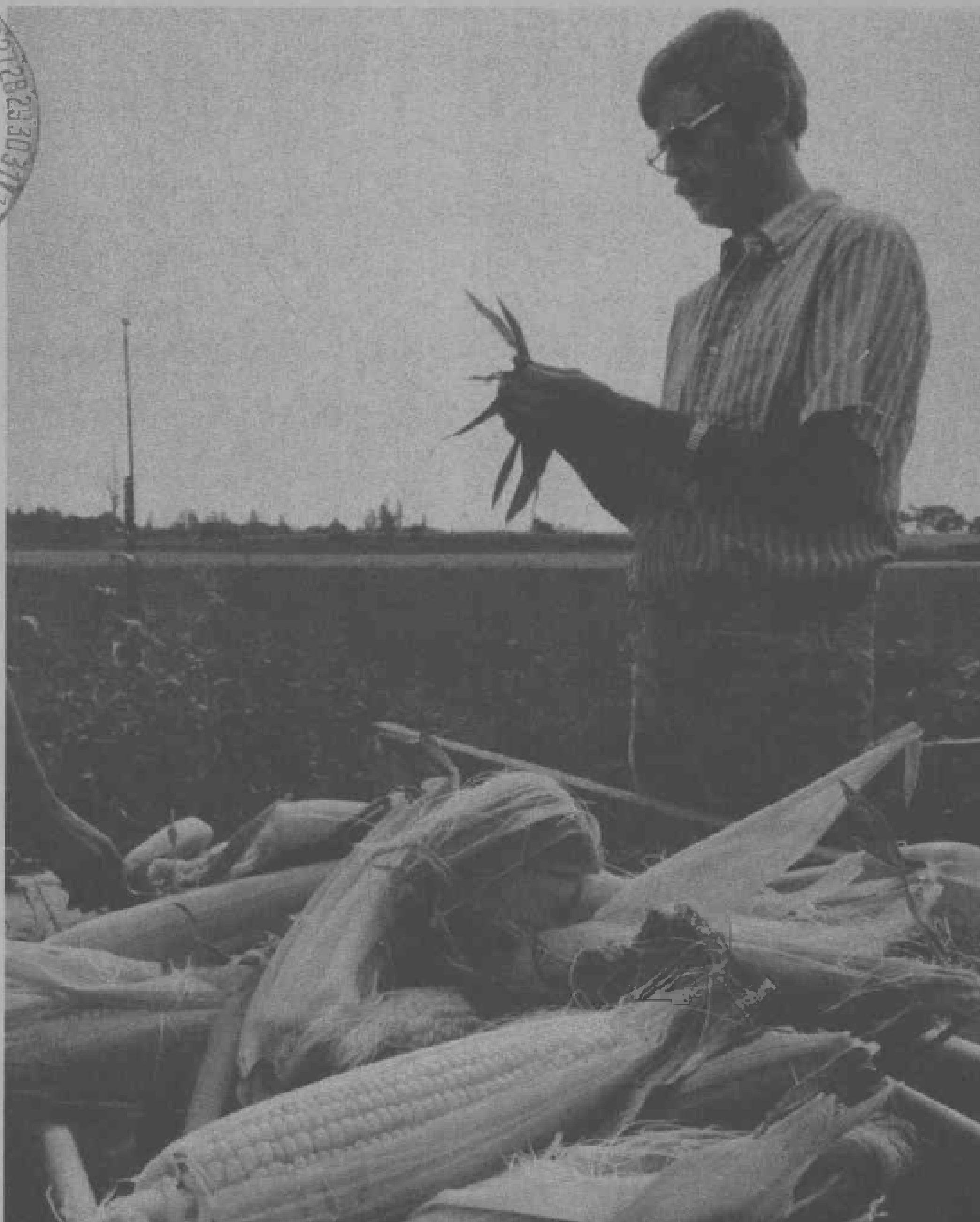
Vegetable Research at the North Willamette Agricultural Experiment Station, 1983-1984



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Cover: The author prepares to evaluate the maturity and tipfill of an ear of sweet corn grown on soil fertilized with experimental P source. See page 47.

VEGETABLE RESEARCH AT THE NORTH WILLAMETTE AGRICULTURAL EXPERIMENT STATION, 1983-1984

Delbert D. Hemphill Jr.

INTRODUCTION

A full-time program of vegetable crop research has been conducted at the North Willamette Experiment Station since 1976. The Station, a branch of the Oregon State University Agricultural Experiment Station, is just north of Aurora, a historic farming community 20 miles south of Portland, Oregon. The land is provided by Clackamas County, with facilities maintained by the university. Major vegetable research emphasis is on the needs of fresh market growers in the Willamette River Valley, but research is also conducted on home garden and small farm intensive vegetable culture, processed vegetable crops, and the recycling of organic waste materials on cropland.

Many research projects reported here involved cooperation with research and Extension Service colleagues in the Oregon State University system and with area vegetable growers. Their contributions are gratefully acknowledged. The financial support of E.I. DuPont de Nemours & Co., the Northern Willamette Valley Horticultural Society, the Oregon State University Agricultural Research Foudnation, the Plant Food Association, the Rhubarb Growers Association, the Tennessee Valley Authority, and the Oregon Danvers Onion Commission was essential to completing these projects and is greatly appreciated.

The first four sections of this report concern trials which may help growers choose plant varieties most suitable for the Willamette Valley. The next 10 sections report research on cultural practices to improve yield and quality of several crops. Soil and plant tissue analysis associated with several of these experiments was performed by the Oregon State University Department of Soil Science. The final section deals with the value of composted sewage sludge in soilless media for bedding plants.

Twelve crops from cabbage to sweet corn were involved in these experiments. This report is the fourth in a series of biannual reports initiated in 1979.

OVERWINTER CAULIFLOWER VARIETY TRIAL

Introduction

This trial is the fourth in a series of winter cauliflower variety trials dating from 1978. Previous trials have established that best quality is obtained with varieties that mature in April or May in average years. Very early varieties are less hardy, often fail to produce sufficiently large frames to support large heads, and may suffer frost damage to the curd. Several varieties maturing in late May and June have good yield potential but poor curd quality. This trial focused on mid-maturity varieties to determine those with the best combination of yield and quality.

Methods

Thirteen varieties were seeded in 2-inch pots in a glasshouse on July 27, 1982. Sixteen plants of each variety were transplanted on 3 x 1.5 foot spacing on September 3. The plot area received a broadcast, incorporated application of 700 pounds/acre of 10-20-10, 50 pounds/acre Epsom salts, 10 pounds/acre Solubor, 20 pounds/acre of a soluble trace element mix, 0.75 pounds/acre trifuralin, and 2.0 pounds/acre fonofos. Diazinon was applied as a drench (2.0 pounds of 50 WP/25 gallons) to the base of the plants in early October. On February 16, 1983, 35 pounds N/acre as ammonium sulfate, 40 pounds N/acre as calcium nitrate, and 100 pounds/acre of 0-45-0 was sidedressed on the soil surface. Ammonium nitrate at 75 pounds N/acre was sidedressed on March 14. Two varieties headed in January and were harvested at weekly intervals from January 7 through January 20, 1983. All other varieties were harvested twice weekly between March 11 and April 26.

Results and Discussion

The 1982-83 winter was unusually mild. Plants made good growth but curd tended to form before plants achieved maximum size. There was no significant winterkill. Peak harvests averaged one to two weeks earlier than average and three weeks earlier than in 1982.

The varieties which headed in January (RS 1831 and Cervina) were not true overwinter types. Plant size was small and the curd was usually freeze-damaged. The earliest of the true overwinter types was Tolteca. Harvest was very concentrated and the percentage of grade #1 heads (no defects) was low because of yellow, fuzzy curds and green stems.

Of the remaining eight varieties, highest gross yields were obtained with Arminda, Armado May, and Maya; highest yield of #1 heads was obtained with Markanta; the highest percentage of #1 heads was obtained with Markanta, Armado April, and Inca (Table 1). In all trials to date, this was by far the best performance of the variety Markanta. This variety often has leaves in the curd but this was not a problem in 1983. Averaged over four trials, the most consistent varieties have been Armado April (early), Inca (early), Maya (late) and Arminda (late). Curd quality of some varieties was below average because of slug damage and a higher than normal incidence of diseases. Notes on causes of poor curd quality are found in Table 2.

Table 1. Yield and source of overwinter cauliflower varieties, 1983

Variety	Harvest range First	Peak	Last	Mean wt. of #1 heads(lb)	Gross yield (T/A)	Yield of #1 heads (T/A)	% #1 heads	Source[a]
RS 1831	1/7	1/7	1/20	1.0	5.4	0.6	13	1
Cervina	1/7	1/7	1/20	1.0	4.9	0.6	14	1
Tolteca	3/11	3/11	3/14	2.2	6.2	3.0	46	2
Marchpast	3/21	3/24	4/1	1.5	7.9	3.7	53	3
Armado April	3/21	3/28	4/4	1.4	6.7	4.5	69	3
Inca	3/24	3/28	4/4	1.6	6.3	4.9	64	2
Armado May	4/1	4/8	4/19	2.0	7.8	4.5	47	2
Markanta	4/1	4/15	4/15	1.9	7.9	6.5	71	3
Aprilex	4/1	4/15	4/19	1.9	8.3	4.3	47	3
Armado Clio	4/12	4/19	4/22	1.2	5.6	3.6	60	1
Mirado	4/12	4/22	4/22	1.1	4.6	2.1	40	1
Arminda	4/15	4/22	4/22	2.6	12.9	4.9	38	1
Maya	4/19	4/19	4/26	1.8	8.3	3.9	44	2

[a]1 = Royal Sluis, 2 = Bejo Zaden, 3 = Elsoms.

Table 2. Comments on overwinter cauliflower varieties, 1983

Variety	Comments
Aprilex	Low to medium vigor, upright leaves, good cover; but half of heads had yellow curd.
Armado April	Medium vigor, upright leaves, good cover. Twenty-five percent of heads had yellow curd.
Armado Clio	Medium vigor, fairly good cover. One-third of heads with yellow curd.
Armado May	Variable plant growth: some tall and upright, others low and spreading. Some yellow curd, some bracts in curd.
Arminda	Medium to high vigor, upright leaves. Majority of heads yellow and/or brown spotting (disease or slug damage).
Cervina	Small plants, one pound heads, matured during severe weather.
Inca	Low growing, lots of leaves, but only fair cover, tends to be open. Some bracts in curd.
Marchpast	Sprawling, medium to high vigor, fairly good cover. Yellow curd on nearly half of heads.
Markanta	Low vigor, sprawling, but good cover. Some yellow curd and some leaves in curd.
Maya	Medium-low vigor, good cover, one-third of heads with yellow curd. Some leaves in curd.
Mirado	Tall, upright, sparse stovepipe. Conical curds and majority of plants had yellow curd.
RS 1831	Small plants, one pound heads, matured during severe weather.
Tolteca	Medium vigor. Fuzzy, yellow curd. Green stems.

SUMMER (HEAT TOLERANT) CAULIFLOWER VARIETY TRIALS

Introduction

The purpose of these trials was to evaluate varieties of cauliflower for summer harvest. The major desired quality is heat tolerance: the ability to withstand high temperatures without ricing and to maintain the high curd quality typical of autumn-harvested cauliflower. A second desired quality is long wrapper leaves for self-blanching.

Fully satisfactory varieties have not been available to Oregon growers. It would be helpful for both fresh market and processors to have a high quality summer crop. The possibility exists for double cropping, particularly if combined with overwintered cauliflower.

The research involved comparing common autumn-harvested varieties with named varieties and lines from several seed companies which might be useful for a summer crop. These are the fourth and fifth in a series of such trials dating from 1978. Most varieties reported here were also included in earlier trials.

Methods

Twenty-four (1983) or 14 (1984) lines of cauliflower were seeded on April 18 (1983) or April 19 (1984) and placed in a glasshouse. Seedlings were transplanted to the field on May 19, 1983, and May 22, 1984. Land preparation included broadcast and incorporation of 1,000 pounds/acre of 10-20-10, 0.75 pounds/acre trifluralin, and 1.3 pounds/acre chlorpyrifos. Diazinon, as a 1 pound/acre drench, was applied in June for root maggot control, along with 5 pounds Solubor/acre. *Bacillus thuringiensis* insecticide was applied for worm and looper control in July. A total of 150 pounds N/acre was sidedressed as urea or calcium nitrate during June. Plant spacing was 3 feet x 1½ feet. Each variety was replicated three times in randomized block design. Heads were harvested at 2- to 4-day intervals. Heads were not tied so adequately self-blanching varieties could be determined.

Results and Discussion

Sources of seed, yields, and harvest spans are listed in Tables 1 and 2. Table 3 contains comments on curd quality.

Harvest period weather was extremely mild in 1983. During the harvest period of June 29 to July 29, the mean maximum temperature was 74°F, exceeding 80°F only six times. The mean minimum temperature during harvest was 53°F. Pre-harvest temperatures were stressful only in late May, between one and two weeks after transplanting. The mean maximum temperature during harvest in 1982 was 81°F. The mild weather would be expected to lead to a high percentage of high quality heads. This was the case for several varieties which had higher quality in 1983 than in earlier trials, including Dok Elgon, King, Matra, Snowball 42, and Suprimax.

Highest gross yields in 1983 were obtained with Matra, EO-222, Suprimax, and Snowball 42. However, highest yields of Grade #1 heads were obtained with Andes, Snowball 123, Suprimax, and Silverstar.

Harvest period weather was warmer in 1984 and was moderately stressful. Solar radiation and light intensity were higher than normal. During the harvest period of July 9 to August 3, the mean maximum temperature was 81°F, exceeding 90° on 5 days. Mean minimum temperature during harvest was 52°. There was no precipitation and virtually no cloud cover during harvest. Plant size and curd cover were generally poorer than usual. These conditions would be expected to lead to poor curd quality, particularly since the heads were not tied.

Highest gross yields were obtained with the autumn cauliflower Vernon, followed by Andes, Dok Elgon, and White Top. Highest yields of Grade #1 heads were obtained with Andes, Silverstar, and Vernon. Only Andes and Silverstar produced more than 50% #1 heads.

Quality of all varieties declined. Varieties such as White Summer, White Top, Snowball 123, and Dok Elgon, which have all performed well in some years, fared poorly in 1984. Vernon has not previously been evaluated and appears to offer some promise because of good head size and some heads with excellent curd quality.

Silverstar has performed consistently well every year. Andes was introduced to the trials in 1983 and had the highest percentage of #1 heads in both 1983 and 1984.

