Special Report 900
June 1992

Malheur County Alternative Crops and Marketing Research

Agricultural Experiment Station
Oregon State University

Special Report 900
June 1992

Malheur County Alternative Crops and Marketing Research

Agricultural Experiment Station
Oregon State University

Important Notice - The following report includes information concerning unregistered use of pesticides. Experimental results should not be interpreted as recommendations for use. Use of unregistered material or use of any registered pesticide inconsistent with its label is against both Federal and state laws.

MALHEUR EXPERIMENT STATION

SPECIAL REPORT 900

GARBANZO BEANS

GARBANZO BEAN VARIETY TRIAL 1

GARBANZO BEAN PLANTING DATE TRIAL 3

LIMA BEANS

IMPROVING STANDS OF EARLY PLANTED LARGE SEEDED LIMA BEANS 5

SOYBEANS

SOYBEAN PERFORMANCE AND DEVELOPMENT AT ONTARIO THROUGH 1991 10

SQUASH

IMPROVEMENT OF SUGAR LOAF SQUASH STAND ESTABLISHMENT 19

VARIETY AND PLANTING METHOD EVALUATION FOR WINTER SQUASH 21

GROUNDCOVER OPTIONS AND IRRIGATION METHODS FOR THE PRODUCTION OF KABOCHA SQUASH 26

STORAGE CONDITIONS FOR WINTER SQUASH 33

SUPERSWEET CORN

OPTIMUM PLANT POPULATION OF SUPERSWEET CORN 39

COMMERCIAL SORTING OF SUPERSWEET CORN SEED 44

CONTRIBUTORS

MALHEUR EXPERIMENT STATION SPECIAL REPORT 900

MALHEUR COUNTY OFFICE, OSU EXTENSION SERVICE PERSONNEL:

Schneider, Gary	Professor

MALHEUR EXPERIMENT STATION:

Barnum, Mike	Research Assistant
Chamberlain, Keefe	Research Aide
Feibert, Erik	Research Assistant
Kee, Mary Jo	Office Coordinator
Saunders, Lamont	Bio Sciences Research, Technician 3
Selfridge, Mary	Research Aide
Shock, Clinton C.	Superintendent and Assoc. Professor
Wimpy, Sally	Research Aide

OREGON STATE UNIVERSITY, CORVALLIS, AND OTHER STATIONS:

Baggett, James	Professor, Dept. of Horticulture
Kogan, Marcos	Director, IPPC
Seddigh, Majid	Research Assoc., Dept. of Crop and Soil Science

UNIVERSITY OF IDAHO:

Stieber, Tim	University of Idaho, Extension Agent

OTHER PERSONNEL COOPERATING ON SPECIAL PROJECTS REPORTED HERE:

Auyer, Za Dean	Regional Economic Development Strategy, Vale, OR
Cooper, R. L.	ARS, Wooster, OH
McLaughlin, Ed	Gustafson Inc., Twin Falls, ID
Meier, Ken	Ken Meier International, Brookings, OR
Rushing, Kyle	Gustafson Inc., McKinney, TX
Simon, Jim	Dept. of Horticulture, Purdue University, IN
Trent, Bob	Crookham Seed Co., Caldwell, ID
Williams, W.A. "Bill"	Dept. of Agronomy and Range Science Univ. of Calif., Davis, CA
Zalewski, Jim	Ore-Ida Foods, Inc., Boise, Idaho

GROWERS ASSOCIATIONS SUPPORTING RESEARCH REPORTED HERE:

Oregon Processed Vegetable Commission

OREGON PUBLIC AGENCIES SUPPORTING RESEARCH REPORTED HERE:

Malheur County Regional Economic Development Strategy

GARBANZO BEAN VARIETY TRIAL

Clint Shock, Erik Feibert, and Monty Saunders
Malheur Experiment Station
Oregon State University
Ontario, Oregon, 1991

Objective

Garbanzo beans (Cicer arietinum L.) are a potential alternative crop for Malheur County, Oregon. Three varieties and four lines have been evaluated for yield and seed size at the Malheur Experiment Station since 1989.

Procedures

The trials were conducted on a Greenleaf silt loam soil planted to onions the previous season. The field was deep-ripped twice and 120 lbs P_2O_5 per acre (0-41-0) and 10 lbs zinc per acre (zinc sulphate) were plowed down in the fall of 1990. A soil sample was taken on June 14, 1991 and showed a pH of 7.5, 1.5 percent organic matter, 24 CEC, 50 ppm nitrate, 13 ppm phosphorus, 391 ppm potassium, 2938 ppm calcium, 463 ppm magnesium, 195 ppm sodium, 1.0 ppm zinc, 3.9 ppm iron, 2.4 ppm manganese, 0.4 ppm copper, 32 ppm sulfate, and 0.5 ppm boron.

The soil was worked over twice with a groundhog on March 18. The field was bedded into 22 inch rows on March 19. Two pounds ai/acre of Dual were incorporated with a bed harrow on March 20 for weed control. Seed of the four lines and three varieties was planted on April 25 at 180 lbs/acre using an Amalco cone seeder on a John Deere 77 Flexi Planter. Apron fungicide (dry) was applied to seed packets at the recommended rates. Plots were 22 feet long and four rows wide (22 inch rows) in a complete randomized block with six replicates. The trial was irrigated seven times on alternate furrows from May 3 to August 1. Soil implant inoculum was applied using a John Deere Flexi Planter preceding cultivation on May 3. Due to unavailability, the inoculum was not applied at the same time as planting. The field was subsequently hand weeded once. The middle two rows of each plot were harvested on August 27. The number of seeds per pound was determined by weighing 200 seeds. Seed moisture content was determined by the weight difference between cleaned and oven dried beans. Beans were dried in a force draft drier at 170 °F for 15 days. Yields and seed counts were corrected to 13 percent moisture.

Results and Discussion

Yields ranged from 3,310 lbs/acre for MES #10 to 2,371 lbs/acre for UC-15 (Table 1). MES #10 was the highest yielding variety in 1989 and 1991 and in the three year average (Table 1). MES #10 also had the largest seed in 1989 and 1991 and in the three year average (Table 1). The experimental lines MES #10 and MES #9 were single plant selections with an upright growth habit. Strong upright central branching favors seed quality since the pods are held above soil moisture.

Compared to California, the main garbanzo bean producing state in the United States, the yields at Ontario have been higher. None of the lines yielded less than 1,900 lbs/acre in the three years of trials (Table 1). Presently, the main producing area in California is the west side of the central valley. Irrigated yields in that area have averaged 1,800- 2,200 lbs/acre (Steve Temple, UC Davis, pers. commun.). Compared to the other major garbanzo bean producing areas, which are the dryland farming areas of coastal California (av. yield = 1,500 lbs/acre) and the Washington-Idaho border (av. yield = 1,000 lbs/acre), the Ontario yields are even better (Fred Muehlbauer, USDA-ARS, Pullman, WA, pers. commun.). In addition, as shown in the 1991 planting date trial, yields in Ontario can be increased by 35 percent by planting in March instead of in May.

