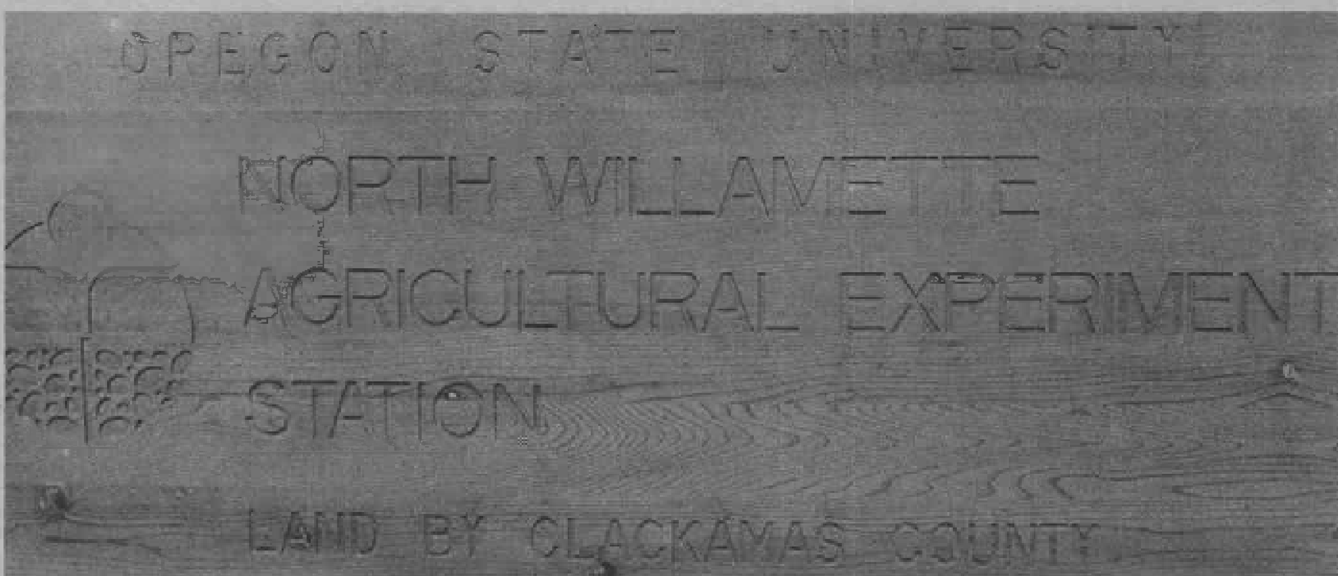
Vegetable Research at the North Willamette Agricultural Experiment Station 1979-1980



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VEGETABLE RESEARCH AT THE NORTH WILLAMETTE
AGRICULTURAL EXPERIMENT STATION, 1979-1980
Delbert D. Hemphill Jr.

INTRODUCTION

In 1976, a full-time program in vegetable crop research was instituted at the North Willamette Station of Oregon State University, located in Aurora, a farming community twenty miles south of Portland, Oregon. The major emphasis is placed on the needs of Portland-area fresh market growers, but research is also conducted on home garden and small farm intensive vegetable culture, processing crops, and the recycling of municipal and agricultural wastes on cropland. Many of the research projects reported here involved cooperation with colleagues at Oregon State University in Corvallis and county Extension agents and their contributions are gratefully acknowledged.

The first five sections of the report relate the results of trials which may help the market gardener or homeowner to choose varieties most suitable for the Northern Willamette Valley. Each year several trials are conducted in which varieties of proven performance are compared with new varieties from seed companies and university breeding programs. This enables Station and Extension personnel to make recommendations based on local conditions.

The next six sections deal with research on cultural and fertility practices to improve yield and quality of a number of vegetable crops. Two of these sections deal with soil fertility trials with yield responses related to such soil characteristics as acidity, metal content, and levels of major and minor nutrients. The important laboratory work for these experiments was performed in the Soil Science Department of Oregon State University.

The next two sections deal with cultural and management methods to improve stands of vegetable crops, that is, the percentage of seed which germinates and results in an emerged seedling. Poor stands lower yields and may necessitate replanting.

The last secion reports on the fertilizer value of wastes from the chrome tanning industry.

Nineteen crops from beans to zucchini squash were involved in the trials reported here. Several of these experiments also will be reported in the Oregon Vegetable Digest or scientific journals this year.

OVERWINTERING ONION VARIETY TRIAL

Cooperator: N. S. Mansour, Department of Horticulture, Oregon State University, Corvallis

Introduction

The purpose of this experiment was to evaluate the performance of several Japanese onion cultivars in overwinter trials. The Willamette Valley appears to have a suitable climate for production of spring-harvested onions if bolting, disease, and weed control problems can be overcome. Previous experiments at the North Willamette Station have indicated that late August planting dates are superior to September planting dates for maximum yields. With a June harvest, this would allow double-cropping the onion ground.

Methods

The cultivars evaluated were Amber Express, Dragon Eye, Express Yellow, Imai Early Yellow, Kaizuka Extra Early, Keep Well, and Senshyu Yellow Globe, all from Takii & Co., Ltd., Kyoto, Japan. The plots were seeded on August 30, 1979, with a plant population of about 15/foot. Subplot size was two rows x 12.5 feet with 1.5 feet between rows. The plot area was fertilized with 500 pounds/acre of 13-39-0 before planting and four pounds/acre of propachlor herbicide was applied immediately after seeding. An early (1) and a late (2) spring nitrogen application was made as follows: (1) 300 pounds/acre of 34-0-0 on January 2, 1980, and again on February 15, 1980; (2) 300 pounds/acre of 34-0-0 on February 20, 1980, and March 20, 1980. The fertilizer treatments were applied in a randomized block design with four replications and with cultivars as subplots. All plots were harvested on June 10, 1980, after most tops had died back. Plant population at harvest was 10-13/foot.

Results

Table 1. Effect of Timing of N Application on Yield of Onion Cultivars

Cultivar	Yield, tons/acre		
	Early N application	Late N application	Mean, cultivar^z
Amber Express	13.7	13.6	13.7 bc
Dragon Eye	14.3	14.7	14.5 bc
Express Yellow	14.5	15.0	14.8 c
Imai Early Yellow	11.8	11.7	11.8 ab
Kaizuka Extra Early	11.9	11.1	11.5 ab
Keep Well	16.2	15.6	15.9 c
Senshyu Yellow	10.8	10.6	10.7 a
Mean, N application	13.3	13.2	

^{z}Means followed by same letter not significantly different at 95% confidence level.

The timing of the spring N application did not significantly affect the yield of any onion cultivar but the later application slightly delayed maturity. The highest yielder, Keep Well, had elongated bulbs. Express Yellow and Dragon Eye had the most desirable characteristics of the higher yielding cultivars.

Table 2. Notes on Onion Quality Characteristics Two Weeks before Harvest

Cultivar	Maturity rank[z]	Mildew susceptibility[y]	Uniformity[x]	Percent bolted
Amber Express	1	2	3	0
Dragon Eye	5	4	3	2
Express Yellow	2	4	5	0
Imai Early Yellow	7	4	3	4
Kaizuka Extra Early	4	3	3	4
Keep Well	6	4	4	4
Senshyu Yellow	3	4	4	2

[z] 1 = most mature, 100% of tops down and dry; 7 = least mature, 25% of tops down

[y] 1 = most susceptible, 5 = least susceptible

[x] 1 = least uniform bulb size and shape, 5 = most uniform

MUSKMELON VARIETY TRIAL

Introduction

This trial included several standard varieties, newly named varieties from several seed companies, several experimental lines from Harris Seeds, and a large number of early maturing varieties from across the country, for a total of 51 lines or varieties. Commercial production in the Willamette Valley must compete with high quality, high-yield production from California. For a variety to be commercially successful here, it must be early maturing, disease resistant, and capable of storage. Home garden requirements are similar except that keeping quality is relatively unimportant and novelty varieties may be desirable.

Methods

All varieties were seeded in a heated greenhouse on April 20, 1979, and transplanted to black plastic-covered, raised beds on May 28. Before formation of the seven foot center beds, 1,000 pounds/acre of 10-20-10 and 100 pounds/acre of calcium nitrate were broadcast and incorporated. Between plant spacing on the beds was three feet. Viaflo tubing was used for drip irrigation. Six plants of each variety, in three randomly distributed replications of two plants each, were set through holes cut in the plastic and watered in with a solution of one ounce/gallon of 10-30-20.

Table 3 contains data on the yield, mean fruit size, and harvest period of 20 varieties which were judged most successful in terms of yield, earliness, and quality. Table 4 lists the source of each of the 20 varieties and some comments. Table 5 lists the sources of the remaining 31 varieties included in the trial.

Table 3. Size, Yield, and Harvest of Muskmelon Varieties, NWES, 1979

Variety	Percent harvest by date					Mean fruit weight (pounds)	Yield, tons/acre	Rank by yield
	8/1	8/20	9/10	9/30	10/20			
Samson	0	15	16	3	66	2.6	20.9	1
Burpee Early Crenshaw	1	24	21	14	40	4.4	20.1	2
Hale's Best Jumbo	0	17	26	37	20	2.7	17.8	3
Gold Star	0	65	3	9	23	2.6	16.9	4
Earlidew (honey dew)	1	33	14	12	40	2.3	10.8	5
Iroquois	0	31	7	25	37	2.6	16.4	6
Zenith	2	57	5	2	34	2.0	16.1	7
MRM 9	7	54	29	7	3	2.9	15.9	8
Chaca Hybrid	0	50	4	3	43	1.4	15.6	9
Honey Drip (honey dew)	2	32	30	27	9	2.1	15.2	10
Golden Champlain	2	40	0	35	23	1.8	14.9	11
Kazakh (honey dew)	0	31	12	12	35	1.5	14.9	12
PCNVB	0	78	0	8	14	3.4	14.7	13
GQVW	3	49	5	8	35	2.6	14.4	14
Summet	3	43	2	9	43	1.8	13.2	19
Early Dawn	22	40	0	4	34	2.3	13.2	20
Supermarket	2	40	4	23	31	1.8	12.9	22
G-25-VB	0	76	20	0	14	2.8	12.2	25
G-25-P	7	77	0	0	16	2.3	12.1	26
Harper Hybrid	4	58	2	8	28	1.8	12.1	28

Table 4. Sources of Muskmelon Varieties; Comments

Variety	Source	Comments
A. Crenshaw Types		
Burpee Early Crenshaw	2	Vigorous vines; salmon flesh, bland flavor, small seed cavity; large fruit; mid-season maturity.
B. Honeydew Types		
Earlidew	3	Medium vigor; green flesh; cream to yellow skin splits easily; small cavity, good honeydew flavor; good size and yield; early to mid-season.
Honey Drip	7	Medium vigor; green flesh; cream skin which splits very easily; crisp, sweet, strong honey flavor, excellent during hot weather, but poor quality if ripens during cool weather; good yield; early to mid-season.
Kazakh	3	Medium vigor; green to cream flesh; smooth green and orange skin; large cavity, bland honeydew flavor; good yield; mid-season.
C. Cantaloupes, musk-flavored		
Chaca Hybrid	6	Medium vigor; salmon flesh; lightly ribbed and moderately netted; mild, almost honeydew type flavor; small cavity; good yield; early.
Early Dawn	4	Vigorous; salmon flesh; heavily ribbed, finely netted; fair flavor; fair yield; very early; concentrated set but will mature a second crop in a warm year.
G-25-P	4	Vigorous; salmon flesh; small cavity; heavily ribbed and netted, oval; very sweet and somewhat bland; fair yield; very early and concentrated set.
G-25-VB	4	Same as G-25-P
Gold Star	4	Vigorous; salmon flesh; heavily ribbed and netted; resists cracking, holds well; sweet, juicy, a little bland; very good yield and early, concentrated maturity.
Golden Champlain	3	Medium vigor; salmon flesh; moderately ribbed and heavily netted; large, dry cavity; bland; good yield; early and will mature second crop in warm year.
GQVW	4	Vigorous; salmon flesh; heavily ribbed and netted; large cavity; cracks easily; bland flavor; good yield; early.
Hale's Best Jumbo	4	Medium vigor; salmon flesh; nearly ribless and heavy, finely spaced netting; large cavity; firm flesh with good flavor; very good yield; mid-season to late maturity.