Table 1. Source, yield, and grade of summer cauliflower varieties, 1983

Variety	Source[a]	Harvest period First	Harvest period Peak	Harvest period Last	Mean head wt. (lbs)	Gross yield (T/A)	Yield of #1 heads (T/A)	% #1 heads[b]
Alpha Paloma	7	6/29	7/3	7/15	0.8	3.1	2.4	68
Andes	6	7/15	7/18	7/22	1.5	7.3	6.2	87
Christmas White	7	7/18	7/18	7/20	0.9	4.5	0.5	13
Dok Elgon	1	7/15	7/20	7/25	1.3	6.4	3.7	59
Dominant	1	7/15	7/20	7/29	1.3	6.4	2.6	41
Duromax	6	7/15	7/20	7/29	1.2	5.7	1.4	24
Early Abundance	7	6/28	6/28	7/11	0.4	2.1	0.6	18
Early Snow-ball A	8	6/29	7/11	7/15	0.9	4.4	1.7	43
Fortados	6	7/15	7/15	7/15	1.3	6.2	1.1	24
Imperial 10-6	2	7/15	7/18	7/18	1.6	7.2	2.9	41
King	1	6/29	7/11	7/15	0.9	3.7	2.9	75
Matra	6	7/5	7/25	7/29	2.3	10.5	4.5	45
Raket	7	7/1	7/11	7/15	1.0	4.9	2.5	56
Silverstar	5	7/15	7/18	7/25	1.6	7.4	5.6	80
Snowball 42	4	7/18	7/22	7/25	1.7	7.9	3.1	44
Snowball 76	4	7/18	7/18	7/25	1.5	7.4	1.8	22
Snowball 123	2	7/18	7/18	7/25	1.8	8.8	5.7	60
Snow Pack	8	7/11	7/18	7/29	1.6	7.7	3.6	52
Snow White	8	7/15	7/15	7/15	1.1	5.2	0.6	14
Suprimax	6	7/15	7/18	7/18	1.8	8.2	5.8	76
White Summer	3	7/15	7/22	7/25	1.4	6.8	5.3	77
White Top	7	7/15	7/18	7/25	1.6	7.4	4.3	59
EO-222	4	7/15	7/18	7/25	1.6	8.1	0.8	10
LSD(0.05)					0.3	1.2	1.1	

[a]1: Elsoms, 2: Jos. Harris, 3: Stokes, 4: Ferry Morse, 5: Rijk Zwaan, 6: Royal Sluis, 7: Territorial Seed Co., 8: Petoseed.

[b]Curd white, free of defects. No leaves, bracts in curd. Dense and tight. Percent by number.

Table 2. Source, yield, and grade of summer varieties, 1984

Variety	Source[a]	Harvest period First	Peak	Last	Mean head wt. (lb)	Gross yield (T/A)	Yield of #1 heads (T/A)	% #1 heads
Andes	6	7/19	7/23	7/30	1.6	7.6	5.2	63
Cervina	6	7/23	7/26	8/3	1.3	6.0	0.4	8
Dok Elgon	1	7/19	7/23	8/3	1.5	6.9	0.8	12
Dominant	1	7/9	7/19	7/30	1.1	5.3	0.8	13
Fortuna	5	7/16	7/23	8/3	1.1	5.0	2.0	30
Matra	6	7/13	7/19	7/26	1.4	6.5	0.8	17
Silverstar	5	7/16	7/19	7/30	1.3	6.2	3.9	61
Snowball 42	4	7/13	7/26	7/30	1.2	5.5	0.0	0
Snowball 123	2	7/9	7/19	7/26	1.1	5.4	0.0	0
Snow Pack	8	7/13	7/16	7/23	0.9	4.2	0.5	12
Suprimax	6	7/9	7/13	7/19	0.8	3.7	0.0	0
Vernon	6	7/16	7/30	8/3	1.9	9.3	3.7	42
White Summer	3	7/16	7/19	7/26	0.8	4.0	0.9	13
White Top	7	7/16	7/26	8/3	1.4	6.7	0.5	4
LSD(0.05)					0.3	1.3	1.4	

[a]1: Elsoms, 2: Jos. Harris, 3: Stokes, 4: Ferry Morse, 5: Rijk Zwaan, 6: Royal Sluis, 7: Territorial, 8: Petoseed.

Table 3. Comments on summer cauliflower varieties, 1983 and 1984

Alpha Paloma: Short to medium size plant, spreading. Large leaves, fair cover. Early maturity. Small heads, good quality.

Andes: Small plants with upright leaves, good cover. Good yield, very high quality. Small (20%) percentage of discolored curd. Few (17%) ricey heads.

Christmas White: Large but spreading plant. Large leaves but poor to fair cover. Heads small, yellow curd.

Cervina: Grown out of its proper season. High proportion (62%) of ricey heads.

Dok Elgon: Medium size, upright plant with fair to good cover. Fair yield and quality. Some yellowing of curd in 1983. In 1984, curd was fuzzy, contained bracts, leaves.

Dominant: Medium size, spreading plant. Fair cover. Only fair quality with 39% ricey and 35% yellow curd.

Duromax: Lacks vigor early in season. Upright leaves, fair cover. Low curd quality. Many ricey or yellow heads.

Early Abundance: Small plant, spreading, poor cover. Very early, low yield and quality. Heads often ricey.

Early Snowball A: Medium size plant, spreading, poor cover. Early. Poor yield, fair quality. Curd tends to be ricey, yellow.

Fortados: Medium size plant, somewhat upright leaves with fair cover. Very concentrated maturity. Low quality from yellow curd.

Fortuna: More than half the heads had yellow curd.

Imperial 10-6: Medium size plant, somewhat upright leaves. Good yield but quality low this year. Ricey and discolored curd.

King: Medium vigor, spreading, variable. Poor to fair cover. Very pale leaves. Low yield but high curd quality. Small heads.

Matra: Low to medium vigor, upright leaves. Good cover, pale leaf color. Excellent head size and gross yield but only fair quality. High percentage of yellow (42%) and fuzzy (21%) curd.

Raket: Fairly vigorous, spreading habit. Fair cover. Early maturity. One pound heads of fair quality.

Silverstar: Low to medium vigor early in season. Upright with good cover. Good yield, excellent quality. Attractive heads.

Snowball 42: Medium vigor, upright, good cover. Late maturity. Good yield, fair quality. Curd tended to be yellow, ricey.

Snowball 76: Low to medium vigor, spreading to upright. Good cover. Late maturity. Good yield, poor quality. Ricey, yellow curd.

Snowball 123: Medium vigor, spreading to upright. Good cover. Good yield and quality in 1983, but some heads with yellow or purple curd, ricey. Most heads had yellow curd in 1984.

Snow Pack: Medium vigor, spreading, fair cover. Good yield, fair quality. Yellow curd (71% in 1984).

Snow White: Medium vigor, spreading, good cover. Very concentrated maturity. Mostly yellow curds.

Suprimax: good vigor, upright, good cover. Pale leaves. Good yield and quality in 1983 but high percentages of yellow (48%) and ricey (43%) curd in 1984.

Vernon: High yield, good head size, but 46% of heads off-color.

White Summer: Medium vigor, upright. Good cover. Very dark green leaves. Late maturity. Fair to good yield with very good quality.

White Top: Medium to very vigorous, upright, good cover. Good yield, better than average quality in cooler summers. Approximately one-third of heads with yellow curds.

EO-222: Variable vigor, spreading. Fair cover. Good yield but poor quality. Heads ricey, yellow.

EARLY CABBAGE VARIETY TRIAL

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

Introduction

The purpose of this trial was to evaluate several lines of cabbage for late spring or early summer harvest. This requires planting out in early spring and many varieties will bolt under these conditions. Since direct-seeding is often impractical in early spring and emergence would be slow and erratic, the lines were seeded in an unheated screenhouse and transplanted about six weeks later.

Methods

Sixteen lines or varieties were obtained from five seed companies. Most were seeded in 2-inch pots on Feb. 8, 1984, and placed in an unheated greenhouse. Four lines which were received in late February were not seeded until Feb. 27, 1984. The plot area was plowed and disked the previous October. Just prior to planting, glyphosate was applied to kill off standing weeds and the cabbage was transplanted without further tillage operations.

Lines seeded on Feb. 8 were transplanted on March 28, and lines seeded on Feb. 27 were transplanted on April 10 on 3 foot x 1½ foot spacing with four replications/line and five plants/plot. Trifluralin, 0.75 pounds/acre, and 1,000 pounds/acre of 10-20-10 were surface applied on March 29 but were not incorporated. An additional 50 pounds N/acre as urea was sidedressed on April 26 and an additional 100 pounds N/acre was applied on June 8. The plots were cultivated once and one application of B. thuringiensis was made on June 15. The crop was irrigated once in early July.

Harvest began on June 22 and continued twice weekly until July 16. Since the seeding and transplant dates differed among lines, the harvest data are reported as days from transplanting (Table 1).

Results and Discussion

Several lines (Cabaret, Excel, Market Topper, Resistant Danish) bolted excessively and most heads were slightly elongated (ovoid) to pointed in shape. Largest heads were obtained with Bravo, highest yields with Bravo and Conquest. Earliest lines were Sunup, Earliana, AVX 4006, and the four Asgrow lines transplanted on April 10. Comparisons of earliness between transplant dates are not valid, but it appears that the four Asgrow lines would have produced marketable heads at least as early as Sunup or Earliana. Head Start appeared to have the most promising combination of earliness, head size, and head shape.

Table 1. Harvest spans and yields of cabbage lines, 1984

Variety	Source[a]	Harvest span (days from transplant) First	Peak	Last	Usable Heads(%)	Mean head wt.(lb)	Yield (tons/A)
Transplanted 3/18							
AVX 4006	1	86	86	99	90	1.6	6.9
Bravo	2	96	99	107	90	3.0	13.0
Cabaret	2	96	96	103	50	2.3	5.5
Earliana	3	86	86	96	90	1.9	8.5
Excel	2	103	107	111	60	2.1	6.0
Market Prize	2	96	103	111	90	2.4	10.4
Market Topper	2	91	91	96	50	2.1	5.2
Ocala	1	99	99	107	80	2.2	8.4
Res. Danish	2	107	107	110	50	2.2	5.2
Sunup	2	86	86	96	100	2.2	10.6
55-629	4	86	91	107	100	1.8	8.8
55-707	4	91	91	96	90	2.4	10.7
Transplanted 4/10							
Conquest	5	78	78	86	100	2.3	11.1
Express	5	78	78	83	90	2.1	9.1
Head Start	5	73	73	83	100	2.1	10.4
XPH 1104	5	78	78	83	100	2.1	10.3
			LSD(0.05)		20	0.5	3.1

[a] 1. Sun Seeds, 2. Harris Seed Co., 3. Burpee Seeds, 4. Takii Seed Co., 5. Asgrow

Table 2. Comments

Variety	Comments
AVX 4006	Pointed head, light green to blue color, with some purpling of veins. Loose heads.
Bravo	Round to slightly elongated head, green to light blue. Large firm heads.
Cabaret	Round to slight elongated, blue color. 50% bolted.
Earliana	Round to slightly pointed, medium green with some purpling. Small heads, early.
Excel	Elongated shape, blue color, 40% bolted. Late.
Market Prize	Round to slightly pointed, green to blue color with some purpling.
Market Topper	Round to pointed, medium green, firm, 40% bolted.
Ocala	Round to slightly elongated, blue.
Res. Danish	Elongated, blue with some purpling, 50% bolted, late.
Sunup	Very pointed, medium green with purple veins. Early.
55-629	Slightly elongated, green to blue, some purpling. Small heads.
55-707	Round to slightly elongated, medium green, some purpling.
Conquest	Round, light blue-green color, some purpling.
Express	Round, green with some purpling, firm.
Head Start	Round to slightly pointed, medium green with some purpling. Attractive, early.
XPH 1104	Very pointed, dark green

LEEK VARIETY TRIAL

Introduction

Extremely high quality leeks are being produced on a small scale in the Willamette Valley. The crop is usually seeded in early spring, matures in autumn, and can be held through the winter for harvests until the following spring. Very few varieties are grown commercially and the highest quality plants have been transplanted and grown in trench culture. The most lucrative market is the restaurant trade, which demands long, thick, blanched stems. Healthy foliage can also be used decoratively in presentation of restaurant dishes. This trial had two purposes: to evaluate a number of varieties in a late spring planting for autumn and overwinter harvest, and to evaluate several winter hardy varieties in a late planting for overwinter harvest. Growers would benefit if planting of the overwinter crop could be delayed, allowing the possibility of double cropping with a short season crop and reduced weed control problems. Only the early harvests from the spring-sown crop are reported here. The late planting (July 31 transplant) had not produced marketable leeks at this writing (1/5/85).

Methods

Nine varieties were seeded in flats on a greenhouse bench on March 23, 1984. The plot area received a broadcast application of 1,000 pounds/acre of 10-20-10, followed by formation of raised beds with 18 inch tops, 40 inches furrow to furrow, and about 7-inch height. Seedlings were transplanted on May 31 into holes dibbled approximately 4 inches deep on 6 inch spacing, with two rows/bed. A single plot consisted of 20 feet of bed (80 plants). Treatment (varieties) were replicated 3 times in randomized block design. Propachlor herbicide was applied at 4 pounds/acre after planting and was reapplied on June 29, July 31, and October 8. The plots were also hand-hoed twice. An additional 25 pounds N/acre as nitroform was applied on July 6 and again on August 31. Twenty plants were harvested from each plot on August 24 and again on October 8. Plants were topped approximately 2 inches above the base of leaves.

Results and Discussion

At the first harvest, all varieties were somewhat immature and did not differ significantly in weight/plant, blanched stem length, or stem width (Table 1). Often there appeared to be more variation between blocks than between cultivars. Stem length did vary significantly with cultivar, with Conqueror and Acadia the shortest and Tivi the longest. All stems were slightly bulbed at the root end; color was light blue-green for all cultivars.

At the second harvest, all varieties had produced mature, marketable plants. Mean leek weight did not vary greatly except that Conqueror was lighter and Argenta, heavier, than most other varieties (Table 2). Stem length varied considerably among varieties with

Tivi, Bluvetia, and Kilima producing longer stems, Conqueror and Electra shorter stems. Blanch length did not vary significantly and appeared to be mostly controlled by transplanting depth. Stem width also varied little among cultivars, with great variability within a variety.

Differences in growth habit and foliage color were very evident by the second harvest. Acadia and Conqueror had the darkest blue foliage; Argenta, Bluvetia, Kilima, and Tivi had pale green foliage, with the other three varieties intermediate in color. Tivi plants were tall and upright; Electra and Kilima plants were taller than average but with less upright foliage. Alaska and Conqueror had the shortest leaves. All cultivars were judged of acceptable quality, with the blue-foliage plants more attractive.

Table 1. Leek size on August 24, 1984, 85 days after transplanting

Variety	Stem wt.	Stem length[a]	Blanched length[b]	Stem width[c]
	oz.	inches		
Acadia	4.3	3.3	2.2	1.2
Alaska	3.6	3.5	2.3	1.0
Alberta	4.4	4.0	2.8	1.2
Argenta	4.7	3.8	2.8	1.2
Bluvetia	4.6	4.0	2.2	1.2
Conqueror	4.0	3.2	2.0	1.0
Electra	4.9	3.5	2.0	1.3
Kilima	4.9	3.7	2.1	1.3
Tivi	5.1	4.3	2.5	1.3
LSD(0.05)	NS[d]	0.7	NS	NS

[a]Measured from base of bulb to point of leaf branching.
[b]Measured from base of bulb to mean extent of white area.
[c]Measured just above the bulb.
[d]No significant differences.