Table 1. Yield and seed size of garbanzo bean varieties. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Variety or line	Yield				Seed count			
	1989	1990	1991	89-91 Average	1989	1990	1991	89-91 Average
	---------- lbs/acre ---------				---------- seeds/lb ----------			
MES #10	3450	1657	3310	2806	874	1030	845	916
UC-5	2517	2852	3009	2793	1111	1062	979	1051
UC-15	3212	2443	2371	2675	1032	1009	972	1004
UC-27	2654	2225	2510	2463	991	977	941	970
MES #9	1876	1346	3107	2110	919	1004	859	927
MES Late Suratado	1987	1219	2888	2031	925	1019	928	957
MES Early Suratado	1904	1434	2641	1993	982	1095	991	1023
LSD (0.05)	532	515	ns		30	40	85	

Bean size at Ontario has not been satisfactory. The main market for garbanzo beans is canning. Canneries require that beans be in the 800 to 832 beans/lb range for number one's. Beans at Ontario have not met this requirement. Future research could address this aspect. Garbanzo trials at Ontario have not been fertilized with nitrogen, and fertilization would probably increase bean size.

GARBANZO BEAN PLANTING DATE TRIAL

Erik Feibert, Clint Shock, and Monty Saunders
Malheur Experiment Station
Oregon State University
Ontario, Oregon, 1991

Objective

Garbanzo beans (Cicer arietinum L.) are a potential alternative crop for Malheur County, Oregon. The 1989 and 1990 variety trials at the Malheur Experiment Station were planted in early May. This trial evaluated the effect of earlier planting on performance of two varieties. Earlier planting might also allow garbanzo bean production using less irrigation water.

Procedures

The trial was conducted on a Greenleaf silt loam soil planted to onions the previous season. The field was deep ripped twice and 120 lbs P_2O_5 per acre,(0-41-0) and 10 lbs zinc (zinc sulphate) were plowed down in the fall of 1990. A soil sample was taken on June 14, 1991 and showed a pH of 7.5, 1.5 percent organic matter, 24 CEC, 50 ppm nitrate, 13 ppm phosphorus, 391 ppm potassium, 2938 ppm calcium, 463 ppm magnesium, 195 ppm sodium, 1.0 ppm zinc 3.9 ppm iron, 2.4 ppm manganese, 0.4 ppm copper, 32 ppm sulfate and 0.5 ppm boron.

The field was worked twice with a groundhog on March 18 and was bedded into 22 inch rows on March 19. Two pounds ai/acre of Dual were incorporated with a bed harrow on March 20 for weed control. Seed of two varieties (UC15, UC27) from the California Crop Improvement Association was planted on three dates (March 22, April 12, and May 3) at 180 lbs/acre using an Amalco cone seeder on a John Deere 77 Flexi Planter. Apron fungicide (dry) was applied to seed packets at the recommended rate. Plots were 22 feet long and four rows wide (22-inch rows) in a randomized complete block with five replicates. The trial was irrigated nine times on alternate furrows from March 26 to August 1. Soil implant inoculum was applied using a John Deere Flexi Planter preceding cultivation on May 3. The inoculum was not available for the two earlier planting dates. The field was hand weeded once. The middle two rows of each plot were harvested on August 27. The number of seeds per pound was determined by weighing 200 seeds. Seed moisture content was determined by the difference in weight between cleaned and oven dried beans. Beans were oven dried at 170°F for 10 days.

Results and Discussion

Days from planting to emergence were 21 for the March 22 planting, 13 for the April 12 planting, and 12 for the May 3 planting. There were no differences in plant stand between the different planting dates with the average stand being five plants per foot. Days to from emergence to flowering were 69 for the March 22 planting, 54 for the April 12 planting and 50 for the May 3 planting (Table 1). UC27 flowered in fewer days than UC15 (Table 1). Plants from the first two planting dates were at harvest maturity in early August and plants from the last planting date were at harvest maturity in late August.

Planting date had a significant effect on yield with the March 22 planting producing the highest yield (Table 1). The March 22 planting date is much earlier than the early May date used in 1989 and 1990 at the Malheur Experiment Station. This result is also interesting considering the unusually cool spring of 1991. There were 1,530 cumulative growing degree days from January 1991 to the end of July 1991, well below the six year average of 1,821. This was the lowest accumulation of the previous six years. The results suggest that a March planting date would be best for garbanzo beans in Malheur County, Oregon.

Table 1. Performance characteristics of two garbanzo bean varieties on three planting dates. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Planting Date	Variety	Days to flowering*	Yield lbs/acre	Seeds/lb
March 22	UC 15	74	4189	894
March 22	UC 27	64	3169	863
Average		69	3679	879
April 12	UC 15	57	2831	954
April 12	UC 27	52	2986	868
Average		54	2908	911
May 2	UC 15	52	2917	932
May 2	UC 27	48	2534	918
Average		50	2726	926
LSD (0.05) Planting Date		3	699	ns
LSD (0.05) Variety		3	ns	38^+

* from emergence
$^+$ $p < 0.10$

IMPROVING STANDS OF EARLY PLANTED LARGE SEEDED LIMA BEANS

Erik Feibert, Clint Shock, and Monty Saunders
Malheur Experiment Station
Oregon State University
Ontario, Oregon, 1991

Introduction

In order to establish large seeded lima beans as a crop adapted to the Snake River Valley, the time needed for maturity of current commercial cultivars must match the available growing season. Previous trials found that earlier planting dates subject germinating seeds to cold soil conditions resulting in insect and fungal attack and low plant stands. The appropriate soil temperature for germination (70°F) is usually only reached in mid-June, whereas the ideal planting date for timely harvest is early in May. Consequently, if germinating seeds can be protected from insect and fungal attack, an earlier planting date could be used. Effective insecticide treatments have been determined previously. A fungicide seed treatment trial was carried out in 1990 and 1991. The 1990 trial showed that the fungicide Thiram resulted in significantly higher emergence.

Procedures

One biological and seven chemical anti-fungal products were evaluated in 15 combination treatments and four single product treatments (Table 1). In addition, two control treatments were used. The layout of the trial was a randomized complete block with five replicates.

The trial was conducted on a Nyssa silt loam previously planted to winter squash. Twenty pounds of N and 100 lbs P_2O_5 (11-52-0) per acre were plowed down and the field planted to winter wheat in the fall of 1990. The wheat was killed by a Roundup spray on May 21. The field was rototilled on May 29 and bedded to 30 inch rows on May 30. Thimet 20G was incorporated for seed corn borer control on May 31 at 1.4 oz ai/1000 ft of row. Dual at 2 lbs ai/acre and Treflan at 1.5 lbs ai/acre were applied and incorporated on May 31 for weed control. The variety used was certified Lee from the University of California foundation seed with 95 percent germination. Seeds were treated by Gustafson Inc. Seed Technology Laboratory at McKinney, Texas and planted on May 31 at approximately three inch depth using an Amalco cone seeder on a John Deere 77 Flexi Planter. Each replicate of each treatment consisted of 100 seeds in two 30 inch beds 30 ft long. Plots were irrigated on June 1, June 13 and June 27. Emerged seedlings were counted five times starting June 18.

Results and Discussion

An unusually wet spring delayed the field preparation to one day before planting which did not allow for pre-irrigation. It was then necessary to irrigate the day after planting which resulted in low soil temperatures and poor emergence (Figure 1 and Table 2). The recommended minimum soil temperature for planting of lima beans is 70 °F (Oregon State University Vegetable Production Recommendations 1991, O.S.U., Corvallis, OR). The mean minimum soil temperature for the trial period was 58 °F, well below soil temperature requirements (Figure 1).

