 24 hours. Where the furrows had already been irrigated three times, infiltration rates averaged 0.05 inches per hour. Infiltration rates were 1.08 inches per hour with the first irrigation. Repeating this procedure for the equivalent of a fifth irrigation, we see that the infiltration rate decreased yet further to 0.036 inches per hour.

Thio-sul added to the irrigation water at 10 gallons per acre did not improve infiltration. The infiltration rate declined to 0.033 inches per hour for the fifth irrigation, similar to the fifth irrigation withour Thio-Sul. It appears that one primary reason for sugar-end occurance with early watered potatoes on silt loam soils is that the infiltration rate of the soils is decreasing. The soil particle structure may be collapsing and crusting. The declining infiltration rates with successive irrigations are consistent with observations. In 1953, Tileston found that with each successive 24-hour furrow irrigation on a field of corn in Ontario, he observed lower and lower water intake rates.

In conclusion, early irrigation, "watering-up" the crop, should be avoided. Begin watering only when the potatoes absolutely need irrigation. Furthermore, furrow irrigation should only be made in every other row. The infiltration rates are so much higher with the first irrigation in a furrow that watering every other row provides sufficient moisture. Subsequent irrigations can stay in the same furrow until tubers are set. Delaying watering a row will make it easier to get the soil to a higher water status in the second half of June and later on in the season when moisture stress to the potato plants must be minimized.

C. FURROW IRRIGATION VERSUS SPRINKLER IRRIGATION

In a set of two experiments, one conducted on the station and one conducted off-station, sprinkler and furrow irrigation were compared for their ability to reduce sugar-ends. Simulta neously the effect of straw mulch on both furrow- and sprinkler-irrigated potatoes was investigated at both locations. The potatoes were furrow-irrigated with no straw, furrow-irrigated with 800 pounds of straw per acre, sprinkler-irrigated with no straw, and sprinkler-irrigated with 800 pounds of straw per acre. The straw was applied loosely in the furrow after all planting and herbicide incorporation practices were completed, but before first irrigation. At the station both sprinkler and furrow irrigations were initiated using the same criteria, when the soil reached near 65 percent field capacity. The furrow-irrigated plots without straw needed both more frequent irrigation and more hours of irrigation. In spite of more frequent irrigations in the furrows with no straw, the soil moisture level was more difficult to maintain.

At the experiment station, the average moisture content of the soil was higher under sprinkler irrigation and higher under the furrow irrigation with straw. The total amount of water delivered was far greater in the furrow-irrigated plots than in the sprinkler-irrigated plots, but the exact amount was not measured. A large proportion of the furrow-irrigated water went off the end of the field through the tail ditch, whereas none of the water from the sprinkler-irrigated plots left the field. Irrigation systems and the use of straw were evaluated based on potato yields, the percent of number-one tubers, the percent of number-two tubers, the specific gravities, and the sugar-end fry color reflectance.

At the experiment station, on rather level ground, the addition of straw to either furrow- or sprinkler-irrigated potatoes did not increase total yields, but the percent of number-one tubers increased with straw under furrow irrigation while the percentage of number twos decreased. The highest percentage of number-one potatoes was produced under sprinkler irrigation irrespective of whether straw was present.

Results were similar in the off-station plots with furrow irrigation, sprinkler irrigation, with or without straw, except that sprinklers not only enhanced the percent of number-one tubers, but both the sprinklers and the straw enhanced total yields over the furrow-irrigated check. The straw may have had greater benefits on the off-station plots because they were on a greater slope.

Potatoes from the sprinkler plots reflected a greater amount of light (the sugar-end fry color was lighter) and the colors corresponded to potatoes that would average somewhere between double-zero and one on the USDA chart. The furrow-irrigated potatoes at the station had darker fry colors irrespective of whether there was straw present. There were more undesirable dark-end french fries from the furrow-irrigated plots. On the off-station experiments the use of straw in the furrow-irrigated plots produced lighter sugar-end fry colors than the potatoes grown without straw. There was a trend toward higher specific gravity potatoes under the sprinkler system compared with the furrow irrigation.

Where economically feasible, a sprinkler system provides immediate advantages, both in the percent of number-one tubers and in lighter sugar-end fry colors. The advantage of sprinkler systems has been demonstrated at only two locations based on one year's observation. Management practices with positive results should be repeated for several years. The results are consistent with observations by the industry that growers who change from furrow-irrigated to sprinkler-irrigated potato crops in the Treasure Valley obtain a higher-quality product.

Although the trials showed only marginal benefits of straw, the full benefits of straw may not have been realized in these trials. Perhaps if the irrigation frequency had been the same with straw and without straw and of shorter irrigation duration in the strawed plots, potato quality would have been better. With the same frequency of irrigation of strawed and non-strawed furrows both would have had the same number of cooling cycles. The strawed plots would have had less extreme variations of soil moisture levels.

D. THE TIMING OF STRESS THAT PRODUCES SUGAR-ENDS

In previous research, workers have shown that sugar-end potatoes can be produced by moisture stress in the latter part of June. From fragmented industry records it has been very difficult to verify which years in the last two decades have produced the greatest indices of sugar-ends, and to correlate those observations with particular periods of moisture stress or high temperatures within any given year. Two years that did produce a great deal of sugar-ends in potatoes were 1971 and 1985. The weather of 1985 had hot periods and high evapotransiration demand in late June, and July set a new heat record for monthly temperature. Weather records reveal that 1971 and 1985 both had long periods of elevated temperature. Certainly prolonged heat would allow the possibility of inadequate irrigation during any small period of the summer to produce stress on the plants. It is of great practical significance to the grower to know during which periods of the year moisture stress is likely to be most damaging to the potato crop.

The treatments were specific moisture stress periods in June, early 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, during the interval in question. The plots that had a period of stress for two to three weeks received fewer hours and numbers of irrigations than the checks. The soil in the check plots was maintained at or above 65 percent field capacity throughout the whole growing season. In a fifth treatment the soil was kept wetter than the check during the late June period. The plots that were maintained wetter during late June received considerably more water than the check plots.

Potatoes stressed in July 1986 produced low yields. The August 1986 stress period was intermediate in reducing yields. The June stress period in 1986 produced a very small proportion of number-one potatoes and a very large proportion of number-two potatoes. These potatoes were typically bottle necked or had some restrictions in them.

July and August moisture stress periods resulted in lower specific gravities than the check treatment. Potatoes stressed in June and August had higher incidence of sugar-ends as seen in lower sugar-end reflectance from these tubers. Perhaps the 1986 data are not really representative because July weather was relatively cool. So, these potatoes may not have received the same combination of moisture and temperature stress as the potatoes that were stressed for moisture in June or August. August was considerably hotter than the July stress period and moderately hotter than the June stress period.

Soil temperatures were monitored at 8 inches deep in the beds of all treatments. Soil temperatures were 2^{o}F hotter in stress treatments in June and August compared to the minimally stressed check treatment. There was no difference in soil temperatures produced by July moisture stress in 1986.

The timed stress results from 1986 have important practical consequences. July stress reduced yield. We observed higher sugar-ends in our June and August stress. There were lower specific gravities with July and August stress. The highest percent of number twos was observed with June stress. It is quite clear from the results of 1986 that periods of stress, regardless of whether they are in late June, July, or August, will have negative consequences for the potato producer. As a practical matter this helps us keep in focus that all periods of growth from mid-June through late August are exceedingly important for potato production, and that we cannot allow the potatoes to be stressed for moisture in any of these periods of time if we want to maximize yield and quality.

E. PLANT CANOPY TEMPERATURES AND THE EXTENT OF STRESS

Potatoes were planted at increasing distance from a solid-set sprinkler system to provide a range of irrigation treatments. Potatoes grown between the sprinkler lines were irrigated when the soil neared 65 percent field capacity. These potatoes constituted the well-watered check treatment. Potatoes grown in soil along the sprinkler line had wetter soil than the check treatments all season. Potatoes in plots outside the sprinkler lines were in successively drier soils.

Applied water, soil moisture content, and soil temperature were monitored. Potato plant canopy temperatures were measured using an infrared thermometer in a Scheduler (equipment trademark of Standard Oil of Ohio). The Scheduler also calculates a crop canopy temperature, the air temperature, and the air relative humidity. Potatoes from all plots were harvested, graded, and subjected to specific gravity and dark-end fry color determinations.

The seasonal average soil moisture was consistent with the variation in the amount of applied inches of water during the season. Potato yield was highest and market grade was best when the soil was maintained above 65 percent moisture. The potato grade differences were statistically significant with a much higher percentage of number-one tubers in the sprinkler plots that were held at the higher moisture levels.

The specific gravities were poorer in the plots that received a lower amount of moisture during the season. The stem-end french fry color was much lighter from tubers grown in the check plots than it was from tubers grown in the drier plots. Specific gravity decreased with decreasing average season-long soil moisture content. When the season-long average soil moisture is compared with the fry color, the lightest sugar-end fry color is associated with potatoes that have an average soil moisture level about 75 percent field capacity and season-long minimum moisture content of 65 percent field capacity. The fact that potatoes grown in the driest plots had high incidence of sugar-ends means that growers must make sure that sprinkler systems apply water adequately and uniformly. The soils that average a higher moisture rating than the check may have had slightly darker sugar-end fry color.

We have seen in the date-of-first-irrigation experiment that the plant canopy temperature is a close mirror of the soil moisture status. Canopy measurements provide a useful tool since they are easy and rapid to measure. Soil moisture status is more difficult. Could plant canopy temperatures be used to evaluate the water stress of the plant, and hence predict sugar-ends? Could we avoid sugar-ends by monitoring the plant canopy temperatures? On these same treatments which are a gradient of moisture stress, we periodically evaluated the plants for potato canopy temperatures. By using the plant temperature, the air temperature, and the relative humidity of the air it is possible to calculate the amount of water stress that a plant is suffering at a particular moment. The water stress is measured in units called the "crop water stress index," CWSI. CWSI values range from 0 to 1. A non-stressed plant has a CWSI close to zero and a highly stressed plant that is not cooling itself at all with evaporative cooling has a CWSI reading of 1.

Stress readings were closely related to the amount of moisture in the soil in our 1986 plots. Across the gradient of soil moisture status, potato canopy temperature differences were observed. Higher CWSI values were closely related to sugar-ends. The higher the stress index, the higher the sugar-ends. The ability to rapidly read crop canopy temperatures and estimate plant water stress may give us a tool to evaluate when a potato crop needs to be watered to provide cooling, to increase its water status, and maintain high-quality potatoes.

Over the sprinkler gradient of moisture the soil 8 inches deep in the beds at the highest soil moisture levels was 6°F cooler than the same soil in the beds at the lowest soil moisture level. Soil temperatures in the potato beds are directly related to soil moisture status.

When irrigations are started, the water immediately starts to cool the environment. The data from August 11, 1986, indicate how both furrow and sprinkler irrigations cool the soil surface and the air 8 inches above beds. The cooling effects of irrigation are presented in Figure 1.

Soil moisture, soil temperature, and air temperature apparently interact in sugar-end susceptible potato varieties like Russet Burbank to produce sugar-end tubers.

Conclusion

From initial one- and two-year studies, applied cultural practices have been identified which minimize sugar-end potato problems.

1. Delay the onset of furrow irrigation as long as feasible.
2. Begin furrow irrigation in every other row, and water the second row beginning at tuber set.
3. Use cultural practices and rotations that enhance water infiltration rates into the soil, such as planting potatoes after grain.
4. Use low rates of straw mulch to increase water infiltration rates where furrow irrigation is used on sloping ground.
5. Install sprinkler irrigation systems where economically feasible.
6. Make sure sprinkler coverage is uniform to avoid spots with season-long moisture stress.
7. Maintain adequate soil moisture from tuber set through the end of August. A season-long minimum level is 65 percent field capacity.
8. Assure that plants have sufficient soil moisture to maintain cool tops through transpiration.
9. Soil moisture levels and canopy cooling require closer grower attention when air temperatures are elevated.

Acknowledgments

Research was supported financially by the Oregon Potato Commission. Irrigation pipe was provided by B 2 M Irrigation of Weiser. Sugar-end fry colors and specific gravities were determined at the Agricultural Research Department of Ore-Ida. Denise Burnett helped conduct the date-of-first-irrigation experiment in 1985. Jerry Swisher completed many of the cultural operations.

Table 1. Effect of date-of-first-irrigation on yield and quality of Russet Burbank potatoes. Malheur Experiment Station, Ontario, Oregon, 1985.

Days from Planting to First Irrigation	Growth Stage at First Irrigation	Percent of Tubers US No. 1	Total Yield	Specific Gravity	Critical Dark-Ends (#4s)
		%	Cwt/ac		%
8	Post-Plant	31.9	532	1.0805	16.6
22	First Emergence	27.8	551	1.0788	13.0
28	Full Emergence	33.5	446	1.0785	13.7
40	6-8" Tall	39.3	462	1.0792	6.1
50	Rows Touching	38.4	436	1.0835	3.0
	Correlation (r^2)	+.390	-.467		-.301
	Significance[1]	**	**	NS	≠

[1] NS = not significant, ≠= significant at P = .10,
* = significant at P = .05, ** significant at P= .01

Table 2. Effect of date-of-first-irrigation on yield and quality of Russet Burbank potatoes. Malheur Experiment Station, Ontario, Oregon, 1986.

Days from Planting to First Irrigation	Growth Stage at First Irrigation	Percent of Tubers US No. 1	Total Yield	Specific Gravity	Critical Dark-Ends (#4s)
		%	Cwt/ac		%
9	Post-Plant	61.6	489	1.081	24.3
30	Full Emergence	56.9	474	1.085	2.5
36	6-8" Tall	64.2	519	1.084	2.5
45	W-12" Tall	66.4	507	1.088	6.2
51	Rows Touching	76.9	478	1.083	2.5
	Correlation coefficient (r^2)				
	Significance [1]	.51**	.03^{NS}	.34^{NS}	-.58**

1/ Significant at P.01 = **, NS = not significant

THE EFFECTS OF TIME OF SPRING TILLAGE, PLANTING DATE, AND IRRIGATION ON TUBER YIELDS, QUALITY, AND SUGAR-ENDS IN RUSSET BURBANK POTATOES

Charles E. Stanger and Joey Ishida
Malheur Experiment Station, Ontario, Oregon, 1986

Purpose

The purpose of this study was to evaluate the effects of soil compaction from early spring tillage, planting dates, and delaying irrigation until plants were stressed for water on potato tuber yields, quality, and percent of tubers with sugar-ends.

Procedures

The study was conducted in a grower-cooperator field (Min Okuda) one-half mile north of the Malheur Experiment Station near the intersection of State Highway 20 and Oregon Avenue. Crops in rotation preceeding the potatoes were sweet corn in 1985 and onions in 1984. The foliage remaining after the sweet corn harvest was chopped with a steel flail beater and incorporated into the soil. The field was corrugated and furrow irrigated in preparation for fall fertilization, moldboard plowing, and fall bedding. Fall fertilization consisted of applying 120 pounds of P_2O_5, 70 pounds of nitrogen, and 32 pounds of zinc per acre. It was applied as broadcast treatments before plowing.

Soils in the trial area were classified as a silt loam texture containing 0.92 percent organic matter with a pH of 7.7. In the spring, the soil in the fall-prepared beds was very firm and a three-inch crust had formed on the surface. Because of the firm condition of the beds, a power-driven bed mulcher was used to prepare the soil for planting.

The experiments were conducted in two separate trials. Spring tillage and planting dates were tested in one trial and dates of water application were variates in the second trial.

A. Treatments in the spring tillage and planting date trial were:

Date Seed Bed Prepared	Planting Date
Treatment 1 - March 31	April 1
Treatment 2 - April 21	April 21
Treatment 3 - May 2	May 2
Treatment 4 - March 31	May 2

Equipment and procedures used in spring tillage to prepare the fall-bedded land for planting were:

a. rehilling fall-bedded land with hilling shovels to shape beds for herbicide application. Enough soil was moved from the furrows to form a peak at the center of the furrow;

b. applying Prowl (1.5 lbs ai/ac) and Dual (2 lbs ai/ac) as double overlap broadcast treatments over rebedded land;

c. mulching tops of beds with power-driven bed mulcher equipped with straight teeth, tilling the soil to a depth of 4 inches;

d. tilling beds with triple-k to aerate and mulch soil to an 8-inch depth;

e. planting Russet Burbank variety potatoes using a Parma cup type planter (potato tubers were planted at 9-inch spacings);

f. rehilling potatoes using hilling shovels mounted in front of and behind rolling teeth on a lilliston cultivator. Herbicide and soil from the furrow area were thrown over the bed to form a high, well-shaped potato hill. This operation was the final tillage operation and the potatoes were layed-by.

B. Dates in the study evaluating time of applying irrigations were:

1. May 13 - (72 percent available soil moisture at depth of seed piece). Irrigated wheel row with 12-hour irrigation. Potatoes in the trial area were fully emerged with 3 to 4 inches of foliage growth.

2. May 31 - (58 percent available soil moisture at depth of seed piece). Irrigated wheel row with 12-hour irrigations. Potato foliage was 12 to 16 inches high. Foliage color was good, did not show signs of water stress.

3. June 19 - (42 percent available soil moisture at depth of seed piece). Irrigated wheel row with 12-hour irrigations. On this date potato foliage was showing symptoms from severe moisture stress. Foliage across rows was touching.

The field was irrigated uniformly after planting to assure potato emergence from the dry soil. After the irrigations on May 13, May 31, and June 19, potatoes were irrigated when available soil moisture in the potato hills fell to about 65 percent.

Estimation of water usage and percent soil moisture was determined by using an evaporation bottle and from soil samples taken from the center of planted rows to a depth of 12 inches.

All treatments in both trials were replicated four times and arranged at random within blocks using a complete block experi mental design.

An additional 100 pounds of nitrogen and 3.0 pounds of active Temek per acre were sidedressed at planting time. Nitrogen was applied by foliar sprays and in water runs during the growing season.

The trials were harvested during September 4-8. Each plot was four rows wide and 100 feet long. Fifty feet of potatoes from the two center rows were harvested and graded to determine tuber yield for U.S. No. 1's size 4 to 6, 6 to 10, and 10 ounces and larger. Yields for number-twos and culls were also measured. One-hundred number-one grade tubers ranging in size from 6 to 10 ounces were picked at random from the remaining plot area for determination of percent sugar-ends and specific gravity. The 100 tuber samples were stored in coolers at Ore-Ida research facilities until analyzed in late November.

Fry color ratings to determine the percent of tubers with sugar-ends was done by frying pieces of tubers clipped one-half inch deep off the stem end of 20 tubers. The samples were fried for 2.5 minutes in oil at a temperature of 375°F. Color ratings of the fried potatoes was determined using a photometer which measured light reflectance. The light reflectance readings recorded from the photometer were correlated to the USDA fry color chart rating fry color as 0, 1, 2, 3, and 4 as follows:

Fry Color Chart	Light Reflectance
00	> 55.9
0	46.9 - 55.9
1	37.9 - 46.9
2	28.9 - 37.9
3	19.9 - 28.9
4	19.9 and less

Results

Tillage and Planting Date Trial. Total tuber yields ranged from 498 to 578 cwt per acre between time-of-tillage and planting-date treatments (Table 1). Delaying planting date to May 2 on beds tilled on March 31 reduced yield of number-one tubers and total tuber yields when this treatment was compared to the other three treatments. Yield reduction in the early tillage late-planting treatment was attributed to the combination of late planting and early vine senesence caused by soil compaction from tillage when soil moisture was 85 percent of field capacity. Potato vines in the late-tillage and planting-date treatments remained green until harvested. Delaying harvest of these plots may have increased tuber yields above yields from the early tillage (March 31) and planting-date (April 1) treatment. Soil conditions resulting in fewer clods at harvest were better from the late tillage (May 2) and planting-date plots. There were fewer number-two tubers but more culls (< four-ounce tubers) when tillage and planting dates were delayed. Differences in time of tillage and planting did not affect fry color or specific gravity readings (Table 2). Fry colors were acceptable for all treatments with light reflectance reading averaging 47.3 and color chart ratings falling in the 0 and 1 range. Specific gravities varied insignificantly between treatments and averaged 1.0762.

The single most important factor affecting tuber yields and quality obtained in this trial was time of vine senescence or early dying. Compacted soil restricting aeration and water movement initiates diseases which cause premature senescence of potato vines. Delaying tillage for seed-bed preparation until soil is dry enough to work properly without compaction will improve conditions for optimum potato growth. Delaying planting until these conditions prevail will increase tuber yield, tuber quality, and improve harvest conditions.

<u>Irrigations</u>. Total tuber yields and tuber size were less in the May 13 irrigation treatment. Delaying irrigation until May 31 increased total tuber yield by 98 cwt per acre and increased the yield of number-one tubers by 87 cwt per acre. Delaying irrigation until June 19 increased tuber size and yield of 10-ounce number one tubers, but total tuber yields were equal to the May 31 irrigation treatment and significantly better than the May 13 irrigation. Light reflectance (fry color) and specific gravity readings were comparable for all irrigation treatments (Table 4). Results indicate that delaying application date of irrigation will increase tuber yields and tuber size without affecting fry color or specific gravity quality. Early applications of water increased early vine growth, vine size, and enhanced earlier vine senescence. These three factors are all detrimental in potato production.

Table 1. The effect of soil compaction and planting dates on yield and quality of Russet Burbank potatoes. Malheur Experiment Station, Ontario, Oregon, 1987

Tillage Date	Planting Date	U.S. No. 1 4-6 oz cwt/ac %	U.S. No. 1 6-10 oz cwt/ac %	U.S. No. 1 > 10 oz cwt/ac %	U.S. No. 1 Total cwt/ac %	No. 2 < 10 oz cwt/ac %	No. 2 > 10 oz cwt/ac %	Culls < 4 oz cwt/ac %	Total Yield cwt/ac
March 31	April 1	128	150	30	308	72	18	153	573
March 31	May 2	94	84	28	206	57	16	197	498
April 21	April 21	117	121	28	266	41	11	214	555
May 2	May 2	134	142	29	305	43	19	199	578
	LSD .05	24	28	NS	48	26	NS	42	63
	CV (%)	16	14	18	9	15	21	13	8

Average of 4 replications

Table 2. The effect of soil compaction and planting date on fry quality, specific gravity, and field rot. Malheur Experiment Station, Ontario, Oregon, 1986

Tillage Date	Planting Date	Light Reflectance	USDA Fry Color Rating	Specific Gravity	Field Rot %	Soil Moisture at Planting % Field Capacity	Soil Temp. at Planting °F
March 31	April 1	45.9	1	.0782	8	85	50
March 31	May 2	49.4	0	.0750	7	58	59
April 21	April 21	45.9	1	.0750	4	75	58
May 2	May 2	47.8	0	.0768	2	50	61
	LSD .05	NS	-	NS	3	--	--
	CV (%)	3	-	8	11	--	--

Table 3. The Effect of irrigation timing on tuber yield and quality of Russet Burbank potatoes. Malheur Experiment Station, Ontario, Oregon, 1986

Date of Irrigation	U.S. No. 1								No. 2				Culls		Total
	4-6 oz		6-10 oz		> 10 oz		Total		< 10 oz		> 10 oz		< 4 oz		Yield
	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac
May 13	180	34	173	33	36	7	389	75	24	5	8	2	93	18	518
May 31	231	37	195	81	50	8	476	77	24	4	13	2	98	15	620
June 19	111	18	201	33	150	25	462	76	41	7	42	7	52	8	609
LSD .05	68	--	NS	--	18	--	53	--	11	-	17	-	23	--	67
CV (%)	18	--	16	--	13	--	10	--	17	-	21	-	26	--	9

Table 4. The effect of irrigation timing on tuber yield and quality of Russet Burbank potatoes. Malheur Experiment Station, Ontario, Oregon, 1986

Date of Irrigation	Light Reflectance	USDA Fry Color Rating	Specific Gravity	Field Rot	Soil Moisture at Irrigation	Soil Temp. at Irrigation
				%	% Field Capacity	°F
May 13	35.9	2	.0742	3	69	65
May 31	35.8	2	.0734	2	57	74
June 19	34.3	2	.0729	2	50	79
LSD .05	NS	NS	NS	NS	--	--
CV (%)	2	4	11	19	--	--

POTATO VARIETY TRIALS

Charles E. Stanger and Joey Ishida
Malheur Experiment Station, Ontario, Oregon, 1986

Purpose

Experimental lines of russet skin potatoes were evaluated in five separate trials. The primary objective in variety testing is to identify new potato cultivars which are superior to Russet Burbank.

Introduction

When Russet Burbank potatoes are stressed by high soil and plant temperatures, they produce a higher percentage of tubers with sugar-ends than can be tolerated by the potato-processing industry. Selecting new varieties to replace Russet Burbank will enable potato growers in southwest Idaho and Malheur County of Eastern Oregon to recover acres lost to other potato-growing areas. New varieties offer the best potential for overcoming the inherent sugar-end problem associated with Russet Burbank.

Procedures

Experimental lines of potatoes were planted in the following trials: Oregon Preliminary, Oregon Statewide, Northwest Regional, Ore-Ida Eight-Hill Trial, and Oregon Single-Hill Trial. Individ ual trials were planted between April 25 and 28.

The soil in the trial area was an Owyhee silt loam. Soils had a pH of 7.3 and contained 1.2 percent organic matter. The trial was planted in a field which had grown wheat in 1985, potatoes in 1984, and wheat in 1982 and 1983. In the fall of 1985, following wheat harvest, the straw was shredded and the field disced and rill-irrigated in preparation for fall fertilizer application and moldboard plowing. One-hundred pounds of phosphate and 60 pounds of nitrogen were broadcast before plowing. The field was not tilled after plowing until spring.

On April 20, the field was tilled crossways with a triple-k, loosening the soil as deep as the triple-k would operate. The land was then bedded on 36-inch centers. Large hilling shovels were used to shape the beds and throw the soil, forming a high peak in the center of the individual rows.

Weed control was obtained with a tank-mix combination of Prowl (1.5 pounds ai per acre) and Dual (2 pounds ai per acre). These materials were broadcast over the tops of the beds just before the beds were harrowed down to prepare for planting.

The size of plots and number of replications for each entry varied between trials. Seventy-one entries were planted in the Oregon Preliminary Trial. Individual plots were 12 hills long and each entry was replicated twice. The Oregon Statewide Trial had 19 entries and the Northwest Regional Trial had 14 entries. In these trials each entry was 25 hills long with 4 replications. The Ore-Ida Eight-Hill Trial had 71 entries, 8 hills per entry. Seed piece spacing in all trials was 9 inches apart. Seed pieces of Red Norland potatoes separated each entry planted in the variety trials.

The Oregon Single-Hill Trial had approximately 7,500 lines. Seed piece spacing in the single hill was 27 inches. Seed of Red Norland potatoes separated groups of related crosses in the single-hill trial.

After planting, the potatoes were sidedressed with 125 pounds of nitrogen $(NH_4)_2SO_4)$ and 2.0 pounds active ingredient per acre of Temik and layed-by using hilling shovels mounted on a lilliston.

The potatoes were first irrigated in wheel rows on May 4 to add adequate soil moisture for plant emergence. Subsequent irrigations were not needed until after potatoes emerged. During June, July, and early August when water demands were greatest, water was applied in every row, usually for 12 hours on four day intervals.