Table 2. Leek size on October 8, 1984, 130 days after transplanting

Cultivar	Stem wt.	Stem length	Blanched length	Stem width
	oz.	inches		
Acadia	7.9	4.7	2.5	1.5
Alaska	7.4	3.9	2.4	1.4
Alberta	8.4	3.9	2.6	1.4
Argenta	9.9	4.5	2.9	1.6
Bluvetia	8.2	5.2	2.1	1.4
Conqueror	6.4	3.3	2.5	1.4
Electra	7.6	3.5	2.5	1.5
Kilima	9.1	5.1	2.1	1.6
Tivi	8.4	5.2	2.6	1.4
LSD(0.05)	2.1	0.6	NS	NS

WEED CONTROL IN OVERWINTERED SHALLOTS

Introduction

Shallots can be planted in October for harvest the following summer. A major problem in overwinter shallot culture is weed control. Winter rains make tractor cultivation or hand-hoeing nearly impossible and effective herbicides have not been available. These trials were designed to test the weed control effectiveness of four herbicides applied immediately after planting and their effect on crop fields.

Methods

In both 1982 and 1983, "French red" shallots were planted on 0.5 foot x 2.0 foot spacing. Plots were 4 rows wide x 10 feet long with 4-foot borders. Six treatments were applied in completely random design with three replications of each treatment. The plot area received a broadcast application of 500 pounds/acre of 10-20-10 which was incorporated by rotary tilling. Shallots bulbs were set on October 14, 1982, and October 10, 1983. Herbicides were applied immediately after planting followed by an irrigation of 0.6 inches. All herbicides were applied with a hand-held sprayer in 50 gallons/acre of water. Treatments were: 1. Non-weeded check, 2. Hand-hoed (1983 only), 3. propachlor at 4.0 pounds/acre, 4. linuron, 1.0 pound/acre, 5. napropamide at 4.0 pounds/acre in 1982 and 3.0 pounds/acre in 1983, 6. clorpropham at 4.0 pounds/acre. Herbicide-treated plots were not cultivated and no further herbicide applications were made. Plots were rated for weed control in February and May 1983, and in May 1984. Shallots were harvested July 21, 1983, and July 17, 1984.

Results and Discussion

1982-83.

Propachlor controlled all weeds for approximately five weeks after planting. By February, control was ineffective, with chickweed, several grasses, many mustards, dog fennel, and groundsel present on propachlor-treated plots. No injury to the shallots was observed. Linuron and chlorpropham provided much more effective and lasting weed control, although linuron did not control grasses. No crop injury was observed with either material. Napropamide provided nearly complete weed control. The only weed present at harvest was miner's lettuce, and at less than 0.1 plants/ft^2. However, crop injury was severe. Severe shallot root dieback was evident by the May rating period.

Gross yields were highest with linuron and chlorpropham, lowest with napromide and the non-weeded check (Table 1). The number of shallots harvested/plot was significantly lower on napropamide-treated and non-weeded plots than for the other treatments. Moreover, mean bulb weight was also lowest on non-weeded and napropamide-treated plots.

Table 1. Effect of herbicides on shallot yield, 1983

Treatment	Yield (T/A)	# shallots/plot	Mean bulb wt. (g)
check	1.4	266	8.8
hand-hoed	5.6	450	19.6
clorpropham	7.3	496	24.8
linuron	8.5	495	28.8
napropamide	3.1	281	18.2
propachlor	5.0	399	21.1
LSD(0.05)	3.5	101	8.1

1983-84.

All herbicides provided effective weed control for about five weeks after planting, and all herbicides except propachlor continued to provide effective control until early December. A severe freeze in late December (5°F) killed most emerged weeds. All herbicides continued to provide some control until early May (Table 2), when napropamide-treated plots had the smallest weed mass present. By harvest in July, all plots except the hand-hoed had extensive weed infestation.

No treatment completely controlled false dandelion and groundsel, but napropamide effectively controlled all grasses, chickweed, miner's lettuce, and shepherdspurse (Table 1). Weed control by linuron and chlorpropham was not as effective as in 1983, when these two herbicides were clearly superior to propachlor. The apparently improved performance of propachlor relative to linuron and chlorpropham in 1984 may have been from the winter-kill of emerged weeds on propachlor-treated plots.

All herbicides increased yield and mean bulb weight when compared to non-weeded check plots, but yields for all herbicide treatments were lower than those on hand-hoed plots (Table 3). Unlike 1983, there was no severe crop injury with napropamide, which was applied at a lower rate in 1984 than in 1983.

The importance of effective weed control in shallots is seen in the six-fold yield increase on hand-hoed compared to non-weeded plots. Effective early weed control can be obtained with several herbicides. However, complete reliance on chemical weed control will only be feasible if an effective burn-down herbicide can be applied in late winter without undue crop injury, followed by reapplication of a germination inhibitor such as propachlor.

The fact that these herbicides were included in this trial should not be taken to mean that the materials have been registered for shallots or other members of the onion family.

Table 2. Effect of herbicides on fresh weight of weeds present on May 9, 1984

Treatment	Weed fresh wt.(lb/ft^2)	Weed species present in descending order by number
check	0.74	groundsel, fescue, orchard grass, annual bluegrass, false dandelion, chickweed, miner's lettuce, shepherdspurse.
chlorpropham	0.09	groundsel, false dandelion, annual bluegrass, chickweed, shepherdspurse.
linuron	0.05	groundsel, chickweed, false dandelion, annual bluegrass, shepherdspurse.
napropamide	0.01	false dandelion, groundsel.
propachlor	0.10	groundsel, false dandelion, chickweed, fescue, annual bluegrass.
LSD(0.05)	0.06	

Table 3. Effect of herbicides on shallot yield, 1984

Treatment	Total yield (T/A)	# bulbs harvested/plot	Mean bulb wt. (g)
check	0.6	139	7.6
hand-hoed	3.8	244	25.5
chlorpropham	1.1	136	14.0
linuron	1.6	149	18.6
napropamide	1.1	132	14.2
propachlor	1.6	187	14.4
LSD(0.05)	0.8	67	5.1

RESPONSE OF MUSKMELONS TO FLOATING ROW COVERS

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Introduction

Production of muskmelons in the Willamette Valley is limited by low air and soil temperatures, particularly early in the growing season. Daily minimum temperatures are commonly between 50 and 55°F even during the warmest months.

Several methods have been used to stimulate early melon production or to increase yields, including transplanting, clear or black plastic ground mulches, and hoop-supported plastic tunnels. The major effect of the various plastic materials is to increase soil and air temperatures, improving vine growth and fruit set. A recent development is the production of "floating row covers", materials which can be laid directly on the crop or seedbed and which do not need structural support. These materials are usually perforated or slit to allow some air movement and to avoid excessive temperatures under the material. The following trials were designed to evaluate the effects of floating row covers on muskmelon earliness and yield.

Methods

1983.

Three 200-foot long beds were prepared by rotary tillage in early April 1983, after a broadcast application of 800 pounds/acre of 10-20-10. Drip irrigation tubing was run the length of the beds and the beds were then covered with 4 feet x 1½ mil black plastic ground mulch. Transplants seeded in a heated glasshouse on March 17 or seeds of 'Gold Star' muskmelon were planted on April 14 through holes cut in the ground mulch. Floating row covers were applied immediately after planting.

Plot size was 20 feet long with 8 feet between rows and 6 plants/plot on 3-foot spacing in the row. Nine treatments were replicated three times in randomized block design. Treatments included 1) black ground mulch (check); 2) Vispore, a finely perforated clear polyethylene (Ethyl Visqueen Corp.), removed on May 13, 1983; 3) Vispore removed on June 1; 4) Reemay, a spunbonded polyester (DuPont Co.), removed on May 13; 5) Reemay removed on June 1; 6) Xirofilm, a slit clear polyethylene, removed on May 13; and 7) Xirofilm removed on June 1. Each of the above treatments was on transplanted melons. In addition, Xirofilm was applied over direct-seeded melons and removed on 8) May 27 or 9) June 9, 1983.

Irrigation was through the drip system as needed. An additional 20 pounds N/acre was also applied through the drip system. Thermocouples were placed at one-inch soil depth and between the ground mulch and floating covers for all treatments. Temperatures were recorded every half hour from April 14 until June 1. Melons were harvested at least twice weekly from mid-July until all fruit had matured in mid-October 1983.

1984.

Methods were as above except that transplants were started on April 2 and May 3 and planted on April 25 and May 29, 1984, respectively. These treatments included black ground mulch on transplants (1); black ground mulch on direct-seeded (2); Vispore removed on June 22 for transplants(3); June 27 for direct-seeded (4); Vispore removed on July 2 for transplants (5); July 9 for direct-seeded (6); Reemay removed on the above early removal dates (7, 8); Reemay removed on the above late removal dates (9, 10). Temperatures were recorded every half hour until July 1.

Results and Discussion

1983.

A frost (29°F one inch above the ground mulch) occurred the night after planting. Minimum air temperature recorded at the same time under each of the floating row covers was 32°F, indicating significant frost protection. Most plants on the black plastic ground mulch were killed as were several under the row covers. All frost-killed plants were reset the following day. Some further losses occurred, with significantly fewer check plot plants surviving to produce fruit than survived under row covers (Table 1).

Daily mean soil temperatures were increased by 5 to 9°F by row covers compared to bare ground; the ground mulch increased the mean daily soil temperature by only 2° (Table 2). The row covers increased minimum air temperatures by 2 to 3° but increased mean maximum air temperature by as much as 31°. Heat unit accumulation [summation of(daily mean air temp minus 50°)] nearly tripled under the row covers compared to over bare ground. Air temperatures were often in excess of 115°F under the row covers, particularly the Vispore and Xirofilm. These excessive temperatures may have offset some of the positive effects of increased temperatures on plant growth. Although vine growth was greatly increased under the row covers, leaf size was also noticeably reduced. Since the growing plants were unable to force open the slits in the Xirofilm, this material was not used in 1984.

Early row cover removal occurred at close to first bloom for each treatment, with the late removal treatments designed to sacrifice fruit set on early blooming flowers in exchange for continued plant protection and increased vine growth. Since late May was unusually warm and sunny, all treatments might have benefited from earlier plastic removal in 1983. However, time of plastic removal had no significant effect on any yield parameter (Table 1). Late removal of row covers did tend to increase the percentage of fruit harvested by the end of August (Table 3), but this effect was not statistically significant.

Within the transplanted treatments, type of row cover had no significant effect on yield/plant, number of fruit/plant, mean fruit weight, or percentage of small and large fruit (Table 1). Use of row covers with transplants tended to increase the number of fruit harvested/plant (Table 1) when compared to the check treatment, but this effect was statistically significant only for the late removal of Vispore. All row covers reduced mean fruit weight and percentage of large fruit (more than 2 pounds), probably as a result of greater fruit set on covered plants.

Direct-seeded plants covered with Xirofilm tended to have greater fruit set and reduced fruit weight when compared with any of the transplanted treatments.

Effects of row covers on number of days required for ripening the first fruit were striking. For transplanted treatments, the first fruit harvest occurred from 5 to 28 days earlier with row covers than with ground mulch only. Type of cover and time of removal did not significantly affect first fruit harvest. Row covers did not substantially increase early production, however, as there were only a few very early fruit. Only in mid-September was the percentage of fruit harvested from row-covered treatments significantly higher than for the uncovered treatment (Table 3). Row covers usually brought peak production 7 to 10 days early (Table 3). All fruit were harvested from most row-covered plots by September 23 (data not shown); substantial numbers of fruit from check plots were not harvested until mid-October. October in the Willamette Valley brings rain and cool weather, generally reducing fruit quality. Thus, the earlier final harvests with row covers may be a distinct advantage.

Direct-seeded plants under Xirofilm had very concentrated production. First harvest was comparable to that of transplants on black plastic ground mulch, while peak and final harvests were considerably advanced (Table 3). Although fruit size was reduced as a result of increased set on the direct-seeded plants (Table 1), use of the Xirofilm produced yield and earliness of direct-seeded plants comparable to standard culture with transplants and black plastic mulch. The cost of raising transplants versus cost of the row covers must be considered before conclusions can be drawn regarding the profitability of direct seeding with row covers versus use of transplants.

Table 1. Floating row cover effects on survival and yield of muskmelon, 1983

Treatment	Plants surviving	Total yield	Yield/ plant	Fruit/ plant	Mean fruit weight	Fruit less than 1 lb	Fruit more than 2 lb
	%	T/A	lb	#	lb	%	%
Transplanted							
Ground mulch	56	8.6	18.9	8.5	2.4	1	72
Reemay, early removal	83	11.6	16.9	10.5	1.6	15	31
Reemay, late removal	67	9.8	17.4	9.5	1.8	5	36
Vispore, early removal	100	15.4	18.9	11.0	1.7	8	34
Vispore, late removal	83	12.9	20.0	12.1	1.7	14	32
Xirofilm, early removal	94	14.2	18.2	11.6	1.7	14	29
Xirofilm, late removal	100	13.4	16.7	10.5	1.7	18	33
Direct-seeded							
Xirofilm, early removal	100	13.5	16.5	12.9	1.3	32	10
Xirofilm, late removal	100	15.2	18.7	14.8	1.3	28	4
LSD (0.05)	33	5.0	NS[a]	3.4	0.6	20	34

[a]no significant differences.

Table 2. Effect of floating row covers on air and soil temperatures

Treatment	Mean air temperature (°F)[a] Max.	Min.	Daily mean	Heat units	Mean soil temperature (°F)[b] Max.	Min.	Daily mean
1983							
Bare ground	76	44	60	461	78	50	64
Black plastic	82	44	63	651	75	56	66
Reemay	102	47	75	1204	80	58	69
Vispore	104	47	76	1294	78	59	69
Xirofilm	107	47	77	1313	89	57	73
1984							
Bare ground	78	49	64	461	76	57	66
Black plastic	86	49	67	589	79	60	70
Reemay	102	52	77	913	80	64	72
Vispore	112	51	81	1062	85	63	74

[a]Measured 1 inch above ground or black plastic, 1 inch above black plastic but beneath row cover.
[b]Measured at 1-inch depth.

Table 3. Effect of floating row covers on earliness of muskmelon, 1983

Treatment	% fruit harvested by: 8/15	8/22	8/31	9/15	9/30	Days from planting or seeding to harvest: First	Peak	Last
Transplanted								
Ground mulch	1	4	11	50	88	124	157	184
Reemay, early	3	6	20	83	100	96	150	161
Reemay, late	8	10	23	86	100	110	150	158
Vispore, early	1	1	13	73	99	110	150	180
Vispore, late	9	17	27	72	100	107	150	161
Xirofilm, early	3	6	19	78	100	96	150	169
Xirofilm, late	1	4	33	79	96	119	147	176
Direct-seeded								
Xirofilm, early	0	1	20	96	100	119	147	158
Xirofilm, late	0	0	26	96	100	128	145	155
LSD (0.05)	NS[a]	NS	NS	25	NS			

[a]No significant differences.