Harper Hybrid	8	Medium vigor; salmon flesh; heavily ribbed and netted; oval; large cavity; good flavor but soft texture; fair yield; early.
Iroquois	8	Vigorous; salmon flesh; heavily ribbed and netted; fairly good flavor, keeps well; good yield; mid-season.
MRM9	4	Medium vigor; salmon flesh; heavily ribbed and nette pronounced oval shape; fair flavor, tends to be overripe at full slip; good yield; very early and concentrated set.
PCNVB	4	Medium vigor; salmon flesh; good yield; heavy ribbing and netting, squat spheroid; large cavity; good flavor; early and highly concentrated set.
Samson	6	Vigorous; salmon flesh; ribless, heavily netted; small cavity; good flavor but tends to be overripe at full slip; excellent yield of large fruit but main crop too late for Willamette Valley.
Summet	1	Medium vigor; salmon flesh; heavily ribbed and netted, thick skin; soft, sweet flesh, fair yield; early but with large second crop.
Supermarket	4	Medium vigor; salmon flesh; nearly ribless and heavily netted; large cavity; very sweet even when firm; fair yield; early to mid-season.
Zenith	5	Medium vigor; salmon flesh; heavily ribbed and netted, thick skin; small, dry cavity; crisp, sweet, mild flavor; good yield; early.

Sources: (1) Asgrow Seed Co. (2) Burpee Seed Co. (3) Gurney Seed Co. (4) Jos. Harris Co. (5) Keystone Seed Co. (6) Geo. Park Seed Co. (7) Rogers Bros. Seed Co. (8) Stokes Seeds, Inc.

Table 5. Other Varieties Included in Trial

Source	Varieties
Geo. Ball, Inc.	Ball 1776
Burpee Seed Co.	Burpee Hybrid, Fordhook Gem, Haogen, Mainerock, Sweet'n Early
Farmer Seed Co.	Charentais Sweetheart
Ferry Morse Seed Co.	Perlita Honey Rock
Gurney Seed Co.	Bush Midget, Classic, Far North, Minnesota Honey, Minnesota Midget
Jos. Harris Co.	Delicious 51, GQM9, Saticoy
Keystone Seed Co.	Cameo
Geo. Park Seed Co.	Bushwhopper, Granite State, Luscious, Short'n Sweet
Petoseed, Inc.	Top Score, X1876
Rogers Bros. Seed Co.	Summer Dream
Stokes Seeds, Inc.	Ambrosia, Canada Gem, Charentais Improved, Earlisweet, Honey Rock, Perfection, Sugar Salmon

The 1979 growing season was unusually warm and dry. Thus, disease pressure was low and late season varieties may have performed better than would be expected in a normal summer. Total yields in Table 3 should be reduced by the percentage of fruit harvested in October to determine yield potential in most years. For example, the variety Samson had the highest overall yield but nearly two-thirds of the fruit ripened in October. Several early varieties, such as Gold Star, Earlidew, Zenith, and Chaca, also had high total yields because of the ripening of a second crop.

Honey Drip was the most impressive of the honeydew types with excellent fruit quality during August. But later ripening fruit was of mediocre quality and splitting was a problem. Earlidew was the more consistent performer, although not equal to Honey Drip at its best. X1876 also had good quality.

Of the salmon-fleshed and musky-flavored types, Gold Star, an industry standard for several years, had the best combination of yield, quality, and earliness. Hale's Best Jumbo yielded very well but matured late. Zenith and MRM9 were other good, early, high yielding melons. Early Dawn was best of the melons which matured significant quantities of fruit by August 1. Several experimental lines from Harris, such as MRM9, PCNVB, and GQVW, were notable for earliness, good yield, and concentrated maturity.

Burpee Early Crenshaw, the only Crenshaw in the trial, had high yield, but most fruit matured late and quality was only adequate.

Small or large cavity under comments refers to the volume of the seed cavity. Many large fruit contain rather little flesh and this was considered a negative quality. A dry cavity with easily removed seeds was considered a positive quality. Varieties which stood out because of some unique quality included Fordhook Gem (green flesh but musk flavor), Saticoy (spicy flavor), MRM9 and G-25 (extreme ovoid shape). Earliest harvest date was July 25 with Summet, X1876, Charentais Sweetheart, Delicious 51, Early Dawn, Far North, and Bush Midget each maturing at least one fruit by this date.

A complete report, including yields and comments on varieties listed in Table 5, is available from the author.

WATERMELON VARIETY TRIAL

Introduction

This trial included 26 varieties or experimental lines from a total of eight seed companies. Production of watermelons in the Willamette Valley is limited by the cool growing season and proximity to major production areas of Eastern Oregon and California. Market garden production requires high quality, productive, disease-resistant, early maturing varieties. For the home garden, the same qualities are desirable, although keeping quality is less important.

Methods

All varieties were seeded in a heated greenhouse on April 24, 1980, and transplanted to black plastic-covered beds on May 28. The plot area received a broadcast application of three tons/acre of lime, 1,000 pounds/acre of 10-20-10, 100 pounds/acre of calcium nitrate, 100 pounds/acre of Epsom salts, and 50 pounds/acre of fritted trace elements. Viaflo tubing was used for drip irrigation and an additional 20 pounds/acre of N was applied through the drip system in mid-August. Nine plants of each variety, in three randomly distributed replications of three plants each, were set through holes cut in the plastic mulch and watered in with a cup of 2 ounces/gallon of 10-30-20. Volcanic ash covered the beds on May 25. Much ash was subsequently washed into transplant holes and may have contributed to poor early growth of many plants.

Results

Table 6 presents yield, mean fruit weight, rank by yield, and percentage of fruit harvested during August, September, and October for the 15 varieties judged most successful in terms of yield, quality, and earliness. Table 7 lists the sources of these varieties and comments on fruit type and quality.

It should be noted that the heat unit accumulation (50°F base) for June, July, and August, 1980, was 10 percent below the previous 20-year average. Thus, bloom tended to be late, fruit set may have been affected, and maturity probably was later than in most years. However, very few fruit failed to ripen by first frost on October 23.

The highest yielder was New Shipper with a mean fruit weight of 18 pounds but only fair fruit set. Other large fruited varieties were Klondike Striped Blue Ribbon, Prince Charles, Sweet Favorite, Allsweet, and Crimson Sweet. Greatest fruit set was on Northern Sweet, Global X4901, Golden Midget, and New Hampshire Midget.

Flavor favorites were Seedless 313, Prince Charles, Yellow Baby, Yellow Doll, Klondike Striped Blue Ribbon, Crimson Sweet, and New Shipper. Considering the combination of earliness, good flavor and texture, yield, and large fruit size, the most successful varieties were New Shipper, Klondike

SBR, Seedless 313, Yellow Doll, You Sweet Thing, and Burpee's Fordhook. It was very difficult to judge the ripeness of the varieties Early Canada, Kengarden, Market Midget, and X4901. Color of ground spot, dryness of the tendril at the node to which the fruit is attached, and thumping consistently failed to indicate when these varieties were ripe. Fruit of Kengarden, Golden Midget, Market Midget, and New Hampshire Midget were too small for commercial production.

A more complete report, including the varieties Yellow Baby, Burpee Seedless, New Hampshire Midget, Sugar Bush, Global X4901, Early Canada, Market Midget, Kengarden, Golden Midget, Panonia, and Stoke's Sugar, may be obtained from the author.

Table 6. Yield, Size and Harvest Period of Watermelon Varieties, 1980

Variety	Percent harvested by date 8/29	9/29	10/22	10/31[z]	Yield tons/acre	Rank by yield	Mean fruit weight, pounds
New Shipper	0	84	16	0	35.1a	1	18.0
Klondike Stripe BR	12	54	34	0	33.8ab	2	15.5
Seedless 313	58	23	19	0	30.3bc	3	9.7
Yellow Doll	20	64	14	2	27.9cd	4	8.3
You Sweet Thing	33	41	24	2	26.3d	5	10.7
Sweet Favorite	6	69	25	0	26.2d	6	13.5
Northern Sweet	9	52	39	0	25.9de	7	6.7
Peacock WR60	0	61	39	0	25.7de	8	11.7
Burpee Fordhook	30	34	34	2	25.6de	9	12.3
Northern Delight	37	46	15	2	24.4de	11	9.9
Prince Charles	21	63	16	0	22.2ef	12	15.5
All Sweet	0	75	22	3	19.5fg	14	13.7
Crimson Sweet	0	97	3	0	19.1fg	15	13.4
Super Sweet Seedless	37	63	0	0	16.1gh	16	8.3
Sugar Baby	53	34	13	0	13.1h	21	8.4

[z]Percent of fruit not ripened before first killing frost (October 23, 1980).

Table 7. Sources of Watermelon Varieties and Comments

Variety	Source[z]	Comments
Allsweet	6	Long, cylindrical, striped light green fruit, pink flesh, small seeds, good flavor; poor fruit set, low vigor, rather late maturing.
Burpee Fordhook	1	Round, dark green fruit; red flesh, small seeds, good flavor, sweet; poor fruit set; some fruit early but wide maturity range.
Crimson Sweet	1	Round, striped light green fruit, red flesh, large heart, good flavor; poor fruit set; mid-season maturity.
Klondike Striped Blue Ribbon	2	Oblong, striped light green fruit; pink flesh, small heart; good flavor; fair fruit set; large fruit; mid season; vigorous.

New Shipper	3	Round, dark green fruit; red flesh, large black seeds, good flavor; fair fruit set, very large fruit; concentrated mid-season maturity.
Northern Delight	6	Oblong, striped, light green fruit; pink flesh, small seeds, fair flavor; fair fruit set; early.
Northern Sweet	3	Round, striped, light green fruit; pink flesh, large pale seeds, fair flavor; good set of small fruit; mid-season maturity.
Peacock WR60	2	Round, dark green fruit; red flesh, fair flavor; fair fruit set; mid-season maturity.
Prince Charles	7	Large, cylindrical, patterned green fruit; pink flesh, large seeds, good flavor; poor fruit set; fairly early.
Seedless 313	4	Round, striped, light green fruit; pink flesh, seedless, good flavor; good fruit set; very early.
Sugar Baby	4	Round, dark green fruit; salmon flesh, seeds few and small, fair flavor; poor set; early.
Super Sweet Seedless	5	Round, striped, light green fruit; pink flesh, seedless, good flavor; fair set; early.
Sweet Favorite	1	Large, oblong, striped, light green fruit; red-flesh, good flavor; fair set; mid-season maturity.
Yellow Doll	7	Round-oval, striped, light green fruit; yellow flesh, good flavor; good fruit set; fairly early.
You Sweet Thing	5	Round, striped, light green fruit; pink flesh, large black seeds, fair flavor; fair fruit set; early but with wide maturity spread.

[z]Sources: (1) Burpee Seed Co. (2) FerryMorse Seed Co. (3) Gurney Seed Co. (4) Jos. Harris Co. (5) Geo. Park Seed Co. (6) Stokes Seeds, Inc. (7) Petoseed, Inc.