Emergence started on June 11. The effects of the different seed treatments on emergence are shown in Table 2. The composite treatment effects were not significant. Breakdown analysis of the treatments by product composition showed that Apron, Thiram, and Rival resulted in significantly higher emergence (Figure 2). The products Terraclor and Vitavax significantly reduced emergence.

Acknowledgements

The cooperation of Gustafson Inc. is gratefully acknowledged. Support for this study was provided by the Malheur County Regional Economic Development Strategy Board.

Table 1. Lima bean seed treatment product specifications. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Treatment	Formulation Rate
Check	none
Water Check	8.0 fl oz/cwt
Water Check + Apron - Terraclor O.T.*	8.0 fl oz/cwt + 2.0 oz/bu**
Water Check + Apron - Terraclor - Kodiak***	8.0 fl oz + 3.0 oz/bu
Water Check + Prevail	8.0 fl oz + 3.0 oz/bu
Water Check + Apron Dry	8.0 fl oz + 2.0 oz/bu
Thiram 42-S	2.0 fl oz/cwt
Thiram 42-S + Apron - Terraclor O.T.	2.0 fl oz/cwt + 2.0 oz/bu
Thiram 42-S + Apron - Terraclor - Kodiak	2.0 fl oz/cwt + 3.0 oz/bu
Thiram 42-S + Prevail O.T.	2.0 fl oz/cwt + 3.0 oz/bu
Thiram 42-S + Apron Dry O.T.	2.0 fl oz/cwt + 2.0 oz/bu
RTU - Vitavax - Thiram	6.8 fl oz/cwt
RTU - Vitavax - Thiram + Apron - Terraclor O.T.	6.8 fl oz/cwt + 2.0 oz/bu
RTU - Vitavax - Thiram + Prevail O.T.	6.8 fl oz/cwt + 3.0 oz/bu
RTU - Vitavax - Thiram + A-T-K O.T.	6.8 fl oz/cwt + 3.0 oz/bu
RTU - Vitavax - Thiram + Apron Dry O.T.	6.8 fl oz/cwt + 2.0 oz/bu
Rival T	4.0 fl oz/cwt
Rival T + Apron - Terraclor O.T.	4.0 fl oz/cwt + 2.0 oz/bu
Rival T + Prevail O.T.	4.0 fl oz/cwt + 3.0 oz/bu
Rival T + Apron - Terraclor - Kodiak O.T.	4.0 fl oz/cwt + 3.0 oz/bu
Rival T + Apron Dry O.T.	4.0 fl oz/cwt + 2.0 oz/bu

*O.T. - Over treatment with dust or hopper box product

**bu. - 56 lbs of beans

*** - Bacillus subtillis

Table 2. Effects of lima bean seed treatments on plant emergence. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Seed Treatment	Plant Emergence				
	June 18	June 22	June 25	July 1	July 4
	---------------- % ----------------				
Check	18.4	17.4	19.2	19.0	18.0
Water Check	16.2	18.2	18	17.2	17.4
Water Check, Apron-Terraclor	28.5	26.8	26.3	26.3	25.5
Water Check, Apron-PCNB-Kodiak	20.8	23.8	22	24	21.8
Water Check, Prevail	25.8	26	24.8	25.4	24.6
Water Check, Apron	25.4	27.8	26.2	26.6	25.4
Thiram	26	24.8	23.6	24.4	24.8
Thiram, Apron-Terraclor	31.8	31.4	30.4	27.6	28
Thiram, Apron-PCNB-Kodiak	36	37.2	31.2	33.8	36.2
Thiram, Prevail	30	31.5	27	31.5	30.3
Thiram, Apron	31.2	30.2	28.4	28.4	31.2
RTU-Vit-Thiram	26.4	29.6	26	25.8	28
RTU-Vit-Thiram, Apron-Terraclor	17.8	20	21	22.4	19.2
RTU-Vit-Thiram, Apron-PCNB-Kodiak	26.2	28.4	25.2	26.8	27.6
RTU-Vit-Thiram, Prevail	19.6	20.8	20	19.8	20.2
RTU-Vit-Thiram, Apron	27.2	27.2	28.2	26.2	26
Rival T	29	27.4	24.2	26.4	26.6
Rival T, Apron-Terraclor	27.8	24.6	22.6	23	25.6
Rival T, Apron-PCNB-Kodiak	28.2	30.2	29.4	30	30.4
Rival T, Prevail	24	24.2	23.4	24	23.2
Rival T, Apron	32.2	32.2	31.8	31.6	31.2
LSD (0.05)	10.1	ns	ns	ns	ns

Figure 1. Soil temperatures at 4 inch depth during the large seed lima bean emergence trial at Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