1984.

As in 1983, a severe frost (27°F) occurred shortly after planting. Also as in 1983, the minimum air temperature recorded under the floating row covers was 2 to 4° higher than over bare ground or black plastic mulch during the frost period, but not sufficiently higher to prevent frost-kill of all transplants. All plots were replanted on May 29, about the normal time for planting melons in the Willamette Valley. Thus, the row covers were not used to extend the length of the growing season in 1984 as they were in 1983.

Mean temperatures and heat unit accumulations for May 29 - July 1 are listed in Table 2. The black plastic ground mulch increased mean daily soil temperature at 1-inch depth by 4°; the combination of ground mulch and row covers increased mean soil temperature by 6° (Reemay) or 8° (Vispore). Vispore raised soil maximum temperatures more than did Reemay but their effects on soil minimum temperatures were essentially equal. The ground mulch increased the mean daily air temperature at 1 inch above ground by 3°, mainly through an increase in the maximum temperature. This was probably caused by heat reflected from the plastic surface. Row covers raised the mean low temperature by 2 to 3° and maximum temperature by an average of 24° (Reemay) or 34° (Vispore). Maximum temperatures often exceeded 115° under row covers, particularly the Vispore. Heat unit summation more than doubled under the row covers. Greater vine growth under row covers (Table 4) and no apparent reduction in leaf size or leaf injury indicated no heat injury from the covers in 1984. Both mean temperatures and solar radiation were lower than normal between May 29 and July 1, which may have prevented injury.

Direct-seeded plants generally took almost 20 days to emerge. On June 25, transplants averaged above 15 leaves/plant, direct-seeded about 2.5

leaves/plant. Row-covered plants were also more advanced in development than were non-covered plants (Table 4). Type of row cover had no effect on transplant development but development of direct-seeded plants was slightly more advanced under Vispore. On July 2, flowers were present only on transplants. More flowers were present on row-covered plants and more flowers were present on plants with late row cover removal. Early fruit set showed a similar pattern: more fruit with late removal and no difference between Reemay and Vispore.

Ripening of the fruit was advanced 10 to 20 days by transplanting and 12 to 21 days by row covers (Table 4). Direct-seeded, non-covered plants did not produce ripe fruit until late September compared to August 15 for non-covered transplants. Generally, type of row cover made no difference for transplants, but first harvest was earlier with Vispore for direct-seeded plants. Early fruit ripening was usually promoted by late row cover removal.

Total yield/plot was also increased by transplanting and row covers (Table 5). On August 22, all row-covered transplants had produced significant yields, compared to no yield from non-covered transplants and direct-seeded plants. Yield did not vary with type of row cover but tended to be increased by late removal. By August 31, all transplants and two of the direct-seeded treatments had produced significant yields. Again, late removal produced higher yields. At final harvest on October 5, most of the direct-seeded plants still did not reach the yield level of the transplants. This was caused, in part, by less than desired stands on the Reemay early and late removal and non-covered, direct-seeded treatments. However, even when yields were expressed on a per plant basis (Table 6), transplants outyielded direct-seeded plants. On a per plant basis, yields with Reemay and Vispore were not significantly different, whereas on a per acre basis, Vispore tended to outyield Reemay for direct-seeded plants.

In contrast to 1983, fruit size in 1984 did not vary significantly with treatment (Table 6) and most yield differences can be explained on the basis of numbers of harvested fruit.

Since the first planting was lost to freeze damage, first ripe fruit production occurred more than two weeks later in 1984 than in 1983. Total yields were also lower. However, even with the late May planting, row covers significantly advanced maturity and yield. Some growers in the Willamette Valley attempt to direct-seed melons in May without any row cover protection or ground mulch. In 1984, they would not have been able to produce ripe fruit of a main-season variety before late September, missing more than a month of the potential marketing season.

Muskmelons are a very limited acreage crop in this area and the price does not vary greatly during the season. A grower's roadside stand sold his own melons for 29¢/pound throughout the season, even though the supermarket price for California melons fell below this figure.

If this price situation held true every year, the cost of row covers must be recovered in higher yields, or locally produced melons must have enough drawing power to increase overall business at the stand.

Assuming a price of 29¢/pound and an additional cost of $600/acre for using row covers, it is evident that for the entire season, use of row covers yielded increased return for all treatments except the Vispore late removal transplants (Table 5). Even more striking, on August 22, after only one week of harvest, the additional cost of row covers had already been recovered on all transplanted treatments.

In summary, row covers are a useful and profitable means to increase earliness and, to a certain extent, yield of muskmelons in the Willamette Valley. Both Vispore and Reemay are excellent covers, with higher maximum temperatures under the Vispore. If temperatures are not excessive (more than 120°F), row covers should not be removed until several days after bloom.

Table 4. Effects of row covers on plant development and days to harvest, 1984

Treatment	Leaves/plant on 6/25	Flowers/plant on 7/2	Fruit/plant on 7/19	Days to harvest First	Days to harvest Peak
Transplanted					
Ground mulch	11.5	4.6	0.0	92	103
Reemay, early	15.1	9.5	0.6	78	100
Reemay, late	18.2	13.2	1.8	78	90
Vispore, early	15.3	6.8	0.8	78	107
Vispore, early	15.4	11.1	1.8	80	85
Direct-seeded					
Ground mulch	0.2	0.0	0.0	111	129
Reemay, early	2.3	0.0	0.0	96	112
Reemay, late	1.0	0.2	0.0	92	114
Vispore, early	3.8	0.0	0.0	94	113
Vispore, late	4.0	0.6	0.0	90	95

Table 5. Total yield and value of muskmelons, 1984

Treatment	Total weight harvested by: 8/22	8/31	9/24	10/5	Gross return on: 8/22	10/5	Net increase over check 8/22	10/5
Transplanted	---------------	T/A	---------		-----------------	$/A	-----------------	
Ground mulch	0.0	3.3	10.3	12.6	0	7335	--	--
Reemay, early	1.3	3.2	10.5	14.0	$ 761	$8104	$ 161	$ 169
Reemay, late	3.9	6.4	13.3	14.2	2242	8218	1642	283
Vispore, early	2.3	3.7	14.3	16.4	1317	9487	717	1552
Vispore, late	3.0	6.7	10.4	12.9	1712	7499	1112	(436)
Direct-seeded								
Ground mulch	0.0	0.0	0.4	3.6	0	2077	--	--
Reemay, early	0.0	0.0	4.6	8.2	0	4749	--	2072
Reemay, late	0.0	0.7	2.9	4.7	0	2751	--	74
Vispore, early	0.0	0.4	6.2	10.0	0	5827	--	3150
Vispore, late	0.0	3.5	10.3	11.2	0	6503	--	3826
LSD (0.05)	2.3	3.2	7.2	8.4				
Main Effects								
Transplanted	2.1	4.6	11.7	13.7				
Direct-seeded	0.0	0.9	4.9	7.5				
	**[a]	**	**	*				
Row covers	1.0	3.1	9.0	11.2				
Ground mulch	0.0	1.6	5.4	8.1				
	*	*	*	NS				
Early removal	0.9	1.8	8.9	12.1				
Late removal	1.7	4.3	9.1	10.3				
	NS	*	NS	NS				
Reemay	1.3	2.6	7.8	10.3				
Vispore	1.3	3.5	10.2	12.6				
	NS	NS	NS	NS				

[a]**, *, NS: Means significantly different at 1% and 5% levels, and not significantly different, respectively.

Table 6. Yield per plant and mean muskmelon fruit weight, 1984

Treatment	Yield/plant harvested by: 8/22	8/31	9/24	10/5	Mean fruit weight
Transplanted	------------------	------------------	lb	------------------	------------------
Ground mulch	0.0	3.2	10.0	12.2	3.5
Reemay, early	1.3	3.1	10.1	13.5	3.6
Reemay, late	3.7	6.2	12.8	13.6	3.1
Vispore, early	2.2	3.6	13.8	15.8	3.2
Vispore, late	2.8	6.4	9.6	10.7	2.8
Direct-seeded					
Ground mulch	0.0	0.0	0.6	6.8	2.9
Reemay, early	0.0	0.0	5.5	9.9	2.7
Reemay, late	0.0	0.7	2.8	7.2	3.4
Vispore, early	0.0	0.4	5.9	9.7	3.3
Vispore, late	0.0	3.3	9.9	10.8	3.0
LSD(0.05)	2.2	3.0	6.9	8.0	NS
Main Effects:					
Transplanted	2.0	4.5	11.3	13.2	3.2
Direct-seeded	0.0	0.9	4.9	8.9	3.1
	**[a]	**	**	*	NS
Row covers	1.0	3.0	8.8	11.4	3.1
Ground mulch	0.0	1.6	5.3	9.5	3.2
	*	*	*	NS	NS
Early removal	0.9	1.8	8.8	12.2	3.2
Late removal	1.6	4.1	8.8	10.6	3.1
	NS	*	NS	NS	NS
Reemay	1.3	2.4	7.8	11.1	3.2
Vispore	1.3	3.4	9.8	11.8	3.1
	NS	NS	NS	NS	NS

[a]*, *, NS: Means significantly different at 1% and 5% levels, and not significantly different, respectively.

SIZE GRADING OF TRANSPLANTS ON LETTUCE HEAD SIZE VARIABILITY

Introduction

Transplanting lettuce seedlings can insure a nearly perfect stand. In addition, transplanting offers the possibility of bringing the crop to market earlier than a direct-seeded crop, taking advantage of higher early season market prices and allowing marketing over a longer time period. Perhaps more importantly, transplanting may allow for multiple cropping. In the Willamette Valley, for example, transplanting would allow three rather than two crops of lettuce. Transplanting may also take place when soil conditions would not allow direct seeding. However, if weather conditions prevent transplanting on the scheduled date, planting can be delayed until conditions are more favorable.

Transplanting also offers the opportunity to start all plants in the field at the same stage of development, reducing variability in maturity. Greater uniformity at harvest reduces costs by reducing the number of harvests necessary to gather all marketable heads.

Optimal size and shape of transplant blocks for Oregon conditions are not known. The effects of variability in transplant size on variability in head size at harvest or time to maturity have not been widely studied. With the advent of automatic transplanters, it would be helpful to understand how variability at the time of transplanting will affect variability at harvest. This trial examined the effects of size of transplant block and grading of transplants by shoot size on yield and head size variability at harvest.

Methods

'Ithaca' lettuce was seeded approximately 2 millimeters deep in peat-vermiculite (1:1) mix in either 2 x 2 x 3 inch square cross-section plastic pots or in trays with cells of 0.8 x 0.8 x 1.2-inch dimensions (Growers Transplanting, Inc.). Pots were seeded on July 18, 1984, trays on July 18 and July 25, and placed in a glasshouse. Seedlings were watered daily with a solution of 9-45-15 fertilizer containing 100 parts per million nitrogen. On the August 14 transplant date, seedlings in trays seeded on July 18 were judged overmature; seedlings started on July 25 were used for field transplanting. Thus, pot-grown transplants were one week older than the tray-grown when set in the field. The plot area was plowed, disked, and 1,000 pounds/acre of 10-20-10 was broadcast and incorporated with the final tillage operation. Pronamide was applied at 1.5 pounds/acre after planting and irrigated in.

Plants in pots and trays were graded into three size categories (small, medium, large) based on 3 or less, 4-5, and more than 5 leaves present on pot-grown seedlings and 2 or less, 3, and more than 3 for tray-grown seedlings. These six treatments plus ungraded plants from each container type were set out on 3 foot x 1.5 foot spacing, with 10 plants/plot and four replications of each treatment in randomized block design. Plots were irrigated weekly and diazinon was applied once for diabrotica control. All plots were harvested on October 2. Each head was trimmed and weighed separately.

Results and Discussion

Plants grown in pots produced much larger heads than did those grown in trays (Table 1), caused in large part by the seven-day earlier seeding. However, more rapid establishment of the larger-rooted pot-grown plants also may have been a factor. Plants from trays appeared to be more than seven days behind in maturity. Regardless of container size, head size increased with increasing number of leaves present at time of transplant. Small transplants produced smaller mean head size than did ungraded transplants; medium and large transplants produced larger heads than did the ungraded. Most of the difference in seedling size at transplanting could be attributed to 1 or 2 days difference in emergence date. Apparently, these small differences are maintained through maturity of the head.

Variability in lettuce head size is known to decrease with increasing maturity, so it is not surprising that pot-grown seedlings produced less head size variability than did the younger tray-grown seedlings. However, the tray-grown seedlings appeared more uniform at time of transplanting than did the pot-grown seedlings. More plants fell into the medium category with tray-grown seedlings (72% vs. 60%).

Grading the transplant by number of leaves definitely decreased variability at harvest for pot-grown plants (Table 1, column 3). It appears that a mechanism to presort transplants by maturity/size could lead to greater uniformity and greater pack-out at first harvest.

For the immature heads produced from tray-grown transplants, only the largest size grade produced less head size variability that did the ungraded plants. The high degree of variability in the small size grade may indicate that the seedling root balls were too immature to plant.

Table 1. Interaction of seedling block size and grading of transplants on yield and head size variability of 'Ithaca' lettuce.

Treatment		Mean head wt. (lb)	Total yield (lb/ft^2)	Head size C. V. (%)[a]
2" pots,	ungraded	1.63	0.36	28.6
"	small	1.56	0.34	21.9
"	medium	1.90	0.41	14.0
"	large	1.99	0.43	15.0
trays,	ungraded	0.52	0.11	33.8
"	small	0.48	0.10	37.7
"	medium	0.54	0.12	33.1
"	large	0.65	0.14	29.3
	LSD(0.05)	0.19	0.14	

[a]C. V.= coefficient of variation (standard deviation of mean x 100%/mean).

IN-FIELD FORCING OF RHUBARB WITH GIBBERELLIC ACID

Cooperator: Jack Parsons, Extension Service, Clackamas County

Introduction

Prices paid for rhubarb are usually highest at the beginning of the production season. Growers would benefit from an inexpensive and reliable method for forcing crowns into early production. Hot house forcing has been used but this practice is expensive and the field must be replanted. Clear plastic mulch has been used to force rhubarb in the field but mulch costs may exceed $200/acre and plastic removal and disposal are an additional expense. Gibberellin plant hormone (GA) has been used to stimulate growth of hot house-forced rhubarb and has been used in the field on an experimental basis since 1980. These experiments have demonstrated that direct injection of GA into buds or crowns stimulates early spear production. Injection was shown to be more effective than spray treatments.

The objectives of the 1983 field experiments were 1) to evaluate the effectiveness of applying GA through a drip irrigation system, 2) to determine the optimum timing of GA application relative to calendar date or chilling degree day accumulation, 3) to determine the optimal rate of GA application, and 4) to determine whether two different commercial formulations of GA are equal in growth stimulating activity.