BRUSSELS SPROUTS VARIETY TRIAL

Cooperator: N. S. Mansour, Department of Horticulture, Oregon State University, Corvallis

Introduction

The objective of these trials was to evaluate several lines of brussels sprouts for suitability for fresh market or processing production in the Willamette Valley. Several quality factors were observed in a replicated planting: length of season, height, tendency to lodge, ability to withstand warm weather, resistance to mildew and internal browning, sprout size distribution, smoothness, solidity, color, spacing, picking and deleafing ease, and uniformity.

Methods

Twelve cultivars were seeded in a greenhouse on three dates, March 11, March 26, and April 23, 1980, and transplanted approximately one month later. Plots consisted of 10 plants spaced three feet between rows and two feet in the row. There were three replications of each cultivar. The plot area received a broadcast application of 800 pounds/acre of 10-20-10 and several sidedress applications of ammonium nitrate or calcium nitrate. Pesticides used were trifluralin at 0.75 pounds/acre for weed control, fonofos at 2.0 pounds/acre for symphylan control, and biweekly diazinon sprays at 1.0 pounds/acre for aphid and looper control.

The first planting was harvested on August 12 (Jade Cross E and Kronos) and September 23 (other ten cultivars), the second planting on November 14, and the third planting had not been harvested by December.

Results

Observations on each cultivar are listed below.

First planting

Jade Cross E: No mildew or internal browning; solid sprouts with fair color; average spacing, picking and deleafing ease; favorable sprout shape and angle with stem; uniform; good yield potential.

Kronos: no mildew, very little browning; smooth, solid sprouts with fair color; average spacing, picking, and deleafing ease; good shape and stem angle; uniform; fair yield potential.

Goldmine: moderate mildew and browning; smooth, solid sprouts with fair color; average picking and deleafing ease, tight sprout spacing; sprout shape and stem angle average; fairly uniform; high yield potential.

Argosy: no mildew or browning; smooth, solid sprouts with good color; average deleafing and picking ease; very tight sprout spacing but good (nearly right angle) stem angle; fair sprout shape; uniform; high yield potential.

Dorema: no mildew, very little browning; very smooth, solid sprouts with fair color; average ease of deleafing and picking; tight spacing, good shape, average angle; uniform; fair yield potential.

Agi: very little mildew, no browning; very smooth, solid sprouts with fair color; easy to deleaf and pick; good sprout spacing and shape but average angle; only fair uniformity; fair yield potential.

Craton: fairly severe mildew and browning; very smooth, solid sprouts with fair color; easy to deleaf, average picking ease; fair spacing, shape, and angle; only fair uniformity; good yield potential.

Allrounder: moderate mildew and browning; average smoothness and solidity, fair color; easy to deleaf but difficult to pick; good spacing, but only fair shape and angle; only fair uniformity; below average yield and sprouts did not hold in hot weather.

Predora: very little mildew, some browning; extremely smooth and solid, fair color; average picking ease but difficult to deleaf; average spacing, shape, angle; only fair uniformity; good yield potential.

Silverstar: severe mildew, browning; fairly smooth, very solid sprouts with fair color; easy to deleaf, average picking ease; average spacing and angle, good shape; fair uniformity; fair yield potential.

Lindo: some mildew and moderate browning; fair smoothness, solidity, and color; easy to deleaf and pick; good spacing, shape, and angle; fair uniformity; fair yield potential; sprouts did not hold in warm weather.

Early Morn: severe mildew and browning; smooth, solid sprouts with fair color; easy to deleaf but difficult to pick; average spacing, shape, and angle; only fair uniformity; low yielder; short, squat plants.

Second planting

Jade Cross E: rather severe mildew and browning; only fair smoothness, solidity and pale color; average picking and deleafing ease; average spacing, good shape and angle; uniform; good yield potential.

Jade Cross F: average mildew and browning; good smoothness and solidity, poor color; average ease of deleafing and picking; average spacing, shape, good angle; uniform; good yield potential.

Jade Cross G: severe mildew, average browning; average smoothness and solidity; poor color; average picking and deleafing ease; poor, tight spacing; fair to good shape, angle; fairly uniform; fair yield potential.

Pegasus: light mildew and browning; less than average smoothness, solidity; fair color; moderate deleafing and picking ease; average spacing, shape, angle; poor uniformity; good yield potential.

Cor: Severe mildew and browning; fairly smooth, solid, poor color; average ease of picking and deleafing; tight spacing, good shape, poor angle; fair uniformity; good yield potential.

Rovoka: moderately severe mildew and browning; average smoothness and solidity, poor color; easy to deleaf and pick; good spacing and shape but poor angle; fair uniformity; good yield potential.

Achilles: average mildew and browning; good smoothness and solidity; good dark color, average deleafing and picking ease; good spacing, shape, angle; fair uniformity; good yield potential.

Roodnerf Rido: average mildew and browning; poor smoothness, solidity, and color; hard to pick and deleaf; good spacing but only fair shape and angle; non-uniform; fair yield potential.

Palisade: average mildew and browning; average smoothness, solidity, and color; average deleafing and picking ease; average shape, spacing, angle; fair uniformity, good yield potential.

Lunet: severe mildew and browning; average smoothness and solidity, poor yellow color; average ease of picking and deleafing; good shape but only fair angle and spacing; fair uniformity; fair yield potential.

Horatius: better than average resistance to mildew and browning; smooth, solid sprouts of fair color; average picking ease but difficult to deleaf; average spacing, shape, angle; very uniform; good yield potential.

Roodnerf Champion Reselected: moderately severe mildew and browning; very rough sprouts with fair color; average picking, deleafing ease; fair spacing and shape, good angle; non-uniform; fair yield potential; purple petioles and sprouts.

OVERWINTERING CAULIFLOWER FOR SPRING HARVEST

Introduction

Several of the coastal and marine-influenced valleys of the Pacific Northwest appear to have a suitable climate for overwintering cauliflower for spring harvest. Research on variety adaptability and cultural methods has been limited and commercial production has been primarily restricted to a few acres in the northern Willamette Valley, the Puget Sound area, and the Skagit Valley. The single greatest limiting factor has been a lack of proven cold-hardy varieties with acceptable curd quality. Research on overwintered cauliflower at the North Willamette Station commenced in 1977 and has focused on three areas: 1) finding adapted varieties, 2) determining the proper planting dates, and 3) determining proper fertilizer rates.

Methods

Methods employed varied with specific experiments, but the following fertilizers and pesticides were used in most trials and have proven acceptable. Most trials were transplanted into fields with a soil pH of about 6.0 and which had received a broadcast application of 700 to 1,000 pounds/acre of 10-20-10, 1,000 pounds/acre of dolomite, and one pound/acre of born. The only herbicide used was trifluralin at 0.75 pounds/acre; the most common soil insecticide program was fonofos incorporated at two pounds/acre followed by diazinon drenches if necessary for cabbage maggot control. No other insecticides were found necessary and fungicides were not used. Most plots were planted at three foot by 1.5 foot spacing. All treatments were randomized.

Further spring applications of nitrogen were made as discussed below. Plots were harvested at least twice a week from maturity of the first head.

Results and Discussion

I. Variety Evaluation

At least limited variety trials have been conducted each year since 1977. In general, the varieties heading in April were the most successful. The varieties Armado April and Armado Quick were superior in yield, quality, and hardiness. Subsequent trials have tended to reaffirm their superiority. In addition, the variety Preminda (or Primo) has also proven well-adapted to the Willamette Valley. Late varieties, which are exposed to higher temperatures, greater light intensity, and greater insect and disease pressures, have lower curd quality and smaller heads than the earlier varieties. Heads were not tied in these trials and discoloration of curd on late varieties may be prevented by this practice. Curd color of the early varieties is excellent but depth and density of the head is low. However, at least one Willamette Valley processor has found the quality acceptable for processing. Fresh market potential of the early varieties appears to be excellent.

II. Planting date

One of the major advantages of winter cauliflower is the suitability for double cropping. In the Station research program we were interested in varieties and planting dates which would allow for a second crop both before planting and after harvest. Planting date affects yield and quality in two ways: winter hardiness and size of plant at time of head formation. Early planting dates produce larger plants capable of producing high yields but early plantings are also more susceptible to winterkill (Table 8). Total yield of Armado April was highest at the second planting date since the larger plants from the first planting date suffered greater freezing and ice damage. Subsequent trials indicate that a transplant date near September 1 is optimal at the Station. Earlier dates may be better in areas with milder winter temperatures. The proper planting window will have to be determined for each potential growing area.

Planting date has relatively little effect on date of maturity. Trials separated by as much as one month at transplant have reached peak maturity no more than one week apart.

III. Winterkill

Most of the common winter cauliflower varieties have been considered hardy to about 18^{o}F. However, many of the more recent F-1 hybrids have survived temperatures of 10^{o}F at the Station. Planting in areas with expected winter low temperatures below 10^{o}F risks losing the entire crop. For example, with the variety April, the following mortality rates were observed in the Willamette Valley in 1979: Station, 11^{o}F, 10%; 4 miles SW of Station, 9^{o}, 25%; 12 miles S of Station, 0^{o}, 80%.

IV. Spring Nitrogen Application

Winter cauliflower has consistently responded to spring nitrogen application with increased yield, greater head size, and better foliage cover of the curd. Greatest yields have been obtained with sidedress application of 100 pounds/acre of N in early February and again in early March.

Summary

Winter cauliflower appears to have potential as a significant crop west of the Cascades. Areas normally free of ice storms, heavy snowfall, and with expected winter lows above 10^{o}F are suitable. The potential exists for double cropping winter cauliflower with other early maturing crops with compatible pesticide and herbicide programs. Production costs for winter cauliflower should be lower than for autumn-harvested since insect problems are minimal and irrigation is unnecessary after plants are well established.

Table 8. Effect of Transplant Date on Yield, Mean Head Weight, and Winterkill of Cauliflower, 1978-79

Transplant date	Cultivar	Yield (tons/acre)	Head Weight (pounds)	Percent dead plants
8/21/78	Armado April	8.2	1.5	31
8/21	Armado Quick	8.5	1.3	16
9/12	Armado April	11.7	1.4	5
9/12	Armado Quick	6.5	1.0	8
9/26	Armado April	8.7	1.2	8
9/26	Armado Quick	6.8	0.9	13

SWEET CORN YIELD AFFECTED BY TIMING OF NITROGEN APPLICATION

Introduction

Production of commercial nitrogen (N) fertilizers depends on fixing atmospheric N, a process which consumes natural gas. As world energy prices soar, the cost of fertilizer N must also increase, making efficient crop uptake of applied N ever more important. It may be possible to increase the efficiency of crop N utilization by splitting the total crop requirement among two or more applications. In some situations, application of the entire crop N requirement at one time may lead to significant losses to volatilization, leaching, or runoff. In addition to the economic loss, N fertilizer contamination of ground or surface water is considered an environmental pollutant. The following experiment was designed to determine whether splitting N applications would increase the yield of sweet corn relative to applying all N at planting.

Methods

The experiment was first carried out during the 1979 growing season and was repeated in 1980. The variety 'Jubilee' was used both years. Planting date was May 14 in 1979 and May 16 in 1980. In both years the plot area received a broadcast application of 200 pounds/acre of 0-0-52; atrazine (1.25 pounds/acre) and alachlor (2.0 pounds/acre) were used for weed control. Total irrigation plus precipitation during crop growth was 16 inches in 1979 and 15 inches in 1980. Between-row spacing was 30 inches; plant population was about 25,000/acre in 1979 and 20,000/acre in 1980. Individual plots consisted of 6 rows x 30 feet. All plots received 300 pounds/acre of 13-39-0 banded two inches to the side and two inches beneath the seed row at planting. The following nitrogen treatments were applied in randomized block design with six replications. (1) All N at planting; 360 pounds/acre of ammonium nitrate (34-0-0) was broadcast and irrigated in immediately after seeding. (2) Two-way split; the 360 pounds/acre of ammonium nitrate was sidedressed when corn plants were about one foot tall (early July). (3) Three-way split; sidedressed with 180 pounds/acre of ammonium nitrate at the one foot stage and again just prior to tasseling. (4) Four-way split; sidedressed with 120 pounds/acre of ammonium nitrate at the one foot stage, at tasseling, and again at first silk. Thus for each treatment, total N applied was 161 pounds/acre. Plots were once-over harvested on August 20, 1979, and September 10, 1980. Ears were weighed with husks on and graded as follows: Grade 1, completely filled ears with fully mature kernels; Grade 2, incomplete fill or immature; Grade 3, culls.