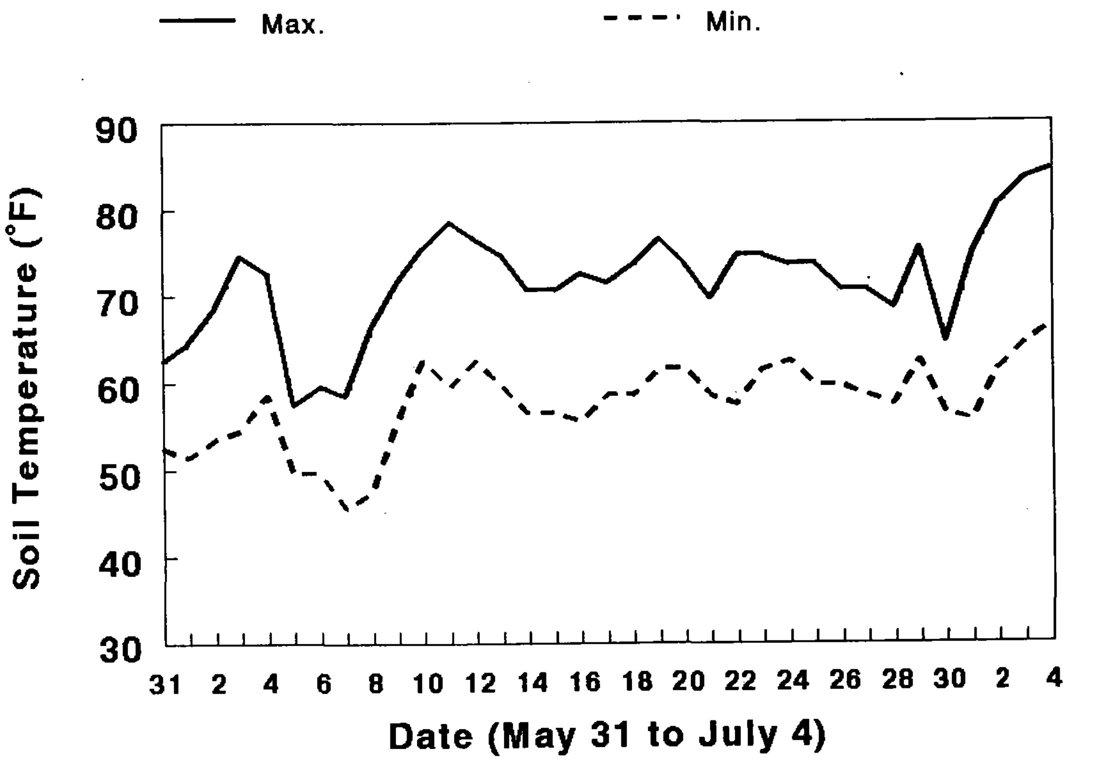
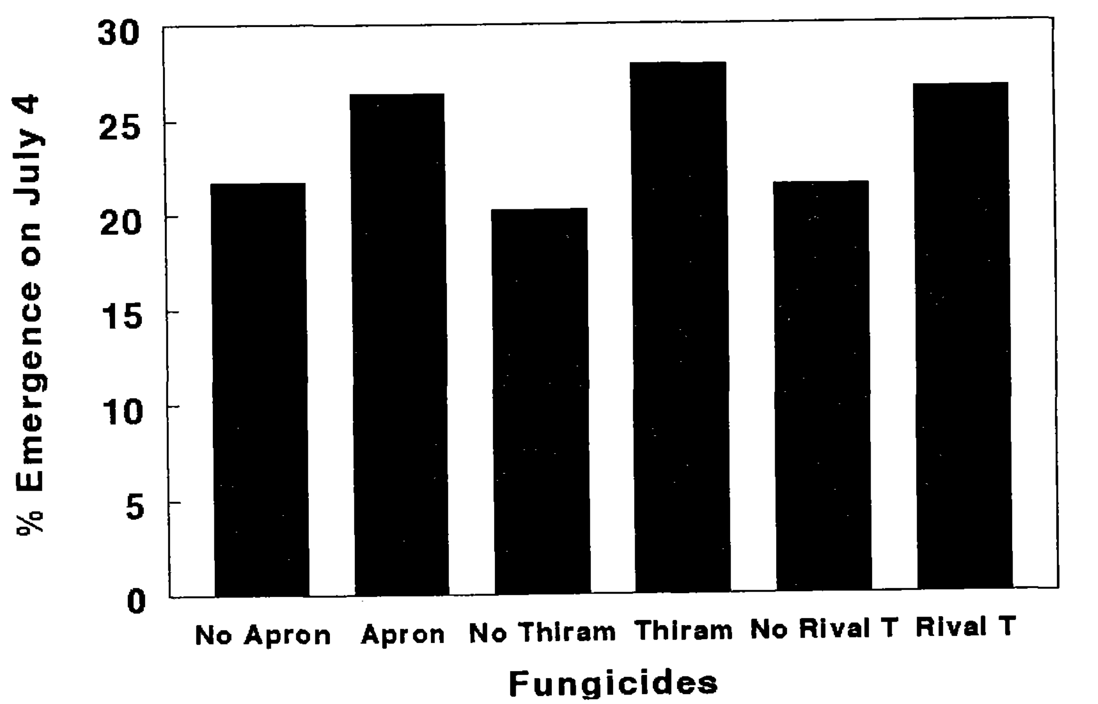


Figure 2. Effects of fungicides on lima bean emergence. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.



SOYBEAN PERFORMANCE AND DEVELOPMENT AT ONTARIO THROUGH 1991

Clint Shock, Erik Feibert, and Monty Saunders
Malheur Experiment Station
Oregon State University
Ontario, Oregon, 1991

Introduction

Soybeans are a potentially valuable new crop for Oregon. Soybeans could provide a high quality protein for animal nutrition and oil for human consumption, both of which are in short supply in the Pacific Northwest. In addition, edible or vegetable soybean production could be exported to the Orient and provide a raw material for specialized food products. Soybeans would also be a valuable rotation crop because of the soil improving qualities of its residues and N_2-fixing capability.

Because of the irrigated cropping patterns in the Snake River Valley, soybeans may be economically feasible only at high yields. Hoffman and Fitch (1972) demonstrated that soybean cultivars adapted to Minnesota could yield 50 to 65 bushels/acre per year at Ontario. The most productive lines averaged 60-65 bushels/acre for several years. Furthermore, yields were increased by approximately 20 percent for certain cultivars by decreasing row widths from 22 to 10 inches.

Soybean varieties developed for the midwestern and southern states are not necessarily well-adapted to Oregon, due to lower night temperatures, lower relative humidity, and other climatic differences. Previous research at Ontario has shown that, compared to the commercial cultivars bred for the midwest, plants for Oregon need to have high tolerance to seed shatter and lodging, reduced plant height, increased seed set, and higher harvest index (ratio of seed to the whole plant).

Three variety trials were conducted in 1991 as part of a continuing breeding and selection program to adapt soybeans to eastern Oregon. In addition, five vegetable soybean varieties were evaluated for performance and insect resistance in a trial in collaboration with Marcos Kogan and Sergio de Bortoli from the Integrated Plant Protection Center at Oregon State University, Corvallis, Oregon.

Procedures

The trials were conducted on a Greenleaf silt loam soil planted to onions the previous season. The field was deep ripped twice and 120 lbs of P_2O_5 per acre (0-41-0) and 10 lbs of zinc per acre (zinc sulphate) were plowed down in the fall of 1990. A soil sample was taken on June 14, 1991 and showed a pH of 7.5, 1.5 percent organic matter, 24 CEC, 50 ppm nitrate, 13 ppm phosphorus, 391 ppm potassium, 2,938 ppm calcium, 463 ppm magnesium, 195 ppm sodium, 1.0 ppm zinc, 3.9 ppm iron, 2.4 ppm manganese, 0.4 ppm copper, 32 ppm sulfate, and 0.5 ppm boron.

The soil was worked over twice with a groundhog on March 18. The field was bedded into 22 inch rows on March 19. Two lbs ai/acre of Dual were incorporated with a bed harrow on March 20 for weed control. Soybean seed for the advanced trial and for the vegetable soybean seed trial had Apron fungicide (dry) applied to seed packets at the recommended rate. The new selections, preliminary, and advanced trials were planted at 200,000 seeds/acre and the vegetable soybean trial was planted at 120,000 seeds/acre. All trials were planted in four row plots 22 feet long on May 9. Rhizobium japonicum soil implant inoculant was applied at planting into the seed furrow. Kelthane 4F (0.6 lb ai/acre) for preventive control of spider mites and zinc sulphate (0.25 lb zinc/acre) were tank mixed and sprayed on June 24. The vegetable soybean trial received only the zinc sulfate. The field was cultivated on June 25 for weed control and to maintain the furrows for irrigation. The advanced, preliminary, and vegetable soybean trials were planted in randomized complete block designs with five, four, and three replicates respectively. The new selections had only one replicate.

The trials were irrigated nine times on alternate furrows from June 3 to August 30. One plot of each variety was evaluated weekly for vegetative and reproductive stages. On October 15, one plot of each variety was evaluated for lodging and shatter. Kelthane at 0.6 lb ai/acre was sprayed on the field borders for mite control on August 8.

Four insect samplings for Stinkbugs were done from August 8 to September 16. Stinkbug samplings were done by placing a rectangular plastic sheet under the canopy between two rows, shaking the plants and then counting the number of bugs. This same method was used for the insect samplings in the vegetable soybean trial. Insect samples were taken every ten days from July 26 to September 6 from all plots in the vegetable soybean trial. All insects collected in each sample were put in paper bags and shipped to the Integrated Plant Protection Center at Oregon State University, Corvallis Oregon, for analysis.