Methods

Experiments related to Objectives 1-3 were conducted in a commercial field of the 'Crimson' variety. Experiment 4 was conducted in the North Willamette Station variety planting on the 'Victoria' and 'German Wine' varieties. For Experiment 1, GA was applied as Gibrel(R) (potassium gibberellate) Gibb-Tabs at 28, 56, or 84 milligrams/crown, 6 crowns/treatment, on January 25, February 8, and March 1, 1983. The GA was dissolved in warm water and injected into a Chapin drip system with 1, 2, or 3 emitters/crown. Approximately 400 milliliters of solution was applied per emitter and was allowed to soak into emerged buds and soil immediately over each crown.

In Experiment 2, GA as Gibrel was applied at 0 or 20 milligrams/crown on January 25, February 8, and March 1, 1983. The GA was injected directly into the crowns at the base of emerged buds. Each crown was injected at three sites with 3.3 milliliters/site of a 2,000 parts per million GA solution or distilled water. Marketable spears from the first two injection dates were harvested on March 15; spears from the March 1 injection were harvested on March 30. Plots consisted of three crowns and were replicated four to six times.

In Experiment 3, GA as Gibrel was applied at 0, 2.5, 5, 10, or 20 milligrams/crown on February 8, and March 1, 1983. In each case, 10 milliliters of distilled water or GA solutions of 250, 500, 1,000, or 2,000 parts per million were applied to each crown, with three injections of approximately 3.3 milliliters/injection site. Spears were harvested on March 15 and March 30, respectively. Each plot consisted of three crowns and treatments were replicated five (February 8) or four (March 1) times.

In Experiment 4, GA as either Gibb-Tabs or Pro-Gibb at 20 milligrams/crown, or distilled water was injected as above on February 2. Each plot consisted of two crowns and the treatments were replicated four times on 'Victoria' and twice on 'German Wine'. Marketable spears were harvested on March 14 and again on April 5.

Results and Discussion

Experiment 1.

Application of GA through the drip system had no effect on growth of rhubarb spears (data not shown). This confirms results previously obtained with spray applications. Apparently, GA uptake is minimal unless the GA can be injected directly into crown or bud tissue.

Experiment 2.

Application of GA at 20 milligrams/crown dramatically increased yields at both the January 25 and February 8 treatment dates (Table 1). In both cases, the major effect of GA was to increase the number of marketable spears (more than 5/8 inch wide, 10 inches long). Average spear weight of the marketable spears was increased very little, if any, by GA treatment. At the March 1 treatment date, GA tended to increase yields slightly, but the increase was not statistically significant. Yield of untreated crowns had increased to a level nearly equal to that of GA-treated crowns for the February 8 treatment date.

Experiment 3.

For the February 8 treatment date, gross yield of marketable spears increased with increasing rate of GA application with very little indication of a yield plateau at high rates (Table 2). However, the yields at 10 and 20 mg GA/crown did not differ significantly. Mean spear weight did not differ among the 5, 10, and 20 mg rates. For the March 1 treatment date, yields tended to increase with increasing rate of GA application up to 5 milligrams/crown, but the yield increases were not statistically significant.

Table 1. Effect of timing of GA application on rhubarb growth response

Application date	Rate of GA (mg/crown)	Yield of marketable spears (lb/crown)	No. of marketable spears/crown	Mean spear wt. (oz.)
Jan. 25	0	0.7	6.8	1.6
	20	1.9	16.9	1.8
		**[a]	**	NS
Feb. 8	0	0.7	8.5	1.3
	20	3.4	29.2	1.8
		**	**	*
March 1	0	2.9	17.7	2.6
	20	4.6	24.2	3.0
		NS	NS	NS

[a]*, *, NS: difference between means significant at 1% and 5% levels and nonsignificant, respectively.

Table 2. Effect of several rates of GA application at two planting dates on rhubarb growth response

Application date	Rate of GA (mg/crown)	Yield of marketable spears (lbs/crown)	No. of marketable spears/crown	Mean spear wt. (oz.)
February 8	0	0.7	8.5	1.4
	2.5	2.1	21.3	1.6
	5	2.4	20.5	1.5
	10	2.9	24.3	1.9
	20	3.4	29.2	1.8
	LSD(0.05)	0.9	5.3	0.2
March 1	0	2.9	17.7	2.6
	2.5	3.6	20.1	2.9
	5	4.9	25.2	3.1
	10	4.5	24.4	2.9
	20	4.6	24.2	3.0
	LSD(0.05)	NS[a]	NS	NS

[a]No significant differences.

Table 3. Effect of GA formulation on growth of rhubarb

Treatment	Yield of marketable stalks (lb/crown)	No. of marketable stalks/crown	Mean stalk wt. (oz.)
First cutting[a]			
Check	1.4	9.2	2.5
Pro-Gibb	2.8	16.5	2.7
Gibb-Tab	2.3	14.0	2.6
LSD(0.05)	0.8	4.0	NS[c]
Second cutting[b]			
Check	0.9	7.1	2.0
Pro-Gibb	2.1	13.2	2.5
Gibb-Tab	2.1	13.1	2.6
LSD(0.05)	0.5	2.6	0.3

[a]Averaged over 'German Wine' and 'Victoria'.
[b]'German Wine' only.
[c]No significant differences.

Experiment 4.

Both Gibrel Gibb-Tab (Merck) and Pro-Gibb (3.91% liquid concentrate, Abbott) stimulated growth of rhubarb (Table 3) and there was no significant difference between formulations when applied at equal rates of 20 milligrams/crown. The growth response of 'German Wine' to GA was greater than that of Victoria regardless of formulation (data not shown). Spears left at first harvest were pulled at a second harvest three weeks later. This second harvest of 'German Wine' was increased by the original GA applications (Table 3), but little response was seen on 'Victoria' (data not shown).

Although GA increased rhubarb yield when applied at each of three calendar dates, the percentage increase in yield was by far the greatest at the second injection date. This was somewhat surprising since the first two sets of treatments were harvested on the same date and the plants injected on the first date had two more weeks to produce marketable shoots. The limited response from the first injection may have been from to the limited bud emergence and poor GA-bud contact in late January. Alternatively, the rest requirement of the crowns may not have been satisfied. For the crowns injected on March 1, it is evident that the rest requirement was satisfied and soil and air temperatures were conducive to rapid spear growth. Control spears grew nearly as rapidly as did the GA-treated spears.

Since climatic differences influence the time required to satisfy the crown rest requirements, GA application on the basis of a pre-determined calendar date is not very useful. Alternative approaches are to inject when the buds have emerged to a certain height or to inject after accumulation of a certain number of chilling units. Correlations of plant response to GA with chilling unit accumulation will need to be confirmed by several years of field observation. In the interim, the best guide to proper injection time remains bud emergence.

There is some evidence in the rate studies (Table 2) to indicate that early application should be at 10 to 20 milligrams/crown and late applications at 5 milligrams/crown. This is to be expected since the native GA in the crowns peaks when the rest requirement is satisfied. Assuming effective injection into buds or crowns, 10 milligrams/crown is probably adequate at any injection date.

ANTICRUSTANT EFFECTS ON VEGETABLE SEEDLING EMERGENCE

Introduction

The purpose of this trial was to compare the anticrustant activity of phosphoric acid, a recently produced (1983) lot of the commercial anticrustant Nalco 2190, and an older (1980) lot of Nalco 2190 which had undergone some browning of the normally colorless liquid. It was speculated that the relatively poor performance of Nalco 2190 compared to phosphoric acid in some previous trials might have been caused by breakdown with age of the Nalco 2190.

Methods

The plot area was rototilled for seedbed preparation and 'Salad Bowl' lettuce and 'Nantes' carrot were seeded with a Planet Jr. on July 26, 1983. Seeding rate was 6/feet for carrots, 3/feet for lettuce. No pesticides or fertilizers were applied. Phosphoric acid, new and old Nalco 2190, and a water-sprayed check treatment were applied immediately after seeding with a hand-held sprayer. In each case, the spray band width was three inches. Rate of phosphoric acid was 0.3 ounce/foot of a solution derived by mixing one part concentrated acid (85% H_3PO_4) with two parts water. Rate of both Nalco 2190 lots was 0.3 ounce/foot of a 10% solution. Water was applied to check plots at the same rate.

Plot size was 20 row feet for each crop and each crop x treatment combination was replicated four times in randomized block design. Irrigation of 0.75 inch was applied by overhead sprinkler on July 27 and again on August 4. Stand counts were made on August 2, 4, 8, and 11. Mechanical resistance of the soil was measured on August 9 with a Technical Products Co. penetrometer.

Results

Lettuce emergence was initially more rapid, but carrot emergence surpassed that of lettuce by August 8 and final (August 11) carrot stands were much higher than for lettuce (Table 1). On August 2 and 4, lettuce emergence was greatest with phosphoric acid, intermediate with Nalco 2190. Carrot emergence at the early date was promoted only by phosphoric acid. By August 8, no treatment significantly affected stands of lettuce but the same trend existed. Carrot stands at this date were more than doubled by phosphoric acid but not significantly improved by Nalco 2190. On August 11, the final stands of carrots were doubled by phosphoric acid (5.0 vs 7.5 seedlings/foot), and increased significantly, but to a lower degree, by Nalco 2190. In no instance were stands of lettuce or carrots affected differently by the two lots of Nalco 2190.

Emergence of seedlings was approximately inversely proportional to soil mechanical resistance (crusting). Phosphoric acid reduced mechanical resistance by 50%. The two lots of Nalco 2190 reduced resistance by approximately 20% (Table 1). Again, there was no evidence for significant differences between lots of Nalco 2190. This relatively poor performance of Nalco 2190 compared to phosphoric acid as an anticrustant on Willamette silt loam confirms previous results at the

North Willamette Station but differs from results reported by certain other researchers. Relative activity of these anticrustant materials may be related to soil type or other local environmental conditions.

Table 1. Effects of phosphoric acid and two lots of Nalco 2190 on stands of lettuce and carrot and soil mechanical resistance 14 days after seeding

	Stand (seedlings/ft.)								
	Lettuce				Carrots				
Treatment	8/2	8/4	8/8	8/11	8/2	8/4	8/8	8/11	Soil MR(g)
Check	0.1	0.2	0.5	0.6	0.1	0.1	2.2	2.5	730
Phosphoric Acid	1.0	1.1	1.2	1.3	1.1	1.5	4.8	5.0	365
Nalco 2190, old	0.6	0.8	1.0	1.1	0.1	0.1	2.9	3.2	585
Nalco 2190, new	0.6	0.7	0.9	1.0	0.1	0.2	2.5	3.5	595
LSD(0.05)	0.6	0.7	NS[a]	NS	0.3	0.3	1.1	0.6	88

[a]No significant differences.

LIME AND FERTILIZER EFFECTS ON OVERWINTERED CAULIFLOWER

Cooperators: Dr. N.S. Mansour, Department of Horticulture and Dr. T.L. Jackson, Department of Soil Science, Oregon State University, Corvallis

Introduction

Overwintered cauliflower can now be considered a crop of proven potential in the Willamette Valley. Trials at the North Willamette Station and by growers have usually given acceptable yields and quality. However, yields of early varieties, and particularly in cold springs, have occasionally been disappointing. Since plant nutrient uptake is limited on cold soils, these low yields may have been caused by inadequate availability of P or other elements. Past recommendations for overwintered cauliflower have called only for application of N in the spring. The effects of spring-applied P and the form of spring-applied N on cauliflower yield and quality have not been investigated. Likewise, the response of overwintered cauliflower to lime, which increases P availability, has not been studied. The purpose of these trials was to investigate the effects of lime, spring applied P, and source and rate of N on the yield and grade of overwinter cauliflower.

Methods

1983.

Agricultural limestone (95% $CaCO_3$ equivalent) at 0, 2, 4, and 6 tons/acre was applied in 1979 to 2,300 aquare foot plots of Willamette silt loam with four replications of each treatment in randomized block design. Resulting soil pH in August 1982 averaged 5.5, 6.0, 6.2, and 6.6, respectively. After a broadcast, incorporated application of 0.75 pounds/acre trifluralin, 2.0 pounds/acre fonofos, and 700 pounds/acre of 10-20-20, 'Arminda' cauliflower was direct-seeded on approximately 3 feet x 4 inches spacing on August 4, 1982. Sprinkler irrigation was applied as necessary for stand establishment. In late September, the stand was thinned to 18 inches in the row. Diazinon (1 pounds/acre) was applied as a soil drench on August 30 and again on October 4. After a mechanical cultivation, napropamide was applied at 2.0 pounds/acre.

On February 15, 1983, the lime main plots were split into 5 subplots (2 rows x 24 inches) by band application of the following: 1) ammonium nitrate at 50 pounds N/acre, 2) urea at 50 pounds N/acre, 3) ammonium nitrate as above plus 100 pounds 0-45-0/A, 4) urea as above plus 0-45-0 as above, 5) no spring-applied fertilizer. Treatments 1-4 also received a band treatment of 30 pounds N/acre as ammonium sulfate. The ammonium nitrate and urea applications were repeated on March 25.

Leaf samples for plant tissue analysis were collected from plots receiving 0 and 4 tons lime/acre and all subplot treatments on March 24. The first harvest occurred on April 8, 1983, with additional harvests on April 15 and April 22. Heads were graded into #1 (free of any defect) and #2 (off color, mildew, slug damage, leaves or bracts in head, ricey etc.) before weighing.

1984.

Methods for the lime x P experiment were essentially the same as in 1982-1983, except as follows: seeding date was August 3, 1983; variety was 'Inca', pre-plant fertilizer was 500 pounds/acre of 10-20-20; chlorpyrifos and carbaryl were used for insect control. Subplot treatments were made on February 6, 1984, as follows: 1) ammonium nitrate at 50 pounds N/acre, 2) ammonium nitrate at 100 pounds N/acre, 3) ammonium nitrate at 50 pounds N/acre plus 0-45-0 at 150 pounds/acre, 4) ammonium nitrate at 100 pounds N/acre plus 0-45-0 at 150 pounds/acre. Gypsum, at 150 pounds/acre, and Solubor at 2 pounds B/A were applied to all plots on the same date. Nitrogen treatments were reapplied on March 9. Leaf samples were taken on March 14. First harvest was on March 14 and plots were harvested weekly through April 20.

In a separate experiment, 'Inca' cauliflower was seeded on an area of Willamette soil which had received a uniform application of lime at 3 tons/acre in 1980. Soil pH at planting was 6.1. All practices were as above, except that the following side dressed treatments were applied at 100 pounds N/acre on February 6, 1984: 1) ammonium nitrate, 2) ammonium sulfate (21-0-0-24), 3) calcium nitrate (15.5-0-0), 4) urea (46-0-0). Treatments were reapplied at 100 pounds N/acre on March 9. Leaf samples were taken from all plots on March 14.

Results and Discussion

1983.

Initial seedling stands increased slightly with increasing lime rate (data not shown) but, after thinning, there were essentially equal stands on all plots. Application of lime tended to increase yield of grade #1 heads at the first harvest only (Table 1). In general, yields of #1 heads were lower at the highest rate of lime than at the intermediate rates. Lime had no effect on mean head weight of all heads but did increase weight of # 1 heads at the first harvest. The number of grade #1 heads harvested/plot also tended to be higher with lime at the first harvest, but the increase was not statistically significant. Both the increase in mean weight of #1 heads and the increased number of heads harvested appeared to contribute about equally to the increase in #1 yield with lime. Lime had no effect on total yield over three harvests. Thus, lime appeared primarily to hasten maturity, particularly of quality heads. No specific defect affecting grade was found to be related to lime rate.