The Oregon Single-Hill Trial was harvested on October 2. The remaining trials were harvested during the week of October 6. Data recorded for each entry included total tuber yield, tuber yield by size category for U.S. number ones (4-6oz, 6-10 oz, > 10 oz), number twos, and culls. Ten large tubers from all entries were cut and evaluated for hollow heart and internal abnormalities, including black spot and internal necrosis. Fry color and specific gravity values were determined for all entries from 8-pound samples of 6- to 10-ounce tubers. Fry color evaluations were recorded by a Photometer from pieces of potatoes clipped one-half inch deep from the stem-end. The clippings were deep fried for 2.5 minutes at $375^{o}F$. Recorded data are the amount of light reflected from the center of the cut surface of the clipped piece of potato.

Results

Trial results are summarized in data tables 1 through 4. The experimental lines listed below will be evaluated again in 1987. Lines selected for testing in 1987 were superior to Russet Burbank in fry color and at least equal to Russet Burbank in tuber yield, yield of number-one tubers, and freedom from internal defects.

Tubers from 154 single-hill plants were selected at harvest. These samples were stored in refrigeration at Ore-Ida Foods and fried for sugar-end evaluations in November. Tubers from 63 of the 154 lines evaluated had fry quality superior to Russet Burbank. These are stored at Redmond and are being eye-indexed in preparation for planting in 5-and 8-hill trials in 1987.

Oregon Statewide

A74212-1
A081178-11
A081178-12
A081216-1
A081394-7
C0080152-1
C008177-2
ND534-4

Oregon Preliminary

Lemhi	A082254-24	A082611-7
A81362-3	A082260-4	A082616-12
A81727-9	A082260-7	A082616-18
A081084-2	A082260-8	C0082136-2
A081509-1	A082281-1	C0082063-3
A081512-1	A082283-1	ND01062-1
A081522-1	A082283-5	ND01567-2
A081783-7	A082283-9	ND02061-2
A082023-1	A082606-13	

Regional Trial

A76147-2
A79141-3
AC79100-1
C008014-1

Oregon Single-Hill Entries

C0084061-202	A084336-202	A084421-203
A084439-212	ND02788-201	A084441-210
A084421-205	C0084027-203	A084418-203
A084428-203	A084408-204	C0084042-202
ND02788-203	C0084024-204	A084441-223
A084439-210	ND02692-203	A084427-205
C0084056-201	A084180-201	A084428-204
C0084055-203	C0084055-206	A084427-206
ND02704-208	C0084055-205	A084441-212
A084408-211	A084408-210	C0084055-201
A084428-201	A084439-211	A084421-201
C0084026-202	C0084055-204	A084427-207
A084418-202	ND02692-204	A084439-205
A084408-203	C0084056-204	A084439-206
A084408-205	C0084056-202	A084441-208
A084439-208	C0084026-201	A084427-203
A084408-202	C0084042-203	A084439-202
A084428-202	A084418-205	A084427-201
C0084030-201	C0084056-203	A084427-202
C0084061-204	C0084074-202	A084427-204
ND02692-202	A084431-201	A084418-206

Entries listed above from the single-hill trials will be further evaluated in 5- or 8-hill plots in 1987 because of their excellent fry color and general appearance compared to Russet Burbank. The number of lines will be increased to about 15,000 in 1987 to evaluate a large number of progeny when grown under local environmental and cultural conditions.

Table 1. Yield and quality data for experimental lines entered in the Oregon Statewide Trial. Malheur Experiment Station, Ontario, Oregon, 1986

	No. 1's					No. 2's							Light	Fry Color (%)[1]	
	4-6 oz	6-10 oz	> 10 oz	Total No 1's		< 10 oz	> 10 oz	Culls	Total	H.H	Int. Nec.	S. Gravity	Reflectance	3	4
	- - - - cwt/ac	- - - - -		cwt/ac	%	- - cwt/ac	- - -	cwt/ac	cwt/ac	%	%				
1-R. Burbank	52	119	187	358	84	23	81	47	428	11	0	.0849	33	29	15
2-Lemhi	47	117	230	394	75	9	73	45	522	15	0	.0863	39	17	3
3-Norgold	42	111	246	399	79	12	34	57	504	57	0	.0715	41	8	3
4-A7869-5	30	95	248	373	79	9	64	25	471	3	3	.0812	34	32	5
5-A79141-3	65	169	222	456	74	53	27	84	619	28	4	.0950	52	1	0
6-A7919-1	34	113	332	479	81	0	78	35	592	5	9	.0818	29	44	9
7-A7987-14	61	176	292	529	88	5	20	46	600	0	3	.0855	32	41	4
8-A07869-20	29	122	399	550	77	45	80	37	712	7	3	.0929	42	6	0
9-A07920-4	41	84	201	326	84	6	14	41	387	17	7	.0880	32	26	5
10-A079336-3	51	102	95	248	73	10	21	59	338	15	0	.0912	41	6	0
11-A081195-11	60	124	170	354	77	5	26	77	462	8	2	.0895	42	7	0
12-A081216-1	104	230	164	498	78	3	10	125	636	10	0	.0866	41	8	0
13-A081388-1	44	157	393	594	86	10	22	63	689	16	3	.0818	36	14	3
14-A081394-7	63	126	229	418	84	8	8	65	499	3	1	.1041	42	11	1
15-A081681-1	92	208	371	671	79	27	73	75	845	4	0	.0834	35	23	7
16-A081772-5	75	173	276	524	87	7	21	52	604	4	3	.0842	33	32	4
17-C008014-1	45	131	307	483	84	2	28	60	573	29	0	.0855	45	8	0
18-C0080152-1	38	102	182	322	79	6	23	56	407	2	4	.0875	31	28	13
19-C008177-2	102	128	160	390	78	6	22	79	497	6	3	.0866	46	6	1
LSD (.05)	38	63	111	112	--	15	29	32	144	--	-	.0052	7	15	NS
LSD (.01)	NS	78	NS	NS	--	21	42	47	NS	--	-	.0069	10	21	NS
Mean	57	136	248	441	--	13	38	60	552	--	-	.0867	38	18	4
CV (%)	30	18	19	14	--	42	31	25	11	--	-	4.	13		

[1] Percent of tubers with fry colors falling in 3 and 4 fry color categories of USDA fry color chart.

Table 2. Yield and quality data for experimental lines entered in the Regional Potato Trial. Malheur Experiment Station, Ontario, Oregon, 1986

	No. 1's			Total No 1's		No. 2's		Culls	Total	H.H	Int. Nec.	S. Gravity	Light Reflectance	Fry Color (%)[1]	
	4-6 oz (cwt/ac)	6-10 oz (cwt/ac)	> 10 oz (cwt/ac)	cwt/ac	%	< 10 oz (cwt/ac)	> 10 oz (cwt/ac)	cwt/ac	cwt/ac	%	%			3	4
1-AD7267-3	18	86	196	300	76	7	30	56	393	5	0	1.0858	29	42	7
2-TC582-1	37	134	212	383	79	4	22	72	481	2	0	1.0994	36	10	0
3-AC79100-1	36	104	337	477	82	14	44	44	579	20	0	1.0902	36	14	2
4-AC76147-2	24	118	428	570	77	11	122	39	742	3	3	1.0879	45	7	0
5-A7411-2	31	119	235	385	73	19	79	45	528	2	2	1.0989	44	6	0
6-A74114-4	22	70	285	377	84	5	26	40	448	5	2	1.0902	34	21	7
7-A76260-16	28	133	355	516	83	12	49	38	615	7	3	1.0823	49	0	0
8-A79141-3	58	181	190	429	70	35	59	93	616	12	1	1.0995	59	0	0
9-C008014-1	25	108	347	480	81	18	63	29	590	3	2	1.0878	50	0	0
10-ND534-4	65	158	214	437	85	0	7	67	511	6	0	1.0792	36	12	2
11-Norgold	22	84	278	384	75	16	32	45	514	37	0	1.0738	38	10	5
12-Lemhi	24	89	260	373	76	9	63	47	492	10	5	1.0952	44	11	2
13-R. Burbank	114	178	124	416	70	27	48	102	593	1	0	1.0886	34	24	2
14-A74212-1	39	157	367	563	73	25	129	55	772	0	2	1.08513	30	37	4
LSD (.05)	25	38	91	100	--	NS	54	22	91	--	-	1.0048	4.7	15	NS
LSD (.01)	34	50	124	134	--	NS	72	29	122	--	-	1.0064	6.3	20	NS
Mean	39	123	264	436	--	14	55	56	562	--	-	1.0889	40.4	15	2
CV (%)	45	21	24	16	--	97	68	27	11	--	-	3.8	8.2	69	195

[1] Percent of tubers with fry colors falling in 3 and 4 fry color categories of USDA fry color chart.

Table 3. Yield and quality data for experimental lines entered in the Oregon Preliminary variety trial. Malheur Experiment Station, Ontario, Oregon, 1986

	No. 1's 4-6 oz	6-10 oz	> 10 oz	Total No 1's		No. 2's < 10 oz	> 10 oz	Culls	Total	H.H.	Int. Nec.	S. Gravity	Light Reflectance	Fry Color (%)[1] 3	4
	- - - - cwt/ac - - - - -			cwt/ac	%	- - cwt/ac - - -		cwt/ac	cwt/ac	%	%				
1-R. Burbank	126	117	49	292	65	35	16	108	451	0	0	.0773	36	22	0
2-Lemhi	93	192	114	399	55	75	116	64	565	0	0	.0814	35	23	3
3-Norgold	42	198	59	299	53	87	72	161	559	5	0	.0810	36	13	0
4-851	66	69	59	194	36	181	174	97	646	0	0	.0834	29	59	9
5-852	22	137	372	531	80	51	49	31	662	20	15	.0844	29	54	3
6-A7920-16	36	117	419	572	72	33	142	48	795	0	6	.0788	33	33	0
7-A81320-2	31	60	82	173	63	30	18	55	274	0	0	.0728	37	17	0
8-A81362-3	59	138	224	421	69	61	24	101	607	5	0	.0845	36	13	5
9-A81727-9	74	152	101	327	70	35	33	74	469	0	0	.0797	47	7	0
10-A07869-104	16	53	125	194	53	6	119	45	364			.0817	35	30	0
11-A080229-101	94	124	140	358	70	46	5	100	509	0	6	.0877	36	10	0
12-A081018-4	67	63	31	161	55	33	0	99	293			.0792	41	5	0
13-A081604-2	73	170	141	384	72	29	38	85	536	0	6	.0826	42	3	0
14-A081140-1	49	81	164	294	57	94	56	69	513	20	20	.0939	28	55	12
15-A081227-101	169	83	30	282	64	8	5	147	442	0	0	.0751	48	4	0
16-A081238-101	80	157	195	432	65	28	122	79	661	5	0	.0939	36	14	0
17-A081347-101	59	134	173	366	72	37	37	65	505	0	0	.0972	41	5	0
18-A081479-110	19	90	305	414	79	49	14	45	522	0	0	.0830	37	13	3
19-A081509-1	11	32	40	83	27	50	43	135	311	0	0	.0707	51	8	0
20-A081509-2	115	108	11	234	55	10	0	179	423	0	0	.0915	49	0	0
21-A081512-1	37	140	205	382	83	21	7	48	458	0	0	.0911	41	10	0
23-A081522-1	55	156	154	365	73	42	37	55	499	0	0	.0920	46	5	0
24-A081620-3	55	74	277	406	75	31	41	62	540	9	0	.0918	28	43	25
25-A081783-4	49	103	180	332	72	19	45	64	460	0	0	.0719	43	0	0
26-A081783-7	63	115	150	328	75	37	17	53	435	0	10	.0833	52	3	0
27-A081783-10	6	39	88	133	51	35	42	50	260			.0718	44	5	0
28-A081783-12	39	77	203	319	63	59	73	54	505	25	0	.0829	53	3	0
29-A081794-1	103	102	85	290	47	177	17	129	613	0	0	.0836	47	9	0
30-A081794-2	67	206	159	432	66	124	25	78	659	65	0	.0855	41	5	3
31-A081794-5	43	107	154	304	76	9	16	72	401	33	0	.0822	44	9	3
32-A081794-7	52	85	163	300	65	67	26	69	462	0	0	.0787	41	14	6
33-A081794-8	50	103	59	212	49	90	49	81	432	0	0	.0808	46	0	0
34-A081794-9	70	182	76	328	54	157	67	52	604	0	0	.0888	52	0	0
35-A081794-11	86	150	75	311	69	40	15	83	449	0	0	.0764	48	3	0
36-A081794-17	97	126	74	297	58	60	31	116	512	0	0	.0885	46	0	0
37-A082023-1	131	169	105	405	63	68	7	163	643	0	0	.0820	40	8	3
38-A082024-4	80	196	193	469	68	50	33	142	694	0	10	.0780	35	20	6
39-A082260-4	53	154	158	365	71	43	36	71	515	0	0	.0812	49	8	0
40-A082260-5	28	103	227	358	79	63	49	42	512	0	5	.0852	40	13	10
41-A082260-7	104	83	61	248	54	28	76	104	456			.0859	48	0	0
42-A082260-8	72	167	59	298	59	69	9	130	506	0	0	.0870	54	0	0
43-A082263-7	46	49	37	132	39	119	16	73	340			.0812	55	0	0
44-A082263-107	50	143	154	347	69	52	28	78	505	24	0	.0845	43	8	3
45-A082283-1	49	134	262	445	60	86	153	60	744	0	0	.0915	52	0	0
46-A082283-5	40	104	238	382	66	39	81	79	581	0	0	.1001	41	3	0
47-A082283-9	47	98	314	459	84	21	25	43	548	5	0	.0912	46	5	0
48-A082545-2	41	112	207	360	76	26	45	40	471	15	0	.0737	39	10	3
49-A082606-13	65	156	59	280	56	71	33	120	504	0	15	.0878	37	22	0
50-A082611-7	69	155	220	444	68	50	97	59	650	5	0	.0904	54	3	0
51-A082616-4	47	85	107	239	57	14	92	74	419	0	0	.0855	43	7	7
52-A082616-8	120	136	18	274	64	20	18	113	425	0	0	.0951	47	0	0
53-A082616-12	118	125	37	280	62	73	0	102	455	0	0	.0956	48	0	0
54-A082616-18	49	126	108	283	62	41	13	113	455	0	0	.0922	53	0	0
55-A082764-1	18	76	227	321	75	25	38	42	426	66	65	.0848	37	22	0
56-A082764-6	45	100	235	380	83	0	45	52	477	0	0	.0892	33	22	0
57-A083188-3	84	61	18	163	50	33	25	108	329	100	0	.0873	49	5	0
58-C0082006-1	34	157	149	340	83	16	22	33	411	25	0	.0815	44	3	3
59-C0082105-2	22	114	148	284	77	23	24	40	371	0	0	.0903	35	20	6
60-C0082123-11	34	78	49	161	49	58	18	89	326			.0770	42	8	0
61-C0082013-4	93	97	73	263	58	48	7	134	452	0	0	.0796	33	32	0
62-C0082136-2	36	43	120	199	51	38	85	67	392	0	0	.0850	52	0	0
64-C0082063-3	44	113	184	341	85	18	6	35	400	0	0	.0806	43	10	0
65-C0082067-1	37	124	182	343	67	55	9	105	512	16	0	.0849	43	5	0
66-C0082068-1	30	94	201	325	48	136	.179	34	674	27	33	.0781	39	4	0
67-C0082582-3	52	51	14	117	62	10	22	40	189			.0719	49	6	0
68-ND01062-1	44	48	152	244	51	120	69	47	480			.0867	48	6	0
69-ND01076-2	30	81	129	240	66	33	41	47	361	0	0	.0814	52	6	0
70-ND01496-1	93	124	126	343	59	33	12	195	583	83	83	.0947	62	0	0
71-ND01567-2	112	165	53	359	79	10	0	83	443	0	0	.0745	48	3	0
R8-R. Burbank	112	192	112	416	66	94	19	103	632	7	0	.0841	37	10	0
LSD (.05)	32	84	78	98	—	65	73	45	121	—	—	.0100	8	26	NS
LSD (.01)	49	NS	91	129	—	79	95	61	172	—	—	.0133	10	26	NS
Mean	61	115	139	313	—	52	44	81	490	—	—	.0841	43	11	2
CV (%)	33	27	23	14	—	58	63	29	9	—	—	6.	9	—	—

[1]Percent of tubers with fry colors falling in 3 and 4 fry color categories of USDA fry color chart.

HERBICIDE TRIALS IN RUSSET BURBANK POTATOES

Charles E. Stanger and Joey Ishida
Malheur Experiment Station, Ontario, Oregon, 1986

Purpose

Herbicides were applied as preplant incorporated, pre-emergence non-incorporated, and postemergence treatments to obtain efficacy data for weed control and tolerance in potatoes grown using furrow irrigation.

Procedures

Russet Burbank potatoes were planted in Owyhee silt loam soil with a pH of 7.3 and an organic matter content of 1.2 percent. The land had previously grown wheat. Before the wheat stubble was plowed it was shredded, disced, irrigated, and fertilized. Fertilizer applied in the fall of 1985 consisted of 100 pounds of phosphate and 60 pounds of nitrogen. After plowing, the field was left until spring without further tillage.

On April 10, 1986, the soil was tilled with a triple-k once and the loose soil bedded in rows 36 inches apart. Large 12-inch hilling shovels were used to make high well-hilled beds. Peaked beds with deep furrows are essential to successful use of herbicides applied to bedded land for weed control. The preplant herbicide treatments were applied as double overlap broadcast applications over the bedded land and the beds were harrowed to incorporate herbicides and prepare land for planting.

The potatoes were planted on May 12. The planted rows were rehilled using hilling shovels mounted in front and behind the rolling teeth of a lilliston cultivator. Soil and herbicides from the furrows were thrown over the tops of the planted potato rows and mulched by the tilling action of the rolling teeth of the lilliston. The potatoes were layed-by and the pre-emergence non-incorporated herbicide treatments were broadcast over the top of the hilled rows.

On May 14, the potatoes were furrow irrigated for moisture to sprout and emerge potatoes and to germinate weed seed and activate the preplant and pre-emergence herbicide treatments.

The preplant and pre-emergence herbicides were applied using a single-wheel bicycle plot sprayer. The spray pattern was double overlap. The spray boom was nine feet long. Spray nozzles were teejet fan nozzles size 8002 spaced at 10-inch intervals along the boom. Spray pressure was 35 psi and water as the carrier was applied at a volume of 28 gallons per acre.

The postemergence treatments were applied on June 4. The potato foliage was about eight inches tall. The herbicides were applied using a CO_2 backback sprayer. The boom was six feet wide covering the width of two potato rows. The spray nozzles were teejet fan size 8002. Spray pressure was 35 psi. Water as the carrier was applied at a volume of 32 gallons per acre. The weed species emerged at time of spraying were barnyardgrass, pigweed, and lambsquarters. The broadleaf weeds were less than three inches tall when herbicides were applied. The largest barnyardgrass had four leaves and one tiller.

Individual plots were two rows wide and 30 feet long. A three-foot wide non-planted area was a buffer separating adjacent plots. Each treatment was replicated four times and was placed at random using a complete block experimental design.

The treatments were evaluated for weed control and crop tolerance on June 20 and September 17. The potato vines were beat off on September 19 and the tubers harvested on September 20. The harvested tubers were graded to obtain tuber yields and yields of number ones, number twos, and culls. Samples of 20 tubers were taken from each plot and analyzed for specific gravity and fry color. Fry color is reported as light reflectance from readings taken with a Photometer. A clipped section one-half inch deep was taken from the stem-end of the tuber and deep fried for 2.5 minutes at 325^{o}F to determine fry quality and percent of tubers with sugar-ends.

Results

The better herbicide treatments were Genep/Cobra + Sencor (ppi + pe), Cinch (ppi), and the postemergence treatments of Sencor + Fusilade (Table 1). These herbicides gave nearly complete control of barnyardgrass, pigweed, and lambsquarters. Tillage was necessary to adequately incorporate herbicides for soil activity under furrow irrigation. Sencor applied pre-emergence in sequence with the preplant application of Genep + Cobra enhanced the activity of Genep + Cobra even though Sencor was a pre-emergence soil surface treatment. Fusilade was needed for barnyardgrass control in Sencor + Fusilade tank-mix combinations.

The potatoes were tolerant to all herbicide treatments (Table 2). Tuber yields and tuber quality for treated plots were equal to those in the hand-weeded control plots. Weed competition in the non-weeded control plots reduced tuber yields but did not affect fry color ratings or specific gravity values. Weeds competing with the crop in the non-weeded control caused significant yield reductions in 10-ounce number ones and increased cull yield. Cull yield was increased because of the number of small tubers ($<$ 4 ounces). Total yield of tubers from certain herbicide treatments was not great enough to be significantly higher than tuber yields in the non-weeded control. This effect however, was a result of the number of culls in the non-weeded control. If the cull yields had been dropped in calculating total yield, yield differences would be significantly higher for all herbicide treatments when compared to yield in non-weeded control.

Table 1. The percent weed control and tolerance of potatoes to the herbicides applied as preplant, pre-emergence, and postemergence treatments to Russet Burbank potatoes. Malheur Experiment Station, Ontario, Oregon, 1986

Herbicide	Rate lbs ai/ac	Applied	Crop Injury		- - - - Percent Weed Control - - - - -					
					Barnyardgrass		Pigweed		Lambsquarters	
			6/20	9/17	6/20	9/17	6/20	9/17	6/20	9/17
Genep/Cobra	3 + 0.3	ppi/pe	0	0	95	88	96	90	94	90
Genep/Cobra	3 + 0.6	ppi/pe	0	0	95	90	98	92	95	91
Cobra/Fusilade	0.3 + 0.25	pre/post	0	0	98	92	99	96	96	91
Dual/Cobra	3 + 0.3	pe	0	0	82	78	92	83	76	65
Cinch/Cobra	0.4 + 0.3	pe	0	0	98	96	98	98	92	90
Genep/Cobra + Sencor	3 + 0.5 + 0.25	ppi/pe	0	0	98	98	100	100	99	99
Cinch	0.8	ppi	0	0	99	98	97	95	96	94
Cinch	1.2	ppi	0	0	99	99	98	95	99	98
Cinch	0.8	pe	0	0	74	83	68	80	65	78
Cinch	1.2	pe	0	0	78	88	78	81	68	83
Fusilade + Sencor	0.125 + 0.5	post	0	0	100	100	100	100	100	100
Fusilade + Sencor	0.188 + 0.5	post	0	0	100	100	100	100	100	100
Sencor	0.5	post	0	0	85	82	100	100	100	100
Handweed Check	---	----	0	0	100	80	100	92	100	95
Weedy Check	---	----	0	0	0	0	0	0	0	0

Evaluated June 20 and July 17.

Ratings: 0 = no effect, 100 = all plants killed.

Table 2. Tuber yields and tuber quality from Russet Burbank potatoes treated with herbicides applied as preplant, pre-emergence and postemergence treatments. Malheur Experiment Station, Ontario, Oregon, 1986

Herbicides	lbs ai/ac	Applied	U.S. No. 1's 4-6 oz cwt/ac	U.S. No. 1's 6-10 oz cwt/ac	U.S. No. 1's > 10 oz cwt/ac	Total No.1's cwt/ac	No.2's cwt/ac	Culls cwt/ac	Total cwt/ac	Light Reflectance	Specific Gravity
Genep/Cobra	3 + 0.3	ppi/pe	55	137	166	358	70	50	478	35.6	0.0831
Genep/Cobra	3 + 0.6	ppi/pe	41	143	169	353	82	50	485	33.4	0.0811
Cobra/Fusilade	0.3 + 0.25	pe/post	58	157	174	389	77	53	519	36.3	0.0836
Dual/Cobra	3 + 0.3	pe	65	147	179	391	72	60	523	39.4	0.0840
Cinch/Cobra	0.4 + 0.3	pe	48	137	172	357	77	60	494	31.3	0.0831
Genep/Cobra + Sencor	3 + 0.5 + 0.25	ppi/pe	70	146	186	402	79	55	536	35.1	0.0829
Cinch	0.8	ppi	58	137	178	373	79	53	505	37.6	0.0837
Cinch	1.2	ppi	60	140	186	386	77	60	523	38.7	0.0836
Cinch	0.8	pe	53	145	164	362	65	60	487	33.1	0.0836
Cinch	1.2	pe	62	157	162	381	68	60	509	32.8	0.0834
Fusilade + Sencor	0.125 + 0.5	post	65	149	169	383	73	63	519	36.7	0.0832
Fusilade + Sencor	0.188 + 0.5	post	61	153	174	388	76	57	521	37.2	0.0839
Sencor	0.5	post	59	143	161	363	71	59	493	35.9	0.0835
Handweeded Check	---	----	65	155	159	379	72	63	514	32.6	0.0836
Weedy Check	---	----	47	122	116	285	58	107	450	35.4	0.0831
LSD (.05)	---	----	NS	28	38	62	NS	31	72	NS	NS
CV (%)	---	----	24	14	18	11	36	21	9	6	7
Mean	---	----	58	140	177	376	72	55	508	35.4	0.0833

AN EVALUATION OF POSTEMERGENCE APPLICATIONS OF METRIBUZIN ON SUGAR-ENDS IN RUSSET BURBANK POTATOES

Charles E. Stanger and Joey Ishida
Malheur Experiment Station, Ontario, Oregon, 1986

Purpose

Trials were initiated to determine if Sencor can cause an increase in the percent of sugar-ends in Russet Burbank potatoes.

Introduction

Preliminary research has indicated that Sencor applied as postemergence treatments to Russet Burbank potatoes has caused enough growth stress on potato foliage to increase the percent of sugar-ends. Foliar stress was observed as chlorosis and in some cases has been severe enough to cause necrosis on leaf margins. Most often foliar symptoms occur when Sencor is applied under high air temperatures and light intensity one or two days following cool, cloudy, or rainy weather. Sencor destroys chlorophyll and interferes with carbohydrate formation and movement when postemergence applications are appled in June when tubers are sensitive to the initiation of sugar-ends.

Procedures

Russet Burbank potatoes were planted on April 22 on land that was plowed in the fall of 1985 and bedded in the spring of 1986. The land had been rotated to Stephens wheat in 1984 and had grown an experimental crop, Cuphea, in 1985. One-hundred pounds per acre phosphate and 60 pounds per acre of nitrogen were applied broadcast in the fall of 1985 and plowed under with a moldboard plow. The field was left plowed during the winter.

In the spring, the seed bed was tilled with a triple-K field cultivator and bedded into rows 36 inches apart. A tank-mix combination of Prowl (pendimethalin) at 1.5 pounds active ingredient per acre and Dual (metalochlor) at 2 pounds active ingredient per acre was applied for weed control. The herbicides were broadcast over the bedded land before the beds were harrowed in preparation for planting. After planting, 150 pounds of nitrogen per acre and 2 pounds active ingredient of Temik were sidedressed. The potatoes were then hilled using a lilliston and layed-by without further tillage.

On May 1, the potatoes were irrigated lightly, in alternate rows, to add soil moisture for sprouting and emergence.

The first Sencor treatments were applied on June 13. The potato foliage was 8 to 10 inches tall. Sencor was applied at 0.38 and 0.5 pounds active ingredient per acre as single and double applications. The second application for the double-applied treatments was made on June 22 just before the potato foliage closed the rows. The additional herbicide was applied on July 12 at 0.5 pounds active ingredient per acre. This treatment was applied following two to three days of cool, rainy weather in which temperatures dropped from a high of 91.5°F for two days to 78°F for one day, and 0.22 inches of rain fell on July 10. Air temperature on July 12 was 85°F.

Skies were clear on June 13 and 22 and respective temperatures on those dates were 92° and 89°F.

All herbicides were applied using a CO_2 backpack sprayer with a spray boom covering a six foot width. Spray pressure was 35 psi, and water as the herbicide carrier was applied at a rate of 28 gallons per acre. Individual plots were six feet wide (two rows) and 30 feet long. A buffer area, one row wide, separated plots that were adjacent to each other. Each treatment was replicated four times and all treatments were arranged at random using a randomized block experimental design.