The middle two rows from each plot were harvested on October 17 using a Wintersteiger Nurserymaster small plot combine. Seed percent moisture was determined by the difference in weight between cleaned and oven dried beans. Beans were dried in a forced draft drier for 15 days at 170 °F. Seed yields were corrected to 13 percent moisture.

Results and Discussion

Emergence started thirteen days after planting and the earliest varieties started flowering on July 2 (41 days after emergence). Average stand was 7.36 plants/ft for the advanced trial, 7.64 plants/ft for the preliminary trial, 6.93 plants/ft for the new selections and 5.40 plants/ft for the vegetable soybean trial. Stinkbug populations in all trials except for the vegetable soybean trial were low during the sampling period. Only 0.4 to 0.5 bugs/sample (0.25/meter of row) on average were found. Control is recommended when infestations average one bug per 0.9 meter of row in Arkansas

(Miner, 1966), one per 0.3 meter of row in South Carolina (Nettles et al.,1970) and 2 per sample as above in Sao Paulo, Brazil (de Bortoli, pers. comm.).

Single Plant Selections, Preliminary Yield Trial and Advanced Trial

Propensity to shatter was generally low in all three trials, while lodging was low to severe. Yields ranged from 22.0 bu/acre to 64.0 bu/acre in the single plant selections (Table 1), from 40.24 bu/acre to 59.34 bu/acre in the preliminary trial (Table 2) and from 33.4.6 to 55.7 bu/acre in the advanced trial (Table 3). Table 4 shows performance characteristics for lines from different origins and levels of adaptation to the Snake River Valley. Jolliff and Sedigh found lines of soybeans with resistance to cold during pod fill at Corvallis in the early 1980s, but many of these lines had excessive shatter when grown in Eastern Oregon. In the late 1980s, Shock selected lines from Corvallis that had less shatter at Ontario (Shock, 1986; Shock and Stieber, 1987). R.L. Cooper, a USDA soybean breeder at Wooster, Ohio, has developed semi-dwarf soybeans with high productivity and short stature. Cooper and Shock have crossed the cold tolerant lines of Jolliff and Sedigh with semi-dwarf lines which resulted in the Ontario lines. The improvements resulting from these crosses possess the other desirable characteristics of soybeans for Ontario and can be seen in the Ontario lines such as H16-3 and H16-25, the highest and third highest yielding lines in the preliminary trial. These Ontario lines were only selected for desirable genotypes in the F_2 generation and further selection could improve their performance.

Vegetable Soybean Trial

Yields ranged from 8.3 to 33.3 bu/acre (Table 5). All these lines showed one or more of the undesirable characteristics for soybeans when first introduced to the Snake River Valley. These characteristics include high shatter, high lodging, low harvest, index and too many days to maturity. The low yields are probably a result of these characteristics. In addition, the late harvest for seed that resulted from a common harvest date for all plots in all trials aggravated the loss of yield to shatter. The market objective for these lines is production as green beans or as roasted beans for snacks. The loss of yield to high shatter would not be a factor with the early harvest at the green bean stage. The earlier harvest could substantially increase the yield of variety PI194647 which does not have any of the other undesirable characteristics (Table 5). Additional selection and crosses could improve these lines as has been done with the lines in the previous trials.

Literature Cited

Hoffman, N.E. and L.A. Fitch, 1972. Annual report of the Malheur Branch Experiment Station, 1972, p. 84-89.

Miner.F.D. 1966. Biology and control of stinkbugs on soybeans. Arkansas Exp. Sta. Bull. 708.

Nettles, W.C., F.H. Smith and C.A. Thomas. 1970. Soybean insects and diseases. South Carolina (Clemson Univ.) Ext. Circ. 504.

Shock, C.C., 1986. Soybean performance at the Malheur Experiment Station. Malheur Experiment Station, Oregon State University, Special Report 814, p. 125-137.

Shock, C.C. and T. Stieber, 1987. Soybean performance at Ontario, Oregon. Malheur Experiment Station, Oregon State University, Special Report 814, p.125-137.

Table 1. Performance characteristics of soybean new selections. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Line	Days to maturity*	Lodging	Shatter	Height	Yield
		0-10[1]	%	cm	bu/acre
737	151	0	0	70	22.0
Vinton	151	6	0	130	28.0
738	151	0	0	70	29.9
600	144	4	0	85	30.7
725	151	2	0	80	31.6
726	144	0	10	75	32.8
671	151	0	0	95	33.0
735	151	0	0	90	33.3
501	144	0	0	90	35.2
640	151	4	0	110	35.4
791	151	0	0	70	36.8
871	144	0	0	90	39.8
597	151	0	0	85	41.0
583	151	1	0	105	41.1
1078	144	2	0	95	41.5
699	151	0	0	84	42.0
710	151	0	0	110	42.2
331	144	1	10	80	42.2
736	151	0	0	70	43.0
500	151	0	0	90	43.4
1158	144	0	5	85	44.1
1471	160	0	0	90	44.2
1075	144	0	10	80	44.6
566	151	4	0	100	45.0
591	144	0	15	85	45.1
551	144	3	10	105	45.3

* from emergence.
1) 0 = none, 10 = 100% lodging

Table 1. Continued.

Line	Days to maturity*	Lodging 0-10[1]	Shatter %	Height cm	Yield bu/acre
763	144	0	0	95	45.5
734	151	0	5	90	45.6
614	144	1	0	90	46.1
716	144	1	40	90	46.2
670	151	0	0	95	47.9
746	151	6	0	118	48.0
673	144	4	0	115	48.3
629	151	0	5	95	48.7
908	144	2	0	105	49.1
745	144	5	0	107	49.5
1074	144	0	10	95	49.8
676	144	0	0	95	50.6
707	144	0	0	90	50.8
630	144	3	5	113	51.1
1077	151	1	5	96	51.5
669	151	2	0	102	51.9
442	151	1	0	90	52.2
636	137	2	10	102	52.3
1076	144	0	0	95	53.9
711	144	0	0	110	54.8
661	151	0	0	95	55.5
587	144	2	0	112	55.7
565	144	0	5	92	56.0
752	144	4	0	100	56.2
333	144	1	0	104	56.2
953	137	3	0	95	56.6
586	144	1	10	85	58.1
684	151	3	0	113	58.6
712	144	2	15	90	58.8
945	144	3	0	102	61.9
1246	144	4	5	124	64.0