Results

In both 1979 and 1980, the differences in total ear weight as a result of treatment were small and not statistically significant. But the yield of Grade 1 ears did respond to treatment in both years (Table 9). In 1979, the yield of Grade 1 ears increased by 49 percent from 7.6 to 11.3 T/A when application of the bulk of the N was delayed until early July. Further splitting of N application did not increase yield. Similarly, a 57 percent yield increase occurred with the two-way split in 1980 and, again, further splitting did not affect yield. The overall lower yields in 1980 were caused by lower plant population and poorer growing conditions.

These results, obtained on a Willamette Sandy shot loam, are in contrast to those of Spencer Apple (personal communication) who found no yield differences caused by timing of N application with 'Golden Cross Bantam' grown on Chehalis silty clay loam. Heavier soils with higher clay content may absorb and retain fertilizer and water more effectively than lighter, sandier soils. The form of N applied may also influence the loss to leaching and volatilization. Application of all N in the ammonium form or as urea may slow leaching loss.

In situations where significant N loss is likely, the economic gain of splitting the application to insure more efficient N utilization must be weighed against the higher costs for an extra application. Applying the additional N through the irrigation system should result in an increased net return provided that the higher cost of liquid N fertilizer solutions does not exceed expected increase in gross because of higher yield.

Table 9. Effect of Timing of N Application on Sweet Corn Yield

	Yield of Grade 1 ears		Total yield (Grades 1 plus 2)	
Treatment	1979	1980	1979	1980
	-----------tons/acre fresh weight[z]-------			
All N at Planting	7.6a	5.3a	14.3a	9.6a
Two Applications	11.3b	8.3b	15.8a	10.4a
Three Applications	10.7b	8.4b	15.2a	10.6a
Four Applications	10.9b	7.2b	15.0a	10.4a

[z]Means within a column which are followed by different letters are significantly different at 99% confidence level.

LETTUCE YIELDS AFFECTED BY TRANSPLANTING AND DIRECT SEEDING

Introduction

Lettuce is difficult to plant to stand, particularly in early spring and again during mid-summer periods of high soil temperature. Transplanting greenhouse-grown seedlings may offer the advantage of nearly ideal stands and even permit one extra crop during the growing season. Other possible advantages which may offset the cost of raising transplants include elimination of thinning equipment or labor, reduced herbicide use or cultivation, and production of a more uniform head of lettuce.

Methods

Ithaca crisphead lettuce was seeded in Speedling trays with one inch cells on March 15, 1979. The plot area was prepared for seeding on April 24. Pronamide at one pound/acre and 1,000 pounds/acre of 10-20-10 were incorporated into the surface three inches of soil. Seeding and transplanting took place on May 1. The direct seeding was with a Planet Jr. and transplanting was with a Jetspeed HydroSynchron three-row transplanter. Direct-seeded plots were thinned by hand to obtain the best stand possible. Transplants were not graded before planting but were slightly overmature and were topped at three inches with a rotary blade, resulting in a high degree of uniformity at time of transplanting. Plots were arranged in a randomized block design with six replications per treatment. Plot size was 20 feet x three rows with two feet between rows and nine inch ideal in-row-spacing. Transplants were harvested on June 15 and direct-seeded plants were harvested on July 12.

Results

Table 10. Yield of Ithaca Lettuce as Affected by Direct Seeding vs. Transplanting

Treatment	Yield, tons/acre	Mean head weight, pounds	C.V.[z]
Transplant	22.5	1.65	14.8
Direct Seed	18.2	1.22	31.8

[z]C.V. = std. deviation of mean x 100%/mean head weight

Transplanting with the HydroSynchron machine and Speedlings resulted in a 100 percent stand. Direct-seeded plants were thinned to the same number of plants/plot but between neighbor distances were irregular. Transplants out-yielded direct-seeded by over four tons/acre but this was primarily because of greater average head weight at harvest. The difference in head weight was from greater maturity of transplants when harvested. The coefficient of variation (C.V.) for transplanted heads was far smaller than for direct-seeded heads, reflecting a far greater degree of uniformity in head size for transplants. However, head size variability is known to decrease with increasing maturity, and the C.V. for direct-seeded lettuce might have been the same as for transplants if the direct-seeded heads had achieved the same mean size. Transplants were harvested 17 days earlier than direct-seeded plants and were at least seven days more mature. Thus, transplanting requires at least three weeks less field time per crop and could allow three crops per season rather than two.

RESPONSE OF VEGETABLES TO CYTEX, A CYTOKININ PREPARATION

Introduction

The purpose of these experiments was to determine the effect of a commercial cytokinin preparation on yield and quality of several Willamette Valley horticultural crops. Atlantic and Pacific Research, Inc. manufactures a marine algae extract, containing 100 ppm kinetin, which has increased fruit and vegetable yields in several areas of the country and is registered for use on tomatoes. This product, Cytex, is stable and can be applied with standard spray equipment.

Methods

Five crops were involved in these trials which took place in 1979: 'Hood' strawberry, 'Russet Burbank' potato, 'Nantes' carrot, 'Summer Pascal' celery and 'Early Girl' tomato. All plots were laid out in randomized block design with three to six replications per treatment. All plots were on Willamette sandy loam, pH 5.6, three percent organic matter. Details for each crop are as follows:

Strawberry: A two-year-old planting of strawberries with three foot x 1¼ foot spacing was used. Each plot consisted of a single 20-foot row and treatments were replicated six times. Treatments consisted of a control, one spray at 10 percent bloom (April 26) and a 10 percent bloom spray plus a second spray two weeks later. All sprays were at a rate of two quarts Cytex/acre in 25 gallons/acre of solution. Data collected included total yield, marketable yield, and berry size from harvests on June 7 and June 18.

Potato: The crop was planted on May 8. Plot size was 20 row feet with four replicates per treatment. In-row spacing was 1.5 feet and 100 percent stand was obtained. The four treatments included a control, one spray at early bloom, one spray at the first sign of foliar dehiscence, and a combination of both sprays. All sprays were at two quarts/acre. Data collected included gross yield, number of tubers, and percentage by grade. All plots were harvested on September 27.

Carrots: The crop was planted on May 11. Plot size was three 10-foot rows with five replicates per treatment. Between-row spacing was 20 inches. The three treatments included a control, application of a single spray at first sign of fleshy taproot formation, and a single spray three weeks later. All sprays were at two quarts/acre. Data obtained included total yield and yield by grade.

Celery: The crop was seeded in flats in a glasshouse on March 19 and transplanted to the field on May 16. Plot size was 10 row feet, in-row spacing was six inches and there were five replicates per treatment. The three treatments were a control, single pre-transplant application at the four leaf stage, and a post-transplant application on May 21. Sprays were with 2.0 percent Cytex solution applied to runoff, approx. two quarts/acre. Data obtained included yield/plot and stalk length.

Tomato: The crop was seeded in a greenhouse on April 25 and transplanted on May 25. Plots consisted of two plants with three replications per treatment. Plants were grown on black plastic mulch with drip irrigation. Treatments were a control and a single spray of two quarts/acre at full bloom of the first cluster. Data obtained included gross yield, mean fruit size, percent blossom-end rot and percent misshapen fruit.

All crops were fertilized at a rate of 100 pounds/acre of total N at planting. The celery received an additional 100 pounds/acre N on July 7. The herbicide linuron at a rate of one pound/acre was used on potatoes and carrots. The other crops were hand weeded. All sprays were at total volume of 25 gallons/acre and applied with handheld equipment.

Results

Table 11. Effect of Cytex on Yield* of Strawberry

Treatment	Total marketable weight, tons/acre	Percent rotted fruit	Mean berry size, grams/fruit
Check	9.6	6.0	9.2
Single Applic. Cytex	8.6	5.7	9.0
Two Applic. Cytex	9.1	6.8	8.3

*Yield for June 7 and June 18 combined.

Table 12. Effect of Cytex on Yield of Potato

Treatment	Gross yield, tons/acre	Tubers/plot	%Tubers> 5 inch
Check	33.0	101	41
Early Bloom Spray	35.1	109	38
Late Spray	37.0	111	37
Both Sprays	33.0	115	35

Table 13. Effect of Cytex on Yield of Carrot

Treatment	Yield, tons/acre	Mean root weight, grams	Percent Grade 1*
Check	13.3	65	47
Early Spray	10.6	60	43
Late Spray	11.9	61	43

*Over six inches length and without defects.

Table 14. Effect of Cytex on Yield of Celery

Treatment	Yield, pounds/plant	Stalk length, inches/plant	Yield, tons/acre
Check	0.65	16.3	13.5
Pre-Transplant Spray	0.67	16.5	13.8
Post-Transplant Spray	0.69	15.6	14.1

Table 15. Effect of Cytex on Yield of Tomato

Treatment	Gross yield, tons/acre	Mean fruit size, pounds	Percent blossom-end rot	Percent mis-shapen fruit
Check	21.5a	0.31 a	10 a	8 a
Single Applic.	27.6 b	0.33 a	11 a	7 a

Out of five crops tested, Cytex significantly increased yield only for tomatoes. Lack of positive results for potato were expected as this confirms the lack of response of Russet Burbank potatoes in trials at other sites in North America. Positive results for carrots, strawberry, and celery have been reported by other researchers. Failure of Cytex to increase strawberry yields may be attributable to heavy rains within 24 hours of application. The major effect of Cytex on tomato was on number of fruit produced rather than on fruit size.

"SOLAR TRENCHES" FOR PRODUCTION OF WARM-SEASON VEGETABLES

Cooperator: N. S. Mansour, Department of Horticulture, Oregon State University, Corvallis

Introduction

The purpose of this experiment was to evaluate the effectiveness of "solar trench" techniques for extending the season of vegetable production and bringing warm weather crops into earlier production. The solar trench consisted of a V-shaped furrow 12 inches deep and 18 inches wide at the top. The bottom and sides were lined with 1.5 mil black plastic mulch for weed control. After seeding or transplanting through holes cut into the black plastic, the trench was covered with 4 mil perforated clear plastic. The purpose was to form a miniature greenhouse, trapping heat and possibly giving some frost protection.

Methods

Two sets of trenches were formed and three tons/acre of lime and 1,000 pounds/acre of 10-20-10 were broadcast. The first set of north-south oriented trenches was prepared for planting on April 22, 1980. Viaflo tubing was placed in the trench bottom for drip irrigation. Pepper 'Keystone Giant', tomato 'Pikred', muskmelon 'Early Dawn', and zucchini 'Elite' transplants, seeded in a heated glasshouse on March 13, were set into the trench and an equal number of planting holes were direct-seeded with the same varieties. The planting was replicated three times with four transplants and four direct-seeded plants of each species per replication. In-trench spacing was two feet for tomato and pepper, and three feet for melon and squash. Trenches were six feet apart.

The second set of trenches was planted on May 8. Pepper transplants had been seeded on March 31, tomatoes on April 8, zucchini and muskmelons on April 24. Varieties were the same as for the first planting. In addition to the trenches, black plastic-covered flat beds were also planted. Thus, for the second planting date there was a four-way comparison among transplanted trenches, transplanted beds, direct-seeded trenches, and direct-seeded beds.