The potatoes were observed for symptoms of Sencor injury to the potato foliage on June 19 and 29. On both dates, the potato foliage treated at all rates was showing some yellowing from chlorosis, and leaf margins of some leaves were burning from necrosis. More yellowing and burn were evident at the higher rate and on the plants receiving two applications.

The tubers were harvested to determine yield, quality, specific gravity, and fry color on October 12 and 13. Tuber yield and tuber quality were determined from tubers harvested from two rows 15 feet long. Twenty tubers of uniform size (8 to 10 ounces) were selected from the remaining 15 feet of two rows for specific gravity and fry color evaluations. The tubers selected for density and fry color evaluations were stored in coolers at 65°F temperatures until they were processed by OSU staff in December at Ore-Ida Foods research laboratories. Fry color was determined using a Photovolt reflection meter measuring the light reflectance. Rating fry color was accomplished by correlating reflectance reading with a USDA color chart.

Results

Metribuzin (Sencor) applied at rates and time of application evaluated in this trial had no detrimental effect on tuber yield or tuber quality. The rates and time of application are in accord with label rates for postemergence applications. In fry color determinations it was noted that light reflection varied more between replications for the control than from any treatment.

Higher application rates will be evaluated to find an effect level on quality to determine what amount of tolerance growers have in using metribuzin as postemergence treatments to Russet Burbank potatoes.

Table 1. Tuber yields from metribuzin-treated Russet Burbank Potatoes. Malheur Experiment Station, Ontario, Oregon, 1986

Rate lbs ai/ac	Applied	U.S. No. 1's > 10 oz cwt/ac	U.S. No. 1's 6-10 oz cwt/ac	U.S. No. 1's 4-6 oz cwt/ac	Total No. 1's cwt/ac	Total No. 1's %	NO. 2's < 10 oz cwt/ac	NO. 2's > 10 oz cwt/ac	Culls cwt/ac	Total cwt/ac
0.38 + 0.38	6/13 & 6/22	144	213	110	467	72	53	46	107	673
0.50	6/13	146	179	104	429	64	59	68	109	665
0.50 + 0.50	6/13 & 6/22	171	200	93	464	66	68	66	108	706
0.50	7/12	181	186	104	471	69	70	59	85	685
Check	----	152	198	108	458	68	56	65	96	675
LSD (.05)		NS	NS	NS	NS	--	NS	NS	NS	NS
CV (%)		15	12	7	8	--	30	34	16	6

Table 2. Reflectance reading data as indication of fry color quality from Russet Burbank potatoes treated with postemergence applications of metribuzin. Malheur Experiment Station, Ontario, Oregon, 1986

Rate lbs ai/ac	Applied	Specific Gravity	Reflectance	Standard Deviation	USDA Color Ratings No. 3[1]	USDA Color Ratings No. 4[2]
0.38 + 0.38	6/13 & 6/22	0.0850	34.72	6.6	3.5	0
0.50	6/13	0.0844	35.38	5.6	2.5	0
0.50 + 0.50	6/13 & 6/22	0.0857	34.85	5.8	3.0	0
0.50	7/12	0.0856	34.65	6.4	4.2	0
Check	----	0.0832	34.08	5.5	5.5	0.2
LSD (.05)		NS	NS	NS	NS	NS
CV (%)		2.4	7.6	21	62	--

[1]Number of tubers from 20-tuber sample that had a light reflectance reading less than 28 and more than 19.
[2]

THE EFFECT OF GROWTH-REGULATING AGENTS ON POTATO YIELDS AND QUALITY

Charles E. Stanger and Joey Ishida
Malheur Experiment Station, Ontario, Oregon, 1986

Purpose

MCPA and PPG-1720 were evaluated as foliar-applied treat ments to increase tuber yield, and tuber size, reduce the percent of number two tubers, and improve tuber quality by reducing number of tubers with sugar-ends and low-fry quality in Russet Burbank potatoes.

Procedures

Russet Burbank potatoes were planted on April 13 in Owyhee silt loam soil with a pH of 7.3 and an organic matter content of 1.2 percent. Potatoes and wheat were grown in 1984 and 1985, respectively. After the wheat harvest in 1985, the straw was shredded, fertilizer added (100 pounds phosphate per acre and 60 pounds of nitrogen per acre), and the field was moldboard plowed.

Spring tillage in preparation for planting included triple-k tillage, bedding on 36-inch centers, and applying Dual (2 pounds per acre) and Prowl (1.5 pounds per acre) for weed control. After the herbicides were applied over the bedded land, the beds were harrowed nearly flat and a Russet Burbank variety of potatoes was planted and partially hilled with shovels mounted on the potato planter. After planting, the potatoes were sidedressed with 150 pounds of nitrogen ($(NH_4)_2SO_4$) and 2 pounds of Temik. The potato rows were hilled and the field was layed-by without any further tillage or tractor traffic.

The potatoes were irrigated in every other row to apply only enough soil moisture to sprout the tuber for shoot emergence.

The first application of PPG-1720 was applied on June 7 when the stolons were "hooking." The MCPA treatments and the application of PPG-1720 at "tuber initiation" were applied on June 13. The 7-10 day repeat treatments of PPG-1720 to the tuber initiation treatments were applied on June 20. Application rates of MCPA were 0.25, 0.50, 0.75, 1.00, and 0.25 + 0.25 pounds active ingredient per acre.

Individual plots were two rows wide and 30 feet long. A buffer three feet wide separated adjacent plots. Each treatment was replicated four times and randomized using a complete block experimental design.

The chemicals were broadcast sprayed onto the potato foliage using a back pack CO_2 plot sprayer. The spray boom was six feet long, with five teejet nozzles size 8003. Spray pressure was 35 psi and water was applied as the carrier at a rate of 40 gallons per acre.

The potatoes were harvested during the second week of October. Tubers from two rows 15 feet long were harvested and graded to determine tuber yields and tuber size and quality. Number-one tubers from PPG-1721 treatments were sized from 4 to 8 ounces, 8 to 10 ounces, 10 to 12 ounces, and larger than 12 ounces. Number-one size grades from MCPA treatments were 4 to 6 ounces, 6 to 10 ounces, and more than 10 ounces. Number twos and culls were also determined from both trials.

Twenty 8- to 10-ounce tubers were picked off the ground from the remaining 15 feet of each two row plot for specific gravity and sugar-end analysis. These samples were stored in refrigerated rooms at 65^{o}F until they were analyzed in December by OSU staff at Ore-Ida Foods laboratory. A photovolt meter measuring light reflectance was used in measuring fry color of tubers. A section one-half inch deep from the stem-end of the tuber was deep fried for 2.5 minutes at 325^{o}F. Light reflectance from the center of the clipped tuber was measured with the photovolt meter. Readings less than 28.9 are dark colored and unacceptable by potato processors.

Results

MCPA caused significant reductions in total yield, size, and percent of number ones. Harvested tubers from MCPA-treated plants were severely misshapen with rough skins and warts on the surface of tubers. MCPA did not reduce the fry quality or specific gravity.

Total tuber yields were generally less in plants treated with PPG-1721 compared with the control treatment. Total tuber yields between treatments were variable and with exception of two treatments (50-ppm tuber initiation and 100-ppm stolon hooking) were not enough to be significant at the 5 percent level (Table 1). Percent of 12-ounce tubers increased with rate of PPG-1721 with a compensating reduction in yield of smaller-sized tubers. This effect was evident with the stolon hooking treatments for 50-, 75-, and 100-ppm rates. No differences in fry color or specific gravity readings occurred with PPG-1721 treatments.

In summary, MCPA had a severe adverse effect on potato tuber production. PPG-1721 treatments compared to control treatments tended to reduce total tuber yield but increased size or percent of 12-ounce number one tubers and lowered yield of small number one tubers.

Table 1. Tuber yields from PPG-1721-treated Russet Burbank potatoes. Malheur Experiment Station, Ontario, Oregon, 1986

PPG-1721	Applied	U S No. 1's				Total 1's		U S No. 2's		Culls		Total Yield	Fry Color	Specific Gravity
(ppm)		4-8 oz	8-10 oz	10-12 oz	>12 oz	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac		
50	Stolon Hooking	185	123	48	111	467	65	147	21	95	13	709	31.0	0.0844
75	Stolon Hooking	175	116	40	153	484	65	175	23	82	11	741	32.9	0.0855
100	Stolon Hooking	163	100	54	123	440	62	181	25	86	12	707	30.4	0.0842
150	Stolon Hooking	174	101	64	109	448	61	199	27	89	12	736	31.9	0.0866
50	Tuber initiation & 7 days	186	103	56	89	434	62	172	25	90	13	696	32.1	0.0854
75	Tuber initiation & 7 days	184	106	57	108	455	64	161	22	91	12	707	34.3	0.0851
100	Tuber initiation & 7 days	196	138	47	130	511	69	140	19	90	12	741	32.8	0.0865
150	Tuber initiation & 7 days	200	108	44	112	464	63	174	24	98	13	736	32.6	0.0850
	Check	229	109	66	102	506	65	176	23	89	11	771	33.3	0.0856
	LSD 0.10	---	20	--	---	---	--	29	--	--	--	--	NS	NS
	LSD 0.05	30	--	16	31	61	--	---	--	--	--	--	NS	NS
	CV (%)	11	15	20	19	9	--	14	--	15	--	7	8.5	3.1
	Mean	187	112	53	114	446	--	169	--	89	--	726	32.3	0.0854

Table 2. Tuber yields from MCPA-treated Russet Burbank potatoes. Malheur Experiment Station, Ontario, Oregon, 1986

lbs ai/ac	U.S. No. 1's > 10 oz cwt/ac	U.S. No. 1's 6-10 oz cwt/ac	U.S. No. 1's 4-6 oz cwt/ac	Total No. 1's cwt/ac	Total No. 1's %	No. 2's cwt/ac	No. 2's %	Culls cwt/ac	Culls %	Total cwt/ac	Fry Color	Specific Gravity
0.25	83	124	101	308	46	241	36	116	17	665	39.4	0.0862
0.50	81	107	90	278	38	336	46	113	16	727	34.5	0.0838
0.75	56	133	120	309	44	253	36	142	20	704	36.6	0.0855
1.00	39	138	116	293	44	255	38	112	17	660	33.5	0.0838
025 + 0.25	62	146	97	305	49	176	28	141	23	622	39.1	0.0850
Check	145	151	123	419	55	250	33	86	11	755	33.0	0.0864
LSD .05	24	35	29	44	--	79	--	25	--	82	4.6	NS
LSD .01	33	NS	NS	61	--	NS	--	NS	--	NS	NS	NS
CV (%)	20	17	18	9	--	20	--	14	--	8	8.4	3.3
Mean	78	133	108	319	--	251	--	118	--	689	36.0	0.0851

EFFECTS OF STRAW MULCH AND IRRIGATION RATE ON SOIL LOSS AND RUNOFF

Clinton Shock, Herb Futter, Robert Perry,
Jerry Swisher, and Joe Hobson

Malheur Experiment Station and Soil Conservation Service,
Ontario, Oregon

Summary

A Nyssa silt loam soil was bedded for potatoes. Furrow irrigation for 11 hours at four gallons per minute on a 2.5 percent slope resulted in 17.7 tons of soil lost per acre. Soil loss was reduced to 2.8 tons per acre by the use of 790 lbs/acre of wheat straw mulch. At two gallons per minute, straw reduced soil losses from 3.4 to 0.02 tons per acre. Erosion control benefits from mulch continued to a lesser extent during the second irrigation. Wheat straw mulch increased water intake and decreased runoff. Water intake was not related to the irrigation inflow rate.

Introduction

Furrow irrigation on moderate slopes can lead to high rates of soil loss and low efficiency of water use. Where water intake is limited, crop yield and quality can be adversely affected. Application of small quantities of straw mulch is a possible practical means to decrease erosion and increase water infiltration. Robert Berg (1984) showed that small quantities of straw could increase water infiltration and decrease soil loss in furrow-irrigated crops near Kimberly. Berg's studies were done on straw applied uniformly by hand into the furrows. Miller and Aarstad (1983) showed that at Prosser, Washington, most of the measured soil loss occurring under furrow irrigation could be controlled by relatively small quantities of hand-applied straw (between 360 and 1,080 lbs of straw per acre). Although the costs of wheat straw mulch are low, the labor costs to apply the mulch can be considerable. The use of a tractor-drawn multiple-row straw spreader used in this experiment makes the mulch a more feasible alternative.

Materials and Methods

An experiment was designed to measure the effects of straw mulch and irrigation rate on runoff, water intake, and soil erosion. The soil used was a Nyssa silt loam with average slope of 2.5 percent at the Malheur Experiment Station. The soil is a typical bench soil planted to a wide variety of row crops.

More than 40 beds for potatoes were prepared with three feet between the furrows. Operations in preparing the land were repeated so there would be no difference in tractor traffic between wheel rows and non-wheel rows. Forty furrows 250 feet long were used for the experiment. Each replicate of each treatment was installed in five parallel furrows.

The land was bedded as if a potato crop were going to be planted. No crop was planted. The first irrigation was made on August 6 and 7 and the second irrigation was made on August 20 and 21. The first irrigation dates were chosen for the convenience of making erosion and water measurements.

The treatments were 1) strawed furrows, two gallons per minute irrigation, 2) non-strawed furrows, two gallons per minute irrigation, 3) strawed furrows, four gallons per minute irrigation and 4) non-strawed furrows, four gallons per minute irrigation. Furrows were strawed using Hobson's Baled Mulch Applicator. This machine spread 790 lbs/acre(5.4 lbs/100 ft. of furrow) of baled wheat straw simultaneously down the length of five furrows. The straw distribution was not completely uniform. Most of the straw fell into the furrow. Loose soil in the bedded ground tended to hold the straw in place before the first irrigation.

Furrow irrigation was controlled by adjusting the outlets of gated pipe. Powlus flumes were used to measure water inflow and outflow throughout the duration of the experiment. Soil erosion was calculated by collecting runoff water and allowing collected sediment to settle in Imhoff cones.

Results and Discussion

Differences among the treatments were clearly evident from the beginning of the first irrigation. At approximately four gallons per minute the water reached the end of the non-strawed 250-foot furrow in 40 minutes; the strawed furrow took 89 minutes. At approximately two gallons per minute, the water took 108 minutes in the non-strawed furrows and 175 minutes in the strawed furrows.

Sediment differences in the outflowing water were obvious from subjective evaluation. During the first irrigation, water coming from the strawed furrows appeared as clear as the water entering the furrow at the top of the field regardless of irrigation rate. During the second irrigation, only the strawed furrow at two gallons per minute had clear water at the lower end of the field.

1. Water Inflow

Water inflows were maintained close to the two- and four-gallon per minute rates desired (Table 1). Analysis of the outflow volumes, water intake, and irrigation rate effects on erosion were based on actual rates of inflow into the furrows at the top of the field.

2. Water Outflow

Water outflow volume was closely related to the rate of inflow (Tables 1 and 2). Outflow volumes showed highly significant decreases with straw mulch.

3. Water Intake

Averaged over water inflow rates and irrigations, straw mulch increased water intake by 250 gallons per furrow per irrigation during the first 7 hours and 10 minutes, and by 460 gallons over the entire 11 hours. Increased water intake from straw was greatest during the first irrigation (Table 1). On average, the use of straw increased the amount of total water intake by 20 percent (Tables 1 and 2).

Water intake over time is extremely important for crop growth and water management. The strawed treatment at four gallons per minute was not as effective at promoting water intake during the second irrigations as during the first irrigation (Table 1, Figures 1 and 2).

Water intake was not influenced by irrigation rate (Table 2), suggesting that water intake was severely limited by water infiltration rates in this soil.

4. Sediment Yield

Soil loss at a rate of 18 tons per acre per irrigation occurred with water application rates of four gallons per minute per furrow. At four gallons per minute, 790 lbs/acre of straw mulch reduced soil loss to less than 3 tons per acre on the first irrigation, but soil loss rose to 8 1/2 tons per acre on the second irrigation. The soil loss on the second irrigation was exaggerated on the mulched treatment because the mulch had stimulated high water intake during the first irrigation. The soil retained a large reserve of moisture from the first irrigation that slowed intake, increased outflow, and increased soil loss from strawed furrows during the second irrigation.

At two gallons per minute, soil loss from strawed furrows averaged less than 0.2 tons per acre per irrigation over 11 hours. The non-strawed furrows lost more than 3.3 tons of soil per acre per irrigation. The soil loss over time was least during the initial part of both irrigations (Figures 3 and 4).

Literature Cited

Berg, R. D. 1984. Straw residue to control furrow erosion on sloping, irrigated cropland. Journal of Soil and Water Conservation 39(1): 58-60.

Miller, D. E. and J. S. Aarstad. 1983. Residue Management to reduce furrow erosion. Journal of Soil and Water Conservation 38(4): 366-370.

Table 1. The effects of straw mulch (790 lbs/acre) and irrigation rate on water intake, water loss, and soil erosion loss on land bedded for potatoes. Measurements were made during two successive furrow irrigations. The soil was a Nyssa silt loam with 2.5 percent slope. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1985

Treatments				Average Results After 7:10 Hours					Average Results After 11 Hours				
Strawed or No straw	Planned Inflow Rate	Average Inflow Rate	Average Percent Slope	Total Water Inflow Per Furrow	Total Water Outflow Per Furrow	Total Water Intake Per Furrow	Percent Water Intake	Average Sediment Yield	Total Water Inflow Per Furrow	Total Water Outflow Per Furrow	Total Water Intake Per Furrow	Percent Water Intake	Averaged Sediment Yield
	gpm	gpm	%	gallons	gallons	gallons	%	tons/acre	gallons	gallons	gallons	%	tons/acre
First Irrigation													
Strawed	2	2.16	2.49	940	100	840	90	0.02	1510	430	1080	72	0.02
Non-strawed	2	2.18	2.48	950	320	630	66	0.64	1530	730	800	52	3.37
Strawed	4	4.41	2.50	1860	750	1100	60	1.81	3070	1060	2010	66	2.78
Non-strawed	4	3.89	2.43	1660	1090	570	34	11.50	2800	1940	860	31	17.74
Second Irrigation													
Strawed	2	1.78	2.49	780	300	480	61	.15	1160	480	690	59	0.17
Non-strawed	2	1.74	2.48	780	460	320	41	2.66	1140	710	430	38	3.46
Strawed	4	4.15	2.50	1770	1270	500	28	4.95	2720	1930	780	29	8.47
Non-strawed	4	4.23	2.43	1800	1380	420	23	15.99	2770	2180	590	21	19.51

Statistical relationships are listed in Table 2.

Table 2. Observed variations in water loss, water intake, and soil loss had highly significant relationships to the average water inflow rate, whether or not the furrow was strawed, or whether the observation was during the first or second irrigation. To interpret the equations the average inflow rate per furrow in gallons per minute is represented as "Inflow" and the percent slope is represented as "Slope." Both "Inflow" and "Slope" are continuous variables. The variable "Irrigation" takes on the values 0 or 1 depending on whether it is the first or second irrigation. The variable "Strawed" takes on a value of 1 when strawed and a value of 0 otherwise. Malheur Experiment Station, Ontario, Oregon, 1985

1. Total Outflow Volume to 7:10 hours (gallons/furrow)	= 204	+ 53.7^{***} $(\text{Inflow})^2$	+ 204^{**} (Irrigation)	- 299^{**} (Strawed	ns	$R^2 = .96$
2. Total Water Intake to 7:10 hours (gallons/furrow)	= 665	ns	- 355^{***} (Irrigation)	+ 251^{**} (Strawed	ns	$R^2 = .69$
3. Percent Water Intake to 7:10 hours (%)	= 74	- 1.92^{***} $(\text{Inflow})^2$	- 25.4^{***} (Irrigation)	+ 20.3^{**} (Strawed)	ns	$R^2 = .81$
4. Percent Water Loss at 7:10 hours (%)	= 20	+ 12.5^{***} (Inflow)	+ 20.1^{***} (Irrigation)	- 13.8^{**} (Strawed)	ns	$R^2 = .97$
5. Ln (Sediment Yield to 7:10 hours) (Ln(tons/acre))	= -10.2	+ 1.37^{***} (Inflow)	+ 1.63^{**} (Irrigation)	- 3.06^{**} (Strawed)	+ 2.74^{*} (Slope)	$R^2 = .90$

* statistically significant p. _ .95
** highly significant p. _ .99
*** vary highly significant p. _ .999

<u>Figure 1.</u> Percent water intake over time during the first irrigation in strawed and non-strawed furrows at two irrigation rates. Water intake was measured on a Nyssa silt loam with 2.5 percent slope. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1985.

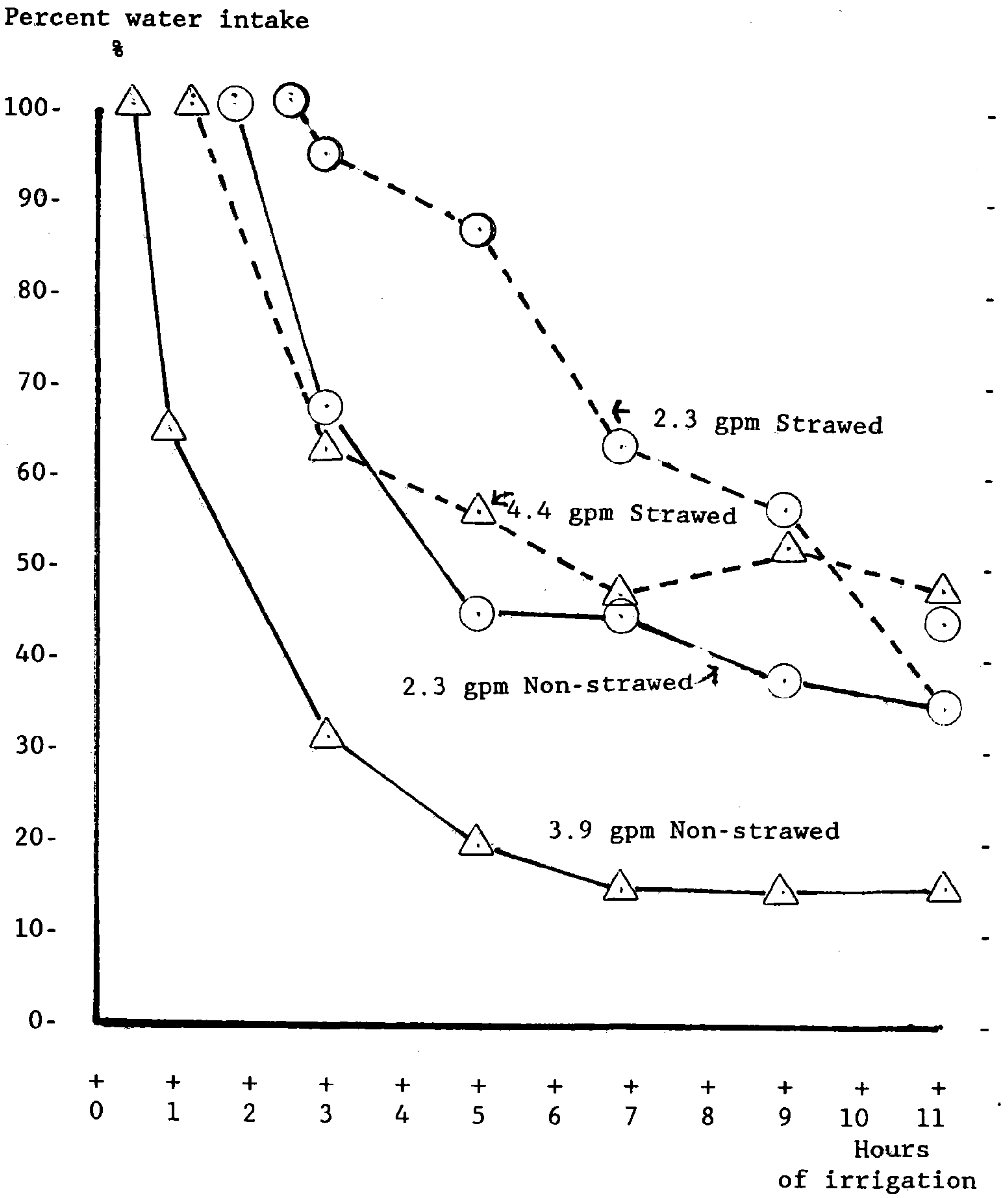


Figure 2. Percent water intake over time during the second irrigation in strawed and non-strawed furrows at two irrigation rates. Water intake was measured on a Nyssa silt loam soil with 2.5 percent slope. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1985.