* from emergence

1) 0 = none, 10 = 100% lodging

Table 2. Performance characteristics of lines in soybean preliminary trial. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Line	Days to maturity*	Lodging	Shatter	Height	Yield
		0-10[1]	%	cm	bu/acre
H16-20	151	3	5	95	40.2
H16-19	144	5	5	137	44.6
H4-4	105	0	5	116	44.9
H16-1	119	6	10	125	46.0
H82-21	119	6	15	137	48.1
H82-4	144	4	15	103	48.2
H4-1	144	5	0	104	49.7
H82-20	151	5	0	109	50.1
H16-14	144	4	5	103	50.1
H16-16	144	4	5	114	50.4
H82-26	144	5	5	115	50.6
H16-7	111	2	10	110	51.0
H4-11	144	6	0	125	51.2
H16-4	113	6	15	145	51.2
H16-2	135	6	15	142	51.3
H4-7	151	6	5	130	51.5
H16-15	144	2	0	110	52.0
H82-8	119	5	0	120	52.6
H4-12	135	1	0	111	53.1
H82-24	119	6	0	110	53.2
H82-1	119	6	10	126	54.4
H4-6	113	2	10	110	54.6
H16-6	119	6	5	133	54.9
H82-2	119	6	5	120	54.9
H16-23	144	6	10	140	55.8
H16-12	135	5	0	114	55.9
H16-22	135	6	0	150	57.3
H16-25	144	2	0	112	57.5
H82-14	113	5	10	120	58.4
H16-3	119	0	0	125	59.3
LSD (0.05) Yield					5.9

* from emergence

1) 0 = none, 10 = 100% lodging

Table 3. Performance characteristics of varieties in advanced soybean trial. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Variety	Days to maturity*	Lodging	Shatter	Height	Yield
		0-10[1]	%	cm	bu/acre
OR8	101	0	7	98	33.5
SP-8	144	6	5	114	39.8
Hoyt	141	2	0	94	40.0
HC89-286	151	0	0	105	40.0
HC87-56	128	0	0	103	43.9
HC88-2595	151	0	0	120	46.6
Sibley	135	6	10	150	46.7
HC89-1868	151	0	5	112	47.6
ORG-83-117	113	0	0	119	47.8
HC88-3157	135	0.5	0	110	51.0
HC87-60	144	2	0	114	51.2
HC87-59	135	2	0	106	51.4
Persian	134	6	0	146	51.6
HC89-2018	135	5	5	110	52.3
9-5dt$_1$-1	151	4	0	115	53.1
Gnome 85	125	5	0	125	53.9
Evans	125	7	10	155	55.7
LSD (0.05) Yield					7.8

* from emergence.

1) 0 = none, 10 = 100% lodging.

Table 4. Performance characteristics of soybean varieties from four different origins and levels of adaptation to the Snake River Valley. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Variety	Days to maturity*	Height	Lodging		Shatter		Yield	
			1990	1991	1990	1991	1990	1991
		cm	0-10[1]		%		bu/acre	
Commercial								
Evans	125	155	6	7	0	10	56.9	55.7
Sibley	135	150	6	6	0	10	53.8	46.7
Semi-dwarf								
Gnome 85	125	125	5	5	0	0	58.9	53.9
Hoyt	141	94	4	2	0	0	39.8	40.0
Corvallis breeding								
OR 8	101	98	1	0	0	7	44.3	33.4
ORG-83-117	113	119	1	0	0	0	49.8	47.8
Ontario lines								
H4-4	105	116	1	0	0	5	55.9	44.8
H16-7	110	110	2	2	0	0	64.2	51.0
H16-4	113	145	3	6	0	0	61.9	51.2
H82-14	113	120	1	5	0	10	57.5	58.4
H16-3	119	125	1	0	0	0	73.2	59.3
H16-25	144	112	0	2	0	0	55.9	57.5

* from emergence

1) 0 = none, 10 = 100% lodging.

Table 5. Performance characteristics of varieties in vegetable soybean trial. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Variety	Days to maturity*	Lodging	Shatter	Height	Yield
		0-10[1]	%	cm	bu/acre
PI417451	135	6	90	110	8.0++
Disoy	165	6	0	125	18.3
Vinton 81	158	5	0	107	31.4
Grande	144	7	5	111	31.6
PI194647	115	0	90	115	32.1+
LSD (0.05) Yield					11.4

* from emergence

+ Hand harvested at 50% shatter

++ Mechanically harvested after most of the seed was lost

1) 0 = none, 10 = 100%.

IMPROVEMENT OF SUGAR LOAF SQUASH STAND ESTABLISHMENT

Erik Feibert and Clint Shock
Malheur Experiment Station
Oregon State University
Ontario, Oregon, 1991

Introduction

Sugar Loaf is a winter squash (Cucurbita pepo L.) variety released by James Baggett at Oregon State University in 1989. Trials conducted at the Malheur Experiment Station have examined the viability of Sugar Loaf squash as an alternate crop. However, stand establishment has been a problem in Ontario, especially in 1990. Sugar Loaf seed tends to have limited endosperm and show poor emergence. A low stand in the field resulted in poor initial soil cover and extended period of vine growth, leading to a high proportion of immature fruit at harvest. This trial tested two registered seed treatment fungicides for their efficacy in improving the emergence of Sugar Loaf squash.

Procedures

The trial was conducted on a Owyhee silt loam planted to potatoes the previous season. The field was worked into 72-inch beds on April 2. Plastic mulch was laid on April 30. The field was pre-irrigated on May 21 and the seeds planted on May 22. Each plot was 55 feet long with 100 seeds planted in 33 holes. Plots were in a randomized complete block with five replicates. The fungicides Thiram 50WP and Captan 75WP were applied as powder at the recommended rate to seed packets both in combination and singly making three fungicide treatments and a check. Emerged seedlings were counted on June 4, 7, and 11.

Results and Discussion

The mean minimum 4-inch soil temperature at the weather station during the field trial period was 60°F. The recommended minimum soil temperature for squash germination is 60 °F (1991 Vegetable Production Recommendations, Department of Horticulture, Oregon State University, Corvallis, OR). Because of the black plastic mulch, actual field soil temperatures were probably equal to or higher than the weather station soil temperatures, despite the pre-irrigation. A preliminary emergence test of this lot of seed in a potting mix in the greenhouse showed 86 percent germination without fungicide. Many of the cotyledons were misshapen.

Emergence in the field started on May 29. Seed treatment resulted in significantly higher emergence on all dates (Table 1). Seed treated with Captan alone was among the best treatments on all dates. Thiram plus Captan was not superior to Captan alone in this trial. Seed treatment with Captan also resulted in significantly higher final stands than Thiram treated seed (Table 1). Captan 75WP was an inexpensive and effective way to increase Sugar Loaf squash stands in this experiment.

Table 1. Effect of fungicide seed treatments on emergence and stand of Sugar Loaf squash. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Seed treatments	Plant counts		
	June 4	June 7	June 11
	------------- % -------------		
Check	43.2	49.8	47.4
Thiram	60.8	66.2	62.0
Captan	72.6	79.4	79.2
Thiram + Captan	70.8	77.8	77.2
LSD (0.05)	15.5	14.5	13.3

VARIETY AND PLANTING METHOD EVALUATION FOR WINTER SQUASH

Erik Feibert, Clint Shock, and Monty Saunders
Malheur Experiment Station
Oregon State University
Ontario, Oregon, 1991

Introduction

During the last three years there has been interest in planting certain squash varieties for export to Japan. Honey Boat and Sugar Loaf are two winter squash varieties (Cucurbita pepo L.) released by James Baggett at Oregon State University in 1989. Kabocha is a Japanese winter squash variety. Trials at Ontario have examined the viability of these varieties as alternate crops. Kabocha squash currently produced in Malheur county is exported to Japan.

This trial evaluates the three varieties with two planting methods (direct seed and transplant) for yield, quality, and relative profitability.