Providing N in the spring increased total yield through increased head size and increased yield of #1 heads both through increased numbers and head size (Tables 1 and 2). The N effect was equally strong through all harvests. Form of spring-applied N affected yield of #1 heads, but not total yields; the number of grade #1 heads harvested was greater with ammonium nitrate than with urea as N source. Mean head weight was not affected by N source. Greater foliar growth on ammonium nitrate-fertilized plants may have provided better curd cover and, thus, better color.

Spring-applied P application had no effect on any yield or quality parameter and there was no interaction of P and N source affecting yield or quality. There were also no significant lime x N or lime x P interactions. Highest yields of #1 heads were obtained with 4 tons/acre lime and spring-applied ammonium nitrate, either with or without P.

The lack of yield response to spring-applied P and the small response to lime might be attributed to an unusually mild winter and spring. Phosphorus availability on warmer-than-normal soils may not have limited yields. Alternatively, the lack of response to P may have resulted from low solubility and poor access to the root mass of the surface-banded application. Results of plant tissue analysis tend to confirm that neither lime nor applied P increased P availability to the plants since neither affected tissue P concentration (Table 3). Applied P also did not affect levels of the other elements.

Application of lime increased leaf Ca concentration, and decreased leaf Mn and Cu levels. Since leaf Mn levels were low even on unlimed soil, Mn toxicity is apparently not a problem at pH 5.5. Spring application of N increased leaf P, K, Mg, Zn, and Mn levels. Form of spring-applied N had no effect on the levels of measured elements (Table 3).

Table 1. Main effects of lime, rate of spring-applied N, form of spring-applied N, and spring-applied P on yield of overwintered cauliflower at first harvest, April 8, 1983

Treatment	Yield of #1 heads	Total yield	Mean head wt.	Mean wt. of #1 heads	No. of grade #1 heads harvested/plot	No. of total heads harvested/plot
	----T/A------		----lb-----			
Lime(T/A)						
0	1.1	2.1	2.0	1.7	4.1	7.6
2	1.5	2.5	1.9	1.8	5.4	9.2
4	1.5	2.7	2.0	2.1	4.7	9.2
6	1.0	2.7	1.9	1.6	3.8	9.4
LSD(0.05)	0.5	0.5	NS	0.3	NS	NS
+N	1.4	2.6	2.1	1.9	4.7	8.6
-N	0.7	1.9	1.3	1.2	3.8	9.8
	**[a]	**	**	**	*	NS
Amm. nitrate	1.6	2.6	2.1	1.9	5.3	8.5
Urea	1.2	2.7	2.2	1.9	4.1	8.6
	*	NS	NS	NS	*	NS
+P	1.5	2.7	2.1	1.9	4.9	8.7
-P	1.3	2.6	2.2	1.9	4.4	8.4
	NS	NS	NS	NS	NS	NS

[a] **, *, NS: significant at 1% and 5% levels, and nonsignificant, respectively.

Table 2. Main effects of lime, rate of spring-applied N, form of spring-applied N, and spring-applied P on yield of overwintered cauliflower, sum of three 1983 harvests

Treatment	Yield of #1 heads	Total yield	Mean head wt.	Mean wt. of #1 heads	No. of grade #1 heads harvested/plot	No. of total heads harvested/plot
	-----T/A-----		----lb------			
Lime(T/A)						
0	2.6	6.5	1.5	1.6	10.8	28.0
2	2.8	6.3	1.5	1.6	11.4	27.6
4	3.1	6.7	1.7	1.7	11.7	26.7
6	2.5	6.7	1.6	1.6	10.0	27.8
	NS[a]	NS	NS	NS	NS	NS
+N	3.1	7.0	1.7	1.7	16.8	27.5
-N	1.4	4.6	1.1	1.2	7.6	27.5
	**	**	**	**	**	NS
Amm. nitrate	3.4	6.8	1.7	1.8	12.9	27.4
Urea	2.7	7.1	1.7	1.7	10.8	27.7
	*	NS	NS	NS	*	NS
+P	3.0	7.0	1.7	1.7	11.7	27.3
-P	3.1	7.0	1.6	1.7	11.9	27.8
	NS	NS	NS	NS	NS	NS

[a]**, *, NS: significant at 1% and 5% levels, and non-significant, respectively.

Table 3. Main effects of lime, rate of spring-applied N, form of spring-applied N, and spring-applied P on leaf elemental concentrations of overwintered cauliflower

Treatment	P	K	Ca	Mg	Zn	Mn	Cu
	-----------%------------				----ppm------		
Lime(T/A), 0	0.49	3.32	1.38	0.19	32	48	7.4
4	0.48	3.29	1.84	0.18	24	29	7.3
	NS[a]	NS	*	NS	*	*	NS
+N	0.51	3.35	1.61	0.19	29	40	7.9
-N	0.41	3.13	1.63	0.17	24	34	5.2
	**	*	NS	*	*	*	NS
Amm. nitrate	0.51	3.36	1.62	0.20	29	40	6.9
Urea	0.51	3.35	1.59	0.19	29	40	8.8
	NS	NS	NS	NS	NS	NS	NS
+P	0.52	3.40	1.65	0.19	28	42	7.5
-P	0.50	3.31	1.57	0.19	30	38	8.2
	NS	NS	NS	NS	NS	NS	NS

[a]**, *, NS: significant at 1% and 5% level, and nonsignificant, respectively.

1984.

The winter of 1983-84 was unusually severe. Low temperatures of 5°F combined with 20 mph winds to severely damage the crop. Most mature leaves were broken from the plants and approximately 20% of the plants were killed. The freeze damage appeared to be responsible for several crop responses observed in 1984: 1) reduced head size, probably related to reduced plant size, 2) early onset of head formation, perhaps stress-related, 3) extension of the normal three-week harvest to more than five weeks, and 4) greatly reduced head quality with a high percentage of loose curds, leaves in the curd, and early bolting.

For the lime x P x N rate experiment, no treatment significantly affected early yield (March harvests, data not shown). Total season yields tended to be increased by liming and mean head weight was significantly increased by liming (Table 4). Lime had no significant effect, however, on production #1 heads (Table 4). Lime slightly increased leaf Ca and decreased leaf Mn and Zn concentrations (Table 5).

Total yield and mean head weight were higher with 200 rather than 100 pounds/acre of spring-applied N. The higher N rate also increased the total yield and mean head weight of #1 heads (Table 4). Leaf tissue N tended to be higher at the higher rate of N fertilizer but the effect was not statistically significant. Spring-applied P tended to increase production of both total and #1 heads, but the increases were not significant. Leaf tissue P was not affected by P application.

Lime and N significantly interacted in increasing total yield and #1 yield (Table 6): the higher N rate was much more effective in increasing yield at the 6 tons/acre lime rate than at the lower lime rates. Highest total yields were obtained with 6 tons lime/acre and 200 pounds/acre spring applied N. Highest yields of #1 heads, however, were obtained at 2 tons lime/acre and 200 pounds N.

Several interactions affected mean weight of #1 heads (Table 6). Averaged across lime rates, P increased mean head weight of #1 heads at the high N rate but not at the low N rate. The high rate of N increased mean #1 weight on limed, but not on unlimed, soil. The statistically significant lime x P interaction on #1 head weight does not appear to follow any biologically meaningful pattern. There was also a significant 3-way interaction of lime x P x N affecting mean weight of #1 heads (data not shown): the higher N rate increased head weight for all lime x P combinations except for the unlimed soil which received spring-applied P. Again, there is no apparent biological explanation for this interaction, which was probably by chance.

In summary, high yields of overwinter cauliflower are favored by soil pH above 6.0, and high rates of spring-applied N. As in 1983, sidedressed spring-applied P had little effect on yield.

In the second experiment, early and total yield were highest with urea as N source. Mean head weight was not favored by urea, however, and the yield increase was from a greater number of heads harvested (Table 7). The greater number of heads reflects a higher number of plants present on urea-treated plots. This was caused, however, by non-random variability in plant stands; there was no evidence for increased plant survival resulting from urea application. Source of N had no effect on leaf tissue concentrations of any element analyzed (data not shown). No conclusions concerning relative effectiveness of different N sources can be drawn from this experiment.

Table 4. Response of 'Inca' cauliflower to lime, spring-applied P, and rate of spring-applied ammonium nitrate, main effects, 1984

Treatment	Total yield (T/A)	Mean head wt. (lb)	Yield of #1 heads, (T/A)	Mean wt. of #1 heads, (lb)
Lime, 0 T/A	3.4	0.66	0.7	0.89
2 T/A	3.6	0.84	0.8	0.97
4 T/A	3.5	0.79	0.6	0.94
6 T/A	4.0	0.87	0.6	1.05
LSD(0.05)	NS[a]	0.10	NS	NS
N, 100 lb/A	3.3	0.75	0.5	0.88
200 lb/A	3.9	0.83	0.8	1.04
	**	*	*	**
P 0 lb/A	3.6	0.78	0.6	0.96
30 lb/A	3.7	0.80	0.7	0.96
	NS	NS	NS	NS

[a]**, *, NS: significant at 1% and 5% levels, and non-significant, respectively.

Table 5. Main effects of lime, N, and P on cauliflower leaf elemental concentrations, 1984

Treatment	N	P	K	Ca	Mg	Zn	Mn	Cu
	%					ppm		
No lime	5.15	0.57	5.0	1.61	0.23	46	46	5.1
Lime, 4 T/A	5.15	0.58	5.0	1.90	0.22	41	31	5.8
	NS	NS	NS	*	NS	*	**	NS
-P	5.13	0.57	5.0	1.71	0.22	44	40	5.6
+P	5.18	0.58	5.1	1.80	0.23	43	37	5.3
	NS	NS	NS	NS	NS	NS	NS	NS
N, 100 lb/A	5.05	0.58	5.1	1.69	0.22	44	38	5.4
N, 200 lb/A	5.25	0.57	4.9	1.81	0.23	43	39	5.5
	NS	NS	NS	NS	NS	NS	NS	NS

Table 6. Interaction of lime, P, and N rate on yield of 'Inca' cauliflower, 1984

Treatment Lime(T/A)	Treatment N(lb/A)	Total yield (T/A)	Yield of #1 heads (T/A)	Mean wt. of #1 heads (lb)
0	100	3.3	0.8	0.90
	200	3.5	0.6	0.88
2	100	3.6	0.5	0.85
	200	3.6	1.2	1.09
4	100	3.3	0.5	0.82
	200	3.6	0.8	1.06
6	100	3.0	0.4	0.94
	200	4.9	0.7	1.15
	LSD(0.05)	0.4	0.3	0.11

Treatment Lime(T/A)	Treatment P(lb/A)	Mean wt. of #1 heads (lb)
0	0	0.83
	30	0.95
2	0	1.01
	30	0.93
4	0	0.88
	30	1.00
6	0	1.14
	30	0.95
		0.07

Treatment N(lb/A)	Treatment P(lb/A)	Mean wt. of #1 heads (lb)
100	0	0.89
100	30	0.86
200	0	1.03
200	30	1.06
	LSD(0.05)	0.03

Table 7. Effect of form of spring-applied N on yield of 'Inca' cauliflower, 1984

N source	Early yield (T/A)	Total yield (T/A)	# heads harvested/plot	Mean head wt. (lb)	Mean wt. of #1 heads (lb)
Ammonium nitrate	0.1	2.9b	23.5b	0.80	0.88
Ammonium sulfate	0.1	3.3b	24.0b	0.88	1.17
Calcium nitrate	0.1	3.1b	24.5b	0.84	1.19
Urea	0.2	4.4a	35.0a	0.81	1.00
LSD(0.05)	NS	0.6	4.9	NS	NS

LIME AND FERTILIZER EFFECTS ON OVERWINTERED ONIONS

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

Introduction

Overwintered onions in the Willamette Valley are seeded in early September and harvested in the following spring or summer. Obtaining strong and early growth in the spring is essential to achieve large bulb size and profitable yields. However, soil and air temperatures are usually less than optimal during the spring growth period, possibly limiting response to fertilizers.

Highest yields have been obtained with a total N application of 200 to 300 pounds/acre, with the majority of the N applied in the spring. No information is available on potential differences in overwintered onion response to type of spring-applied N; e.g., NO_3-vs. NH_4-N. On cold soils with limited conversion of other forms of N to plant available NO_3, applying a NO_3-N fertilizer might improve N use efficiency. However, NO_3 is also not tightly bound to soil particles and may be quickly leached through the root zone by heavy spring rains.

Since P availability is limited on cold soils, overwinter onions might also respond to banded application of P fertilizers or to lime, which increases P availability. Onions also have a high S requirement, but overwinter onion response to a fertilizer S source has not been studied in the Willamette Valley.

The following experiments were designed to evaluate the effects of lime, spring-applied P, spring-applied $CaSO_4$ (gypsum), and two N sources on yield and elemental concentrations of overwintered onions.

Methods

1983.

Agricultural limestone (95% $CaCO_3$ equivalent) at 0, 2, 4, and 6 tons/acre was applied in 1979 to 2,300 square feet plots of Willamette silt loam with four replications of each treatment in randomized block design. Resulting soil pH at planting in 1982 averaged 5.5, 6.0, 6.2, and 6.6, respectively. Raised beds (8 inches high, 5.5 feet wide) were formed in early September, 1982 following a broadcast application of 800 pounds/acre of 10-20-10 and seeded with 3 rows/bed of OWY 100 (ARCO Seed Co.) onion on September 15.

Propachlor herbicide was applied at 4 pounds/acre on September 16, and again on October 20 and December 10. Many weed species escaped the propachlor treatment. Linuron at 1.0 pound/acre was applied on February 2, 1983 and chloroxuron at 3.0 pounds/acre was applied on March 21. These treatments eliminated most established weeds; large grasses and plantain were pulled by hand in late spring. No further herbicides were applied and plots were hand-hoed in May, primarily to control vetch and groundsel.

On Febraruy 15, 1983, the lime main plots were randomly split into six subplots (one bed x 24 feet) by application of the following: 1) ammonium nitrate at 50 pounds N/acre, 2) ammonium nitrate as above plus 100 pounds gypsum/acre, 3) ammonium nitrate as above plus 100 pounds 0-45-0/acre, 4) ammonium nitrate, gypsum, and 0-45-0, as above, 5) ammonium sulfate at 50 pounds N/acre, 6) check (no spring fertilizer). The N materials were reapplied at 50 pounds N/acre on March 28 and May 13, 1983; concentrated superphosphate (0-45-0) and gypsum were not reapplied. Leaf samples were collected for plant tissue analysis on April 26 from plots representing three replications of the zero and 4 tons/acre lime rates and all subplot treatments. On April 27, stand counts were made for all treatment combinations. Onions were topped and harvested from the center row of each plot on July 5, 1983. Bulbs were graded into #1 (more than 3 inch diameter) and #1 categories before weighing.

1984.