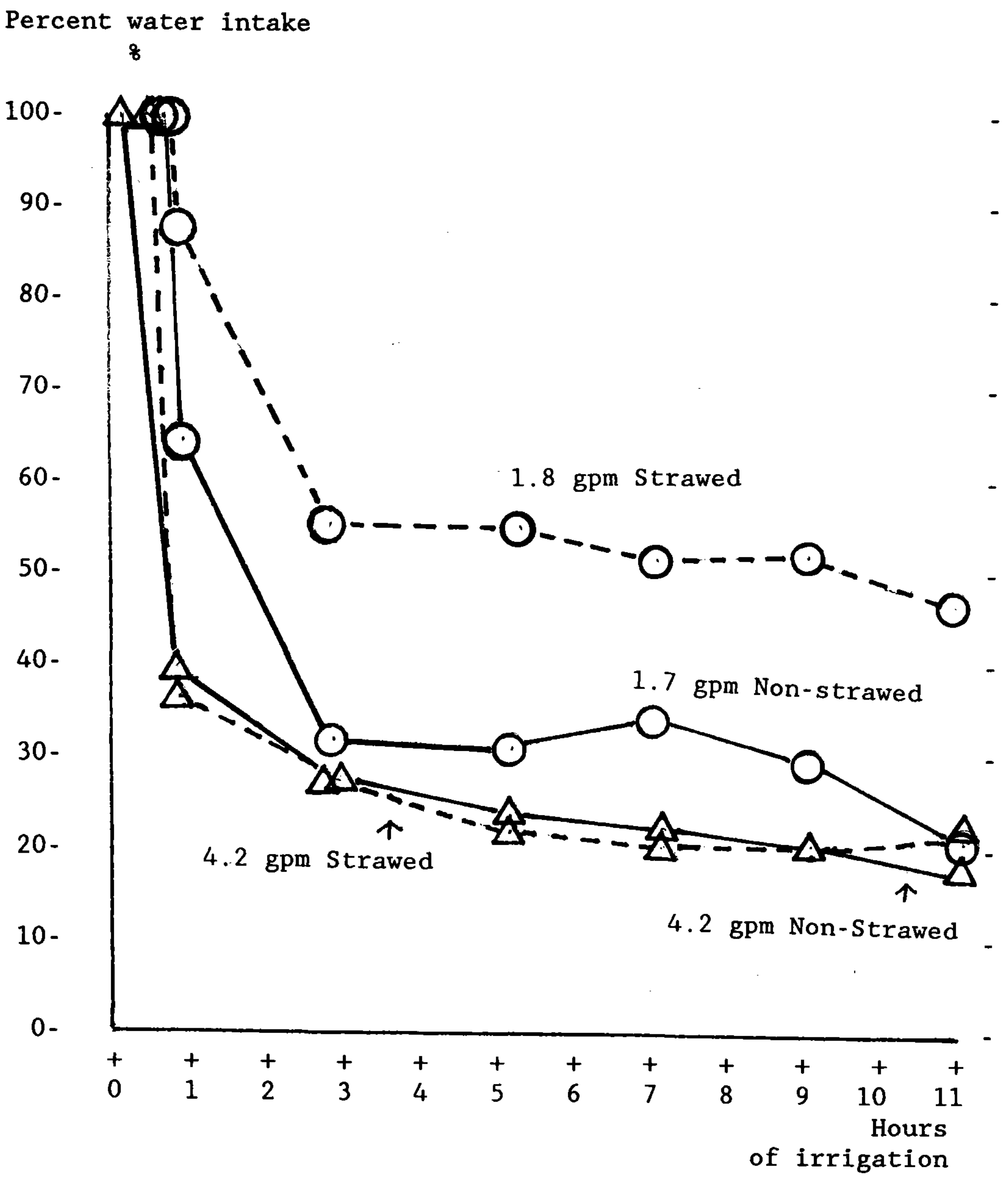
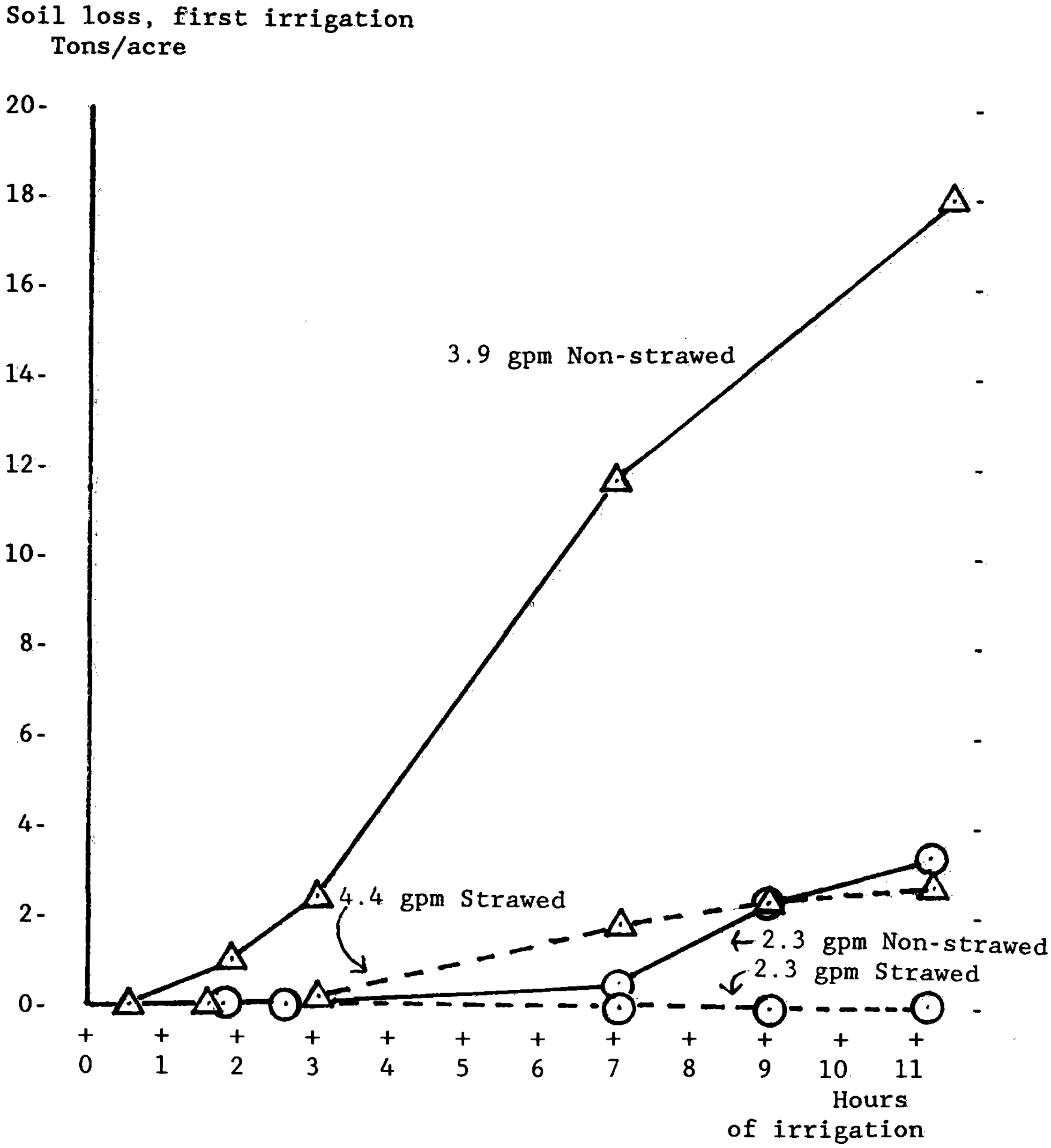
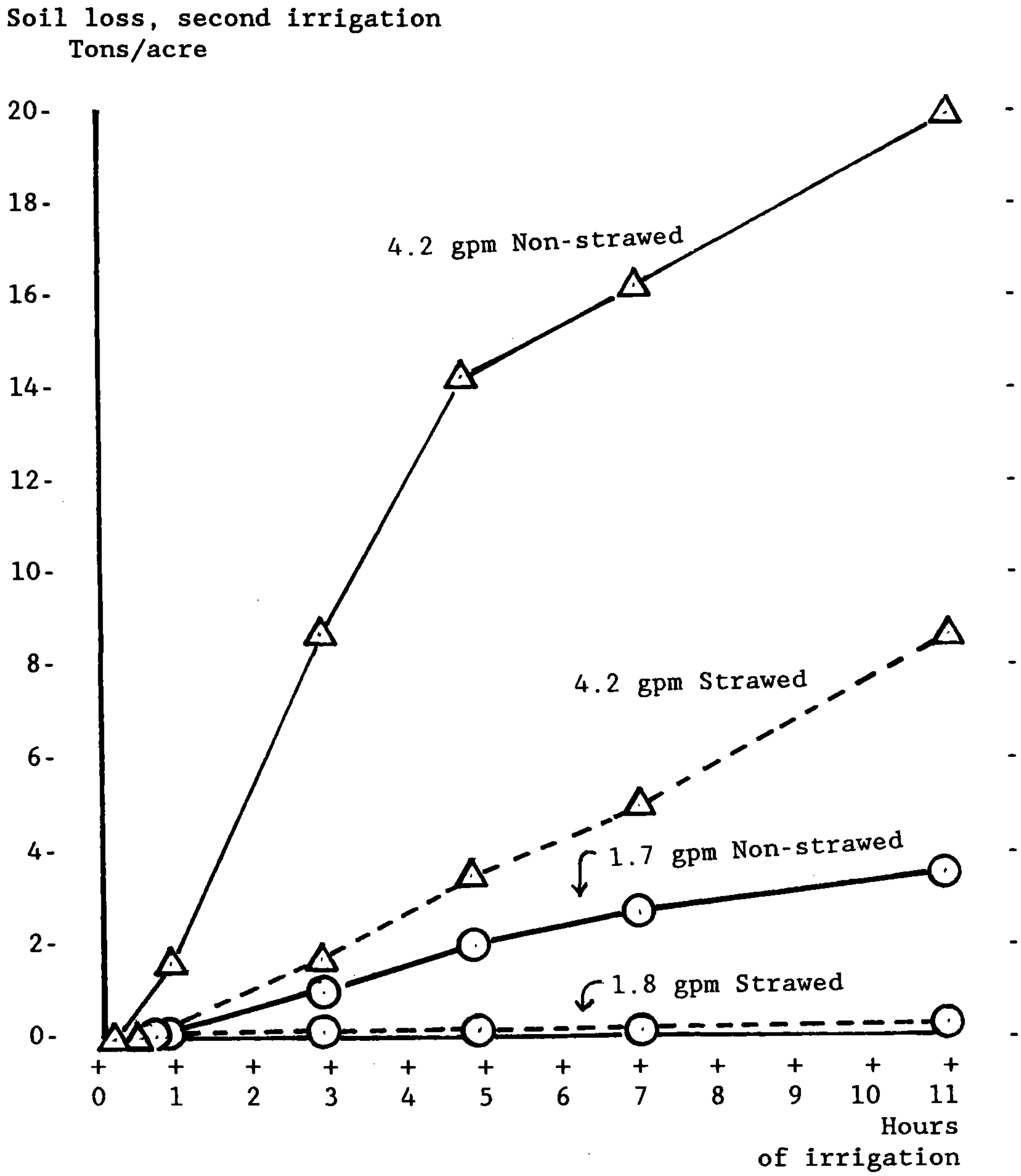


Figure 3. Cumulative soil loss over time during the first irrigation. Soil losses were compared between strawed and non-strawed furrows at irrigation rates. Soil loss was from a Nyssa silt loam with 2.5 percent slope. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1985.



<u>Figure 4.</u> Cumulative soil loss over time during second irrigation. Soil losses were compared between strawed and non-strawed furrows at two irrigation rates. Soil loss was from a Nyssa silt loam with 2.5 percent slope. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1985.



INSECTICIDE TRIALS FOR ONION THRIP CONTROL IN DRY BULB ONIONS

Lynn Jensen, Malheur County Office, O.S.U. Extension Service
Malheur Experiment Station, Ontario, Oregon, 1986

Purpose

The object of this study was to evaluate alternative insecticides for onion thrip control.

Introduction

A combination of parathion and toxaphene has been the standard insecticide for onion thrip control in the Treasure Valley for a number of years. With the decision of the EPA to rescind Toxaphene registration, it became necessary to find other insecticides that would be effective. Some organo-phosphate materials were identified as being effective, but were ineffective in parts of the Treasure Valley in 1985 and throughout most of the valley in 1986. Some growers sprayed five or six times without getting good thrip control. Also, increased onion acreage near alfalfa seed fields necessitated finding insecticides effective on onion thrip, yet relatively safe when used near fields where leafcutter bees are working.

Procedures

Insecticide evaluations were conducted at the Malheur Experiment Station at Ontario and on the Dwayne Bennett farm near Adrian, Oregon. The plots were treated according to standard cultural practices for the area with regards to planting, fertilization, onion maggot control, irrigation, and cultivation.

Plots at the Experiment Station were four single rows wide by 30 feet long. The insecticides were applied with a CO_2-type plot sprayer equipped with a five-foot boom and LF3 nozzles to apply 25 G.P.A. at 30 psi (Table 1). L1-700, a penetrating surfactant, was applied at a rate of 2 pints per 100 gallons of water plus the water was buffered appropriately.

The insecticides were applied at both sites when the thrip counts averaged 25 thrip per plant. All spraying was done in the morning, although 1985 spraying trials did not show any difference in control between morning and evening applications. There were both adults and nymphs at both sites at the time the materials were applied.

Thrip counts were made on July 14 and 22 at the Experiment Station and on July 22 at the Adrian site. The treatments were made on July 11 at the Experiment Station with the second application of the double treatments on July 18. The Adrian site was also sprayed on July 18.

Results

All thrip control was lower than expected for 1986 except the double treatments seven days apart (Table 2). These were the only treatments that gave satisfactory thrip control. This would indicate that probably the best method of control will be to spray two times about seven days apart. It is possible that we are missing those thrip that are pupating in the soil on a one-application schedule, where a second application seven days after the first will control many of these emerging adults. Two applications seven days apart might lessen the need for insecticide applications later in the season. The adults that emerge from the soil are ready to begin a new cycle, so controlling them will delay the cycle buildup. The organo-phosphate insecticides generally performed about as well as the sythetic pyrethroids (Table 6) at the 3-day counts, but did not give any residual control, whereas the synthetic pyrethroid materials continued to give as good or better control at the end of 10 days as they did at 3 days.

One of the problems which was evident from past years and which continued to manifest itself is the variability of control with the organo-phosphate insecticides. Neither Penncap M, methyl parathion, nor Guthion did well at either site, but Lorsban and ethyl parathion showed good control at Adrian and poor control at the Malheur Experiment Station (Table 5). This may explain why a grower in one area can have good control with one particular insecticide while his neighbor a few miles away is not getting any results. Growers experiencing problems may in some cases increase their thrip control by switching to an ethyl parathion formulation. The synthetic-pyrethroid insecticides appear to be much more consistent in their control throughout the different areas of the valley (Table 4).

Conclusions

1. The ethyl parathion formulation may be more effective than other parathion formulations in some areas of the Treasure Valley.

2. The synthetic pyrethroid insecticides give much longer residual control of onion thrip.

3. Two spray applications seven days apart appear to give the best control.

4. Two applications of Baythroid gave significantly better control than two applications of Penncap M + methyl parathion.

Table 1. Summary of insecticide treatments on onion thrip (<u>Thrip tabaci</u> Lindeman) control - three-day counts. Malheur Experiment Station, Ontario, Oregon, 1986

Treatment	Rate lbs ai/ac	Average Number Thrips/Plant	Thrip Control	Thrip Populations Log_{10} [1,2]
			%	
Ammo 2.5 E.C.	0.06	7.1	75.1	.81 a
Baythroid 2 E.C. +	0.05	7.4	74.2	.82 a-b
Vydate L (2)	0.5			
Pounce 3.2 E.C.	0.15	7.5	73.8	.86 a-c
Spur +	0.15	8.2	71.1	.87 a-d
Vydate L (2)	0.5			
Ammo 2.5 E.C.	0.08	8.6	69.9	.93 a-e
Baythroid 2 E.C.	0.05	9.8	65.5	.94 a-e
Pounce 3.2 E.C.	0.2	9.7	66.1	.96 a-e
Penncap M +	0.5	9.7	66.0	.97 a-e
ethyl parathion 4 E.C.	0.5			
Penncap M +	0.5	10.2	64.4	.99 a-e
methyl parathion 5 E.C.	0.5			
Lorsban 4E	1.0	11.1	61.0	1.03 a-e
Baythroid 2 E.C.	0.025	11.7	59.1	1.06 b-e
Penncap M +	0.5	12.3	57.1	1.07 c-e
Guthion 2S +	0.75			
Sulfur-flowable	1.0			
Lorsban 4E +	1.0	12.3	57.1	1.07 c-e
methyl parathion 5 E.C.	0.5			
Penncap M +	0.5	13.2	53.8	1.08 c-e
Guthion 2S	0.75			
Penncap M +	0.5	13.9	51.4	1.11 d-e
ethyl parathion 4 E.C.	0.5			
crop oil				
Vydate L (2)	0.5	16.00	44.0	1.15 e
Control	----	28.6	0.0	1.44 f
LSD				.24

Ratings with same letter are not significantly different at the 5 percent level using Fishers's LSD Test.

The thrip population index was calculated by taking the Log_{10} of the mean number of thrip per plant. Hartley's test for homogenity of population variances was used to determine whether to transform the data to Log_{10}. The extreme variations in population means made this type of analysis necessary to show true treatment differences.

Table 2. Summary of insecticide treatments on onion thrip (Thrips tabaci Lindeman) control - 10-day counts. Malheur Experiment Station, Ontario, Oregon, 1986

Treatment	Rate lbs ai/ac	Average Number Thrips/Plant	Thrip Control	Thrip Populations Log_{10} 1,2
			%	
Baythroid 2 E.C.	0.05	2.0	95.5	.25 a
(2 applications 7 days apart)				
Penncap M +	0.5	7.3	83.3	.77 b
methyl parathion 5 E.C.	0.5			
(2 applications 7 days apart)				
Ammo 2.5 E.C.	0.08	11.3	72.1	1.02 c
Baythroid 2 E.C. +	0.05	10.9	72.8	1.03 c
Vydate L (2)	0.5			
Pounce 3.2 E.C.	0.02	11.9	70.6	1.06 c
Baythroid 2 E.C.	0.025	12.1	60.0	1.08 c-d
Baythroid 2 E.C.	0.05	12.7	68.7	1.08 c-d
Ammo 2.5 E.C.	0.06	13.8	65.9	1.12 c-e
Spur +	0.15	15.0	62.7	1.16 c-f
Vydate L (2)	0.5			
Pounce 3.2 E.C.	0.15	19.4	51.9	1.27 d-g
Lorsban 4 E	1.0	22.8	43.6	1.21 e-g
Penncap M +	0.50	22.1	45.4	1.34 f-g
Guthion 2S +	0.75			
Sulfur	1.0			
Lorsban 4 E +	1.0	24.8	38.5	1.37 g
methyl parathion 5 E.C.	0.5			
Penncap M +	0.5	24.6	39.1	1.38 g-h
Guthion 2S +	0.75			
Vydate L (2)	0.5			
Penncap M +	0.5	29.7	26.5	1.45 g-h
methyl parathion 5 E.C.	0.5			
Penncap M +	0.5	30.1	25.4	1.47 g-h
ethyl parathion 4 E.C.	0.5			
Penncap M +	0.5	30.7	23.9	1.47 g-h
ethyl parathion 4 E.C.	0.5			
Control	----	40.4	0.0	1.58 h
LSD				.20

Ratings with same letter are not significantly different at the 5 percent level using Fishers's LSD Test.

The thrip population index was calculated by taking the Log_{10} of the mean number of thrip per plant. Hartley's test for homogenity of population variances was used to determine whether to transform the data to Log_{10}. The extreme variations in population means made this type of analysis necessary to show true treatment differences.

Table 3. Summary of insecticide treatments on onion thrip (*Thrips tabaci* Lindeman) control, three-day counts. Dwayne Bennett Farm, Adrian, Oregon, 1986

Treatment	Rate lbs ai/ac	Average Number Thrips/Plant	Thrip Control	Thrip Populations Log_{10} 1,2
			%	
Lorsban 4E + methyl parathion 5 E.C.	1.0 0.5	1.6	89.9	1.47a
Lorsban 4E	1.0	1.8	89.0	1.53 a-b
Penncap M + ethyl parathion 4 E.C.	0.5 0.5	2.8	82.7	1.54 a-b
Spur + Vydate L (2)	0.15 0.5	2.4	85.0	1.55 a-b
Pounce 3.2 E.C.	0.15	2.1	87.0	1.56 a-b
Pounce 3.2 E.C.	0.20	2.0	87.3	1.58 a-b
Ammo 2.5 E.C.	0.08	2.1	86.8	1.61 a-b
Baythroid 2 E.C.	0.05	3.4	78.8	1.80 a-c
Ammo 2.5 E.C.	0.06	4.2	74.2	1.89 b-c
Baythroid 2 E.C. + Vydate L (2)	0.05 0.5	4.6	71.3	1.91 b-c
Baythroid 2 E.C.	0.025	4.9	69.5	1.92 b-c
Vydate L (2)	0.5	5.0	69.2	1.93 b-c
Penncap M + mythyl parathion 5 E.C.	0.5 0.5	7.6	53.2	2.06 c-d
Penncap M + Guthion	0.5 0.75	8.0	50.6	2.20 c-e
Penncap M + ethyl parathion 4 E.C. crop oil	0.5 0.5	12.9	21.9	2.40 d-e
Control	----	16.2	0.0	2.48 e
LSD				.41

Ratings with same letter are not significantly different at the 5 percent level using Fishers's LSD Test.

The thrip population index was calculated by taking the Log_{10} of the mean number of thrip per plant. Hartley's test for homogenity of population variances was used to determine whether to transform the data to Log_{10}. The extreme variations in population means made this type of analysis necessary to show true treatment differences.

Table 4. Control of onion thrip with synthetic pyrethroid insecticides, 1986

Treatment	Rate lbs ai/ac	- - Percent Control - - M.E.S. 3-day	M.E.S. 10-day	Adrian 3-day
Baythroid 2 E.C.	0.025	59.1	70.0	69.5
Baythroid 2 E.C.	0.05	65.5	68.7	78.8
Ammo 2.5 E.C.	0.06	75.1	65.9	74.2
Ammo 2.5 E.C.	0.08	69.9	72.1	86.8
Pounce 3.2 E.C.	0.15	73.8	51.9	87.0
Pounce 3.2 E.C.	0.20	66.1	70.6	87.3

Table 5. Comparison of organo-phosphate insecticides for onion thrip at two locations, 1986

Treatment	Rate lbs ai/ac	- Percent Control - Adrian	M.E.S.-3 day
Lorsban 4 E +	1.0	89.9	57.1
methyl parathion 5 E.C.	0.5		
Lorsban 4 E	1.0	89.0	61.0
Penncap M +	0.5	82.7	66.0
ethyl parathion 4 E.C.	0.5		
Penncap M +	0.5	53.2	64.4
methyl parathion 5 E.C.	0.5		
Penncap M +	0.5	50.6	53.8
Guthion 2S	0.75		

Table 6. Comparisons of organo-phosphate and synthetic pyrethroid insecticides on residual control. Malheur Experiment Station, Ontario, Oregon, 1986

Treatment	Rate lbs ai/ac	Percent Control 3 days	10 days
Ammo 2.5 E.C.	0.08	69.9	72.1
Baythroid 2.0 E.C.	0.05	65.5	68.7
Pounce 3.2 E.C.	0.2	66.1	70.6
Penncap M +	0.5	64.4	26.5
methyl parathion 5 E.C.	0.5		
Penncap M +	0.5	53.8	39.1
Guthion 2S	0.75		

ONION VARIETY TESTING RESULTS

Charles E. Stanger and Joey Ishida
Malheur Experiment Station, Ontario, Oregon, 1986

Purpose

Commercial and experimental lines of yellow, white, and red onions were compared for maturity, bulb yields, bulb size, and neckrot developing during storage.[1]

Procedures

The onions were planted on April 11 in Owyhee silt loam soil containing 1.1 percent organic matter with a pH of 7.3. Corn and wheat were grown at the test site in 1984 and 1985, respectively. The grain straw was shredded and the soil chiseled, disced, irrigated, and moldboard-plowed in the fall. Fertilizer (100 pounds P per acre and 60 pounds N per acre) was broadcast before plowing. The plowed land was left open during the winter.

In the spring, the seedbed was prepared by tilling the soil with a triple-k and spike-tooth harrow. For chemical weed control, Ramrod (4 lbs ai/ac) and Hoelon (1.5 lbs ai/ac) were broadcast and incorporated at a shallow depth by a spike-tooth harrow before planting. The trial area was marked out at 22-inch row spacing and planted using cone-seeders mounted on John Deere Model 71 Flexi-planters.

Individual plots were two rows wide and 25 feet long. Each variety was replicated five times using a complete randomized block experimental design. The seed was planted at a rate of about 12 viable seeds per linear foot of row. The plants were hand-thinned to a final stand of four onions per foot when the onions had three to four leaves. The onions were watered by furrow irrigation. Water was applied between each row of onions. Early irrigations were applied in alternate rows. After midseason, all furrows were irrigated. In mid-May, 30 pounds of nitrogen per acre was water run in the form of ammonium nitrate. An additional 150 pounds per acre of nitrogen in the form of ammonium sulfate was sidedressed the first week of July.

Maturity was assessed on August 12, 18, 28, and September 8 and 15. The ratings were expressed as percentages of plants with tops fallen over within each plot (Table 1).

[1] Seed was received for testing from 11 seed companies: American Takii, Arco, Asgro, Crookham, Ferry Morse, Harris-Moran, Mono-Hy, Nickerson Zwann, Petoseed, Quali-sel, and Vanderhave.

The bulbs were lifted on September 15 and hand-topped on September 23, 24, and 25. Onions from individual plots were put in burlap bags and stored in field crib boxes. The onions were put in storage on October 6. The storage shed was equipped with fans forcing air underneath each of the boxes which were stacked across the onion shed in rows six deep and four high. Tempera tures in storage ranged from 32° to 35° and relative humidity was approximately 62°F. The fans were run 12 hours or less during each 24 hours during the time onions were in storage.

The onions remained in storage until January 12 when they were graded. The onions were graded according to diameter of bulbs. Size classes were 2 1/4 to 3 inches, 3 to 4 inches, and greater than four inches. Split bulbs were classed as number twos. The bulbs infected with Botrytis were weighed to determine percent storage rot and then graded to calculate onion yields. The storage rot data were reported as average neckrot and potential neckrot. The average neckrot data are reported as an average amount of rot for all five replications. "Potential" rot was the single replication with the greatest amount of neckrot.

Results

Spring growth was normal and summer temperatures were unusually warm at the end of May and early in June. Approximately 1.6 inches of rain fell in September before the onions were lifted. Clear skies and warm temperatures followed with conditions good for onion harvest and field drying. Generally, the onions stored well with only moderate amounts of neckrot occurring in most lines, but extensive rot did occur in the late-maturing, high-yielding Avalanche variety of white bulbs.

Data are reported for the varieties for each company and are ranked according to total bulb yield (Table 1). Data are reported for thirty-nine yellow, seven white, and six red lines. Bulb yields were generally higher in 1986 than 1985. Bulb yields for yellow lines ranged from 393 to 879 cwt/ac. Lines with greater than 67 percent colossal-sized bulbs included 4265, 615-4, Durango, Valdez, N-128, N-127, 77-N76, Celebrity, and Dai Maru. White varieties ranged from 745 to 563 hundred weight per acre and red varieties ranged in yield from 589 to 475 hundred weight per acre. Early maturing varieties included American Takii lines 327-1, 327-2, 60-12, 60-1, 60-2, and 60-3. Other early lines were Yula, Golden Cascade, 836-2, Benny Red, NIZ 23-1028, Omega, PSX 1183, PSR 385, and Experimental 21633. The later-maturing lines were 4265, 615-4, Valdez, Avalanche, Glacier, XPH 83N128, XPH 83N127, Celebrity, and White Sweet Spanish. Tops of these lines remained green and at least 30 percent of the tops were standing when the onions were lifted. The maturity ratings for other lines evaluated were intermediate.

Multiple-year averages for onion yields, rot, and maturity are reported in Tables 2 and 3.