Procedures

The trial was conducted on a Owyhee silt loam, planted to potatoes the previous season. The field was worked into 72-inch beds on April 2. Black plastic mulch was laid on April 30 using a Model 90 Mulch Layer (Mechanical Transplanter Co., Holland , MI) pulled by a 35 h.p. tractor. Plots for the three varieties and two planting methods were 25 feet long by two rows wide (72 inch rows) in a randomized complete block with four replicates. Seed was treated with Thiram 50WP fungicide. The direct-seeded plots were planted on May 2 using a Model 900 Mulch Planter (Mechanical Transplanter Co., Holland, MI) pulled by a 35 h.p. tractor. Seed for the transplant plots was started in the greenhouse on March 29 and transplanted to the field on May 3. The in-row spacing was one plant each 20 inches. The field was furrow irrigated 11 times from May 3 to August 26. Direct seeded plots were replanted by hand on May 20 due to substantial seed loss to mice.

The strips between the plastic mulch were rototilled before and after the application of ethalfluralin herbicide at 1.5 pounds ai/acre (based on the area of bare soil) between the plastic mulch on June 10 for weed control. Plots were thinned as close as possible to one plant per hole on June 17. Uran was water run at 150 lbs N/acre on June 26. The field was hand weeded on July 2. To avoid competition of one variety with another, vines were separated between plots three times in July. Harvest occurred on September 24. All fruit in each plot were harvested and graded. The plastic mulch was lifted with a Model SL-48 Mulch Lifter (Zimmerman Irrigation, Mifflinburg, PA) pulled by a 85 h.p. tractor and then pulled off by hand.

Results and Discussion

Emergence started on May 20 (18 days after planting) for the first planting and May 29 (9 days after planting) for the second planting. Despite overplanting (2 to 3 seeds/hole) and replanting, three of the four Sugar Loaf direct seeded plots did not have full stand. Among the rest of the direct seeded plots only one Kabocha plot lacked full stand. Most of the transplant plots had set fruit by June 22, whereas most of the direct seed plots set fruit by July 2.

Kabocha had the highest total yield and the highest No. 1 yield (Table 1). Total yields of Kabocha were about double the total yield of either of the other two varieties. The yields in this trial are possibly not representative, possibly due to Kabocha outcompeting the other two varieties, in spite of separating the vines between plots. Kabocha has a higher vine growth rate and larger leaves and longer petioles than Sugar Loaf or Honey Boat. However the yields for Honey Boat and Sugar Loaf fall in the same range as observed in 1990.

When comparing No. 1 fruit as a percentage of the total number, Honey Boat and Sugar Loaf ranked higher than Kabocha (Table 2). This is a reflection of the high incidence of warts on Kabocha fruit ruling them out as No. 1's according to grading standards in Japan (Table 1).

Direct seeding of Honey Boat resulted in a higher percentage of immature fruit and a higher yield of immature fruit (Tables 1 and 2). This result was not related to stand (Table 1). Transplanting Sugar Loaf resulted in a higher total yield and No. 1 yield than direct seeding (Table 1). This result is not related to stand even though the mean stand for each treatment in Table 1 suggests to this conclusion. An examination of the actual plot stand in relation to yield reveals the lack of any relation. The higher proportion of immature fruit in the directly seeded Honey Boat and the lower yields in the directly seeded Sugar Loaf are probably a result of the later maturity of the directly seeded plots compared to the transplant plots. This is evidenced by the later fruit set of the directly seeded plots. Planting method did not have an effect on the Kabocha yields or maturity at harvest.

Certain assumptions were made in order to have the economic analysis better represent a commercial squash crop, but those costs deviated from the procedures of this trial. For fertilizer, 100 lbs P_2O_5 and 150 lbs of N were assumed to have been used. The herbicide Prefar at 5 lbs ai/acre was assumed to be applied pre-plant. The transplants were assumed to be purchased with the grower supplying the seed. The seed necessary was 2 lbs/acre for Kabocha and 1 lb/acre for both Honey Boat and Sugar Loaf. For the direct seeding the seed rates were 2 lbs/acre (1 seed/hole) for Kabocha and 1.5 lbs/acre (2 seeds/hole) for both Honey Boat and Sugar Loaf. The non-custom machinery costs were based on 50 acres of squash. Management costs were 4 percent of cash costs and general overhead was 3 percent of cash costs. The operating capital interest was 10 percent and was assumed to be borrowed for four months. The gross profit was based on the No. 1 yields in Table 1 and on $ 0.235/lb

(F.O.B. Portland) which was the price for export to Japan that Treasure Valley growers received for the 1991 crop.

Transplanting slightly increased net profit for Honey Boat and substantial increased net profit for Sugar Loaf due to the increased No. 1 yields (Table 3). Transplanting Kabocha reduced net profit due to the increased cost associated with transplants (Table 3).

In conclusion, for Kabocha, transplanting does not have an advantage over direct seeding. A good stand can be achieved without a high seeding rate and without thinning. For Honey Boat and Sugar Loaf, transplanting is an advantage, probably due to a better utilization of the available growing season. However, this advantage might be less if an earlier planting date can be used in direct seeding. The earlier planting in this trial (May 2) was largely lost and thus the effective planting date was May 20.

Table 1. Size class yield distribution of three varieties of winter squash with two planting methods. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Treatments		Yield by size class							
Variety	Planting method	Rot	Warts	Culls	Undrsz	Immatr	Num. one	Total yield	Plant stand
		---------------- Tons/acre ----------------							#/ac
Kabocha	Direct seed	2.08	7.31	0.22	0.01	0	13.92	23.54	4211
	Transplant	0.29	7.40	0.37	0.07	0	12.27	20.41	4356
	Average	1.19	7.36	0.29	0.04	0	13.10	21.98	
Honey Boat	Direct seed	0.82	0	0	0.25	0.81	9.94	11.82	4356
	Transplant	0.96	0	0	0.32	0.28	10.73	12.30	4356
	Average	0.89	0	0	0.28	0.55	10.34	12.06	
Sugar Loaf	Direct seed	0.10	0	0.07	0.45	0.49	8.40	9.51	4066
	Transplant	0.24	0	0.03	0.37	0.56	12.79	13.98	4356
	Average	0.17	0	0.05	0.41	0.53	10.59	11.75	
LSD(0.05) Variety		ns	1.19	ns	0.17	0.18	1.82	3.00	
LSD(0.05) Planting method		ns	ns	ns	ns	0.15	ns	ns	
LSD(0.05) Var.x plntng method		ns	ns	ns	ns	0.25	2.58	4.24	

Table 2. Size distribution of three varieties of winter squash with two planting methods. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Treatments		Fruit number by size class					
Variety	Planting method	Rot	Warts	Culls	Undrsz	Immatr	Number one
		%					
Kabocha	Direct seed	7.5	31.7	1.2	0.3	0	59.3
	Transplant	1.4	38.0	2.2	0.8	0	57.6
	Average	4.5	34.8	1.7	0.6	0	58.4
Honey Boat	Direct seed	8.5	0	0	4.3	11.3	75.9
	Transplant	9.5	0	0	5.3	3.3	81.8
	Average	9.0	0	0	4.8	7.3	78.9
Sugar Loaf	Direct seed	1.9	0	0.4	8.0	7.0	82.7
	Transplant	2.3	0	0.1	5.3	6.0	86.3
	Average	2.1	0	0.2	6.7	6.5	84.5
LSD(0.05) Variety		4.6	4.6	ns	2.8	2.1	6.6
LSD(0.05) Planting method		ns	ns	ns	ns	1.7	ns
LSD(0.05) Variety x plntng meth.		ns	ns	ns	ns	3.0	ns