Methods were as above for 1983, except as follows. Seeding date was September 13, 1983; variety was ARCO Sweet Winter. Propachlor was applied four times and only chloroxuron was applied in the spring. Metalaxyl was applied twice for mildew control. Subplot treatments were applied on February 17, 1984, when half of each main plot was sidedressed with 0-45-0 at 150 pounds/acre. Ammonium nitrate was applied to all plots at 50 pounds N/acre on February 17, March 26, and May 3. Harvest was on July 24, 1984.

Results and Discussion

1983.

Application of lime significantly increased onion stands, total onion yield, yield of #1 bulbs, mean bulb weight, and number of bulbs harvested (Table 1). Stand counts were made in April 1983, too late to determine whether the lime application enhanced onion germination and emergence or enhanced survival by increasing the growth rate of seedlings. Previous experiments on Willamette soil indicated that liming increases seedling emergence of onions and several other small seeded vegetable crops. Since the application of lime also visibly stimulated early plant growth (no measurements recorded), enhanced winter survival of larger seedlings also may have contributed to the effect of lime on onion stands. Of the subplot treatments, only N application affected stands, with a small, but statistically significant, increase in stand on plots which received no spring fertilizer. Since no stand counts were made before application of the first subplot treatments, it cannot be determined whether spring fertilizer application actually caused some stand reduction or the stand differences reflected existing variability within main plots.

Most of the stand and yield response to lime occurred with application of only 2 tons/acre; however, further significant increases in yield and number of grade #1 bulbs were obtained at 4 tons/acre (Table 1). Leaf tissue of plants grown on limed soil contained significantly higher concentrations of P, K, and Ca, and significantly lower concentrations of Zn and Mn than did leaf tissue grown on unlimed soil (Table 2). Since P levels were quite low compared to reported values and were increased 24% with application of 4 tons/acre of lime, much of the yield response to lime might be ascribed to increased P availability. However, increased K and Ca uptake or reduction of Mn toxicity may also have been involved in the lime response.

Application of spring N fertilizer, when averaged across lime, P, gypsum, and form of N applied, significantly increased total and #1 yields and bulb weight (Table 1). There were no significant N x lime interactions, and highest overall yields (30-33 tons/acre) were obtained with combinations of the highest rate of lime and spring application of either ammonium nitrate or ammonium sulfate. Application of spring N increased leaf tissue N, Zn, and Mn concentrations. Undoubtedly, the yield response to N was primarily attributable to increased soil N supply. The increase in tissue Zn concentration may also have played a role since Zn concentration of plants which received no spring fertilizer application was low compared to values reported in the literature. The increase in leaf tissue Zn and Mn concentrations with spring N application may have been caused by a temporary localized decrease in soil pH after application of the acidifying N fertilizers.

Within the subset of plots receiving a spring application of fertilizer, there was a trend toward higher yields and mean bulb weights with ammonium sulfate as N source (Table 1). These differences were never significant at the 95% level; however, the increase in total yield was significant at the 90% level. Leaf tissue N levels were slightly higher with ammonium sulfate as N source, but other tissue elemental concentrations were not significantly affected by N source (Table 2). Certainly, it does not appear necessary to provide NO_3-N to assure good onion yields.

Within the subset of treatments receiving a spring application of ammonium nitrate, application of concentrated superphosphate did not affect overall yields but did slightly increase mean bulb weight (Table 1). There were no significant P x lime interactions. Application of P had no effect on leaf elemental concentrations (Table 2). Since P had no effect on tissue P levels, it is evident that the surface application did not bring the relatively insoluble P into sufficient contact with the root mass, or that some other factor prevented effective uptake. Lack of P uptake from the fertilizer probably precluded any yield response. However, since the winter and spring were unusually mild, any P effect on yield may have been masked by better than normal spring growth on all plots.

Also within the subset of plots fertilized with ammonium nitrate, application of gypsum increased total and #1 yields. Some of this increase was caused by slightly higher (increase not statistically significant) stands on subplots fertilized with gypsum. Mean bulb weight, however, also increased with gypsum application and was the major component of the yield increase (Table 1). Leaf tissue concentrations of the analyzed elements were not affected by gypsum application. Leaf S levels were not measured, but it is possible that the response to gypsum was caused by increased S availability. Sulfur availability may also have been involved in the nearly significant yield increase with ammonium sulfate compared to ammonium nitrate.

There were no significant P x gypsum interactions affecting yield or leaf elemental concentrations, but lime and gypsum interacted strongly in increasing yield of #1 onions (Table 3). The greater response to gypsum at higher rates than at lower rates of lime, and the tendency for yields to increase with the last increment of lime in the presence but decrease in the absence of gypsum, indicate that S uptake may be a limiting factor in onion production at near neutral soil pH. There were no significant lime x gypsum interactions affecting leaf elemental concentrations.

Table 1. Main effects of lime, spring-applied N, form of N, spring-applied P, and gypsum on yield parameters of overwinter onion, 1983

	Stand onions/ plot	Total yield (T/A)	Yield of #1 onions (T/A)	#1 bulbs harvested/ plot	Mean bulb wt., all onions (oz)	Mean bulb wt., #1's (oz)
Lime (T/A)						
0	92	7.6	3.1	17	2.7	8.0
2	127	22.3	13.7	66	5.6	8.9
4	129	25.1	16.7	82	6.0	8.9
6	129	26.5	18.6	89	6.2	9.1
LSD(0.05)	19	3.1	3.6	9	0.8	0.5
Ammonium nitrate	117	21.0	14.1	45	5.4	8.9
Ammonium sulfate	125	23.3	15.4	49	5.6	8.9
	NS[a]	NS	NS	NS	NS	NS
+P	116	20.8	14.2	45	5.4	9.2
-P	118	21.2	13.9	46	5.2	8.7
	NS	NS	NS	NS	*	*
Gypsum	123	22.3	15.4	48	5.6	9.0
Gypsum	112	19.8	12.8	42	5.1	8.8
	NS	*	**	*	*	*
+N	119	21.5	14.4	46	5.4	8.9
-N	125	14.9	6.5	24	3.8	8.0
	**	**	**	*	**	**

[a] **,*,NS: significant at 1% and 5% levels, and non-significant respectively.

Table 2. Main effects of lime, spring-applied N, form of N, spring-applied P, and gypsum on onion leaf tissue elemental concentrations, 1983

Treatment	N	P	K	Ca	Mg	Zn	Mn	Cu
	- - - - - - -	- - %	- - - - -	- - - - -	- - -	- -	ppm	- -
Lime, 0 T/A	2.87	0.136	2.00	0.59	0.148	15.4	93	3.9
4 T/A	2.87	0.168	2.38	0.69	0.157	14.0	52	3.7
	NS[a]	*	*	*	NS	*	*	NS
+N	2.97	0.150	2.22	0.64	0.153	15.3	77	3.8
-N	2.37	0.160	2.05	0.63	0.148	11.8	48	3.5
	**	NS	NS	NS	NS	**	**	NS
Ammonium nitrate	2.94	0.152	2.20	0.64	0.153	15.3	74	3.8
Ammonium sulfate	3.09	0.143	2.30	0.64	0.157	15.2	91	3.8
	*	NS	NS	NS	NS	NS	NS	NS
Gypsum	2.97	0.151	2.24	0.65	0.153	15.3	76	3.8
Gypsum	2.91	0.153	2.16	0.64	0.153	15.2	71	3.8
	NS	NS	NS	NS	NS	NS	NS	NS
+P	2.94	0.153	2.22	0.64	0.152	15.4	78	3.8
-P	2.94	0.151	2.18	0.64	0.154	15.2	70	3.8
	NS	NS	NS	NS	NS	NS	NS	NS

[a]**,*,NS: significant at 1% and 5% levels, and non-significant, respectively.

Table 3. Interaction of lime and gypsum on yield of overwinter onion, 1983

Lime rate (T/A)	Gypsum (lb/A)	Total yield (T/A)	Grade #1 yield (T/A)
0	0	6.4	2.9
	100	6.9	2.4
2	0	22.7	14.3
	100	24.8	15.7
4	0	25.3	17.5
	100	27.5	20.1
6	0	24.5	16.5
	100	30.1	23.1
	LSD(0.05)	5.2	4.6

1984.

Onion yields obtained from all treatments were very low compared to those recorded in previous years. For example, the highest yielding lime treatment produced only 3.6 tons/acre (Table 4) compared to 26.5 tons/acre in 1983. This was due primarily to losses in plant stand which occurred during the severe freeze of December 23-24, 1983. Temperatures as low as 6°F were accompanied by 20 to 40 mph winds, resulting in plant breakage and dessication.

Nevertheless, the surviving plants responded to treatment much as they did in 1982-83. Highest total yields and by far the highest weight of #1 bulbs were obtained with the 6 tons/acre lime treatment. More bulbs were harvested from limed plots, perhaps because of better plant survival or better initial stands. Mean bulb weight also increased markedly with increasing rate of lime. Sidedressing concentrated superphosphate in early spring tended to increase total and #1 yield and mean bulb weight, but these differences were not statistically significant. Mean weight of #1 bulbs did increase significantly with P application, as in 1983. Also as in 1983, there were no significant P x lime interactions.

Because of reduced stands, the gypsum and N source portions of the 1983 experiment were not repeated. Confirmation of these effects awaits the 1984-1985 trials.

Table 4. Mean effects of lime and spring-applied P on yield of overwintered onions, 1984

Treatment	# bulbs harvested/plot	Total yield (T/A)	Yield of #1 bulbs (T/A)	Mean bulb wt., all onions (oz)	Mean bulb wt., #1's (oz)
Lime (T/A)					
0	22	0.4	0.0	1.2	-
2	55	1.6	0.4	2.6	6.8
4	41	1.5	0.6	3.1	6.4
6	56	3.6	2.3	5.6	8.4
LSD(0.05)	15	2.3	0.9	1.7	1.8
+P	43	1.8	0.9	3.4	7.6
-P	44	1.6	0.8	2.9	6.9
	NS[a]	NS	NS	NS	**

[a]**, NS: significant at 1% level and non-significant, respectively.

LIME AND FERTILIZER EFFECTS ON SPRING-PLANTED ONIONS

Introduction

Fertilizer trials with overwinter onions at the North Willamette Station have shown a strong onion yield response to application of lime and gypsum and, in one experiment, a higher yield with ammonium sulfate rather than ammonium nitrate as N source. The yield response to gypsum and ammonium sulfate indicates that when soil pH, P, K, and N are optimal, S may be the element most limiting to onion bulb development. The following trial was designed to investigate the effects of lime, gypsum, and form of N on spring-seeded onions.

Methods

The lime variable main plots were formed in 1981 by application of 0 or 3 tons limestone flour/acre to 30 foot x 120 foot plots of Willamette silt loam. Lime plots were in randomized block design with four replications of each treatment. Resulting soil pH in spring 1984 averaged 5.5 and 6.0, respectively. 'Benny's Red' onion was seeded in 3-row beds, 20 inches between rows, approximately 8 seeds/foot, on May 14, 1984. Propachlor herbicide was applied at 4 pounds/acre on May 15 and was reapplied at the same rate on June 11 and July 13. Plots were also hand-hoed several times.

The lime main plots were split on June 13, 1984, by a sidedressed application of factorial combination of gypsum ($CaSO_4$) at 0 or 150 pounds/acre and calcium nitrate or ammonium sulfate at 100 pounds N/acre. The N treatments were reapplied at the same rate on July 10. Individual subplots were one bed x 30 feet. Plants were topped two inches above the bulb and all plots were harvested on October 16, 1984.

Results and Discussion

Liming significantly reduced the original plant stand (Table 1). This is in contrast to many previous stand establishment experiments at the North Willamette Station, in which application of lime has generally increased stands of several small-seeded vegetables, including onions, over a pH range of 5.0 to 6.4. Stands of overwinter onions have tended to increase with increasing soil pH in previous experiments. An explanation for the stand decrease with liming in this experiment is not apparent, but the effect was consistent over all replications of the main plots and almost every bed, regardless of subplot treatment. The post emergence sidedress application of gypsum and N had no effect on stands (data not shown).

The stand difference was maintained through harvest, with a significantly higher number of bulbs harvested from unlimed plots (Table 1). Gypsum and N source did not significantly affect the number of bulbs harvested/plot. Neither lime, gypsum, nor N source significantly affected gross yield on an area basis.

Liming significantly increased mean bulb weight. Since there were fewer onions on limed plots, the increase in bulb size could be caused by reduced competition for water or nutrients. However, because of generally poor stands, the highest bulb density for any subplot was only 3.2/foot (1.9/square foot), indicating that competition among plants or crowding was not a factor in bulb size. Liming may have increased availability of P or Ca or reduced toxicity due to Al, Mn, or other metals.

Gypsum and N source did not significantly affect bulb weight in this experiment, although there was a trend toward larger bulbs with gypsum and calcium nitrate. Highest mean bulb weight was obtained with the combination of lime, gypsum, and calcium nitrate (Table 2). Gypsum increased mean bulb weight with calcium nitrate but not with ammonium sulfate as N source, giving some evidence for a yield response to sulfate-S.

Further experiments are planned to investigate the apparent stand reduction on limed soil and the magnitude of the onion response to a sulfate source.

Table 1. Main effects of lime, gypsum, and N source on spring-seeded onion stand and yield, 1984

Treatment	Stand (seedlings/ft)	# bulbs harvested/foot	Yield (T/A)	Mean bulb wt.(oz)
Limed	1.7	1.7	9.7	6.9
Unlimed	2.2	2.2	9.8	5.4
	**[a]	*	NS	*
+Gypsum	--	2.0	9.9	6.4
-Gypsum	--	2.0	9.6	5.9
		NS	NS	NS
Calcium nitrate	--	1.9	9.7	6.4
Ammonium sulfate	--	2.1	9.8	5.9
		NS	NS	NS

[a] **, *, NS: significant at 1% and 5% levels, and non-significant, respectively.

Table 2. Interaction of lime, gypsum, and N source on spring-seeded onion mean bulb weight, 1984

Lime	+Gypsum		-Gypsum	
(T/A)	Calcium nitrate	Ammonium sulfate	Calcium nitrate	Ammonium sulfate
	- - - - - - - - - oz	- - - - - - - - -	- - - - - - - - -	- - - - - - - - -
0	6.1	5.3	4.7	5.5
3	7.8	6.3	7.0	6.3

LSD(0.05) = 2.4

PHOSPHORUS FERTILIZERS AND SWEET CORN PRODUCTION

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

Introduction

Sweet corn yields in the Willamette Valley increase with application of lime and banded P fertilizers, even in the presence of high levels of available soil P. However, the interaction of applied lime, which increases P availability, and applied P has not been explored in detail. Many sources of P are available. These P materials vary both in P content and in the water-solubility of the P compounds present. The effects of various P sources and their interactions with soil pH (lime applied) have not been widely studied. The objective of these experiments was to investigate the effect of different sources of P at two different P rates, and with or without lime, on yield of 'Jubilee' sweet corn.