Table 1. Results of the 1986 onion variety trial. Malheur Experiment Station, Ontario, Oregon, 1986

Company	Variety	Total	Average Neckrot	Potential[3] Neckrot	+4 inch		3-4 inch		2 1/4-3 inch		2's	Maturity Ratings					Bolting[4]
		cwt/ac	%	%	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac	8/12	8/18	8/28	9/8	9/15	
American Takii	327-1	497	0	0	18	4	432	86	48	10	3	52	64	88	97	97	0
	327-2	494	0	0	15	3	432	88	46	9	0	59	92	92	95	95	0
	60-12	490	0	0	16	3	412	84	62	13	1	57	86	87	95	95	0
	60-1	460	0	0	3	1	377	81	100	20	0	77	88	77	98	98	0
	60-2	434	0.3	1.5	5	1	362	81	79	18	1	84	91	98	99	99	0
	60-3	393	0.4	1.8	4	1	231	59	158	40	0	90	95	98	99	99	0
Arco	4265	841	1.5	2.7	628	75	202	24	10	1	23	0	2	13	33	60	2
	615-4	817	2.7	5.7	610	75	195	24	11	1	18	0	0	11	25	54	2
	Durango	810	6.6	22.2	536	65	273	33	13	2	24	0	3	35	35	70	2
	Valdez	779	2.2	4.0	537	69	231	30	11	1	13	0	2	22	45	65	1
	Avalanche[1]	745	28.7	61.4	379	51	355	47	12	2	40	0	3	27	50	67	2
	Winner	727	1.9	2.3	415	55	298	41	26	4	4	5	18	58	75	82	1
	Glacier[1]	702	4.1	7.9	378	54	310	44	14	2	8	2	6	31	51	68	1
	Golden Cascade	690	0.9	2.0	368	52	313	45	21	3	6	16	39	63	76	84	0.2
	Magnum	678	1.5	2.3	378	54	310	44	14	2	8	16	26	61	80	80	0
	Blanco Duro[1]	635	5.7	10.2	190	30	424	67	20	3	4	2	4	34	60	74	1
	836-2	629	0.6	0.9	146	23	462	74	21	3	2	31	51	81	87	89	0.2
	Valient	602	1.7	3.2	167	23	385	61	44	6	18	2	7	41	66	79	0
	Tango[2]	526	1.5	2.6	62	12	403	76	61	12	3	13	28	62	76	82	0
	Carmen[2]	475	1.2	2.6	66	12	364	74	66	14	16	3	6	32	52	81	0
Asgrow	Vega	742	1.0	2.2	411	55	315	43	16	2	32	2	4	29	54	70	1
	Armada	742	2.8	7.2	483	63	272	35	16	2	37	2	5	30	58	74	1
	Yula	654	2.4	3.3	282	43	351	53	32	4	30	37	70	86	90	88	0
	Maya (XP739)	641	0.7	1.2	260	40	378	57	24	3	13	18	28	69	81	82	0
	Ruby (XP3224)[2]	535	0.8	1.8	95	18	393	72	54	10	17	21	32	61	83	84	0
Crookham	XPH-83N128	879	5.6	15.4	703	80	163	18	13	2	28	0	2	14	30	51	0.4
	XPH-83N127	821	4.4	6.4	594	72	216	27	9	1	33	0	0	7	24	48	0
	XPH-77N76	793	2.9	6.3	523	66	262	33	8	1	77	4	13	58	69	75	0.2
	Celebrity	782	2.6	5.2	527	67	232	30	23	3	55	1	5	25	54	64	2
	Dai Maru	776	3.5	4.3	537	69	231	30	9	1	14	1	5	30	56	70	0.4
	Ringmaker	769	1.1	2.5	456	59	299	39	13	2	64	7	20	47	67	74	0.6
	XPH-85N40	720	0.9	2.1	414	58	291	40	15	2	31	3	11	51	72	79	0.2
	Big Mac	695	0.7	1.4	383	54	304	44	18	2	52	3	10	37	64	76	0.2
	White Keeper[1]	581	3.8	10.0	152	26	394	68	33	6	43	2	9	48	65	73	0.2
	White Delight[1]	563	3.1	4.8	163	27	363	65	37	8	32	2	7	30	57	75	0.2
Ferry Morse	70 W 6	711	1.2	2.1	384	54	315	44	12	2	10	10	14	46	73	76	1.2
	Bulleye	654	0.9	1.7	254	39	381	58	19	3	6	4	8	32	56	77	2
	Sweetheart	603	0.8	1.7	250	40	356	57	17	2	5	0	4	26	50	78	1
	Redman[2]	589	1.6	4.6	151	26	412	70	26	4	10	4	8	32	62	78	0.2
Harris Moran	Benny Red[2]	589	0.7	0.8	117	20	428	73	44	7	24	17	25	68	85	93	0
	MOX 1008	578	1.0	2.4	159	28	381	66	37	6	57	5	15	38	63	70	0
Mono-Hy	White Sweet Spanish[1]	709	5.4	8.7	319	45	374	53	14	2	14	0	5	28	55	66	1.2
	WSS Storage[1]	588	3.6	4.8	132	22	424	72	33	6	29	2	7	32	58	74	1
Nickerson Zwann	NIZ 23-1028	625	1.0	1.9	178	28	399	64	48	8	58	21	38	67	82	85	0
	Omega	546	0.5	1.2	106	19	386	71	53	10	17	18	43	70	84	87	0.2
Petoseed	PSX 1183	676	0.9	2.6	244	37	407	61	16	2	7	21	65	66	83	85	0.6
	PSX 1383	644	0.5	1.1	199	32	405	63	22	5	16	4	10	42	66	77	0
	PSR 385	369	0.7	2.8	10	4	200	55	148	41	3	76	92	97	99	99	0
Quali-Sel	Day Brothers	773	2.7	4.1	490	63	268	35	15	2	43	3	9	36	61	70	3
	EXP. 21633	558	0.7	1.9	109	20	393	70	56	10	13	30	49	70	84	85	0.4
Vanderhave	VDH-85089	536	0.4	0.6	64	12	440	82	33	6	1	12	31	66	87	93	0
LSD .05		50	---	---	58	--	39	--	19	--	20						
LSD .01		66	---	---	76	--	52	--	25	--	26						
Mean		644	---	---	274	--	339	--	34	--	23						
CV (%)		6.3	---	---	17	--	9.4	--	24	--	32						

[1] White Bulbs

[2] Red Bulbs

[3] Highest percent neckrot observed in single replication of five replications evaluated.

[4] Average number of bulbs bolting from counts taken in five replications (80 bulbs per replication)

Table 2. Two-year average from onion variety trials (1985 and 1986). Malheur Experiment Station, Ontario, Oregon, 1986

Company	Variety	Total Yield cwt/ac	Average Neckrot %	Potential Neckrot %	+4 inch cwt/ac	+4 inch %	3-4 inch cwt/ac	3-4 inch %	2 1/4-3 inch cwt/ac	2 1/4-3 inch %	2's cwt/ac	Maturity Ratings 8/15	Maturity Ratings 9/1	Maturity Ratings 9/15
Arco	Durango	792	4.15	12.25	459	57	316	40	14	2	21	15	48	68
	Valdez	780	1.42	2.65	514	66	242	31	13	2	18	10	36	64
	Avalanche	764	18.05	43.75	386	51	347	45	16	2	35	5	33	59
	Winner	707	1.90	4.40	345	49	344	49	22	3	6	26	64	76
	Glacier	685	3.30	7.47	262	38	392	57	18	3	24	24	49	69
	Golden Cascade	672	0.68	1.77	297	44	351	52	23	3	10	43	71	82
	Magnum	669	1.13	1.85	289	43	367	55	21	3	10	34	69	80
	Blanco Duro	645	3.40	5.95	209	32	405	63	26	4	6	14	48	69
	Valient	609	1.18	2.49	188	31	382	63	38	6	3	28	59	79
	Tango	529	1.22	2.34	48	8	426	80	54	14	2	43	72	85
	Carmen	466	1.59	5.68	49	11	348	75	73	16	19	17	53	86
Asgrow	Armada	726	2.67	6.21	424	58	284	39	15	2	43	20	49	72
	Vega	707	0.73	1.62	345	49	327	46	20	3	30	26	51	73
	XPH 739 (Maya)	641	0.74	1.38	263	41	359	56	23	4	26	36	71	82
	Yula	612	2.78	6.49	257	43	297	49	28	5	49	60	84	85
	XPH 3224 (Ruby)	507	0.72	1.53	63	12	385	76	61	12	11	40	72	88
Crookham	XPH-83N127	864	3.14	4.97	572	66	258	30	11	2	39	6	21	47
	XPH-83N128	791	3.44	8.55	579	73	173	22	12	2	41	10	34	54
	Dai Maru	788	2.19	3.40	470	61	269	34	19	2	37	17	48	68
	Celebrity	771	1.76	3.26	443	57	289	37	24	3	42	15	43	65
	Ringmaker	728	0.70	1.99	363	50	324	45	22	3	47	34	60	75
	Big Mac	692	0.72	1.43	359	52	290	42	17	3	56	18	51	74
	White Delight	600	2.02	6.26	163	28	365	62	41	7	47	23	49	72
	White Keeper	546	2.59	4.36	120	22	376	69	42	8	29	26	60	74
Ferry Morse	70-W6	697	1.19	2.52	328	47	349	50	12	2	14	23	57	75
	Bulleye	628	0.70	1.77	210	33	392	62	24	4	5	30	54	81
	Sweetheart	586	0.58	1.47	182	31	377	64	36	6	4	28	52	83
	Redman	559	1.18	3.35	106	19	412	77	37	6	9	24	53	83
Harris Moran	MOX 1008	555	1.91	5.34	113	21	371	68	40	8	60	35	58	75
Mono-Hy	White Sweet Spanish	702	4.86	11.03	264	39	381	55	24	3	93	10	42	66
	WSS (Storage)	561	2.55	4.56	104	19	415	74	34	6	21	22	49	73
Quali-Sel	Day Brothers	729	2.37	5.77	409	56	299	41	13	2	30	21	52	69
LSD (.05)		49	-----	-----	48	--	35	--	19	--	21			
LSD (.01)		64	-----	-----	63	--	47	--	25	--	27			
Mean		628	-----	-----	232	--	347	--	38	--	25			
CV (%)		6	-----	-----	17	--	8	--	22	--	33			

Table 3. Three-year average from onion variety trials (1984, 1985 and 1986). Malheur Experiment Station, Ontario, Oregon.

Company	Variety	Total Yield	Average Neckrot	Potential Neckrot	+4 inch		3-4 inch		2 1/4-3 inch		2's	Maturity Ratings		
		cwt/ac	%	%	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac	8/15	9/1	9/15
Arco	Durango	759	3.40	10.07	447	59	296	39	13	2	15	15	54	71
	Valdez	753	2.45	5.57	501	67	230	31	12	2	14	9	43	66
	Avalanche	727	15.57	39.77	366	50	334	46	16	2	26	5	39	60
	Winner	691	1.40	3.37	343	50	325	47	20	3	4	36	69	78
	Glacier	648	2.63	6.24	246	38	377	58	17	3	18	34	59	73
	Golden Cascade	646	1.25	3.14	285	44	340	53	20	3	8	53	76	86
	Magnum	620	2.25	5.37	267	43	334	54	23	4	8	41	74	85
	Blanco Duro	618	2.83	5.63	215	35	372	60	26	4	6	20	56	71
	Valient	574	0.85	1.96	176	31	361	63	36	6	2	37	68	83
	Tango	467	0.98	2.16	74	16	351	75	41	9	1	35	74	87
	Carmen	436	1.46	4.68	46	11	324	74	68	15	15	21	63	89
Asgrow	Armada	709	1.98	4.50	389	55	303	43	15	2	34	26	59	75
	Vega	682	0.78	1.51	330	48	323	47	18	3	21	38	62	78
	XPH 739 (Maya)	597	0.66	1.32	246	41	332	56	21	4	21	38	75	84
	Yula	566	2.45	5.39	229	40	290	51	27	5	40	68	87	89
	XPH 3224 (Ruby)	471	0.64	1.55	48	10	361	77	62	13	9	48	79	90
Crookham	XPH-83N128	766	2.73	7.00	559	73	177	23	11	1	31	10	39	60
	Dai Maru	759	2.26	5.53	447	59	276	36	16	2	28	23	56	71
	Celebrity	741	1.94	4.84	444	60	267	36	19	2	30	14	48	69
	Ringmaker	708	0.63	2.16	344	49	332	47	19	3	33	47	69	79
	Big Mac	688	0.88	1.72	363	53	293	43	15	2	42	20	57	75
	White Delight	571	2.08	6.67	152	27	357	63	41	7	36	29	58	75
	White Keeper	522	1.72	2.90	114	22	363	70	39	7	22	31	65	76
Ferry Morse	70-W6	655	1.39	3.44	349	53	286	44	13	2	10	19	60	79
	Redman	522	1.32	3.73	100	19	382	73	37	7	8	31	64	85
Mono-Hy	White Sweet Spanish	656	4.47	11.29	277	42	335	51	21	3	76	13	48	69
	WSS (Storage)	534	1.87	3.54	107	20	389	73	33	6	17	21	54	75
Quali-Sel	Day Brothers	720	3.75	9.61	431	60	272	38	11	2	23	17	53	71
LSD (.05)		50	----	-----	52	--	38	--	18	--	17			
LSD (.01)		66	----	-----	68	--	50	--	24	--	22			
Mean		601	----	-----	232	--	327	--	33	--	20			
CV (%)		6	----	-----	15	--	8	--	22	--	33			

ARTIFICIAL DRYING OF ONION BULBS TO IMPROVE STORAGE QUALITY

Charles E. Stanger and Joey Ishida
Malheur Experiment Station, Ontario, Oregon, 1986

Purpose

Trials were initiated to compare different drying temperatures and times to identify optimum conditions for drying onion bulbs on a commercial scale.

Summary

Bulb yields for all varieties increased significantly when the harvest date was delayed until October 6. Increases in yield were greatest for late-maturing varieties (Avalanche, Valdez, and Dai Maru). These varieties were also more susceptible to Botrytis neckrot in storage. Artificially drying the onion bulbs at harvest reduced percent neckrot and increased storage quality. Drying at 125°F for 20 minutes reduced neckrot from 19.8 to 2.1 percent for onions harvested September 1 and from 9 to 2.3 per cent for onions harvested October 6. Onion tissue on bulbs dried at 150° F for 80 minutes was cooked and resulted in severe losses in storage.

Introduction

This study is a continuation of trials conducted in 1984 and 1985 to evaluate the interactions between onion varieties, maturity, and harvest dates with yield 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 heat before being put in storage. Each previous 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 percentages of jumbo and colossal-sized bulbs). Yield increases were greatest with late-maturing lines (Avalanche, Valdez, and Dai Maru), but these lines are more susceptible to rot infection during a long storage period. Artificial drying in 1984 and 1985 resulted in a significant reduction in neckrot during storage and has increased yield of marketable onions. Drying temperatures and drying periods were constant during trials conducted in 1984 and 1985 because of the type of drying equipment available.

Materials and Methods

Five varieties of onions (Avalanche, Valdez, Dai Maru, White Delight, and Golden Cascade) were planted 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 9 and 10. Further thinning to remove doubles and weeds was done on June 17.

The onions were sidedressed on May 26 and July 5 with 100 pounds per acre of nitrogen applied each date. The nitrogen source was ammonium nitrate (May 26) and ammonium sulfate (July 5).

The early harvested onions were lifted on September 1 and topped and bagged on September 6. Artificial drying was begun on September 15. Drying temperatures were 125° and 150°F. Drying times were 10, 20, 40, and 80 minutes. Control treatments were included for all temperature and time variables and all treatments included five replications. The early harvested and artificially dried onions were put in storage without forced air ventilation on September 16. The onions were stored in wood boxes used as celery crates. Each celery crate contained about 50 pounds of onions.

The late-harvested onions were lifted and bagged on October 6 and artificial drying began on October 9. The drying temperatures were 100°, 125°, and 150°F and the drying times were the same as used in the early harvest. These onions were also placed in storage without forced air as they were removed from the dryer.

The onions were removed from storage and grading began on January 12. The onions were graded and weighed by size depending on bulb diameter: size categories were less than 2 1/4 inches, 2 1/4 to 3 inches, 3 to 4 inches, and greater than 4 inches. Bulbs infected with <u>Botrytis</u> neckrot were weighed to determine rot weights and then sized and reweighed according to size of diameter to determine field yields.

Total yield by harvest date, jumbos, colossals, and percent rot were calculated. Percent storage rot was calculated and reported as a percent of total yield.

Results

Bulb yields increased for each variety as harvest date was delayed from September 1 to October 6 (Table 1). Average increase in yields was 18 percent. Avalanche and Dai Maru increased 31 and 20 percent respectively. These varieties are late-maturing lines. Golden Cascade was the earliest-maturing line but continued to grow after the tops were down and yielded a 13 percent increase from the growth made in September. The percent in colossal-sized bulbs increased from 44 to 76. Valdez had the highest percent (88) of colossal-sized bulbs. The increase in bulb size from growth during September was significant for each variety tested.

Drying onion bulbs with artificial heat before winter storage reduced the <u>Botrytis</u> neckrot significantly for all varieties. The average percent neckrot for five varieties in non-dried bulbs harvested on September 1 and October 6 ranged from a high of 31 to a low of 4 (Tables 2 and 3). The variety most susceptible to neckrot was Avalanche. The least amount of rot occurred with Golden Cascade. Drying onions harvested on September 1 for 10 minutes at 125°F reduced the average percent neckrot for all varieties from 19.8 percent to 1.3 percent. When Avalanche was dried at 125°F for 10 minutes, neckrot was reduced in the early harvest from 28.7 percent to 3.6 percent. A reduction in percent neckrot occurred with both increases in drying temperatures and drying time. Among the best drying treatments were 100°F for 40 minutes, 125°F for 20 to 40 minutes, and 150°F for 10 to 20 minutes. Damage to onion bulbs occurred when temperature was held at 150°F for 80 minutes. Dai Maru was more sensitive to the higher temperature and exposure time than were the other four varieties. White Delight appeared to be more tolerant to drying at high temperatures.

Clipped necks dried for short periods of time lost significant amounts of moisture (Tables 4 and 5).

Conclusions

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

Data obtained from three years of study show that onion bulbs dried with artificial heat store with less neckrot at the end of storage than non-heat dried bulbs. Although it has not been measured, it was observed that onions artificially dried have skins that are drier with better color compared to skins of non-dried bulbs. It is presumed that the drier bulbs would be better preserved for shipment and more appealing to customers at the marketplace.

Further drying studies evaluating drying temperatures and drying times are needed to identify optimum conditions for drying commercial onions. In addition, costs of drying onion bulbs should be studied and compared to returns expected from drying onion bulbs. Further trials evaluating bulb yields by harvest date are not needed since results are conclusive and support consistent increases in bulb yields as harvest dates are extended through September.

Acknowledgements

Funds and new drying equipment provided by the Idaho-Oregon Onion Committee made the onion drying research possible.

Table 1. Bulb yields, percent jumbo and colossal-sized onion bulbs from five varieties of onions harvested on two dates, September 1 and October 6. Malheur Experiment Station, Ontario, Oregon, 1986

Variety	Jumbos		Colossals		Total Yield		October Yield Increase
	9/1	10/6	9/1	10/6	9/1	10/6	Compared to September
	%				cwt/ac		%
Avalanche	48	25	49	73	727	953	31
Dai Maru	46	21	51	78	745	894	20
Valdez	41	11	56	88	752	879	17
White Delight	65	37	26	61	613	674	10
Golden Cascade	58	24	39	78	640	723	13
Mean	52	23	44	76	695	824	18

Table 2. *Botrytis* neckrot infection in stored onions for five varieties harvested on September 1 and artificially dried at two temperatures for 10, 20, 40, and 80 minutes. Malheur Experiment Station, Ontario, Oregon, 1986

Variety	Occurrence of Neckrot at Drying Conditons									
	125°F					150°F				
	10	20	40	80	ck	10	20	40	80	ck
	%					%				
Avalanche	3.6	1.7	2.7	2.7	28.7	3.0	2.9	1.3	2.1	31.2
Dai Maru	2.0	2.0	3.1	1.6	19.4	3.0	3.0	1.3	2.0	31.2
Valdez	1.5	4.5	4.5	2.4	19.8	1.7	1.9	2.0	3.6	20.5
White Delight	1.4	2.2	1.6	0.9	20.5	---	---	---	---	----
Golden Cascade	0.9	0.1	2.1	1.6	10.4	3.4	0.9	1.5	1.5	11.6
Mean	2.3	2.1	2.8	1.8	19.8	2.2	1.7	1.2	1.8	18.9

Quantity of onions were not available to dry White Delight at 150°F treatment.
Average from five replications.

Table 3. *Botrytis* neckrot infection in stored onions for five varieties harvested on October 6 and artificially dried at three temperatures for 10, 20, 40, and 80 minutes. Malheur Experiment Station, Ontario, Oregon, 1986

Variety	Occurrence of Neckrot at Differing Drying Conditions														
	100°F					125°F					150°F				
	10	20	40	80	ck	10	20	40	80	ck	10	20	40	80	ck
	%														
Avalanche	5.3	3.1	2.3	1.8	13.1	4.3	0.8	0.3	0	12.5	3.4	2.0	0.4	14.0	12.8
Dai Maru	3.5	1.0	0.5	1.4	6.5	2.2	0.6	0.3	0.4	6.9	1.3	0	1.6	25.1	8.6
Valdez	6.4	5.2	2.4	1.9	9.5	1.1	0.8	0.8	0.7	9.1	0.8	0	2.0	15.8	9.4
White Delight	4.0	2.0	0.6	4.7	5.2	3.8	3.8	2.7	1.8	9.3	5.5	1.6	3.1	4.5	8.5
Golden Cascade	0	0.4	0.6	0.6	4.2	0	0.4	0.3	1.6	7.0	1.0	4.2	1.9	11.1	3.9
Mean	3.8	2.3	1.7	2.1	7.7	2.3	1.3	0.8	0.8	9.0	2.4	1.6	1.8	14.1	8.6

Average from five replications.

Table 4. Percent moisture lost from onion necks clipped from tops of bulbs and dried at different temperatures and exposure times. Malheur Experiment Station, Oregon, 1986

Variety	Moisture Lost From Clipped Onion Necks											
	100°F				125°F				150°F			
	10	20	40	80	10	20	40	80	10	20	40	80
	%											
Avalanche	1.3	2.6	4.2	12.7	3.6	4.9	8.9	13.2	5.1	6.7	10.7	15.6
Dai Maru	2.0	3.6	6.8	12.1	3.1	5.3	10.1	15.2	3.5	5.7	12.6	16.7
Valdez	1.9	3.7	5.7	8.5	2.3	3.4	7.6	12.2	3.1	5.6	8.9	16.5
White Delight	---	---	---	----	2.2	5.4	8.2	13.3	---	---	----	----
Golden Cascade	2.2	3.6	5.8	10.9	3.7	5.8	9.7	13.1	2.9	6.4	11.0	13.9
Mean	1.9	3.4	5.6	11.9	3.0	5.0	8.9	13.4	3.6	6.1	10.8	15.7

Table 5. Total moisture in onion necks dried at 125°F for 48 hours. Malheur Experiment Station, Ontario, Oregon, 1986

Variety	Total Water Content of Clipped Onion Necks														
	100°F					125°F					150°F				
	10	20	40	80	Avg	10	20	40	80	Avg	10	20	40	80	Avg
	%														
Avalanche	----	----	----	----	----	69.1	64.9	69.4	65.1	67.1	73.6	66.1	77.5	78.4	73.9
Dai Maru	83.6	81.4	82.8	82.5	82.6	82.6	82.8	82.8	83.4	82.9	82.0	82.7	82.6	82.7	82.5
Valdez	80.0	81.7	76.1	76.5	78.6	76.6	77.4	70.4	81.8	76.6	71.8	79.2	73.6	81.6	76.6
White Delight	----	----	----	----	----	78.2	77.6	77.1	77.4	77.6	----	----	----	----	----
Golden Cascade	69.5	74.6	70.5	75.3	72.5	65.7	74.9	73.9	77.8	73.1	83.0	83.0	82.5	83.0	82.9
Mean	77.7	79.2	76.5	78.1	77.9	74.4	75.5	74.7	77.1	75.5	77.6	61.2	79.0	81.4	79.0

ONION THRIP SURVEY AND RESISTANCE

Lynn Jensen, Malheur County Office, O.S.U. Extension Service
Malheur Experiment Station, Ontario, Oregon, 1986

Purpose

Objectives of this research were to find ways to identify resistant thrips so that appropriate control methods can be applied and determine accurate economic thresholds to give growers a better indication of when to spray for thrips. Thrips collections would show if there were one or more species of thrips attacking onions.

Introduction

Over the last three years a general resistance to the organo-phosphate insecticides has been noted in the Treasure Valley area. Table 1 shows the decrease in activity of two combinations of organo-phosphate insecticides over the last three years. At the present rate of decrease, these products will be totally ineffective in two to three years, and are now essentially useless for proper thrip control. Two possible explanations have been proposed: 1) We are dealing with different thrip species in different areas of the valley, or 2) the thrips are building up resistance to these insecticides. Other production areas such as the High Plains of Texas show two different species of thrips to infest onions, the onion thrips (*Thrips tabaci*) and the western flower thrips (*Frankliniella occidentalis*) which have been shown to respond differently to some of the insecticides used to control them. It was hoped that the presence of several thrip species would explain some of the different responses of thrips to our insecticides in different areas.

Procedures

Thrips were collected at different farms in each of the following areas of the Treasure Valley and identified:

Ontario	Oregon Slope	Weiser
Parma	Fruitland	Vale
New Plymouth	Nyssa	Homedale
Adrian		

William Brindley, Utah State University entomologist, has established a method of determining lygus resistance to dylox, so it was hoped that his experience and expertise could be tapped in developing a similar test for thrips in onions. The first step was to coat small vials with known concentrations (0, .1, 1 and 10 micrograms per vial) of methyl parathion, and collect thrips. Collected thrips were placed in these vials for a period of time, then the number surviving were counted to see if a resistance factor had occurred.

For the economic threshold study, an onion field infested with thrips was used. Replicated plots infested with thrip, partially infested, or kept free of thrips were maintained through-out the growing season to determine yield differences that might occur with varying degrees of thrip pressure.

Results

Thrips collected at all sites were identified as the onion thrips (*Thrips tabaci*). It does not appear that more than one species is involved with local onion production. This indicates a much greater probability that the thrips have developed resistance to the organo-phosphate insecticides.

Thrips collection resulted in significant thrip mortality without insecticide. The thrips were collected using a fine-bristled paint brush to brush the thrip off the onion plant and into a funnel, then brush the thrip from the funnel into the vial. Thrip survival of the brushing technique varied, depending somewhat on whether the thrip was an adult or nymph. The adult appeared able to withstand the technique better. Determining mortality was hard under most conditions, but extremely hard when the thrip were first placed in the vial. The best technique seemed to be to warm the vial with sunlight or an artificial light.

No resistance was determined using the concentrations involved. The thrip in the untreated vials died as quickly as those in the treated vials. By keeping the vials in a dark, cool place, thrips could be kept alive for 24, hours but the concentrations of parathion need to be increased to get a higher mortality at the higher concentrations. It is hoped that 1987 will give us the needed concentration.

Yield results for threshold establishment were not determined in 1986 as a severe infestation of fusarium basal rot developed in the plots during mid-August. The onion variety Valdez is apparently more susceptible to this fungus than some other varieties, since Valdez showed high basal rot in other plots also; other varieties did not show a significant amount of basal rot. In 1985, there was no decrease in yield because of thrip infestation (Table 2). However, thrip injury in 1984 did cause a significant decrease in yield of 138 cwt/acre over the treated plots. There was also much heavier thrip pressure in the trials in 1984 than in 1985, which may be part of the reason for the differences. No significant difference in onion yield occurred until the control fell below 67 percent. This would put the threshold level at somewhere between 25 and 70 thrips per plant. During 1985, the average number per plant did not exceed 25 and did not cause a yield reduction. A practical problem is that when thrip population reaches 25+ per plant, control is extremely hard to obtain, so some way of predicting when the populations might increase beyond 25+ thrips per plant should be explored.

Conclusions

1. The organo-phophate insecticides' effectiveness in controlling onion thrips has continually lessened over the last three years.

2. All thrips infesting onions in the Treasure Valley area during 1986 appeared to be onion thrips (*Thrips tabaci*).

3. There was a significant yield reduction of 138 cwt/acre in 1984 from thrips but no reduction in 1985.

4. Preliminary results indicate that the economic threshold for onion thrip populations may lie between 25 and 60 thrips per plant.

Table 1. Organo-phosphate insecticide decrease in thrip control over a three year period at the Malheur Experiment Station, Ontario, Oregon

Treatment	Rate lbs ai/ac	Percent of Control - Year Applied 1984	1985	1986
		%	%	%
Penncap M + Methyl parathion	0.5 + 0.5	99	88	64
Penncap M + Guthion	0.5 + .075	97	88	54

Table 2. Onion thrip effect on yield. Malheur Experiment Station, Ontario, Oregon, 1985

Treatment	Avg. Number thrip/plant	Thrip Control	Total Yield	Market Class Distribution Colossal	Jumbo	Medium
		%	cwt/ac	- - - - %	- - - - -	
Best Thrip Control	4.1	82	556	10.0	68.0	22.0
No Thrip Control	23.4	0	539	3.5	75.0	21.5
	- - - - - - - - - - - - -		1984	- - - - - - - - - - - -		
Best Thrip Control	0.4	99	386a	17.0	67.9	15.1
#13 of 15 Treatments for Thrip Control	24.0	67	362a	10.3	68.9	10.8
#14 of 15 Treatments for Thrip Control	68.7	4	269b	8.6	71.1	20.3
#15 No Thrip Control	71.8	0	248b	8.0	63.7	28.3
LSD (.05)			62			

ONION PLANT DENSITY AND ROW SPACING TO OBTAIN THE HIGHEST MARKETABLE YIELD AND GROSS RETURN

Clinton C. Shock and Tim Stieber
Malheur Experiment Station, Ontario, Oregon, 1986

PURPOSE

The objective of this research is to determine the plant populations and row spacings that result in the best marketable yields and gross crop value per acre. This study was designed to discover the best target populations that growers should shoot for when they plant their onion seed.