The clear plastic trench covers were slit above each plant when the plant tip reached the plastic. The covers were not removed until July 11 when daytime high air temperatures beneath the plastic consistently exceeded 90^{o}F. Both air and soil temperature were recorded until removal of the plastic covers. No yield comparisons were made, but date of first bloom and harvest, and peak harvest were recorded for each treatment. Additional NPK fertilizer was applied through the irrigation system.

Results

Temperature Effects

Maximum air temperatures recorded beneath the clear plastic trench covers always exceeded the maximum air temperature six inches above the flat beds. However, differences were small during periods of cloud cover. During hours of clear skies, the maximum recorded beneath the clear plastic often exceeded 100°F in late June and early July, but the highs recorded over the flat beds never reached 90°F before plastic removal on July 11. The mean high temperature under the clear plastic exceeded that over flat beds by an average of 16°F during the April 22 to July 11 period (Table 16). In contrast, the clear plastic covered trenches had almost no effect on low air temperatures. Thus, the trench walls provided very little insulating effect. As seen in Table 17, the trenches had very little effect on soil temperature at two-inch depth.

Zucchini

Zucchini responded well to trench culture. Vegetative growth was greatly promoted. In the second planting, flowering of transplants was eight days earlier in the trench than on flat beds and harvest commenced five days earlier. Direct seeded plants bloomed 15 days earlier in the trench and harvest commenced six days earlier. Some scorching of leaves occurred before the covers were removed. Fruit set was poor until the covers were removed, because pollinators would not penetrate the slitted plastic.

Tomato

Transplanted tomatoes bloomed one week earlier in the trench and ripened fruit 10 days earlier. Direct seeded plants failed to respond to trenching, perhaps because the bloom period did not start until shortly before the plastic covers were removed. As with zucchini, poor pollination was a problem in the trenches before uncovering. Lack of air movement may have been a factor. When the plastic was slit, but not completely removed, the plants rapidly emerged. Flowers blooming beneath the plastic had poor set, probably related to lack of air movement and high temperatures, while flowers blooming above the plastic were affected by very low air temperatures through the first week of July.

Muskmelon

Melon transplants and direct-seeded plants bloomed nine and six days earlier, respectively, in trenches. First harvest was nine and 13 days earlier, respectively, in trenches. Overall yields were not good because of poor fruit set under the plastic. Plants in the first trench successfully matured a second crop before first killing frost on October 23.

Pepper

Peppers did not respond well to trench culture. No earliness was noted. Plants were stunted and pollination was poor before plastic removal. Direct seeded peppers generally failed to emerge.

General Comments

The solar trench is most valuable very early in the season, when comparison of the trench with traditional culture is limited by frost danger. Leafy crops or those which do not depend on either insect or wind pollination may be better adapted than the crops studied in this experiment. Poor pollination and lack of growing room were the biggest problem for each crop. No unusual disease or nutritional problems were noted except for the stunting and yellowing of peppers.

Table 16. Weekly Air Temperature Summary

Week ending	Mean weekly temperature, °F			
	Flat bed high	Trench high	Flat bed low	Trench low
4/29	68	82	44	46
5/6	70	84	42	43
5/13	60	69	47	47
5/20	68	85	45	47
5/27	57	68	45	46
6/3	64	75	47	48
6/10	68	85	50	53
6/17	64	86	50	53
6/24	71	95	51	53
7/1	75	95	47	51
7/8	73	94	54	57
Mean, 11 weeks	67	83	47	49

Table 17. Weekly Summary of Soil Temperature at Two Inch Depth

Week ending	Mean weekly temperature, °F			
	Flat bed high	Trench high	Flat bed low	Trench low
4/29	68	71	56	56
5/6	71	73	56	57
5/13	63	63	55	57
5/20	71	74	57	59
5/27	59	60	52	52
6/3	67	69	55	56
6/10	70	74	59	62
6/17	66	71	58	60
6/24	74	80	62	64
7/1	75	80	60	61
7/8	75	79	63	65
Mean, 11 weeks	69	72	58	59

Table 18. Dates of First Bloom, First Fruit Harvest, and Peak Harvest

Crop	Treatment	First bloom	First harvest	Peak harvest
Zucchini	First trench, transplant	6/1	6/29	7/1-8/15
	First trench, direct seed	6/16	6/24	7/15-8/15
	Second trench, transplant	6/10	6/27	7/25-8/30
	Second trench, direct seed	6/17	7/2	7/25-8/30
	Bed, transplant	6/18	7/2	7/25-8/30
	Bed, direct seed	7/2	7/8	7/30-9/5
Tomato	First trench, transplant	6/2	8/11	9/1-9/20
	First trench, direct seed	6/18	8/18	9/5-10/1
	Second trench, transplant	6/18	8/18	9/5-10/1
	Second trench, direct seed	7/1	8/28	9/15-10/15
	Bed, transplant	6/25	8/28	9/15-10/15
	Bed, direct seed	7/5	8/30	9/15-10/15
Muskmelon	First trench, transplant	5/14	8/11	8/20-9/5
	First trench, direct seed	5/23	8/15	8/30-9/15
	Second trench, transplant	6/1	8/18	8/30-9/15
	Second trench, direct seed	6/12	8/25	9/10-9/30
	Bed, transplant	6/10	8/27	9/10-9/30
	Bed, direct seed	6/18	9/8	9/15-10/10
Pepper	First trench, transplant	6/25	7/15	7/30-10/22
	First trench, direct seed	--	--	--
	Second trench, transplant	6/30	7/21	8/5-10/22
	Second trench, direct seed	7/15	7/30	8/15-10/22
	Bed, transplant	7/1	7/21	8/10-10/22
	Bed, direct seed	--	--	--

SOIL ACIDITY AN IMPORTANT FACTOR IN PRODUCTION OF BEANS, LETTUCE, CARROTS

Cooperator: T. L. Jackson, Department of Soil Science, Oregon State University, Corvallis

Introduction

These experiments in 1979 were a continuation of a series begun in the 1977 growing season and repeated in 1978. Bush beans, lettuce, and carrots were again the crops used to determine the effects of soil pH and N fertility level on vegetable yield. In 1979, new plots were established with lime rates of 0, 2, 4, and 6 tons/acre. This produced a narrower range of pH (5.0 to 5.8) than was present in the 1977 and 1978 experiments (4.9 to 6.6).

Methods

The lime variable was applied in a randomized complete block design with four replications. Each lime plot was randomly split into three subplots with N variables of 30, 130, and 230 pounds/acre. The N variable was applied immediately after planting. Trifluralin was applied to the bean area at a rate of 0.75 pounds/acre on May 31 and all plots were seeded the same day. Varieties used were 'Tendercrop' bush bean, 'Ithaca' lettuce (pelleted), and 'Nantes' Carrot. On June 1, pronamide at two pounds/acre was applied to the lettuce area, linuron at 1.5 pounds/acre was applied to the carrot area, and dinoseb amine at three pounds/acre was applied to the bean area. Irrigation was by overhead sprinkler. The lettuce crop failed to emerge satisfactorily and was replanted with unpelleted Ithaca seed June 26. Beans were harvested on August 8, lettuce on September 10, and carrots on September 12.

Results

Table 19. Effect of Soil pH and N on Fresh Weight of Bean Pods

N applied, pounds/acre	Lime, tons/acre	Yield, tons/acre 0	2	4	6	Mean, N rates
30		4.0	6.1	6.3	5.7	5.5
130		4.4	5.4	5.5	6.4	5.4
230		3.7	4.2	5.6	6.1	4.9
Mean, Lime rates[z]		4.0	5.3	5.8	6.1	

[z] $LSD_{(.05)}$ Lime rates = 0.6 tons/acre

Yield = 4.03 + 0.71 [Lime rate] - 0.06 [Lime rate]^2, r^2 = 0.71**

Table 20. Effect of Soil pH and N on Yield of Lettuce

N applied, pounds/acre	Lime, tons/acre	Yield, tons/acre				Mean, N rates
		0	2	4	6	
30		1.9	7.3	6.7	7.5	5.9
130		1.1	4.6	6.4	8.1	5.0
230		1.1	3.0	6.8	7.4	4.6
Mean, Lime rates[z]		1.3	5.0	6.7	7.6	

[z] $LSD_{(.05)}$ Lime rates = 1.2 tons/acre. Yield = 1.40 + 2.04[Lime rate]-0.17 [Lime rate]^2
$r^2 = 0.88^{**}$

Table 21. Effect of Soil pH and N on Yield of Carrots

N applied, pounds/acre	Lime, tons/acre	Yield, tons/acre				Mean, N rates[y]
		0	2	4	6	
30		24.4	30.6	28.4	29.2	28.2
130		23.9	26.5	26.6	27.1	26.0
230		21.7	25.6	26.8	27.0	25.3

[z] $LSD_{(.05)}$ Lime rates = 1.7 tons/acre; [y] $LSD_{(.05)}$ N rates = 1.5 tons/acre
Multiple Linear Regression: Yield = 26.4 + 0.65[Lime rate]-0.014[N rate]; $r^2 = 0.66^{**}$

Discussion

Bean pod fresh weight increased significantly as a function of applied lime over the range zero to six tons/acre. N application tended to reduce yield, particularly at low pH, but the effect was not statistically significant. Highest yields were obtained at six tons/acre lime and any rate of N but yields at four tons/acre were nearly equal to those at six and four tons/acre would probably be the most cost-effective rate of lime application.

As in 1977 and 1978, lettuce yields responded markedly to application of lime, with maximum yields at the six tons/acre rate. High rates of N tended to decrease yields but the differences were not statistically significant.

Carrot yields also responded significantly to application of lime, but the two tons/acre rate was equally as effective as higher rates of lime. Higher rates of N decreased carrot yields. This was primarily because of a decrease in carrot stand at higher N rates (data not shown) rather than to any decrease in average root size.

Plant tissue analysis indicated that liming significantly reduced Mn content of leaves of all three crops. Mn toxicity is implicated in poor lettuce yields at low pH.

PHOSPHORUS, LIME AND COPPER INCREASE SWEET CORN YIELDS

Cooperator: T. L. Jackson, Department of Soil Science, Oregon State University, Corvallis

Introduction

Soil and plant samples taken from 90 sweet corn fields in the Willamette Valley during 1978 showed low Cu and B levels but responses to applied Cu and B in commercial fields have been inconsistent. Yields and maturity dates of sweet corn in the Willamette Valley are known to respond to banding P fertilizer at planting. The yield response to various rates of banded P in the presence of high P soil test is unknown. High rates of P and Cu may be antagonistic. In addition, soil pH may affect uptake of Cu, B, and P and soil temperature is also known to affect availability of these nutrients. The following experiments were designed to evaluate the effects of lime, Cu, B, banded P, and broadcast P on sweet corn yield at both an early and a late planting date.

Methods

For the early planting (May 7, 1980), the entire plot area was limed at 3.5 tons/acre. The main plot treatments were ±10 pounds/acre of Cu x ±three pounds/acre of B x ±200 pounds/acre of broadcast P_2O_5 in randomized block design with four replications. The main plots were split by banded P application of zero, 60, and 150 pounds/acre of P_2O_5 and these subplots were split for two harvest dates.

For the late planting (June 5), the main plot variable was zero, two, four, and six tons/acre of lime in randomized block design with four replications. Main plots were split into four randomized subplots for the Cu x B variable described above. These subplots were again split by the above banded P variable and these sub/subplots were split for harvest date. All plots received 180 pounds/acre of total N, 50 pounds banded at planting, and the remainder broadcast when the corn was about one foot tall. Atrazine and alachlor at 1.0 pound and 2.5 pounds/acre, respectively, were used for weed control. The early planting was harvested on September 4 and September 9, the late planting on September 22 and September 25.