Methods

Lime was broadcast and disked into a Willamette silt loam soil at rates of 0 or 3 tons/acre in March 1982, with four replications of each treatment. On June 2, 1983, the lime strips were split at seeding by a band application of six different nominal ammonium phosphate materials at 50 or 150 pounds P_2O_5/acre. Application rate was based on the labelled citrate-soluble P_2O_5. Within each P rate strip, the six P sources were randomly applied to 2 row subplots of 30-foot length. All plots received a total of 200 pounds N/acre and were irrigated as needed. In 1984, a uniformly limed area was used. Treatments included a check with no P fertilizer, three P sources banded at 50 pounds P_2O_5/acre and one source banded at 150 pounds P_2O_5/acre. All plots received a total of 190 pounds N/acre.

Results and Discussion

The measured water-solubility (presumed plant availability) of the 1983 P sources varied from 49% to 5% (Table 1). If P sources are applied at equal rates of total P, plant response might be expected to vary with the water-solubility of the P materials. Yield of mature ears was affected by P source (Table 2), and, in general, higher yields were obtained with the more water-soluble P sources. This correlation of yield of mature-ear with P source water-solubility was particularly strong at 50 pounds P_2O_5/acre and either rate of lime (Table 1). At the higher rate of P_2O_5, sufficient P may be plant available even at lower water-solubility.

Neither lime rate nor P rate significantly affected yield of mature ears or total ear yield in 1983 because of insufficient replication. Source of P had no effect on total ear yield.

Mean ear weight of mature ears was greater at the higher rate of P than at the lower rate when averaged over lime rates and P sources. Lime and P source did not affect mean weight of mature ears (Table 2) and there were no significant interactions affecting mean weight of mature ears.

Both P rate and P source significantly affected the mean weight of all ears (mature plus immature). Mean ear weight was greater at the higher rate of P (Table 2). Ear weight correlated strongly with P source solubility: ear weight was greatest with the most soluble P source and smallest with the least soluble P source. As with mature ear yield, the correlation was stronger at the lower than at the higher rate of total P (Table 1).

Table 1. Water solubility of nominal ammonium phosphate P sources and interaction of P source and P rate on yield of mature ears and mean ear weight of 'Jubilee' sweet corn, 1983

		P_2O_5 (lb/A)			
	Water soluble	50		150	
P source	P_2O_5	Yield of mature ears	Mean weight of all ears	Yield of mature ears	Mean weight of all ears
	%	T/A	lb	T/A	lb
1	49	6.9	0.69	6.6	0.70
2	41	5.7	0.68	5.8	0.69
3	40	5.2	0.67	6.3	0.70
4	29	5.5	0.67	6.5	0.71
5	16	5.3	0.66	5.9	0.69
6	5	4.4	0.63	5.8	0.67

LSD (0.05) for different P sources at same P rate = 2.2 yield, 0.05 for ear weight.
LSD (0.05) for different P sources at different P rates = 2.5 for yield, 0.05 for ear weight.

Table 2. Main effects of lime, P rate, and P source on yield and mean ear weight of 'Jubilee' sweet corn, 1983

Treatment	Yield of mature ears	Yield of all ears	Mean weight of mature ears	Mean weight of all ears
	---------T/A---------		------------lb/ear------------	
Lime, 0 T/A	5.6	8.6	0.73	0.67
3 T/A	6.1	8.9	0.74	0.69
	NS[a]	NS	NS	NS
P_2O_5, 50 lb/A	5.5	8.6	0.72	0.67
150 lb/A	6.1	8.8	0.74	0.69
	NS	NS	*	**
P source, 1	6.7	9.3	0.74	0.70
2	5.7	8.7	0.73	0.68
3	5.8	8.7	0.74	0.69
4	6.0	8.7	0.74	0.69
5	5.6	8.5	0.73	0.68
6	5.1	8.4	0.70	0.65
LSD(0.05)	0.8	NS	NS	0.03

[a]**,*,NS: significant at 1% and 5% levels, and non-significant respectively.

Table 3. Effects of P sources on sweet corn yields, 1984

Treatment	Total P_2O_5 Citrate-soluble	Total P_2O_5 Water-soluble	Plant ht. on July 5	Mature ear yield	Total yield	Mean ear wt. Mature	Mean ear wt. Total
	------------lb/A	------------	in.	--------T/A	-----	------lb	----
1	150[a]	150	11.3	10.0	11.2	0.76	0.74
2	50[a]	50	10.2	7.6	10.0	0.73	0.67
3	50[b]	41	10.6	8.9	10.0	0.76	0.73
4	50[b]	30	9.6	7.5	9.5	0.75	0.67
5	0	0	8.6	7.6	9.6	0.73	0.68
		LSD(0.05)	2.1	1.9	1.2	0.03	0.05

[a]Monoammonium phosphate.
[b]Urea phosphates.

In 1984, plant growth and yield did not correlate with amount of water-soluble P banded at planting, mainly because of higher yields, ear weights, and plant height with Treatment 3, than with Treatment 2. Ear yields were highest with 150 pounds P in the band and lowest with 30 pounds P (Table 3). Mean ear weights were lowest with no P in the band.

The 1984 results do not provide strong confirmation of 1983 results. More work will be necessary to determine the importance of water-solubility of P sources.

FORM AND TIMING OF APPLIED NITROGEN ON SWEET CORN PRODUCTION

Introduction

Recent experiments at the North Willamette Station indicated that, for a given level of N, yields are increased by delaying application of the bulk of the N fertilizer until the corn is 10 to 12 inches tall. These experiments used ammonium nitrate as N source and the late applied N was sidedressed on the soil surface. No additional benefit was obtained by delaying application of a portion of the N until tasseling or silking. The yield increase with split application of N could be from leaching of NO_3-N below the root zone when all N is applied at planting. Some N also could be volatilized. One purpose of the 1984 experiments was to determine whether application of all N at planting would produce yields equal to those with a split application if an N source other than ammonium nitrate were used.

Methods

'Jubilee' sweet corn was seeded in a Willamette silt loam, pH 5.8, on May 17, 1984. Plot size was 6 rows x 40 feet and spacing between rows was 30 inches. Thirty pounds N and 150 pounds P_2O_5/acre, as 11-55-0 ammonium phosphate were banded 2 inches below and 2 inches to the side of the seed line at planting. In addition to the above, Treatments 1, 2, and 3 received 40, 100, or 160 pounds N/acre, respectively, as ammonium nitrate banded 2 inches below and 6 inches to either side of the seed line on July 3. Treatments 4, 5, and 6 received 100 pounds N/acre as ammonium nitrate, 100 pounds N/acre as urea (46-0-0), or 50 pounds N/acre as urea plus 50 pounds N/acre as ammonium chloride, respectively, banded 2 inches below and 6 inches to either side of the seed line at planting. Total N applied, form of N, etc. are summarized in Table 1. Herbicide and irrigation practices were normal for sweet corn in the Willamette Valley. First irrigation occurred on July 11.

Initial stands did not vary significantly with treatment and all plots were thinned to the desired average spacing of 1.5 plants/foot or about 26,000 plants/acre on June 12. All ears were harvested from 30-foot sections of the center 2 rows of each plot on September 5. Ears were graded as fully mature, immature, or culls.

Results and Discussion

Yield increased with increasing rate of ammonium nitrate-N, when N application was split (Table 1, Treatments 1-3). In comparing Treatment 2 (split application of ammonium nitrate at 130 pounds N/acre) with Treatment 4 (all ammonium nitrate at planting), there was no advantage to splitting the N application. This is in contrast to experiments in 1979 and 1980, in which splitting the ammonium nitrate application increased yields. The lack of yield advantage in 1984 may have been from reduced leaching of nitrate. Also, all N in the earlier experiments, except for the 40 pounds/acre banded with P, was surface applied. Some loss to the atmosphere may have occurred when up to 160 pounds N/acre was applied to the soil surface in 1979 and 1980. In contrast, in 1984, all N, whether at planting or in July, was banded beneath the surface. Another possible explanation for the lack of advantage for split application in 1984 is that the subsurface banding in July may have caused root pruning and temporary stunting of plant growth. Application of N as urea or urea plus ammonium chloride did not increase mature or total ear yield over yields with ammonium nitrate (Treatments 4-6), indicating no leaching of nitrate.

Mean ear weight did not vary greatly with treatments, but the trends were the same as for ear yields. Ear weights were lowest at the low rate of N and N source did not affect ear weight.

In summary, this experiment has confirmed previous results concerning response of corn yields to rate of N but did not confirm previous evidence for the advantage of splitting N applications. No evidence was obtained which would indicate an advantage for any particular N source.

Table 1. Effects of N rate, source, and timing of application on sweet corn yield, 1984

Treatment #	Total N applied	N source in 6-inch band	Time of applic. of N in 6-in.band	Mature ear yield	Total ear[a] yield	Mean ear wt.	
						Mature ears	Total ears
	lb/A			T/A	T/A	lb	lb
1	70	Am. nitrate	July	7.6	9.4	0.74	0.69
2	130	Am. nitrate	July	9.3	10.8	0.79	0.75
3	190	Am. nitrate	July	10.0	11.2	0.76	0.74
4	130	Am. nitrate	at planting	9.8	10.5	0.76	0.74
5	130	Urea	at planting	8.4	10.5	0.78	0.73
6	130	Urea+Am. chloride	at planting	8.9	11.0	0.76	0.70
			LSD(0.05)	1.9	1.2	0.03	0.05

[a]Does not include culls.

SOILLESS MEDIA EFFECTS ON BEDDING PLANT PRODUCTION

Cooperator: Dr. R.L. Ticknor, North Willamette Experiment Station

Introduction

Satisfactory growth of annual transplants can occur in soilless media made up of a wide range of components. Peat-vermiculite mixes have been popular for many crops but the high cost of these components stimulated a search for substitutes. Each geographic area produces waste products which have potential as media components. Bark, woodchips, straw, cinders, nut shells, grains hulls, and many others have been incorporated successfully into growing media. However, the price and availability of these products vary with the economic health of the industry producing the waste. As more communities turn to composting as a means of disposing of sewage sludge or municipal solid wastes, interest in using these composts as soil amendments or as components of soilless media increases. The purpose of this study was to determine the growth and development of three species of bedding plants in media containing a compost of sewage sludge and sawdust in combination with several organic and inorganic components.

Methods

Twenty mixes containing 25 or 50 percent composted Portland sewage sludge from a pilot plant were compared with several grower commercial potting mixes for growing cabbage, pansy, and snapdragon seedlings. The compost mixes contained 25% of a mineral component (Perlite, pumice, or vermiculite) and 25 or 50 percent of an organic component (bark, peat moss, or sawdust).

Pansy and snapdragon were sown on vermiculite on December 10, 1982. Pansy seedlings were transplanted on January 13, 1983, into 2¼-inch cell packs holding six plants which constituted one replication of a treatment. Snapdragon seedlings were transplanted on January 14. 'Golden Acre' cabbage seeds were sown directly into the mixes on January 14. No fertilizer was added to the compost-based mixes. A minimum temperature of 45°F was maintained in the polyethylene greenhouse from January 13 to March 1 when the minimum temperature was raised to 55°F. Supplemental lighting was given from 10 p.m. to 4 a.m.

The plants were liquid fed with 30-10-10 or ammonium sulfate (21-0-0) weekly from transplanting until the crops were harvested. When plants in the better treatments reached salable size, tops of all plants were cut off and weighed. Dates of harvesting were: cabbage, March 7; pansy, March 24; snapdragon, March 28.

Results and Discussion

Growth in most mixes containing 50% compost was equal to or better than that in the commercial or grower potting soils (Table 1). Bark mixed with 20 pounds of North Willamette Container Fertilizer (10-4-3) per cubic yard produced the largest plants. The higher fertility level in this mix is the probable cause for the increased growth. Growth in mixes with 25% compost was significantly less than with 50% compost (data not shown).

Bark was better to dilute the compost than peat or sawdust. Vermiculite was superior to perlite and pumice as an inorganic component for bedding plant mixes.

Cabbage seedlings in many of the mixes showed some chlorosis and bronzing of the leaves. The chlorosis was more severe with 25% than with 50% compost except in the compost:peat:vermiculite mixes where there was no chlorosis. Less chlorosis occurred with bark in the mix than with peat and less with peat than with sawdust. There was no chlorosis with the bark mix. Plants in two of the grower mixes also had very little chlorosis. Treatments which had less chlorosis produced the heaviest plants.

Pansies growing in 50% compost generally had more flower buds than did those in the corresponding treatment with 25% compost (data not shown). Pansies growing in mixes containing vermiculite produced more flowers and were heavier than in the corresponding Perlite or pumice treatments and had little or no chlorosis. The heaviest plants were grown in bark with North Willamette Fertilizer.

Snapdragon growth and flower bud formation was much less in commercial or grower mixes than in mixes containing 50% compost. Even growth in the 25% compost mixes was equal to all but one of the commercial or grower mixes. In 25% compost, the average number of plants with flower buds was 2.2/30 plants while in 50% compost it was 9.7/30 plants. In commercial and growers mixes it was less than 1/30 plants.

In summary, when blended with other components, the tested sample of composted Portland sewage sludge produced mixes in which growth was superior to that in several grower or commercial mixes. Plant weight of cabbage, pansy, and snapdragon seedlings was greater in 50% than in 25% compost. Vermiculite was superior to Perlite or pumice as inorganic component. Bark was superior to peat moss or sawdust as organic component.

Table 1. Growth of bedding plants in several mixes, 1983

% Sludge compost	Organic material	Inorganic material (25%)	Fresh weight (g) Cabbage	Pansy	Snapdragon	Number of snapdragon flower buds/30 plants
50	Peat	Vermiculite	1.91	3.77	2.76	8
50	Peat	Perlite	1.71	3.69	2.16	6
50	Peat	Pumice	1.84	1.85	2.03	5
50	Bark	Vermiculite	2.39	5.03	2.99	14
50	Bark	Perlite	2.18	3.76	2.82	8
50	Bark	Pumice	2.36	4.44	2.82	16
50	Sawdust	Vermiculite	2.21	5.02	2.83	12
50	Sawdust	Perlite	1.96	3.01	2.57	8
50	Sawdust	Pumice	2.17	3.87	2.57	10
75	None	Perlite	2.16	3.86	2.90	17
0	Bark[a]	None	3.02	5.78	3.20	10
0	Various[b]	Various	1.70	2.01	1.51	1
		LSD(0.05)	0.40	1.59	0.60	

[a]Bark plus North Willamette container fertilizer.
[b]Means of five commercial and grower media.

OTHER RESEARCH IN PROGRESS

Several other experiments are underway but results were too preliminary for a full report at this time. Variety trials of early- and late-transplanted leeks are being overwintered for spring harvest. Trials on the effects of various fertilizers and lime on overwintered cauliflower and onions are continuing. Crops of Romaine lettuce seeded in early autumn of 1984, and protected by floating row covers, have not been harvested at this time.

Greenhouse studies on developing soilless media for vegetable transplants are also underway. Control of onion white rot with fungicides, cultivars, or soil sterilants is being investigated in cooperation with Dr. Paul Koepsell of the Botany and Plant Pathology Department, Oregon State University.