Summary

Four Yellow Sweet Spanish onion varieties were grown at increasing plant densities from 2 to 16 plants per foot of bed. Onions were harvested and graded to determine the highest yields, highest yields of jumbo onions, and best gross dollar returns. Populations that produced the highest yields of jumbo onions were 8 onions per foot of bed for the Golden Cascade variety, 10 onions per foot for Vega, and 12 onions per foot for Valdez and Dai Maru. Plant populations that resulted in the best gross return per acre were higher than the populations with the most jumbo onion yields. Best gross returns were at 10 to 12 onions per foot of bed for Golden Cascade and Vega and 14 to 16 onions per foot of bed for Valdez and Dai Maru.

Introduction

Onion producers understand that spotty stands lead to a high proportion of colossal onions (onions with diameters greater than four inches), many split double onions, and reduced yields. Conversely, when onion stands are excessive, the average size of onions is relatively small and economic returns are reduced.

The economic value of Yellow Sweet Spanish onion production in the Treasure Valley is in the "jumbo" market class (onions greater than three inches in diameter). Smaller sizes of onions are produced competitively at locations nearer major onion markets in the east, south, and west.

A number of studies have been conducted in other production areas of the United States on the effects of onion plant density and spacing between rows on marketable yields of onions. Previous work has not been designed to maximize the yields of jumbo onions but to maximize yields of onions 2 1/4 inches and larger. Those studies were conducted in environments not directly applicable to the Treasure Valley.

In the absence of experimental results to optimize jumbo onion production in the Treasure Valley, growers have made progress in technology for direct-seeding onions. Planting rates are often 1 1/4 to 1 1/2 pounds of pure seed per acre. Onions are planted in two single rows or two double rows on top of beds. Beds are approximately 40 to 44 inches between the bottoms of the water furrows. Various specialized planters (for example Graymor, Beck, and Monosem planters) are used to spread a small amount of seed uniformly down the length of the bed.

Materials and Methods

Onions were planted in 40-inch beds at rates in excess of the desired plant populations. Beds at each population density were planted in three styles using conventional Mel Beck Precision Planters.

1. Two single rows 18 inches apart down the length of the bed.

2. Two double rows with the outside of the double rows 18 inches apart and the inside rows 13 inches apart (2 1/2 inches between the double rows).

3. Two double rows with the outside of the double rows 18 inches apart and the inside rows 8 inches apart (5 inches between the double rows).

On June 5 and 6 the plant stands were hand thinned to 2, 4, 6, 8, 10, 12, 14, or 16 plants per foot of bed, corresponding to 26,000, 52,000, 78,000, 104,000, 130,000, 156,000, 183,000, and 208,000 plants per acre. The number of plants in each plot was counted to confirm the plant stand.

The onions were sidedressed May 17 with 100 pounds per acre of nitrogen in the form of ammonium nitrate. An additional 50 pounds per acre of nitrogen as ammonium nitrate were applied June 20.

Onion maturity ratings were made approximately every 14 days. Maturity ratings were 0 to 100 percent depending on plant top fall and top drying. Onions were lifted September 23. They were topped and bagged October 1 and 2. The bagged onions were placed in crates for storage and stored with continuous forced fan ventilation.

The onions were taken out of storage January 8 and graded. The onions were graded and weighed by diameter: less than 2 1/4 inches, from 2 1/4 to 3 inches, from 3 to 4 inches, and greater than 4 inches. Number twos and rotten onions were separated and weighed. Split double onions were considered number twos.

Total yield, total jumbos (> 3-inch diameter), percent jumbos, percent rot, and percent loss were calculated for each variety, row spacing, and plant density treatment. Percent loss included all sources of loss from harvest through grading. Losses included loss of moisture, dirt, and rot before and during storage.

Gross economic returns were calculated by crediting medium packout with $4 per hundredweight and jumbo packout with $8 per hundredweight. No credit was calculated for small onions, double onions, or rotten onions.

Effects of Varieties

By early August the tops of Golden Cascade started to fall over as in 1985. Vega, Dai Maru, and Valdez followed (Table 1). By harvest all varieties were mature if not completely dry.

The varieties differed greatly in total yield, in total jumbo yield, in their tendency to produce doubles, and other factors (Table 2). Golden Cascade was the least productive of the four varieties, averaging 641 cwt/acre. Dai Maru was the most productive variety, averaging 755 cwt/acre. Dai Maru had the greatest production of doubles. Variety lateness to maturity appeared to be related to yield (Table 1).

Effects of Plant Density

The number of onions per foot of bed directly effected onion maturity, yield, market class size distribution, and quality. As the density increased from 2 to 16 plants per foot of bed, the onion necks were considerably thinner, and the tops fell over sooner and dried earlier.

Average total yields increased from 377 to 826 cwt/acre as plants per foot increased from 2 to 16 bulbs per foot (Table 3). Onions at 2 bulbs per foot of bed produced 2 percent small and medium onions and 98 percent jumbo onions. However, 12.7 percent of the total yield at 2 bulbs per foot were doubles. In contrast, at 16 bulbs per foot, onions averaged 69 percent jumbos and only 0.4 percent doubles. Doubles clearly decreased with increased plant density (Table 4, Figure 3).

Interaction of Density with Variety

Varieties and plant density showed strong interaction effects on total yield, market class distribution, doubles, and rot. Valdez and Dai Maru showed the greatest yield and jumbo yield enhancements with increased plant density (Table 5, Figures 1 and 2).

All varieties had increased proportions of small and medium onions and decreased proportions of colossal onions with increased plant density. The surprising result from the 1986 crop is that these four varieties had the same plant populations for maximal yields of jumbo onions as in 1985 (Table 6). The highest yields of jumbo Golden Cascade onions, 652 cwt/acre, occurred at 8 plants per foot of bed. Vega had its highest yields, 787 cwt/acre, at 12 plants per foot of bed, but had maximum yields of jumbo onions, 621 cwt/acre, at 10 plants per foot of bed. In contrast, Dai Maru and Valdez produced the greatest yield of jumbo onions (804 and 752 cwt/acre respectively) at 12 plants per foot of bed.

Gross Return Per Acre

Gross dollar return per acre is influenced by plant population and the relative price of jumbo and medium onions. Economic penalties for low plant populations were severe in 1986. Gross return was best for our arbitrary prices at plant populations slightly above those that produced the greatest yields of jumbo onions (Table 7 and Figure 5).

Effects of Row Spacings

In review, the onions were either planted in two single rows 18 inches apart on the 40-inch beds, or the onions were planted in two double rows. Double rows were 2.5 or 5 inches apart. The effects of row spacings were far less than effects of plant density.

Planting in double rows appeared to enhance total yields at the highest plant densities (Table 8). The total yield of jumbos was effected little by row spacings independent of density. Planting two single rows per bed resulted in larger proportions of double onions than planting two double rows in 1985, but had no effect on double onion production in 1986.

Conclusions

1. Highest yields of jumbo onions were obtained at lower populations for earlier varieties. Top yields of jumbo onions were Golden Cascade at 8 onions, Vega at 10 onions, and Valdez and Dai Maru at 12 onions per foot of 40-inch bed.

2. If jumbo onions are twice as valuable as medium onions, best gross returns were obtained with 10 to 12 onions per foot of bed for Golden Cascade and Vega and 14 to 16 onions per foot of bed for Valdez and Dai Maru.

3. Double onions were very common at low onion populations and reduced at higher populations.

4. Two double rows on a 40-inch bed is just as good or better than two single rows on the same bed.

Discussions

Grower choices of variety, planting density, and row spacings impact onion yield, market class, quality, and economic returns. The large economic responses to changes in plant population observed justify intensive care to seed bed preparation, planting, and seedling emergence. Any advances toward precision planting will not only save seed but result in greater profits to growers.

Acknowledgments

This research was supported by resources provided by the Idaho-Eastern Onion Growers and Oregon State University. Eric Eldredge assisted with the planting and Charles Burnett and Joey Ishida assisted with the onion grading. Seed of the four onion varieties was provided by Asgrow, Crookham, and Arco Seed Companies.

Table 1. Relationship between average maturation, average yield of jumbo onions over four onion varieties. The data were averaged over four plant densities: 6, 8, 10, and 12 onions per foot of 40-inch bed. Malheur Experiment Station, Ontario, Oregon, 1986

Variety	Average Maturity Rating		Jumbo Onions	
	1985	1986	1985	1986
	- - - % - - -		- - cwt/ac - -	
Golden Cascade	61	53	631	615
Vega	51	50	707	588
Dai Maru	47	37	818	741
Valdez	39	40	849	701

Table 2. Performance of four Yellow Sweet Spanish onion varieties averaged over four densities and three row spacings. The onion densities were 6, 8, 10, and 12 onions per foot of 40-inch bed. Malheur Experiment Station, Ontario, Oregon, 1986

Variety	Total Yield	Total Jumbo	Colossal	Doubles
	- - - - - - -	cwt/ac	- - - - - - -	
1985 Results				
Golden Cascade	711	631	70	4
Vega	781	707	111	11
Dai Maru	861	818	218	38
Valdez	892	849	227	17
1986 Results				
Golden Cascade	701	615	137	10
Vega	681	588	157	11
Dai Maru	792	741	282	25
Valdez	762	701	277	17

Table 3. Average total yield response of Yellow Sweet Spanish onions to increasing plant populations. Malheur Experiment Station, Ontario, Oregon, 1986

Population		Variety				
Onions per foot of 40-inch bed	Plants per acre	Golden Cascade	Vega	Dai Maru	Valdez	Average
		- - - - - - - - cwt/ac - - - - - - - - -				
2	26,000	394	362	403	362	377
4	52,000	429	537	598	565	534
6	78,000	587	572	705	649	615
8	104,000	710	645	801	755	725
10	130,000	735	719	761	781	752
12	156,000	775	787	900	863	833
14	182,000	742	627	930	870	807
16	208,000	763	624	939	910	826
Average		641	609	755	719	684

Table 4. The effects of plant density on the yield, size distribution, and loss averaged over four Yellow Sweet Spanish onion varieties. Malheur Experiment Station, Ontario, Oregon, 1986

Plant Densities		Onion Yields by Market Class						Jumbo distribution	
Plants per foot of 40-inch bed	Plants per acre	Small <2.25"	Medium	Jumbo	Total	Crop loss	Doubles	Jumbo 3-4"	Colossal >4"
		- - - - - cwt/ac - - - - -				%	cwt/ac	- - - cwt/ac - - -	
2	26,000	1	7	369	377	15	48	57	312
4	52,000	1	8	525	534	13	38	142	383
6	78,000	3	24	589	616	14	13	310	279
8	104,000	4	42	679	725	11	14	411	268
10	130,000	5	77	670	752	10	10	493	177
12	156,000	7	130	696	833	13	8	569	127
14	182,000	12	169	626	807	9	5	543	83
16	208,000	18	237	571	826	10	3	504	67
Average		6	87	591	684	12	17	379	212

Table 5. The effects of plant density on the yields, size distribution, and loss of four Yellow Sweet Spanish onion varieties. Malheur Experiment Station, Ontario, Oregon, 1986

Varieties	Plant Densities: Plants per foot of 40-inch bed	Plants per acre	Onion Yields by Market Class: Small <2.25"	Medium 2.25-3"	Jumbo >3"	Total	Crop loss	Doubles	Jumbo distributio: Jumbo 3-4"	Colossa >4"
			- - - - - cwt/ac	- - - - -			%	cwt/ac	- - - - cwt/ac	- -
Golden Cascade	2	26,000	1	23	370	394	16	29	115	255
	4	52,000	0	16	413	429	11	10	193	220
	6	78,000	6	26	555	587	11	5	356	199
	8	104,000	5	52	652	709	9	3	487	165
	10	130,000	4	88	642	734	11	2	527	115
	12	156,000	5	158	611	774	9	0	542	69
	14	182,000	16	178	547	741	13	2	504	43
	16	208,000	18	269	476	763	13	1	454	22
Average			2	101	533	641	12	6	397	136
Vega	2	26,000	1	4	357	362	14	51	37	320
	4	52,000	1	6	530	537	9	30	157	373
	6	78,000	2	27	543	572	12	12	323	220
	8	104,000	3	53	589	645	9	14	363	226
	10	130,000	5	93	621	719	9	12	505	116
	12	156,000	13	177	597	787	17	6	530	67
	14	182,000	14	211	401	627	8	2	379	22
	16	208,000	32	307	285	624	9	0	271	14
Average			9	110	490	609	11	16	320	170
Dai Maru	2	26,000	0	3	400	403	13	73	35	365
	4	52,000	0	5	593	598	13	80	113	480
	6	78,000	3	28	675	705	6	33	295	380
	8	104,000	2	32	767	801	7	26	422	345
	10	130,000	4	41	716	761	3	22	490	226
	12	156,000	5	91	804	900	5	19	627	177
	14	182,000	12	149	770	930	5	8	653	117
	16	208,000	12	196	731	939	4	4	646	85
Average			5	68	682	755	7	33	410	272
Valdez	2	26,000	0	3	359	362	19	35	65	294
	4	52,000	1	4	560	565	24	31	96	464
	6	78,000	1	18	630	649	21	15	265	365
	8	104,000	4	31	720	755	17	13	393	327
	10	130,000	5	74	702	781	13	8	462	240
	12	156,000	6	105	752	863	17	8	577	175
	14	182,000	7	155	708	870	10	6	575	133
	16	208,000	17	187	706	910	12	7	555	151
Average			5	72	642	719	17	12	373	269

Table 6. Summary of the plant density for each variety that resulted in the highest yield of jumbo Yellow Sweet Spanish onions. Malheur Experiment Station, Ontario, Oregon, 1986

Variety	1985 Plants per foot of 40-inch bed	1985 Total Jumbo >3"	1986 Plants per foot of 40-inch bed	1986 Total Jumbo >3"
	Number	cwt/ac	Number	cwt/ac
Golden Cascade	8	676	8	652
Vega	10	725	10	621
Dai Maru	12	876	12	804
Valdez	12	903	12	752

Table 7. Gross return for four Yellow Sweet Spanish onion varieties at increasing plant populations. Malheur Experiment Station, Ontario, Oregon 1986.

Variety	Plants per foot of 40-inch bed	Gross Return[1] Medium	Jumbo	Total
		- - - -	$/ac	- - - -
Golden Cascade	2	166	2074	2240
	4	119	2876	2995
	6	188	3917	4105
	8	378	4719	5097
	10	625	4592	5217
	12	1161	4433	5594
	14	1241	3849	5090
	16	1854	3356	5210
Vega	2	29	2116	2145
	4	49	3661	3710
	6	189	3756	3945
	8	381	4185	4566
	10	670	4492	5162
	12	1106	3768	4874
	14	1563	2948	4511
	16	2258	2083	4341
Dai Maru	2	24	2274	2298
	4	37	3578	3615
	6	204	4835	5039
	8	237	5511	5748
	10	321	5360	5681
	12	693	5972	6665
	14	1130	5816	6946
	16	1511	5598	7109
Valdez	2	19	2105	2124
	4	28	3223	3251
	6	116	3792	3908
	8	196	4671	4867
	10	515	4831	5346
	12	713	4909	5622
	14	1110	5074	6184
	16	1300	4994	6294

[1] Gross returns are based on graded packout yields with rot and double onions removed. Medium onions were given the value of $4 per cwt and jumbos were valued at $8 per cwt.

Table 8. Interaction effects of row spacings and plant densities on the yield performance of Yellow Sweet Spanish onions. Malheur Experiment Station, Ontario, Oregon, 1986

Row Spacing	Plant density in Plants per foot of 40-inch bed							
	2	4	6	8	10	12	14	16
	- - - - - Total Yield, cwt/ac - - - - -							
2 single rows	384	515	616	718	722	800	---	---
2 double rows 2.5" apart	375	563	629	752	772	828	802	804
2 double rows 5" apart	367	545	583	686	718	858	835	---

Table 9. Interaction effects of row spacings and plant densities on the yield of double Yellow Sweet Spanish onions. Malheur Experiment Station, Ontario, Oregon, 1986

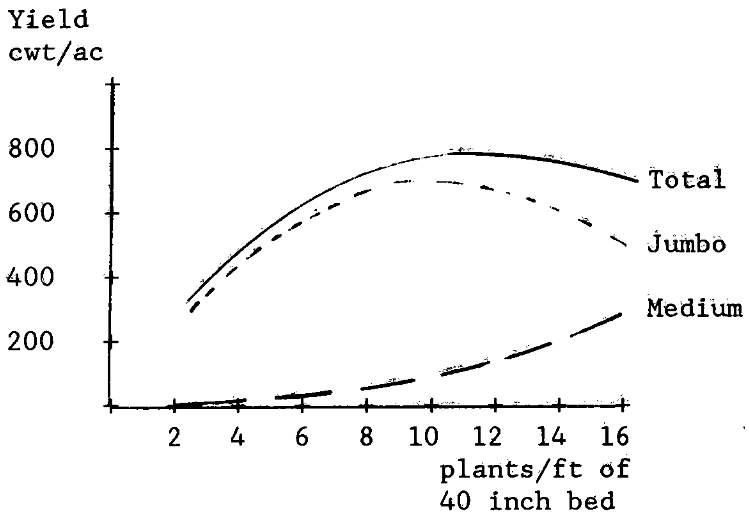
Row Spacing	Plant density in Plants per foot of 40-inch bed							
	2	4	6	8	10	12	14	16
	- - - - - - Doubles, cwt/ac - - - - -							
2 single rows	47	43	12	20	6	12	---	---
2 double rows 2.5" apart	41	21	14	14	12	9	4	1
2 double rows 5" apart	52	40	10	11	5	2	6	---

Table 10. The effect of increasing plant density on the reduction of plant maturity and storage rot. Malheur Experiment Station, Ontario, Oregon, 1985 and 1986

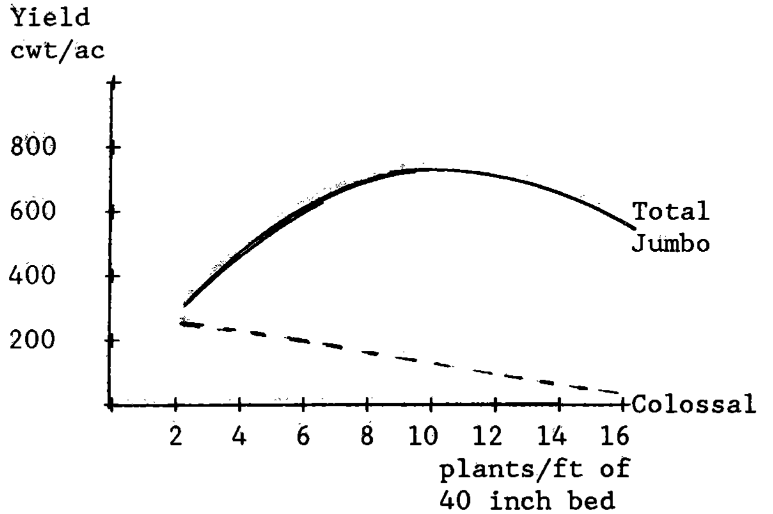
		1985		1986	
		Avg. Maturity		Avg. Maturity	
Variety	Density	Rating	Rot	Rating	Rot
	Plants/foot of bed	%	cwt/ac	%	cwt/ac
Golden Cascade	2	--	---	29	18.1
	4	--	---	44	11.6
	6	57	7.4	50	14.8
	8	60	5.7	52	12.5
	10	63	2.6	55	19.8
	12	65	4.1	56	16.9
	14	--	---	63	16.5
	16	--	---	65	25.4
Avg.		61	4.9	51	16.4
Vega	2	--	---	12	13.6
	4	--	---	26	12.4
	6	44	7.6	40	13.2
	8	50	5.2	44	18.4
	10	53	1.1	54	10.5
	12	56	1.2	61	40.0
	14	--	---	69	14.1
	16	--	---	71	21.7
Avg.		51	3.8	38	16.7
Dai Maru	2	--	---	4	23.2
	4	--	---	15	20.3
	6	40	6.6	23	20.3
	8	46	6.9	35	19.8
	10	50	4.5	44	6.9
	12	52	3.7	47	12.4
	14	--	---	53	17.1
	16	--	---	55	13.0
Avg.		47	5.4	32	17.2
Valdez	2	--	---	10	14.9
	4	--	---	16	23.9
	6	33	3.3	34	19.2
	8	37	4.1	39	26.6
	10	41	3.3	43	22.6
	12	45	1.3	48	37.7
	14	--	---	47	23.4
	16	--	---	50	28.0
Avg.		39	3.0	36	24.7
Average over varieties	2	--	---	13	16.8
	4	--	---	25	16.3
	6	43	6.2	39	16.4
	8	48	5.4	42	19.9
	10	52	2.8	48	16.6
	12	54	2.5	52	27.9
	14	--	---	57	18.1
	16	--	---	60	21.9
Avg.		49	4.2	40	19.1

Figure 1. Performance of Golden Cascade and Vega Yellow Sweet Spanish onions with increasing plant populations. Malheur Experiment Station, Ontario, Oregon, 1986.

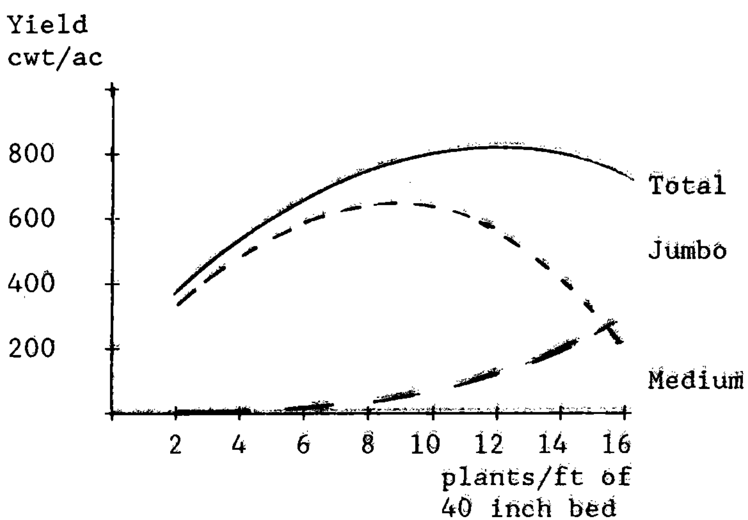
Yields of Golden Cascade onions by market grade with increasing plant populations. 1986



Yields of jumbo and colossal Golden Cascade onions with increasing plant population. 1986



Yields of Vega onions by market grade with increasing plant population. 1986



Yields of jumbo and colossal Vega onions with increasing plant population. 1986

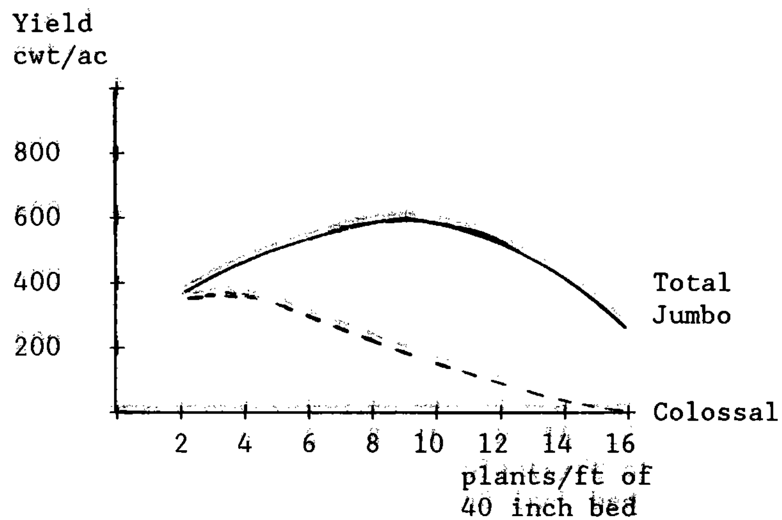
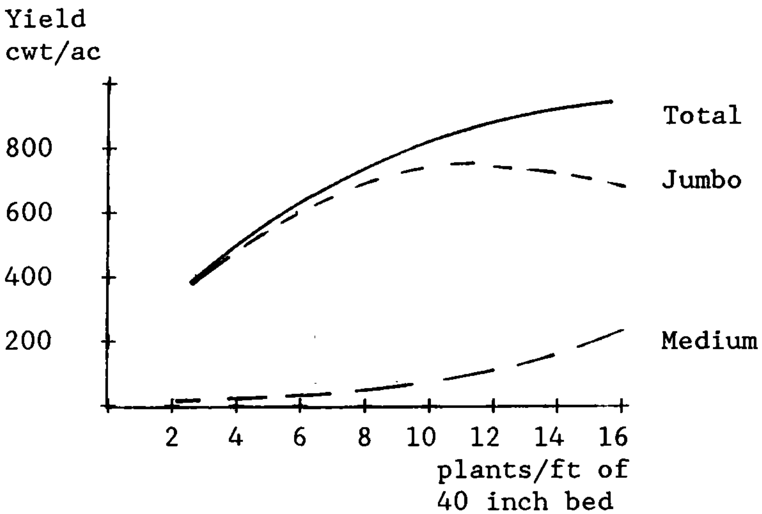
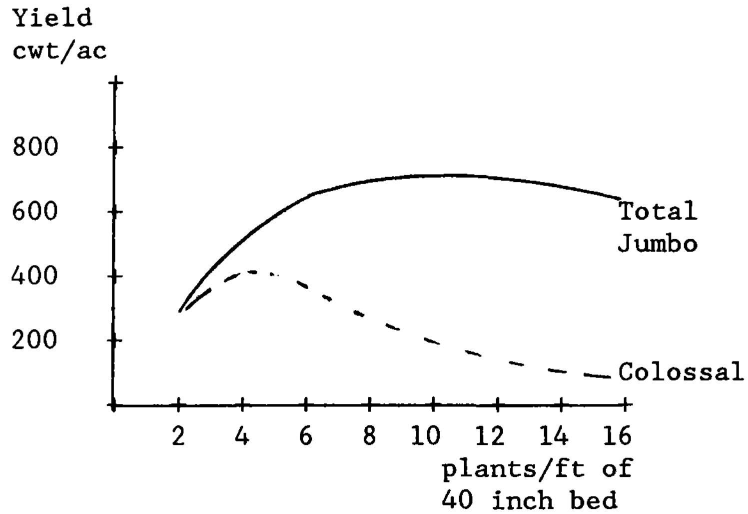


Figure 2. Performance of Valdez and Dai Maru Yellow Sweet Spanish onions with increasing plant populations. Malheur Experiment Station, Ontario, Oregon, 1986.