Results

(Data analysis incomplete; plant tissue samples not yet analyzed.)

For the early planting, there was no significant response to Cu or B. Broadcast P alone, in the absence of banded P, increased yield of mature ears by 34 percent at the first harvest and 11 percent at the second harvest. Thus, the increased yield was primarily because of accelerated maturity. Broadcast P, in the presence of 60 pounds/acre of banded P_2O_5, increased mature ear yield by 58 percent at the first harvest and five percent at the second harvest. Broadcast P had no effect in the presence of 150 pounds/acre of banded P_2O_5.

For the second planting, P again had the major effect on yield. Yields were higher at 150 than at 60 pounds/acre of banded P_2O_5. Liming increased yield in the presence of banded P. At low pH, there was a slight increase in mature ear yield with addition of Cu at the first harvest.

EFFECT OF SOIL pH AND NITROGEN FERTILIZERS ON STAND ESTABLISHMENT OF SMALL-SEEDED VEGETABLES

Introduction

Vegetable yields are, within limits, proportional to the initial stand establishment of the crop, i.e. the percentage of seed which successfully germinates, emerges, and commences sunlight-dependent growth. Improvements in stands should increase yields, reduce thinning labor, and may reduce variability in produce size and maturity at harvest. The purpose of this experiment was to determine the effects of soil pH and type (neutral, basic, acid-forming) of N fertilizer on stand establishment of several small-seeded vegetables. It was based on previous observations that low pH and high rates of fertilizer reduce stands. N fertilizers may reduce stand through salt injury, soil pH reduction, or ammonium toxicity. The 1979 trials involved lettuce, carrots, and cauliflower with calcium nitrate and ammonium sulfate the N sources. In the 1980 trials, the crops were lettuce, carrots and spinach, and several more fertilizers were added.

Methods

The cultivars used in the 1979 study were 'Nantes' carrot, 'Ithaca' lettuce, and 'Snowball Y' cauliflower. The experiment was designed as a 4x3x2 factorial with four levels of soil pH (5.0, 5.6, 6.1, 6.4), three rates of N (0, 100, and 200 pounds/acre), and two sources of N (calcium nitrate and ammonium sulfate). Each treatment combination was replicated four times. Soil pH plots were in randomized block design with each plot split into five randomized subplots of 0 N, 100 pounds/acre of N from calcium nitrate, 200 from calcium nitrate, and 100 and 200 pounds/acre from ammonium sulfate. Fertilizers were surface broadcast and not incorporated. Each subplot was then split among the three crops. The sub/subplot for each crop consisted of four rows x seven feet. Between row spacing was two feet. All plots were seeded on June 20 and stand counts made on the middle two rows for each crop on July 2 and July 11.

Cultivars used in the 1980 study were 'Salad Bowl' lettuce, 'Scarlet Nantes' carrot, and 'Melody' and 'Hybrid 424' spinach. The experiments were designed as 4 x 8 factorials with main plots (four levels of soil pH) in randomized block design and the eight fertilizer treatments as subplots. The broadcast fertilizer treatments were as follows: calcium nitrate, 1,300 pounds/acre; ammonium sulfate, 1,000 pounds/acre; ammonium nitrate, 600 pounds/acre; urea, 435 pounds/acre; calcium nitrate, 750 pounds/acre plus ammonium nitrate, 250 pounds/acre; potassium nitrate, 1,540 pounds/acre; potassium chloride, 600 pounds/acre; and unfertilized check. Thus, each nitrogen-containing fertilizer was applied at 200 pounds/acre of total N. The subplot for each crop consisted of three rows x 10 feet with 20-inch between-row spacing. All plots were seeded on June 23 at a rate of 10 seeds/foot. Fertilizer was broadcast the following day, and stand counts were made at several intervals after seeding.

Results, 1979

Stands of all three crops responded similarly to increasing soil pH and to N application. In each case, raising soil pH from 5.0 significantly increased stand establishment. For carrots, the greatest stand increase occurred between pH 5.0 and 5.6 and best stand was obtained at pH 6.1 (Table 22). Use of calcium nitrate did not affect stand at either 100 or 200 pounds/acre. However, use of ammonium sulfate significantly depressed stand establishment. The higher rate tended to decrease stand more than the low rate of ammonium sulfate, but the difference was statistically significant only at the 90 percent confidence level.

For lettuce, the greatest stand increase occurred between pH 5.6 and 6.2 with a significant decrease at pH 6.4 (Table 23). As with carrots, use of calcium nitrate did not affect stands but ammonium sulfate significantly reduced stand by as much as 50 percent. Again, there was no statistically significant difference in stand between the 100 and 200 pound/acre rates of ammonium sulfate.

For cauliflower, as for lettuce, the greatest stand increase occurred between pH 5.6 and 6.2 with a slight decrease in stand at 12 days when pH was raised to 6.4 (Table 24). As with carrots and lettuce, use of calcium nitrate did not affect stand while ammonium sulfate depressed stand. The 200 pound rate of ammonium sulfate suppressed stand significantly below that obtained with 100 pounds/acre.

For each crop, there was no significant interaction between pH and source or rate of N. That is, higher pH did not reverse or markedly ameliorate the stand-suppressing effect of ammonium sulfate. The effects of low pH and ammonium sulfate were approximately additive. In every case lowest stands occurred with a combination of pH 5.0 and presence of ammonium sulfate fertilizer and highest stands occurred at pH 6.2 or 6.4 with either no applied N or either rate of calcium nitrate.

Table 22. Effect of Soil pH, and Rate and Source of N on Carrot Stand, 12 Days after Seeding - 1979

	Stand, seedlings/foot				
N source, rate Soil pH:	5.0	5.6	6.1	6.4	Mean, fertilizer
Zero N check	5.0	6.6	7.8	7.3	6.7
Ammonium sulfate, 100 pounds/acre	3.0	5.5	6.4	6.2	5.3
Ammonium sulfate, 200 pounds/acre	2.0	5.0	6.4	5.1	4.6
Calcium nitrate, 100 pounds/acre	4.7	7.0	7.3	6.7	6.4
Calcium nitrate, 200 pounds/acre	5.2	6.6	7.0	6.5	6.3
Mean, pH	4.0	6.2	7.0	6.4	Overall mean: 5.9

$LSD_{(.05)}$pH = 0.6; $LSD_{(.05)}$Fertilizer = 0.7

Table 23. Effect of Soil pH, and Rate and Source of N on Lettuce Stand, 12 Days after Seeding - 1979

	Stand, seedlings/foot				
N source, rate Soil pH:	5.0	5.6	6.1	6.4	Mean, fertilizer
Zero N check	2.5	2.4	5.9	3.8	3.7
Ammonium sulfate, 100 pounds/acre	1.2	1.3	3.5	2.3	2.1
Ammonium sulfate, 200 pounds/acre	0.7	1.6	3.3	1.9	1.8
Calcium nitrate, 100 pounds/acre	1.3	3.2	5.2	4.2	3.5
Calcium nitrate, 200 pounds/acre	1.6	4.3	5.4	3.4	3.7
Mean, pH	1.5	2.6	4.7	3.1	Overall mean: 3.0

$LSD_{(.05)}$ pH = 0.6; $LSD_{(.05)}$ Fertilizer = 0.6

Table 24. Effect of Soil pH, and Rate and Source of N on Cauliflower Stand, 12 Days after Seeding - 1979

	Stand, seedlings/foot				
N source, rate Soil pH:	5.0	5.6	6.1	6.4	Mean, fertilizer
Zero N check	5.1	5.3	7.2	7.0	6.1
Ammonium sulfate, 100 pounds/acre	4.0	4.2	6.0	6.2	5.1
Ammonium sulfate, 200 pounds/acre	3.1	3.7	5.4	5.1	4.3
Calcium nitrate, 100 pounds/acre	5.1	6.2	8.0	6.1	6.3
Calcium nitrate, 200 pounds/acre	5.1	5.3	7.4	5.9	5.9
Mean, pH	4.5	4.9	6.8	6.1	Overall mean: 5.6

$LSD_{(.05)}$ pH = 0.7; $LSD_{(.05)}$ Fertilizer = 0.8

Results, 1980

In the 1980 experiments, stand of lettuce was initially depressed by all fertilizers except urea (Table 25) but the effect diminished with time (data not shown). Stand of carrots was affected similarly (Table 26); all fertilizers except urea inhibited stand establishment with ammonium sulfate and potassium chloride causing the greatest inhibition. Considering the relative acidity and salt injury potential of the treatments (Table 27), the lack of stand depressing effect of urea can best be explained by a relatively low salt damage potential. However, potassium nitrate has a high salt damage potential but did not depress stand more than did other treatments with more moderate salt damage potential.

Calcium nitrate and ammonium sulfate did not differ appreciably in their effect on stand in 1980. In general, a surface broadcast application of the complete crop fertilizer needs appears to inhibit stand establishment.

Soil pH had less effect on stand than in previous experiments. Only in the case of carrots and spinach (Table 28) did low soil pH significantly inhibit stand establishment. The fertilizer treatments had no significant effect on spinach stand and the data are not shown. Yield of spinach responded markedly to increasing soil pH (Table 29). At pH 5.0, the emerged seedlings failed to make any harvestable growth. Maximum yields occurred at pH 6.4 for both cultivars.

Table 25. Effect of Soil pH and Fertilizer on Lettuce Stand, 13 Days after seeding - 1980

Fertilizer	Soil pH:	Stand, seedlings/foot				Mean, fertilizer
		5.0	5.6	6.1	6.4	
Zero N Check		5.0	4.7	5.7	6.0	5.3
Calcium nitrate		3.7	2.3	4.3	3.3	3.3
Ammonium sulfate		3.3	3.0	3.3	3.3	3.3
Ammonium nitrate		4.3	3.0	4.7	5.0	4.3
Urea		3.3	4.3	4.0	4.0	4.0
Cal. nit. + amm. nit.		3.0	2.7	4.0	4.0	3.3
Potassium nitrate		4.0	3.0	3.3	4.7	3.3
Potassium chloride		2.3	3.0	3.3	3.3	3.3
Mean, pH		3.7	3.3	4.0	4.3	Overall mean: 3.8

$LSD_{(.05)}$ Fertilizer = 0.7

Table 26. Effect of Soil pH and Fertilizer on Carrot Stand, 20 Days after Seeding - 1980

Fertilizer	Soil pH:	Stand, seedlings/foot				Mean, fertilizer
		5.0	5.6	6.1	6.4	
Zero N check		3.7	4.3	5.3	5.3	4.7
Calcium nitrate		4.0	3.0	4.0	3.7	3.7
Ammonium sulfate		1.7	3.0	2.7	3.3	2.7
Ammonium nitrate		3.0	2.3	3.7	3.0	3.0
Urea		2.7	3.3	4.3	2.7	3.3
Cal. nit. + amm. nit.		2.7	3.3	4.0	4.0	3.7
Potassium nitrate		2.3	2.7	3.3	2.3	3.7
Potassium chloride		3.0	3.7	3.7	3.3	2.7
Mean, pH		3.0	3.3	4.0	3.3	Overall mean: 3.8

$LSD_{(.05)}$ pH = 0.5; $LSD_{(.05)}$ Fertilizer = 0.6

Table 27. Relative Acidity and Relative Salt Damage Potential of Fertilizers

Fertilizer	Relative Acidity[z] pounds $CaCO_3$ equiv.	Relative Salt[y] Damage Potential
Control	0	0
Calcium nitrate	292 (basic)	772
Ammonium sulfate	1243	773
Ammonium nitrate	416	706
Urea	409	365
Cal. nit. + amm. nit.	20	739
Potassium nitrate	0	1277
Potassium chloride	0	766

[z]Pounds $CaCO_3$ equivalent for the amount of fertilizer used per acre.