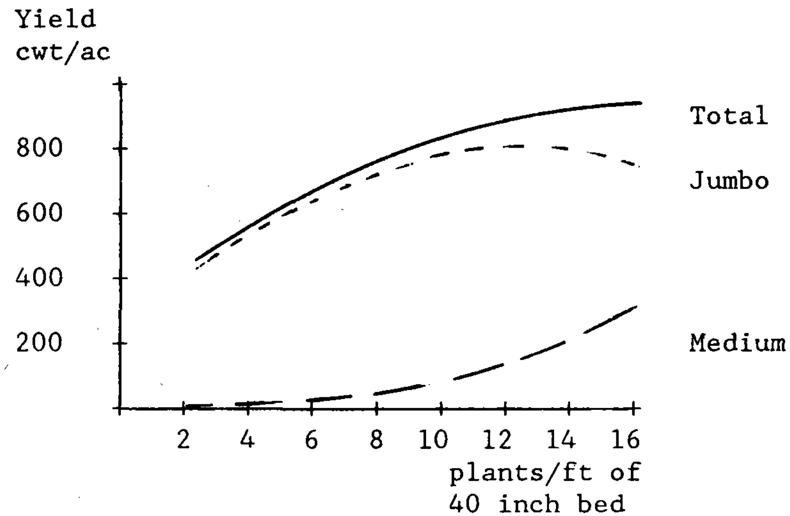
Yields of Valdez onions by market grade with increasing plant populations. 1986



Yields of jumbo and colossal Valdez onions with increasing plant population. 1986



Yields of Dai Maru onions by market grade with increasing plant population. 1986



Yields of jumbo and colossal Dai Maru onions with increasing plant population. 1986

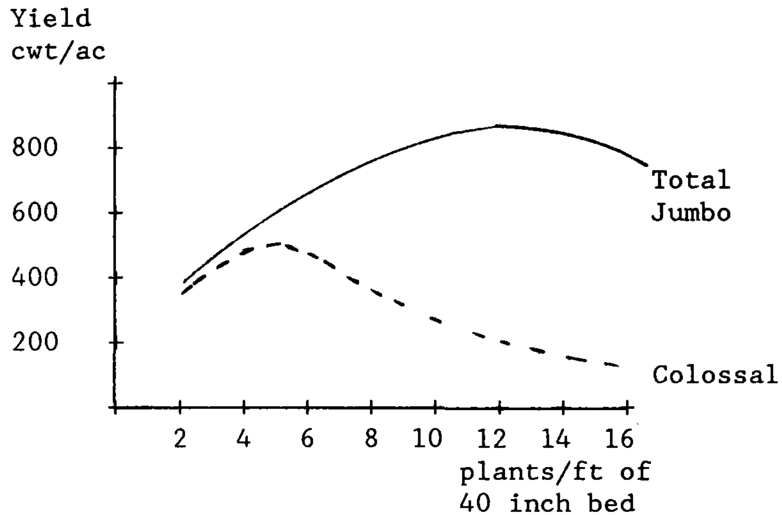


Figure 3. Yields of double onions with increasing plant population. Malheur Experiment Station, Ontario, Oregon. 1986

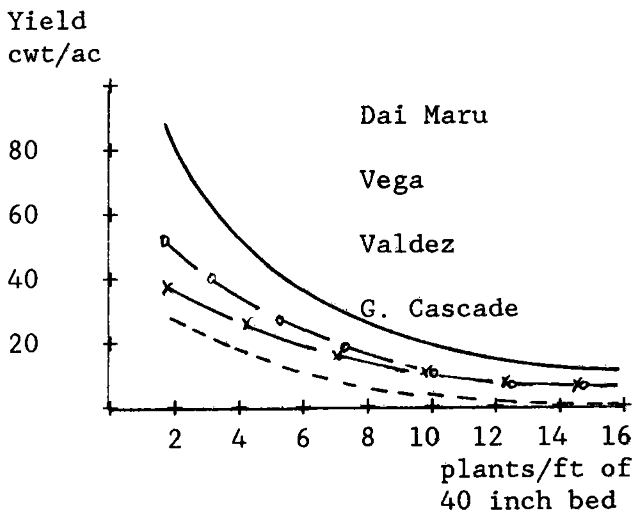


Figure 4. Gross return for four Yellow Sweet Spanish onion varieties with increasing plant population. Malheur Experiment Station, Ontario, Oregon. 1986

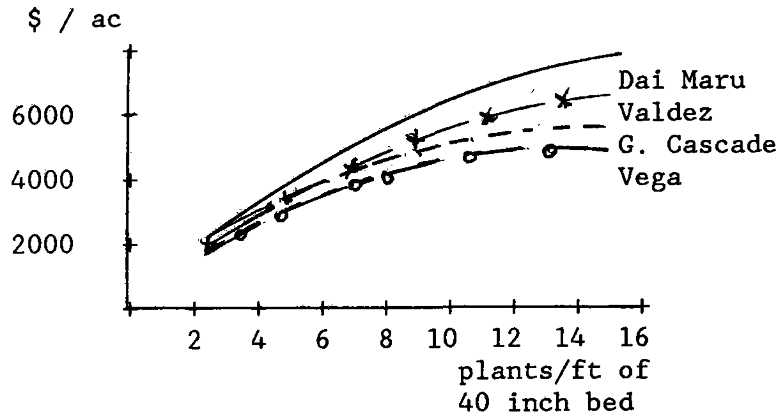
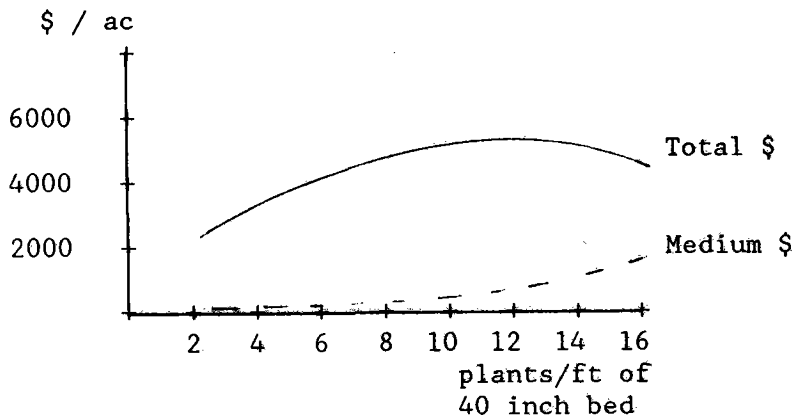


Figure 5. Gross return for Golden Cascade Yellow Sweet Spanish onion with increasing plant population. Malheur Experiment Station, Ontario, Oregon. 1986



FALL-APPLIED HERBICIDES FOR WEED CONTROL IN BULB ONIONS

Charles E. Stanger and Joey Ishida
Malheur Experiment Station, Ontario, Oregon, 1986

Purpose

This study was initiated with the objective of eliminating the need for applying soil-active herbicides in the spring by applying herbicides and/or fumigants in the fall as land is bedded.

Introduction

Fields being planted to onions are customarily bedded in the fall before planting onions in the spring. Soil moisture and tilth for planting onions are generally better when land is bedded in the fall, and growers are reluctant to incorporate herbicides by tilling soil in spring because moisture needed for seed germination is lost. Presently herbicides with soil activity are applied after the onions are planted and mixed to some extent with the soil above the depth of the planted onion seed. Unless rain occurs the herbicides remain inactive in dry soil, and weed control is unsatisfactory.

Procedures

Vapam (fumigant), Nortron, Pyramin, Dual, Hoelon, and Dacthal (herbicides) were applied as band treatments on October 31, 1985, as the land was hilled to form beds. The chemicals were sprayed in bands 11 inches wide on flat soil in the center between furrows spaced 22 inches apart. The soil adjacent to the sprayed bands was thrown over the top of the sprayed area as the hills were made, leaving the chemicals in a layer at the base of individual beds. Each plot was 30 feet long, four rows wide and treatments were replicated three times using a randomized complete block experimental design.

The Vapam and herbicides were applied with a single bicycle wheel type plot sprayer. The boom contained four teejet fan-type nozzles, size 8003E, spaced at 22 inches so that one nozzle was centered over each row. Vapam was applied so the broadcast rate (25 and 50 gallons per acre) was concentrated in the banded area. The amount of herbicides used per acre was adjusted to the width of the area within the band (11/22 of amount used in broadcast application). For the application of the herbicide treatments, water at the rate of 28 gallons per acre was used as the carrier. Vapam was applied at the volume rate of 25 and 50 gallons per acre. Water was added to the 25-gallon rate to bring its volume to 50 gallons per acre. The skies were overcast and the air temperature was 47^{o}F when treatments were applied. The soils were dry on the surface with good soil moisture below. The land was bedded immediately after the chemical treatments were applied.

The soil in the trial area was a silt loam with 1.2 percent organic matter and a pH of 7.3. Spring wheat was grown on the land in 1985. The wheat straw was shredded, the field was disced, irrigated, and fertilizer (100 pounds of phospate and 60 pounds of nitrogen) was applied broadcast before being moldboard-plowed and worked down in preparation for applying the chemical treatments and hilling in rows to form beds.

On April 6, the beds were worked down using a heavy steel spike-tooth harrow. The metal beam on the front of the harrow leveled the beds and the teeth incorporated the herbicide as the soil was mulched in preparation for planting.

Golden Cascade variety onions were planted with a Beck shoe-type drill on April 7. Soil moisture was adequate for seed germination and seedling emergence.

The treatments were evaluated for weed control and crop tolerance on May 14. After evaluations, the plots were sprayed with a tank-mix combination of Ronstar (1.0 pound ai/ac) and Poast (0.25 pounds ai/ac) for weed control. Mor Act oil concen trate was added to the tank-mix at a rate of 1.0 quart per acre.

The onions were hand-thinned to an approximate plant count of five onions per linear foot of row. Prowl (two pounds ai/ac) was applied after the first cultivation following thinning, and cultivated again before irrigating to incorporate the herbicide.

The onions were lifted on September 3 and topped on September 14. They remained in the field for drying until September 28, when they were put in storage. On January 7, they were removed from storage and graded to determine the effect of the chemical treatments on bulb size and bulb yield.

Results

Onion tolerance was satisfactory for all herbicides with the exception of Dual. Dual at two and three pounds active ingredient per acre caused stand losses that reduced the yield of harvested bulbs. Dual effectively controlled all species of weeds at rates above and including 1.5 pounds active ingredient.

Hoelon persisted to give control of green foxtail and barn yardgrass. Nortron at 1.5 pounds active ingredient per acre controlled 98 to 100 percent of pigweed and lambquarters but was less effective on grasses than Hoelon. Four pounds of Pyramin controlled 92 and 97 percent of the lambsquarters and pigweed. Pyramin had very little activity on green foxtail and barnyard grass. The tank-mix combination of Nortron and Pyramin was no better than Nortron alone. Nortron gave better weed control than

Pyramin. Dacthal did not persist overwinter to give adequate weed control.

A tank-mix combination treatment of Nortron and Hoelon would appear to be an excellent combination for fall application to control broadleaf weeds and grasses in onions.

Vapam did have herbicide activity. At the rate of 50 gallons per acre it gave about 94 percent control of lambsquarters and pigweed and 82 to 85 percent control of green foxtail and barnyardgrass. It was less active at the 25-gallon- per-acre rate. At harvest time Vapam did not reduce the amount of pink-rot on the onion roots and did not increase bulb yields when compared to yields obtained from the non-treated control.

Table 1. Weed control and crop injury ratings from herbicides applied in the fall to land bedded for onions. Malheur Experiment Station, Ontario, Oregon, 1986

Herbicides	Rate[1] per acre	Crop[2] Injury	Weed Control[2] Lambsquarters	Pigweed	Green Foxtail	Barnyard-grass
		%	- - - - - - - - - - %	- - - - - - - - -		
Vapam	25 gal	0	78	82	76	73
Vapam	50 gal	0	93	95	85	82
Nortron	1.5	0	98	100	91	87
Nortron	2.0	5	99	100	94	90
Pyramin wp	3.0	0	90	96	20	15
Pyramin wp	4.0	0	92	97	25	18
Hoelon	1.0	0	0	0	100	100
Hoelon	1.5	0	0	0	100	100
Nortron + Pyramin	1 + 2	5	96	100	88	85
Nortron + Pyramin	1 + 3	5	98	100	88	83
Nortron + Pyramin	1.5 + 2	5	98	100	94	88
Nortron + Pyramin	1.5 + 3	7	98	100	92	89
Dacthal	9.0	0	72	78	65	68
Dual	1.0	5	100	100	95	92
Dual	1.5	10	100	100	98	96
Dual	2.0	18	100	100	100	98
Dual	3.0	55	100	100	100	100
Check	--------	--	0	0	0	0

[1]Rates: herbicides Nortron, Pyramin, Hoelon, Dacthal, and Dual expressed as pounds active ingredient per acre.

[2]Ratings: 0 = no effect, 100 = all plants killed. Average of three replications.

Table 2. Total bulb yields and yields for bulbs of different size categories from spring planted onions treated with herbicides applied in October to bedded land. Malheur Experiment Station, Ontario, Oregon, 1986

Herbicides	Rate[1] per acre	Yield of Onion Bulbs[2] Total								
		Total	> 4 inch		3-4 inches		2 1/4-3 inches		< 2 1/4 inch	
		cwt/ac	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac	%
Vapam	25 gal	646	93	14	459	71	57	9	6	1
Vapam	50 gal	616	91	15	469	76	52	8	5	1
Nortron	1.5	642	104	16	485	76	49	8	3	0.5
Nortron	2.0	706	166	24	499	70	39	6	2	0.3
Pyramin	3.0	621	139	22	440	71	40	6	3	0.5
Pyramin	4.0	680	100	15	524	77	53	8	2	0.3
Hoelon	1.0	636	95	15	485	76	54	8	2	0.3
Hoelon	1.5	631	60	10	491	77	75	12	5	1
Nortron + Pyramin	1 + 2	605	126	21	440	73	33	5	6	1
Nortron + Pyramin	1 + 3	639	86	13	494	77	58	9	2	0.3
Nortron + Pyramin	1.5 + 2	639	97	15	482	75	58	9	2	0.3
Nortron + Pyramin	1.5 + 3	675	134	20	484	72	53	8	3	0.4
Dacthal	9.0	689	148	21	502	73	35	5	4	1
Dual	1.0	576	52	9	458	79	62	11	4	1
Dual	1.5	585	111	19	419	71	51	9	4	1
Dual	2.0	554	130	23	379	68	42	8	3	1
Dual	3.0	474	106	22	318	67	46	10	4	1
Check	-------	670	116	17	510	76	41	6	2	0.3
LSD (.05)		97	NS	--	93	--	NS	--	NS	---
LSD (.01)		131	NS	--	125	--	NS	--	NS	---
Mean		621	107	--	461	--	50	--	4	---
CV (%)		9	21	--	12	--	29	--	33	--

[1] Herbicides Nortron, Pyramin, Hoelon, Dacthal, and Dual rates are expressed as pounds active ingredient per acre.

[2] Yields are average of three replications.

SUGAR BEET VARIETY TESTING RESULTS

Charles E. Stanger
Malheur Experiment Station, Ontario, Oregon, 1986

Purpose

Commercial varieties and experimental lines of sugar beets were evaluated to identify lines for superior yield and quality.

Introduction

The data from Ontario are combined with data from eastern Idaho and are used by a joint seed advisory committee, including people from the seed industry, Amalgamated Sugar Company, and sugar beet grower representatives, for the purpose of improving the sugar beet industry by emphasizing improvements in varieties. The committee evaluates the data and recommends varieties of highest quality for planting in different areas of production for Malheur County of eastern Oregon and the sugar-beet-growing areas of Idaho.

Procedures

Forty-three cultivars and experimental lines were evaluated. Twenty entries were included in the commercial trial and 28 lines were evaluated as experimental entries. Seed for evaluation was received from American Crystal, Betaseed, Holly, Mono-hy and, TASCO companies.

The sugar beets were planted in an Owyhee silt loam soil where Stephens wheat was grown for two years. Soil pH was 7.3 and soil organic matter 1.2 percent. The field was plowed in the fall of 1985. One-hundred pounds P_2O_5 and 60 pounds N was applied as a broadcast treatment before plowing. An additional 140 pounds N was sidedressed after thinning. Two pounds active ingredient per acre of Nortron and 1.5 pounds active ingredient per acre Hoelon were broadcast and incorporated with a spike-tooth harrow before planting.

The commercial varietes and experimental lines were planted in separate trials. Commercial checks were planted with experimental lines to use as standards 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 22 feet long with four-foot alleyways between blocks. Enough seed was prepackaged to plant approximately 12 viable seeds per foot of row for each 22 feet of row. The seed was planted on April 10 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 enough moisture for uniform seed germination and seedling emergence.

The sugar beets were thinned during the third week of May. Spacing between plants was approximately eight inches. In mid-July, just before the last cultivation, one pound active ingredient of Bayleton was applied broadcast with a ground sprayer. Another Bayleton application at 0.5 pounds active ingredient per acre and 40 pounds of sulfur dust per acre were aerial-applied on September 1. Comite for spotted mite control and Orthene for armyworm control were also aerial-applied on September 5. Each material was applied at the rate of one pound active ingredient per acre.

The sugar beets were harvested on October 14, 15, 16, and 17. The top foliage was removed by a rubber flail beater and the crowns clipped with dragging scalping knives. The roots from the two center rows of each four-row plot were dug with a single-row lifter type harvester and roots in each 22 feet of row weighed to calculate root yields. A sample of seven beets was taken from the two harvested rows of each plot and analyzed to measure percent sucrose and obtain a conductivity reading as a measure of root purity. The root weights were tared by 5 percent and the percent sucrose content factored to 93 percent when final yields and percent sucrose were recorded.

Results

The entries have been grouped according to companies furnishing seed. Each entry has been ranked within each company's group based on yield of recoverable sugar per acre. These data were analyzed statistically.

Yield of recoverable sugar from commercial entries ranged from a high of 13,927 pounds of sugar per acre to a low of 11,659, with an entry mean of 12,646 (Table 1). Three entries produced sugar yields significantly greater than the mean. Yields of recoverable sugar for entries among the experimental lines ranged from 14,455 to 11,549, with a mean of 12,938 pounds of sugar per acre (Table 2). Twelve of the 28 lines tested had sugar yields above the test average. Seven of these entries had sugar yields significantly higher than the mean at the 5-percent level.

Comparing the 1986 to 1985 recoverable sugar yields, yields were higher in 1986. In the 1986 tests, comparing averages for experimental lines, both root yields and percent sucrose were higher by about three tons per acre and 1.0 percent sucrose. The commercial varieties were also higher in 1986 by slightly more than 1.0 tons per acre and 0.70 percent sucrose. In 1985, average yield of recoverable sugar was 11,701 pounds per acre among the commercial entries and 11,964 pounds per acre among the entries tested in the experimental variety trial.

Table 1. Yield, beet quality, and curley-top virus resistance of commercial sugar beet varieties. Malheur Experiment Station, Ontario, Oregon, 1986.

Company	Entry	Root Yield[2] tons/acre	Sucrose %	Extraction %	Conductivity	Estimated Recoverable Sugar lbs/acre	Curly-Top[1] Aug. 14-15	Curly-Top[1] Sept. 10
American Crystal	ACH-174	44.03	17.18	86.32	738	13059	5.0	6.0
American Crystal	ACH-173	43.98	16.18	86.78	693	12350	3.33	4.67
American Crystal	ACH-184	43.48	16.04	86.16	738	12018	4.67	5.67
American Crystal	ACH-31	42.68	16.09	85.67	775	11766	4.33	5.67
American Crystal	ACH-139	42.95	15.81	85.85	759	11659	4.33	5.33
Betaseed	8555	47.51	15.62	85.17	808	12641	4.0	4.0
Betaseed	8654	47.45	15.64	85.09	814	12629	4.33	4.33
Mono Hy	176	49.69	16.07	87.21	660	13927	3.0	5.0
Mono Hy	R2	49.13	16.19	85.29	805	13568	4.33	5.67
Mono Hy	149	47.94	16.13	84.61	855	13085	4.67	5.67
Mono Hy	55	47.63	15.98	85.47	790	13010	4.33	5.33
Mono Hy	R1	46.43	16.01	85.64	778	12732	4.33	5.33
Mono Hy	100	44.60	16.39	85.98	755	12570	4.33	5.33
Mono Hy	RH-83	44.76	15.82	85.58	779	12119	4.33	5.0
Holly	HH-37	47.19	15.64	84.38	867	12455	4.0	6.0
Holly	HH-32	45.98	15.79	85.64	775	12435	4.33	5.0
Holly	HH-39	46.33	15.62	85.22	804	12334	4.33	5.33
Mart Seed	Hybrid 8	45.15	15.75	86.63	699	12320	4.0	4.33
TASCO	WS-88	50.54	15.59	85.17	808	13421	4.0	4.0
TASCO	WS-76	47.51	15.87	85.04	821	12823	3.67	4.33
LSD .05		2.06	0.41	0.62	44	669		
.01		2.71	0.54	0.81	58	885		
CV (%)		4.5	2.6	0.7	5.8	5.4		
Mean		46.48	15.96	85.66	775	12646		

[1] Comparison — Average Curley Top Ratings

Comparison	August 14-15	September 10
US-33 (Susceptible)	5.26	6.35
US-41 (Resistant)	4.55	5.60

[2] Variety Trial planted - April 10
Harvested October 14-17

Table 2. Yield, beet quality, and curley-top virus resistance of experimental sugar beet lines entered in variety trials. Malheur Experiment Station, Ontario, Oregon, 1986.

Company	Entry	Root Yield[2] tons/acre	Sucrose %	Extraction %	Conductivity	Estimated Recoverable Sugar lbs/acre	Curly-Top[1] Aug.	Curly-Top[1] Sept.
American Crystal	C84-240	48.47	16.56	85.42	804	13712	4.67	5.67
American Crystal	C84-158	49.35	16.18	85.12	817	13593	4.67	5.33
American Crystal	C83-216	49.67	16.06	84.57	857	13492	4.67	5.67
American Crystal	C84-100	46.41	16.54	85.68	779	13154	4.67	6.00
American Crystal	C84-355	44.06	16.67	86.51	719	12708	4.67	5.67
American Crystal	C84-367	42.85	16.55	85.93	761	12187	3.33	5.67
American Crystal	ACH-31	45.06	15.82	85.01	822	12120	4.33	5.67
American Crystal	ACH-139	43.52	15.61	85.00	820	11549	4.33	5.33
Betaseed	3G5567	54.09	15.78	84.36	869	14393	4.33	6.00
Betaseed	2C0115	53.88	15.69	83.53	930	14123	4.00	4.00
Betaseed	5BC-6240	46.95	15.96	84.70	846	12694	4.67	5.00
Betaseed	8654	48.12	15.44	84.32	868	12529	4.33	4.33
Betaseed	5BC-6230	48.29	15.23	83.88	910	12338	4.67	5.33
Holly	1437-02	49.79	16.37	86.28	733	14065	4.33	4.33
Holly	8448-02	47.12	15.10	84.69	838	12052	4.00	4.67
Holly	85T50-013	43.93	15.93	85.83	761	12012	4.00	5.00
Holly	HH-39	46.62	15.24	84.51	852	12009	4.33	5.33
Holly	85C141-06	44.49	15.76	85.21	806	11949	4.67	5.33
Mono Hy	55	48.17	15.81	85.10	813	12962	4.33	5.33
Mono Hy	2901	48.40	15.69	83.92	901	12746	4.67	5.33
Mono Hy	2903	47.95	15.66	84.50	858	12690	4.67	5.67
Mono Hy	2902	45.20	16.16	84.45	867	12337	5.67	7.33
Mono Hy	2904	46.01	14.87	83.20	962	11384	5.00	7.00
TASCO	E-389	53.28	15.89	85.37	796	14455	3.67	4.33
TASCO	WS-88	52.94	15.76	85.17	809	14212	4.00	4.00
TASCO	E-4123	53.01	15.54	83.80	908	13806	3.67	5.00
TASCO	E-4119	49.87	15.92	85.09	816	13511	4.33	5.00
TASCO	E-5080	51.50	15.25	84.95	820	13344	3.00	4.67
LSD .05		2.38	0.44	0.82	56	745		
LSD .01		3.12	0.58	1.07	74	972		
CV (%)		5.0	2.9	1.0	6.9	5.9		
Mean		48.18	15.82	84.86	833	12938		

[1] Comparison

	Average Curley Top Ratings August 14-15	Average Curley Top Ratings September 10
US-33 (Susceptible)	5.26	6.35
US-41 (Resistant)	4.55	5.60

[2] Variety Trial planted - August 10
Harvested - October 14-17

A COMPARISON OF FORMULA 132B + NUTRIENT PELLETED SUGAR BEET SEED TO RAW SEED FOR EMERGENCE AND SUGAR YIELDS

Charles E. Stanger
Malheur Experiment Station, Ontario, Oregon, 1986

Purpose

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

Procedures

The trial contained three treatments, including pelleted seed identified as formula 132B + nutrient, raw seed furnished by Germain's, and raw commercial seed obtained from a local sugar beet seed distributor. The seed lot number for the pelleted seed and the raw seed furnished by Germain's was G 618. The lot number of the locally obtained commercial seed was G 629. All seed was TASCO variety WS-88.

The sugar beets were planted in an Owyhee silt loam soil with a pH of 7.3 and an organic matter content of 1.2 percent. The field had previously been planted to winter wheat for two consecutive years. Land preparation consisted of moldboard plowing in the fall and field tillage in the spring to prepare the seed bed. One-hundred pounds of P_2O_5 and 60 pounds of N were applied as a broadcast treatment before plowing. An additional 140 pounds N were sidedressed after thinning. Two pounds active ingredients per acre of Nortron and 1.5 pounds active ingredients per acre Hoelon were broadcast and incorporated with a spike-tooth harrow before planting.

The three treatments with treated seed were planted in the commercial sugar beet variety trial. Each entry was replicated eight times and arranged in a complete randomized block experimental design. Each plot was four rows wide and 22 feet long with four-foot alleyways between blocks. An equal number of seed was prepackaged to plant approximately 12 viable seeds per foot of row for each 22 feet of row.

The seed was planted on April 10 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 enough soil moisture for seed germination.

Stand counts to determine time of emergence, rate of emergence, seedling vigor, and seedling survival began at first emergence on April 22. Subsequent stand counts were taken on

April 24, April 28, and May 5 at full emergence. Counts were taken from six linear feet of the center two rows of each plot for eight replications. Each row was marked and counts were taken from the same section for all recordings.

The sugar beets were hand-thinned during the third week of May. Spacing between plants was eight inches. In mid-July, just before the last cultivation, one pound active ingredient of Bayleton was applied broadcast with a ground sprayer. A second Bayleton application at 0.5 pounds active ingredient per acre and 40 pounds of sulfur dust per acre were aerial-applied on September 1. Comite for spotted mite control and Orthene for armyworm control were also aerial-applied on September 5. Each material was applied at the rate of one pound active ingredient per acre.

The sugar beets were harvested on October 16 and 17. The top foliage was removed by a rubber flail beater and the crown clipped with dragging scalping knives. The roots from the two center rows of each four-row plot were dug with a single-row lifter type harvester and roots in each 22 feet of row weighed to calculate yield per acre. Samples of seven beets were taken from the two harvested rows of each plot and analyzed to measure percent sucrose and obtain a conductivity reading as a measure of root purity. The root weights were tared by 5 percent and the percent sucrose content factored to 93 percent when final yields and percent sucrose were recorded.

Results

Soil tilth and irrigation made soil conditions excellent for seed germination and seedling emergence. Air and soil temperatures during the period of time from planting date (April 10) to April 22 were the following:

	Air °		Soil °		Precipitation
	Max.	Min.	Max.	Min.	Inches
April 10	68	39	65	50	0
April 11	67	32	64	49	Trace
April 12	55	39	58	48	0.06
April 13	53	34	55	46	Trace
April 14	58	29	58	45	0
April 15	60	38	56	46	0
April 16	66	35	61	47	0.01
April 17	60	39	61	47	Trace
April 18	57	35	55	47	Trace
April 19	62	33	63	47	0
April 20	69	40	68	49	0
April 21	78	44	74	54	0
April 22	83	51	75	57	Trace

4" depth

Data, including percent emergence and number of emerged beets per 12 linear feet (avg. of each plot), are recorded in Table 1. Table 2 contains root yield, percent sucrose, percent extraction, conductivity, and yield of recoverable sugar per acre.