[y]Amount of fertilizer used (x) salt index.

Table 28. Effect of Soil pH on Stand of Spinach - 1980

Soil pH	Stand, seedlings/foot	
	Hybrid 424	Melody
5.0	7.7 a	9.0 a
5.7	9.0 a	9.3 a
6.1	10.7 b	12.7 b
6.4	10.7 b	12.0 b

Table 29. Effect of Soil pH on Yield of Spinach - 1980

Soil pH	Yield, tons/acre	
	Hybrid 424	Melody
5.0	0 a	0 a
5.7	3.0 b	2.5 b
6.1	7.5 c	5.5 c
6.4	11.4 d	6.6 c

RESPONSE OF SMALL-SEEDED VEGETABLES TO SEVERAL ANTICRUSTANTS

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Introduction

Poor stand establishment is often a limiting factor in vegetable production in the Willamette Valley. Carrots, onions, and lettuce, in particular, often fail to emerge because of soil crusting. Most small-seeded crops lack the vigor necessary to emerge when resisted by significant soil impedance. A high degree of impedance or crusting (also known as soil mechanical resistance) is caused by breakdown of soil particle aggregates. Several treatments exist which may reduce the breakdown of aggregates. Phosphoric acid (PA) has been tested extensively at the North Willamette Station as well as elsewhere in Oregon. Results with PA banded over the seed row have been inconsistent. In some years, crusting has been reduced and stands increased, but in other years, PA has not improved stands. The objectives of these experiments were to 1) investigate further the effectiveness of PA as an anticrustant/emergence stimulator and 2) compare it to other materials such as Nalco 2190 (organic polymer), vermiculite, and neutral ammonium phosphate solution (10-34-0), 3) determine to what degree the emergence and yield stimulating effect of PA can be reproduced by banding concentrated superphosphate, 4) compare the effectiveness of PA and other anticrustants at low vs. higher soil temperature, and 5) determine whether soil pH and Ca content affects the emergence stimulating properties of PA.

Methods

Experiment 1.

In 1979, Objective 1 was approached by seeding several crops with and without PA and measuring stands, soil mechanical resistance (MR), yields and leaf P levels. The crops and varieties involved in this experiment were 'Ithaca' head lettuce, 'Waldmann's Green' leaf lettuce, 'Snowball Y' cauliflower, 'Melody' spinach, 'Pickmore' cucumber, 'Nantes' carrot, and 'Japanese Bunching' onion. The plot area was prepared for seeding in late April after plowing down 1,000 pounds/acre of 10-20-10. The area to be planted to cauliflower received a preplant, incorporated application of trifluralin at 0.75 pounds/acre. A very finely pulverized seedbed was prepared by rototilling and packing to encourage optimal conditions for crusting. All crops were seeded on May 2. PA applications were made to appropriate plots immediately after seeding at a rate of nine ounces of 17 percent acid per 25-foot plot. PA treatment and check were replicated six times in a randomized block design. Plot size was three rows x 25 feet for each crop. Between row spacing was 30 inches. Weed control was by post-plant herbicide applications on May 3 and later by hand cultivation. Herbicides used were CDEC at 3 pounds/acre for lettuce and spinach, dinitroamine at 3 pounds/acre for cucumbers, CDAA at six pounds/acre for onions, and linuron at 1.5 pounds/acre for carrots. Irrigation was by overhead sprinkler as needed.

Experiment 2.

In 1980, objectives 2 and 3 were approached by seeding five crops with seven anticrustant or emergence stimulation treatments on April 30. The plot area received a broadcast application of 1,000 pounds/acre of 10-20-10. The five crops were 'Sentinel' onion, 'Snowball Y' cauliflower, 'Waldmann's Green' lettuce, 'Marketmore' cucumber, and 'Scarlet Nantes' carrot. Treatments were 1) check, 2) vermiculite at 12 cubic feet/acre, 3) PA, 17 percent by volume, at 160 ml per 20 row feet (31 pounds P/acre), 4) banded 0-45-0 at 31 pounds P/acre, 5) combination of 3 and 4, 6) neutral ammonium phosphate solution at 31 pounds P/acre, 7) Nalco 2190, 10 percent by volume, at 132 ml per 20 feet (25 gallons/acre). Each treatment was replicated four times in a randomized block design. Stand counts and soil MR were measured at several intervals following seeding. MR was measured with a Technical Products Co. pressure tester. Plots were harvested at maturity of crop (except cauliflower). Herbicides used were linuron (carrots), dinitroamine (cucumbers), pronamide (lettuce), and nitrofen (onions, cauliflower).

Experiment 3.

Objective 4 was met by repeating Experiment 2 with a seeding date of July 1. Treatments 4 and 5 were eliminated. Only stand counts were made. Crops were onion, carrot, and lettuce.

Experiment 4.

(Objective 5). 'Waldmann's Green' lettuce and 'Scarlet Nantes' carrots were seeded on May 15, 1980, on long term lime plots. Main plots consisted of soil treatments of four tons/acre lime, eight tons/acre lime, one ton/acre sulfur, and untreated check. Resulting pH was approximately 6.1, 6.4, 5.0, and 5.6, respectively. Subplot treatment was PA at 31 pounds P/acre vs. untreated check. All eight treatments combinations were replicated four times. Stand counts were made at several intervals after seeding. No fertilizer or pesticides were used.

Results and Discussion

Experiment 1.

In 1979, seedling stands were significantly greater on PA-treated plots for all crops (Tables 30, 31). Cauliflower, lettuce, and spinach responded less to PA application than did onion, carrot, and cucumber. Even on PA-treated plots, only onion and cucumber achieved commercially acceptable stands. Lettuce and cauliflower were replanted in June and, again, PA increased stands of each crop, but not to an acceptable level (data not shown). Several crops were carried through to harvest and yields are shown in Table 32. PA significantly increased yield of cucumber, carrot, onion, leaf and head lettuce. There was a trend toward increased root size for carrot and increased bulb weight for onion on PA-treated plots, but in neither case was the difference statistically significant. Most of the yield increase can be attributed to increased stands.

Are the increases in stand with PA because of an anticrustant effect, increased availability of P, pH effect, or some other cause? Previous work with PA has demonstrated a very slight and probably biologically insignificant increase in soil temperature at the 1-inch depth. PA decreases soil pH in the surface few millimeters but on the already acid soil (pH 5.5) used in this experiment, a decrease in pH probably would depress stands. Soil P levels were raised from 130 ppm to 177 ppm at the half-inch depth by PA application and leaf P content was significantly increased for onion, carrot, and lettuce from PA-treated plots at five weeks after seeding (Table 33). Thus, at least a part of the PA effect may be caused by availability of P to the emerging and growing seedling.

The anticrustant effect of PA, resulting in decreased resistance to cotyledon emergence (Table 34), also appears to play a large role. The soil MR units in Table 34 are measured on a spring-loaded 2-mm diameter plunger which is forced into the surface inch of soil. A reading of 1,000 is equal to 3.2×10^4 g/cm^2 or 3.1×10^6 Pa. Other research has established that most small-seeded vegetables will not emerge if the resistance exceeds 1,000 units. At six and eight days after seeding, the resistance was low and did not differ with treatment. Soil moisture was high at this time and progressively decreased during the following eight days of zero precipitation. Considerable crusting occurred during this period on both treated and untreated plots, but the PA-treated plots always had significantly lower MR. A one inch irrigation occurred on the seventeenth day after planting. MR readings again decreased but the difference between treated and untreated plots was maintained.

Thus, it appears that the stand promoting effect of PA is caused by both an anticrustant action and availability of soil P.

Table 30. Stand of Vegetables as Affected by PA Application, 13 Days After Seeding - 1979

Crop	Stand, seedlings/foot				Significance[z]
	+PA	C.V.	-PA	C.V.	
Leaf Lettuce	3.4	60	1.8	65	*
Head Lettuce	2.0	39	1.1	84	*
Spinach	1.2	32	0.5	91	*
Carrot	1.9	78	0.6	71	*
Onion	8.0	73	2.7	53	**
Cauliflower	0.8	57	0.4	103	N.S.

[z]Single asterisk: Means are significantly different at 95% confidence level
Double asterisk: Means are significantly different at 99% confidence level

Table 31. Stand of Vegetables as Affected by PA Application, 21 Days after Seeding - 1979

Crop	Stand, seedlings/foot +PA	C.V.	-PA	C.V.	Significance
Leaf Lettuce	4.7	36	2.3	44	**
Head Lettuce	2.4	26	1.2	65	*
Spinach	1.9	28	1.5	36	N.S.
Carrot	9.2	46	2.7	30	**
Onion	40.3	22	22.1	20	**
Cauliflower	1.3	47	0.6	54	*
Cucumber	9.9	23	6.6	21	*

Table 32. Yield of Vegetables as Affected by PA Application - 1979

Crop	Yield, tons/acre +PA	-PA	Significance
Cucumber	11.0	6.4	*
Carrot, total	10.6	3.4	**
Onion	8.0	3.6	*
Lettuce, leaf	8.0	6.6	*
Lettuce, head	10.3	7.8	*

Table 33. Effect of PA on Leaf Phosphorus Content of Vegetable Seedings, 5 Weeks after Planting

Crop	Leaf P Content, percent dry wt. +PA	-PA	Significance
Onion	0.32	0.26	*
Carrot	0.20	0.16	*
Lettuce	0.36	0.26	**

Table 34. Soil Mechanical Resistance as Affected by PA Application - 1979

Days after Seeding	Soil Mechanical Resistance[z] +PA	-PA	Significance
6	239	287	N.S.
8	252	276	N.S.
9	417	557	**
12	450	827	**
16	905	1483	**
21	582	924	**

[z]Average of 12 readings/plot, six replications/treatment

Experiment 2.

Mean soil temperature at two-inch depth during the stand establishment phase of this experiment (April 30 - May 22, 1980) was 63°F. MR readings (Table 35) represent the mean of four replications, 10 readings per plot. The treatment most effective in minimizing MR was vermiculite; PA was the second most effective treatment, followed by Nalco 2190. The mechanism of neutral ammonium phosphate reduction of MR is not known but may involve phosphate binding with soil particles. Concentrated superphosphate banded two inches beneath and two inches to the side of the seed row also reduced MR, perhaps caused by the rough condition of the soil surface left by the fertilizer delivery shoe. Based on reduction of MR, all treated plots might be expected to produce greater stands than the control plots.

For lettuce, vermiculite was by far the most effective emergence stimulator with PA and Nalco less effective; ammonium phosphate solution had no effect (Table 36). After 22 days, the vermiculite treated plots showed a better than 400 percent stand improvement over control. For carrots, vermiculite was also most effective (Table 37). After 22 days, vermiculite-treated plots exhibited a 260 percent improvement in stand over the control.

Results with onion were not as striking. Vermiculite, and to a lesser extent, PA promoted early emergence, but final stand was not affected by treatment (Table 38). Results with cauliflower also were less striking than with carrots or lettuce. Only vermiculite increased the final stand (Table 39). Vermiculite was also the only treatment to significantly increase the final stand of cucumber (Table 40). PA promoted early emergence as did ammonium phosphate, but other treatments had no effect.

In summary, vermiculite was by far the most effective anticrustant and emergence stimulator. PA was moderately effective at this planting date. Other treatments usually had no statistically significant effect although banded superphosphate alone occasionally tended to inhibit stand establishment, perhaps because of a salt effect. Other research results have demonstrated that the effectiveness of Nalco 2190 may be greatly increased by incorporating the material into the soil rather than using an over-the-row spray.

Leaf lettuce stands were not thinned. Plots were harvested 71 days after seeding. Yields were proportional to the final stand (Table 41). Highest yield was obtained on the vermiculite-treated plots and lowest yield on the treble superphosphate plots. Lettuce on the neutral ammonium phosphate plots yielded higher than would be expected from the final stand. This may be caused by the extra N (nine pounds/acre) applied to these plots with the anticrustant treatment.

Carrot yields followed much the same pattern as lettuce except that ammonium phosphate did not increase yield. Vermiculite plots had the highest yields, followed by PA-treated plots. There were no significant differences among onion yields in agreement with the lack of a significant treatment effect on final onion stand. Cucumber yields at first picking were proportional to the final stand with only the vermiculite plots outyielding controls. Subsequent cucumber pickings produced no statistically significant yield differences, although plants tended to yield the highest on superphosphate-treated plots.

Experiment 3.

Mean soil temperature at two-inch depth during the stand establishment phase of this experiment (July 1 - July 14) was 73°F, a favorable temperature for germination. MR readings were not made. As with the earlier planting, vermiculite was the most effective emergence stimulator for lettuce, producing both earlier emergence and greater final stand (Table 42). PA and Nalco 2190 were moderately effective while neutral ammonium phosphate had no effect. Emergence of carrots and onions was more rapid with vermiculite but no treatment had any effect on final stand of these crops. Apparently soil temperature and lack of crusting conditions were nearly ideal for crop emergence at this planting date.

Experiment 4.

For both lettuce and carrot, stands increased with increasing soil pH with a maximum at pH 6.1 (data not shown). In this experiment, PA had no significant effect on stand; therefore, the effect of soil pH or Ca content on the emergence stimulating/anticrustant effect of PA could not be determined.

Table 35. Soil MR Eight and Twenty Days after Seeding - 1980

Treatment	Soil MR Eight Days	Soil MR Twenty Days
Control, no treatment	695 f	831 e
Vermiculite	148 a	285 a
Phosphoric acid	304 b	305 a
Superphosphate	555 e	688 d
PA plus superphosphate	341 bc	579 cd
Ammonium phosphate	496 d	436 b
Nalco 2190	383 c	483 bc

Means within a column which are followed by same letter not significantly different at 95% level of confidence.

Table 36. Stand of Lettuce at Several Intervals after Seeding on April 30, 1980

Treatment	Stand, seedlings/twenty feet 5 days	7 days	9 days	12 days	14 days	22 days
Control	0 a	4 a	11 a	28 ab	30 ab	33 ab
Vermiculite	68 b	153 b	160 c	160 d	164 d	141 d
PA	1 a	17 a	38 b	53 c	54 c	54 c
Superphosphate	0 a	4 a	11 a	21 a	21 a	24 a
PA plus superphosphate	1 a	14 a	26 ab	38 abc	39 abc	42 abc
Ammonium phosphate	3 a	11 a	29 b	40 abc	40 bc	39 abc
Nalco 2190	2 a	14 a	31 b	43 bc	48 bc	49 bc

Table 37. Stand of Carrots at Several Intervals after Seeding on April 30, 1980

Treatment	Stand, seedlings/twenty feet 9 days	12 days	14 days	19 days	22 days
Control	1 a	18 ab	28 a	42 ab	40 ab
Vermiculite	15 c	92 e	94 c	114 c	103 c
PA	2 a	43 d	53 b	51 b	63 b
Superphosphate	1 a	15 a	24 a	23 a	26 a
PA plus superphosphate	2 ab	39 cd	53 b	66 b	68 b
Ammonium phosphate	3 b	21 abc	29 ab	49 b	41 ab
Nalco 2190	3 b	35 bcd	44 ab	57 b	54 ab

Table 38. Stand of Onions at Several Intervals after Seeding on April 30, 1980

Treatment	Stand, seedlings/twenty feet 9 days	12 days	14 days	19 days
Control	1 a	31 a	104 b	134 a
Vermiculite	24 b	104 c	126 c	118 a
PA	1 a	50 b	112 bc	116 a
Superphosphate	0 a	26 a	82 a	113 a
PA plus superphosphate	1 a	36 ab	101 b	99 a
Ammonium phosphate	1 a	37 ab	107 b	130 a
Nalco 2190	1 a	39 ab	114 bc	126 a

Table 39. Stand of Cauliflower at Several Intervals after Seeding on April 30, 1980

Treatment	Stand, seedlings/twenty feet 7 days	9 days	12 days	14 days	22 days
Control	6 ab	32 ab	61 ab	67 b	51 a
Vermiculite	68 d	79 e	81 d	81 c	79 b
PA	14 bc	55 d	76 cd	80 c	58 a
Superphosphate	4 a	20 a	51 a	54 a	46 a
PA plus superphosphate	12 abc	46 cd	66 bc	72 bc	46 a
Ammonium phosphate	5 ab	34 bc	63 ab	64 ab	53 a
Nalco 2190	17 c	46 cd	71 bcd	73 bc	56 a

Table 40. Stand of Cucumber at Several Intervals after Seeding on April 30, 1980

Treatment	Stand, seedlings/twenty feet			
	9 days	12 days	14 days	22 days
Control	3 a	31 ab	38 a	38 a
Vermiculite	34 d	60 c	61 b	55 b
PA	22 c	43 b	46 a	45 ab
Superphosphate	4 a	27 a	36 a	42 ab
PA plus superphosphate	11 b	40 ab	44 a	43 ab
Ammonium phosphate	13 b	37 ab	40 a	40 ab
Nalco 2190	7 ab	34 ab	38 a	38 a

Table 41. Effect of Anticrustant Treatments on Yield of Crops Seeded on April 30, 1980

Treatment	Yield, tons/acre			
	lettuce	cucumber[z]	carrot	onion
Control	6.8 ab	10.1 a	4.0 ab	16.9 ab
Vermiculite	13.4 c	18.6 b	8.9 c	20.4 b
PA	9.1 b	8.0 a	6.8 bc	19.6 b
Superphosphate	4.6 a	12.0 a	2.5 a	13.5 a
PA plus superphosphate	7.2 ab	12.8 ab	5.6 b	16.9 ab
Ammonium phosphate	9.5 b	8.3 a	3.9 ab	16.9 ab
Nalco 2190	8.3 b	9.2 a	5.8 b	18.1 b

[z]Yield at first harvest, no significant cucumber yield differences at subsequent harvests.

Table 42. Stand of Lettuce at Several Intervals after Seeding on July 1, 1980

Treatment	Stand, seedlings/twenty feet		
	7 days	9 days	14 days
Control	2 a	13 a	18 a
Vermiculite	78 c	113 c	120 c
PA	5 ab	25 b	44 b
Ammonium phosphate	7 b	15 a	21 a
Nalco 2190	4 ab	25 b	36 b

CHROME TANNERY WASTE AS A VEGETABLE FERTILIZER

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Introduction

Tannery waste plots were established at the North Willamette Experiment Station in June 1978. Further applications of tannery wastes were made to the same plots in 1979. Crops of beans, corn, and tall fescue were grown on the plots in 1978 and 1979. To measure the residual availability of tannery waste nitrogen, the same plots were planted to broccoli and lettuce in 1980. The fescue plots were maintained and harvest of clippings was continued without addition of more waste.

Methods

Broccoli

Broccoli cultivar 'Waltham 29' was direct seeded on June 11 with between-row spacing of 20 inches, six rows per 10 foot x 20 foot plot, four replicates in randomized block design. Trifluralin at 0.75 pounds/acre and fonofos at 1.0 pounds/acre were incorporated before planting. Treatments consisted of unfertilized control, 328 pounds/plot of waste applied in 1978 and again in 1979, 656 pounds waste applied in 1978 and 1979, 1312 pounds waste applied in 1978 only, 656 pounds waste and 50 pounds/acre of commercial N applied in 1978 and 1979, and 100 pounds/acre of N applied at planting in 1980. Stands were thinned to 18 inch in-row spacing. Leaf samples were collected at the seven leaf stage. Plots were harvested once at maturity of the main head on September 12.

Lettuce

Lettuce cultivar 'Ithaca' was direct seeded on June 19 on 20-inch between-row spacing. Pronamide was applied at 2.0 pounds/acre immediately after planting. Treatments were check, 219, and 438 pounds of waste applied per 10 x 20 foot plot in both 1978 and 1979; 875 pounds of waste applied in 1979 only, 438 pounds waste and 50 pounds/acre of commercial N in 1978 and 1979, and 100 pounds/acre of nitrogen applied in 1980. Stands were thinned to 12 inches between plants. Leaf samples were collected at harvest on August 14.

Fescue

Plots established in 1978 and 1979 were kept weed free with one application of 2,4-D and dicamba. Leaf samples were collected at first and last harvests of the 1979 plots. Treatments were check, 164 pounds waste per 7.5x15 foot plot, 328 pounds, 656 pounds, 160 pounds/acre of N applied in 1979 only, and 160 pounds/acre of N applied in 1980 to plots established in 1979.

Results

Broccoli

Results of chemical analysis of leaf samples are not yet available. Plants from plots receiving the intermediate rate of waste in 1978 and 1979 and the plots receiving commercial N in 1980 yielded significantly more than plants from check plots and were not significantly different from each other. Thus, a significant amount of N was made available to the broccoli crop by a previous waste application. Treatments had no effect on plant stand or tendency to flower prematurely.

Lettuce

Results of leaf analysis are not yet available. Treatments had no effect on stand establishment or number of heads harvested. Lettuce on all waste and commercial N treated plots yielded more than lettuce on check plots. As with broccoli, residual N from the waste was sufficient to produce a good crop.

Fescue

Plots were harvested four times in 1980. Significant differences were obtained at each cutting.

Yields from plots treated with the intermediate or high level of waste in 1978 significantly exceeded those from check plots and were proportional to the amount of waste applied. Thus, even after two years, the residual tannery waste was providing significant N for crop growth. Yields from plots treated with waste in 1979 were significantly greater than check plot yields and yields were proportional to amount of waste applied. Yield from plots treated with the highest rate of waste did not differ significantly from the yield of plots receiving 160 pounds/acre of commercial nitrogen in 1980.

Tannery waste appears to be a very effective fertilizer for grass crops and the effect of a single application lasts for at least two years. Use of tannery waste as a fertilizer for food chain crops will not only depend on its efficacy as a fertilizer, but will also depend on demonstration that its use does not result in potentially toxic heavy metal accumulation in the crop. Previous results indicated little increase in metal content of beans and corn grown on tannery waste-amended soil. Analysis of lettuce and broccoli samples is now underway.

OTHER RESEARCH IN PROGRESS

Several other experiments are underway but the results are too preliminary to be included in a full report this year. In addition to the late brussels sprouts trial mentioned on page 12, an overwinter sprouts trial was started in August 1980 and should be harvested in late winter or early spring, 1981. Overwinter variety trials of spinach, cabbage, cauliflower, and onions also will be harvested in the spring of 1981. N. S. Mansour is a cooperator on the spinach and onion trials. The effect of planting date on winter cauliflower yield is again being investigated.

In an experiment in 1980, gibberellic acid was injected into rhubarb crowns in the field in an attempt to increase yields. Results were somewhat promising and similar experiments will be carried out in 1981. Jack Parsons, Clackamas County Extension Agent, is a cooperator in these rhubarb experiments as well as another experiment in which soil moisture was found to have no effect on survival of newly planted rhubarb crown divisions.

White rot control of onion, a serious problem for growers on Lake Labish, is being investigated at the Station in cooperation with Dr. Paul Koepsell, OSU, Corvallis, and the Marion County Extension Service.

A trial of "solar pods" (Solar Survival, Inc.) for overwintering frost sensitive vegetables and extending the growing season of warm-weather crops was initiated in December 1980.