No differences existed between treatments for time and rate of emergence. Cool temperatures for several days after planting may have contributed to even germination and early preemergence seedling growth, and the rapid increase in air and soil temperatures may have resulted in uniform emergence. Stand loss did occur in raw seed plots from fungus disease. This was not noted in the pelleted seed plots where emerged plant numbers remained constant.

Differences between treatments for root yield, percent sucrose, and percent extraction were not significant; however, yields were enough better for these factors in the pelleted seed treatments to result in a significant increase in calculated yield of recoverable sugar when tested at the 5 percent level of confidence.

Recoverable sugar = root yield x % sucrose x % extraction.

The data are reported as one year's results at one location. The coefficient of variation is good. The data justify further testing under our cultural and environmental conditions to substantiate the true effect of the treatment identified as 132B + nutrient in pelleted seed.

Table 1. Sugar beet emergence and survival from raw seed and pelleted seed. Malheur Experiment Station, Ontario, Oregon, 1986.

Days after Planting	Raw Seed (Germain's)		Raw Seed (Local)		Pelleted Seed	
	Plants/12 ft.	% emerged	Plants/12 ft.	% emerged	Plants/12 ft.	% emerged
12	57.2	79.4	58.9	81.8	60.8	84.4
14	62.0	86.1	63.8	88.6	65.2	90.6
18	66.0	91.6	67.4	93.6	68.8	95.6
25	63.6	88.3	64.2	89.2	68.8	95.6

Data - Average of eight replications - Planted 12 seeds per foot.
No significant difference between treatments for plant counts by day.

Table 2. Root yields, percent sucrose, percent extraction, conductivity readings, and calculated sugar yields per acre from plots planted with 132B + nutrient treated pelleted seed and raw seed from two different sources. Malheur Experiment Station, Ontario, Oregon, 1986.

Treatment	Total Root T/A	Sucrose %	Extraction %	Conductivity Readings	Recoverable Sugar lbs/acre
132B + nutrient Pelleted	52.08	15.98	85.47	0.751	14,234
Raw Seed (Germain's)	50.11	15.75	85.44	0.733	13,489
Raw Seed (Local)	50.54	15.59	85.17	0.808	13,446
LSD (.05)	NS	NS	NS	NS	669
CV (%)	4.5	2.6	0.7	5.8	5.4

AN EVALUATION OF POSTEMERGENCE-APPLIED HERBICIDES FOR WEED CONTROL IN SUGAR BEETS

Charles E. Stanger and Joey Ishida
Malheur Experiment Station, Ontario, Oregon, 1986

Introduction

Growers of sugar beets are relying more heavily on foliar-active herbicides to control weeds in their crop. In some cases soil-active herbicides have been eliminated completely from their weed control programs. This change has been brought about primarily because of the availability of new gramicides which are very effective on grasses infesting sugar beets and are compatible when tank-mixed with Betamix. Betamix is active on many species of annual broadleaf weeds and most effective when applied as repeat applications with low volumes of water as the carrier.

PURPOSE

These studies were initiated to evaluate the compatibility of Fusilade 2000 and Poast when tank-mixed with Betamix and to test Chevron's RE-45601 for activity on annual grasses when applied as soil and foliar treatments.

Procedures

Sugar beet variety WS-88 was planted on April 16, in silt loam soil which was plowed and bedded in the fall of 1985. The field had been planted to Stephens variety of winter wheat for two years before planting sugar beets. All straw residue had been returned to the soil. Soil pH is 7.3 and the organic matter is 1.2 percent. The sugar beets were planted in single-row beds spaced 22 inches apart. Individual plots were four rows wide and 30 feet long. Each treatment was replicated four times and randomized within blocks using a randomized-block experimental design.

The sugar beets were watered by furrow irrigation. The first irrigation was applied after planting to assure adequate soil moisture for crop seed and weed seed germination and seedling growth. Weed species included pigweed (*Amaranthus retroflexus*), lambsquarters (*Chenopodium album*), kochia (*Kochia sativa*), barnyardgrass (*Echinochloa crus-galli*), green foxtail (*Setaria virdius*), and wild oats (*Avena fatua*). The preplant incorporated and the postplant pre-emergence nonincorporated treatments were applied on April 15 and April 16, respectively. The preplant treatments were incorporated with a roto-tiller equipped with L-shaped teeth and set to till at a depth of three inches. The pre-emergence treatments were left on the soil surface. They preceded the first irrigation. The earliest postemergence treatments began when the sugar beets had two true leaves. Subsequent applications varied between trials.

Preplant and pre-emergence treatments were applied as double-overlap applications. Fan-type teejet nozzles, size 8002, were used in broadcast applications. Spray pressure was 35 psi and water-carrier volume was 26 gallons per acre. Foliar treatments were applied in 12-inch-wide bands. Fan-type teejet nozzles, size 6501 and spray pressure of 45 psi, were used in applying 11.2 gallons of water per acre. Mor Act activated crop oil was added to all foliar treatments at the rate of one quart per acre.

The sugar beets were thinned at eight-inch spacings on June 17 and 18. Weeds were removed at thinning time and the sugar beets were grown through the summer and harvested on October 15 and 16 to determine root yields and percent sucrose.

Results

Sugar beets were tolerant to all herbicide treatments whether applied singly or as tank-mix combinations (Tables 1-4). Chevron's RE-45601 was very active on all grass species as a foliar treatment (Table 1). Chevron RE-45601 as foliar treatments was as effective on grasses four to six inches tall as smaller-sized grasses. It did not control grasses effectively when applied as a preplant or soil surface pre-emergence treatment. Fusilade 2000 controlled wild oats and barnyardgrass at a low rate of 0.125 pounds active ingredient per acre (Table 2). Control of green foxtail increased with Fusilade 2000 as rates increased from 0.1875 to 0.25 pounds active ingredients per acre. Poast at 0.2 pounds active ingredient per acre was effective on barnyardgrass, green foxtail, and wild oats (Table 4). Difference in Poast activity was not noted between Poast/Betamix tank-mix treatments and treatments when Poast treatments followed Betamix applications at 3-, 6-, and 12-day intervals. Herbicide 273 or Herbicide 273 + Betamix tank-mix combinations were generally less active than Betamix applied alone.

Betamix in combination with any one of the grass herbicides (RE-45601, Fusilade 2000, or Poast) were effective treatments for controlling broadleaf and grassy weeds in sugar beets when applied as foliar treatments.

Table 1. The percent weed control and crop injury ratings from Chevron RE-45601 applied to sugar beets as preplant, pre-emergence, and foliar treatments. Malheur Experiment Station, Ontario, Oregon, 1986

Herbicides	Rate	Applied	Visual Crop Injury	Barnyard grass	Green Foxtail	Wild Oats	Pigweed	Lambs-quarters	Kochia
	lbs ai/ac			- - - - - - - - - -	- - -	% Control	- - -	- - - - - -	- - - -
RE-45601	0.125	ppi	0	48	55	45	15	10	10
RE-45601	0.25	ppi	0	60	70	52	20	12	10
RE-45601	0.50	ppi	0	62	65	62	20	15	12
Nortron + RE-45601	1.75 + 0.125	ppi	0	40	50	28	30	20	25
Nortron + RE-45601	1.75 + 0.25	ppi	0	48	48	42	30	22	22
RE-45601	0.125	pre	0	60	65	53	35	30	33
RE-45601	0.25	pre	0	68	70	63	35	28	30
RE-45601	0.50	pre	0	82	80	82	35	30	25
RE-45601	0.062	post[1]	0	100	100	100	0	50	0
RE-45601	0.125	post	0	100	100	100	0	60	0
RE-45601	0.25	post	0	100	100	98	0	65	0
RE-45601	0.375	post	0	100	100	100	10	65	10
RE-45601 + Betamix	0.062 + 0.75	post	0	100	100	94	98	96	93
RE-45601 + Betamix	0.125 + 0.75	post	0	100	100	96	98	98	95
RE-45601 + Betamix	0.25 + 0.75	post	0	100	100	100	96	96	95
RE-45601	0.062	post[2]	0	98	100	98	0	35	0
RE-45601	0.125	post	0	100	100	100	0	45	0
RE-45601	0.25	post	0	100	100	100	0	60	0
RE-45601	0.375	post	0	100	100	100	0	65	0
RE-45601 + Betamix	0.062 + 1.0	post	3	98	98	93	90	88	85
RE-45601 + Betamix	0.125 + 1.0	post	0	100	100	98	92	90	88
RE-45601 + Betamix	0.25 + 1.0	post	0	100	100	99	90	85	85
Check	---- ---	----	0	0	0	0	0	0	0

[1] Applied when grass species had 1- to 4-inch growth

[2] Applied when grass species had 4- to 6-inch growth

Evaluated June 16, 1986

Weed size - May 20 earliest treatments applied

1- Lambsquarters - 2 inches tall
2- Pigweed - 1 inch tall
3- Kochia - 2 inches tall
4- Wild Oats - 4 inches tall
5- Barnyardgrass - 1 to 3 inches tall
6- Green Foxtail - 1 to 3 inches tall

Weed size - May 30 late foliar treatment applied

1- Lambsquarters - 4 to 6 inches tall
2- Pigweed - 2 to 4 inches tall
3- Kochia - 4 to 6 inches tall
4- Wild Oats - 6 to 8 inches tall
5- Barnyardgrass - 4 to 5 inches tall
6- Green Foxtail - 4 to 5 inches tall

Table 2. The percent weed control and crop injury ratings from Fusilade 2000, Herbicide 273, and Betamix foliar applied treatments for selective weed control in sugar beets. Malheur Experiment Station, Ontario, Oregon, 1986

Herbicides	Rate	Visual Crop Injury	Barnyard grass	Green Foxtail	Wild Oats	Pigweed	Lambs-quarters	Kochia
	lbs ai/ac		- - - - - - - - - - -	- - -	- - - % Control	- - -	- - -	- - - - - - - - - - -
Fusilade 2000	0.125	0	96	76	96	0	0	0
Fusilade 2000	0.188	0	100	88	100	0	0	0
Fusilade 2000	0.250	0	100	93	100	0	0	0
Fusilade 2000 + Betamix	0.125 + 0.75	0	93	95	98	98	95	93
Fusilade 2000 + Betamix	0.188 + 0.75	0	100	100	100	98	93	93
Fusilade 2000 + Betamix	0.250 + 0.75	0	100	100	100	98	95	93
Herbicide 273	4 pts	7	43	46	57	58	63	48
Herbicide 273 + Betamix	2 pts + 6 pts	5	53	55	58	95	92	90
Herbicide 273 + Betamix	3 pts + 7.5 pts	7	57	55	67	98	95	93
Check	---- ----	0	0	0	0	0	0	0

Evaluated June 16, 1986 Herbicides applied May 22, 1986

Weed size when treatments applied

1- Pigweed - 1 1/2 inches tall
2- Lambsquarters - 3 inches tall
3- Kochia - 2 to 3 inches tall
4- Wild Oats - 4 inches tall (1 tiller)
5- Barnyardgrass - 1 to 3 inches tall
6- Green Foxtail - 1 to 3 inches tall

Table 3. The percent weed control and crop injury ratings from Fusilade 2000, Poast, and Poast/Betamix combinations applied as foliar treatments for selective weed control in sugar beets. Malheur Experiment Station, Ontario, Oregon, 1986

Herbicides	Rate	Applied	Visual Crop Injury	Barnyard grass	Green Foxtail	Wild Oats	Pigweed	Lambs-quarters	Kochia
	lbs ai/ac			- - - - - - - - - - - % Control - - - - - - - - - - -					
Poast + Betamix	0.2 + 0.75	0 day	0	99	99	98	96	98	92
Betamix then Poast[1]	0.2 + 0.75	3 days	0	99	99	98	98	96	92
Betamix then Poast	0.2 + 0.75	6 days	0	97	99	96	96	96	90
Betamix then Poast	0.2 + 0.75	12 days	0	98	97	96	98	98	94
Fusilade 2000	0.125	0 day	0	97	83	96	0	0	0
Fusilade 2000	0.188	0 day	0	99	92	99	0	0	0
Fusilade 2000	0.25	0 day	0	100	100	100	0	0	0
Fusilade 2000 + Betamix	0.125 + 0.75	0 day	0	99	96	97	98	96	92
Fusilade 2000 + Betamix	0.188 + 0.75	0 day	0	100	98	99	97	94	90
Fusilade 2000 + Betamix	0.25 + 0.75	0 day	0	100	99	99	98	96	92
Check	---- ----	-----	0	0	0	0	0	0	0

[1] Betamix applied on day 0, then Poast applied 3, 6, and 12 days after.
Treatments were evaluated on June 16, 1986.

Table 4. The percent weed control and crop injury ratings from Poast and Betamix applied as foliar treatments for selective weed control in sugar beets. Malheur Experiment Station, Ontario, Oregon, 1986

Herbicides	Rate	Applied[1]	Visual Crop Injury	Barnyard grass	Green Foxtail	Wild Oats	Pigweed	Lambs-quarters	Kochia
	lbs ai/ac			- - - - - - - - - - - -	- - % Control	- - - - -	- - - - -	- - - - -	- - - - -
Betamix + Poast	0.75 + 0.2	day 0	0	99	99	98	98	93	91
Betamix then Poast	0.75 + 0.2	day 3	0	99	99	98	99	95	92
Betamix then Poast	0.75 + 0.2	day 6	0	97	99	96	98	93	90
Betamix then Poast	0.75 + 0.2	day 12	0	98	97	96	98	95	92
Poast	0.2	day 0	0	98	99	87	0	0	0
Betamix	0.75	day 0	0	28	30	12	98	94	92
Check	---- ----	------	0	0	0	0	0	0	0

Evaluated on June 8, 1986.

1 Betamix and Poast alone and Betamix + Poast tank-mix applied on day 0.

OBSERVATIONS ON THE EFFECT OF STRAW MULCH ON SUGAR BEET STRESS AND PRODUCTIVITY

Clinton C. Shock, Charles E. Stanger, and Herb Futter
Malheur Experiment Station, Ontario, Oregon, 1986

Purpose

Straw mulch was evaluated on a furrow-irrigated sugar beet field to determine potential benefits in increased yield, better soil moisture status, and reduced soil erosion.

Summary

Straw mulch applied at 650 pounds per acre in alternate furrows on a hill at 2 to 5 percent slope appeared to benefit sugar beet yields and sugar production. Soil moisture was enhanced by the mulch. On August 4, sugar beet leaf canopies averaged 7.0°F above air temperatures where the field was not strawed. Sugar beet canopies averaged 4.1°F less than air temperatures where straw was applied. Beet yields were 37.5 tons per acre on strawed furrows compared with 30.1 tons per acre on non-strawed furrows. Estimated sugar recovered was 10,030 pounds per acre from the strawed furrows compared with 7,540 pounds per acre in non-strawed furrows.

Experimental Site Description and Methods

Sugar beet variety Beta Seed 8654 was planted March 28, 1986, on a sloping bench soil near Ontario, Oregon. The soil was a Nyssa silt loam with 2 to 5 percent slope. Every other furrow in most of the field was mulched with wheat straw at the rate of 650 pounds per acre. Strips in the field were left without straw mulch. Throughout the season, the field was watered by furrow irrigation in every other row. The mulched parts of the field were watered only in the strawed furrows.

On August 4, observations were made on crop status and soil moisture. Soil moisture was determined by digging replicated samples representative of the first foot of soil.

Stress on the crop was measured by use of a Standard Oil "Scheduler." The Scheduler measures the crop canopy temperature, air temperature, relative humidity, and solar radiation. The Scheduler calculates plant stress using the actual canopy temperature and compares it with maximum and minimum canopy temperatures at maximal and minimal moisture stress at the current ambient relative humidity and air temperature. Observations were replicated four times at each of four locations north to south through the field for both strawed and non-strawed treatments.

The sugar beets were harvested October 29 and evaluated for sucrose and conductivity October 30 and 31 at the Amalgamated Sugar Company research laboratory at Nyssa, Oregon. Harvests were replicated in four rows each of three locations north to south throughout the field for both strawed and non-strawed treatments.

Results and Discussion

The first irrigation resulted in soil losses of 3 tons per acre from the straw mulched furrows and 17 tons per acre from the non-strawed furrows.

As the season progressed, the beets in the non-strawed rows wilted in the afternoon. Soil moisture was less in the non-strawed rows (Table 1). The sugar beet leaves in the mulched rows were able to maintain evaporative cooling, but the leaves on plants in non-strawed rows were unable to maintain cool plant canopies (Table 1). Stress indices for crop without straw were much higher than the crop with straw.

Beet yields and estimated recoverable sugar were enhanced 25 and 33 percent, respectively (Table 2). Recoverable sugar was found to be negatively correlated with August 4 observations of leaf temperature, leaf temperature from air temperature, and the plant stress index. The sucrose content and conductivity varied more with location north and south and by harvested row than by mulching treatment.

Conclusions

The application of straw mulch to gently sloping (2 to 5 percent) furrows appeared to decrease soil loss, decrease plant stress, and increase sugar beet and sucrose yields. The promising results would justify testing the effects of straw mulch in a complete-block randomized design so that conclusions could be reached with greater confidence.

Acknowledgments

The sugar beet crop was planted and cared for by Dick Tipton of Ontario, Oregon. Sugar beet samples were analyzed by Don Oldemeyer of Amalgamated Sugar Company of Nyssa, Oregon. The Scheduler equipment used to measure sugar beet canopy temperature and plant stress was provided by Bronson Gardner of Standard Oil. Soil losses were calculated by Herb Futter of the Soil Conservation Service.

Table 1. Observations on the effect of straw mulch on the leaf canopy temperature and estimated relative stress of sugar beets, 1:30 to 2:30 p.m., August 4, 1986. Other parameters were measured at the same time. Dick Tipton's sugar beets, Ontario, Oregon.

Treatment	Air Temperature °F	Beet Canopy Temperature °F	Temperature Difference °F	Relative Humidity %	Plant Stress Index PSI	Solar Radiation Watts	Wind Speed MPH	Soil Moisture in The Top Foot Inches/ft
No Straw	90.2	97.2	+ 7.0	22.9	1.27	1085	2.7	2.05
Straw	91.4	87.3	- 4.1	26.7	.44	1084	1.8	3.00

Table 2. Effects of straw mulch on sugar beet productivity. Dick Tipton's sugar beets, harvested October 29, 1986, Ontario, Oregon.

Treatment	Beet Yield tons/ac	Sucrose Content %	Conductivity µohms	Estimated Sugar Recovered lbs/ac
No Straw	30.1	15.1	974	7,540
Straw	37.5	16.1	938	10,030

TAILWATER AND SOIL PERSISTENCE STUDY USING SULFONYLUREA HERBICIDES

Charles E. Stanger
Malheur Experiment Station, Ontario, Oregon, 1986

Purpose

The experiments were conducted: 1) to determine if sulfonylurea herbicides will move with tailwater when these herbicides are applied to seedling wheat and irrigated by surface irrigation, 2) to determine if sulfonylurea herbicides can persist to injure sensitive crops if planted within seven weeks after the sulfonylurea herbicides were applied to seedling wheat.

Procedures

Tailwater Study

DPX-L5300 (Express), DPX-R9674 (Matrix), and 2,4-D-Banvel D mixture were applied as strip treatments on April 17 to fall-planted Stephens wheat. Each treated strip was 14 feet wide and 400 feet long. Application rates for Express were 0.125 and 0.25 ounces active ingredient per acre, Matrix rates were 0.375 and 0.5 ounces active ingredient per acre, and 2,4-D-Banvel D rates were 0.75 and 0.12 pounds acid equivalents per acre. Each treatment was replicated two times. The herbicide applications were applied using a single-wheel plot sprayer. Spray pressure was 35 psi applying water as the herbicide carrier at a volume of 28 gallons per acre. Spray nozzles were teejet fan, size 8002, and the herbicides were applied as double-overlap broadcast treatments. The wheat had three to four tillers when the herbicides were applied. Weed species present when the herbicides were applied included prickly lettuce, tumbling mustard, blue mustard, kochia, shepherds purse, and tansy mustard. All plants of each weed species were small and susceptible to the herbicide treatments, resulting in good weed control.

Soil samples were taken from the 0- to 4-inch depth from each plot. The samples were taken using a 0.75-inch soil tube. The soil was probed at 24 locations and composited to consist of a sample. The samples were frozen for later analysis.

Golden Cascade sweet Spanish onions and Mono-Hy R1 variety of sugar beets were planted on April 28 below the wheat previously treated with sulfonylurea herbicides. Both crops were planted on 22-inch row spacing and the crops were planted alternating the rows across the width of the herbicide-treated area. The winter wheat was irrigated on April 29 and the tailwater from the area planted to wheat was used to irrigate the sugar beets and onions. Water samples of the tailwater coming off the herbicide-treated wheat were collected. The water samples were taken from each replication of the herbicide-treated strips and frozen for chemical analysis.

Irrigation continued through the summer on the wheat with the tailwater used to irrigate the sugar beets and onions. Stand counts were taken of the sugar beets and onions at emergence to determine if the tailwater contained sulfonylurea herbicides to cause injury to the crops. All onions and sugar beets were hand-thinned and weeded. On May 19 before thinning, plants were harvested from six linear feet of row at six locations per replication to obtain dry weights as a measure of plant growth and vigor. The bulbs of onions and roots of sugar beets were harvested on October 19 to obtain yield and quality data.

Soil Residue Study:

Stephens wheat was treated with Express and Matrix on May 13 using rates of Express at 0.25 and 0.5 and Matrix at 0.375 and 0.75 ounces active ingredients per acre. The wheat was fully tillered and the stems were starting to elongate. Individual plots were 14 feet wide and 40 feet long. The herbicides were applied with a bicycle wheel plot sprayer and a boom with 10-inch nozzle spacings to apply the herbicides as double-overlap broad cast treatments. Water as the herbicide carrier was used at a volume of 57 fluid ounces per plot. Spray pressure was 35 psi and nozzles were fan teejet size 8002. Skies were partly cloudy when treatments were applied and air and soil temperatures were 68^{o} and 62^{o}F, respectively. Soil temperature was recorded at a depth of four inches. Soils were dry on the surface but moist below. At both experimental sites, soil texture was a silt loam with a pH of 7.3 and an organic matter content of 1.2 percent. The wheat in the trial area was irrigated on May 15, May 29, and June 10 by rill-type irrigations.

On June 15, the wheat was clipped and the straw residue removed from the trial plots. The soil was rototilled to a depth of four inches on June 18 and the seed bed prepared for planting sugar beets and onions on June 26. After planting, the crops were corrugated and watered by furrow irrigation to supply soil moisture for seed germination and seedling growth. Plant counts were taken at plant emergence to determine emergence rates and rate of seedling growth between herbicide treatments. Plant samples were taken and dry weights measured to study differences between treatments in rate of plant growth. Samples were taken from five locations in each replication and included both roots and foliage.

Results

Observations and measurements of plot emergence, plant growth, and harvested yields indicate that irrigating sugar beets and onions with tailwater from a wheat field treated with Express or Matrix had no detrimental effect on these crops (Tables 1 and 2). The crops grew normally and harvested yields were comparable to yields from control plots.

Express and Matrix applied to wheat at X and 2X rates did not persist in the soil to affect emergence rate or plant growth of onions and sugar beets when the wheat straw residue was removed and the soil tilled to depth of four inches and the crop planted seven weeks after the herbicides were applied.

Table 1. Emergence rates and plant heights of sugar beets and onions irrigated with tailwater off sulfonylurea-treated wheat field. Malheur Experiment Station, Ontario, Oregon, 1986

Herbicide	Rate oz ai/ac	Onions Plants/6 ft of row					Sugar Beets Plants/6 ft of row					Onions[2] Plant Dry Weights(g)			Sugar Beets[2] Plant Dry Weights(g)		
		5/8	5/10	5/14	5/18	5/25	5/8	5/10	5/14	5/18	5/25	R1	R2	Avg	R1	R2	Avg
Express	0.125	4	11	22	33	33	9	24	33	34	34	127	116	121	320	306	313
Express	0.25	3	10	19	32	33	10	26	32	33	33	121	127	124	310	326	318
Matrix	0.375	4	12	20	33	33	11	25	31	34	34	116	121	118	303	319	311
Matrix	0.50	4	11	21	30	32	9	24	32	34	34	120	127	124	314	321	317
2,4-D[1] + Banvel D[1]	15.00 1.92	3	10	20	31	32	10	22	30	32	33	123	118	121	319	313	316
Control	----	4	11	21	32	33	10	23	34	34	34	121	129	125	321	301	311
LSD (.05)		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	---	---	NS	---	---	NS
CV (%)		14	10	8	8	7	13	10	9	8	8	---	---	14	---	---	12

[1] Active acid equivalents per acre.

[2] Dry weights - plants sampled from six feet of row, (average of six samples per replication).

Table 2. Harvested yields of sugar beets and onions irrigated with tailwater off sulfonylurea-treated wheat fields. Malheur Experiment Station, Ontario, Oregon, 1986

	Rate	- Yield of Onion Bulbs[1] -				- - - - - Sugar Beet Yields - - - - -			
Herbicides	oz ai/ac	2 1/4-3"	3-4"	≥ 4"	Total	Roots	Sucrose	Purity	Recoverable Sugar
		- - - - - - cwt/ac - - - - - -				T/A	%	%	lbs/ac
Express	0.125	89	298	201	588	32.6	16.2	84.3	8,904
Express	0.25	96	310	198	604	31.9	16.1	84.7	8,700
Matrix	0.375	81	301	210	592	32.1	16.0	84.5	8,680
Matrix	0.50	90	295	207	592	30.9	16.2	84.2	8,430
2,4-D +	15.00	92	313	192	597	31.3	16.1	84.6	8,526
Banvel D	1.92								
Control	----	87	305	194	586	31.7	16.1	84.4	8,615
LSD (.05)		NS	NS	NS	NS	NS	NS	NS	NS
CV (%)		16	11	9	7	8	4	5	6

[1]Diameter of onion bulbs.

Table 3. Emergence rates and plant weights of sugar beets and onions planted in soil where sulfonylurea herbicides were applied to winter wheat. Malheur Experiment Station, Ontario, Oregon, 1986

Herbicide	Rate oz ai/ac	Onions Plants/6 ft of row					Sugar Beets Plants/6 ft of row					Onions[2] Plant Dry Weights(g)				Sugar Beets[2] Plant Dry Weights(g)			
		7/6	7/8	7/10	7/14	7/18	7/6	7/8	7/10	7/14	7/18	R1	R2	R3	Avg	R1	R2	R3	Avg
Express	0.25	6	15	22	34	35	11	18	31	33	33	146	138	141	142	386	380	378	381
Express	0.50	8	16	23	33	34	12	20	30	32	34	138	142	146	142	373	382	386	380
Matrix	0.375	7	14	21	32	34	11	19	30	33	34	142	146	139	142	384	376	382	381
Matrix	0.75	7	15	22	33	33	10	18	29	30	33	144	139	142	142	381	378	384	381
Control	----	6	15	22	33	34	12	29	31	33	34	146	142	139	142	378	382	386	382
LSD (.05)		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	---	---	NS	---	---	---	NS	---
CV (%)		16	11	9	6	5	14	11	8	8	6	---	---	7	---	---	---	6	---

[1] Dry Weights - harvested from six feet of row at five locations within three separate replications.