Table 3. Estimated costs and income per acre for production of three winter squash varieties and two planting methods. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

	Honey Boat		Sugar Loaf		Kabocha	
Operations and machinery	Direct seeded	Transplant	Direct seeded	Transplant	Direct seeded	Transplant
Rip (custom)	50.00	50.00	50.00	50.00	50.00	50.00
Fertilize (custom)	5.00	5.00	5.00	5.00	5.00	5.00
Plow (custom)	16.00	16.00	16.00	16.00	16.00	16.00
Groundhog (custom)	20.00	20.00	20.00	20.00	20.00	20.00
Bed (custom)	9.00	9.00	9.00	9.00	9.00	9.00
Triple K with herbicide	7.00	7.00	7.00	7.00	7.00	7.00
(custom)	11.25	11.25	11.25	11.25	11.25	11.25
Lay plastic (Tractor)	7.00	7.00	7.00	7.00	7.00	7.00
Mulch layer	11.25	11.25	11.25	11.25	11.25	11.25
Plant (Tractor)	12.77	12.77	12.77	12.77	12.77	12.77
Mulch planter	70.00	70.00	70.00	70.00	70.00	70.00
Truck for harvest	43.00	43.00	43.00	43.00	43.00	43.00
Lift plastic (Tractor)	6.00	6.00	6.00	6.00	6.00	6.00
Mulch lifter	25.00	25.00	25.00	25.00	25.00	25.00
Plastic removal (truck)						

Table 3 continued on the next page

Table 3. continued

Costs	Honey Boat		Sugar Loaf		Kabocha	
Materials	Direct seeded	Transplant	Direct seeded	Transplant	Direct seeded	Transplant
Fertilizer	90.00	90.00	90.00	90.00	90.00	90.00
Herbicide	45.25	45.25	45.25	45.25	45.25	45.25
Plastic	155.00	155.00	155.00	155.00	155.00	155.00
Seed	20.00	12.50	20.00	12.50	98.00	98.00
Transplants		118.00		118.00		118.00
Irrigation water	76.00	76.00	76.00	76.00	76.00	76.00
Dump fee	10.00	10.00	10.00	10.00	10.00	10.00
Labor						
Lay plastic	32.00	32.00	32.00	32.00	32.00	32.00
Plant	16.00	16.00	16.00	16.00	16.00	16.00
Hand weed	40.00	40.00	40.00	40.00	40.00	40.00
Irrigate	50.00	50.00	50.00	50.00	50.00	50.00
Remove plastic	70.00	70.00	70.00	70.00	70.00	70.00
Sub total	897.52	1008.02	897.52	1008.02	974.52	1092.52
Fixed costs						
Interest on land (10%)	200.00	200.00	200.00	200.00	200.00	200.00
Taxes on land	20.00	20.00	20.00	20.00	20.00	20.00
Management	117.60	126.99	102.39	142.58	180.71	170.69
General overhead	88.20	95.24	76.69	106.93	135.52	128.01
Operating capital interest	97.02	104.77	84.47	117.62	149.08	140.82
Total cost (excluding variable)	1420.34	1555.02	1381.07	1595.15	1659.83	1752.04
Variable costs						
Harvest labor	0.016	0.016	0.016	0.016	0.016	0.016
Cleaning	0.020	0.020	0.020	0.020	0.020	0.020
Storage facility	0.009	0.009	0.009	0.009	0.009	0.009
Packing labor	0.003	0.003	0.003	0.003	0.003	0.003
Totes	0.031	0.031	0.031	0.031	0.031	0.031
Hauling to town	0.007	0.007	0.007	0.007	0.007	0.007
Shipping to Portland	0.015	0.015	0.015	0.015	0.015	0.015
Total variable costs	2177.08	2308.76	1796.70	2690.68	3677.64	3211.14
Total cash costs	2940.08	3174.76	2559.70	3564.18	4517.64	4169.14
Total costs	3597.42	3863.76	3177.77	4285.83	5337.47	4963.18
Gross profit	4671.80	5043.10	3948.00	6011.30	6542.40	5766.90
Net profit	1074.38	1179.32	770.23	1725.47	1204.93	803.72

1) 100 lb P_2O_5 and 150 lb N
2) Kabocha: 2 lbs/ac (1 seed/hole), Honey Boat and Sugar Loaf: 1.5 lb/ac (2 seeds/hole)
3) assumed to be purchased (grower supplies seed; Kabocha: 2 lbs/ac, Honey Boat and Sugar Loaf: 1 lb/ac)
4) 4% of cash costs
5) 3% of cash costs
6) 10% (assumed to be borrowed for 4 months)
7) based on #1 yields in Table 1 and $ 0.235/lb (F.O.B. Portland)

GROUNDCOVER OPTIONS AND IRRIGATION METHODS FOR THE PRODUCTION OF KABOCHA SQUASH

Erik Feibert, Clint Shock, Tim Stieber, and Monty Saunders
Malheur Experiment Station
Oregon State University
Ontario, Oregon, 1991

Introduction

Kabocha is a Japanese winter squash variety. Trials at Ontario have examined the viability of this variety as an alternate crop. Kabocha squash currently produced in Malheur County, Oregon, is exported to Japan. One of the problems with Kabocha grown in Ontario is the high incidence of skin defects that resemble warts. Fruit with warts are graded as No. 2's according to Japanese standards. Skin warts may be caused by the contact of the fruit skin with wet soil. Three groundcovers and two irrigation methods are evaluated in relation to the incidence of warts and in relation to yield and quality of Kabocha squash.

Procedures

The trial was conducted on a Owyhee silt loam which had been planted to potatoes the previous season. The field was worked into 72 inch beds on April 2. Wheat for the wheat straw plots was planted on April 4. The trial was uniformly furrow irrigated on April 4 and on May 4. Wheat plots were sprayed with Roundup (1.2 lb ai/ac) to kill the wheat on May 25. Drip tube and black plastic mulch were laid on May 29 using a Model 90 Mulch Layer (Mechanical Transplanter Co., Holland, #MI) pulled by a 35 h.p. tractor. The black polyethylene drip tubing (Wade Mfg. Co., Tualatin, OR) was placed in the furrow under the plastic mulch. Seed was obtained from American Takii Inc., Salinas, CA and was treated with Thiram 50WP fungicide. The squash was planted on May 29 using a Model 900 mulch planter (Mechanical Transplanter Co., Holland ,MI) pulled by a 35 h.p. tractor. The combination of three groundcover types and two irrigation methods resulted in six treatments (Table 1). Plots were 25 feet long by two rows wide (72 inch rows) in a randomized complete block design with four replicates. The in-row spacing was one plant each 20 inches.

The strips between the plastic mulch were rototilled before and after the application of ethalfluralin herbicide at 1.5 pounds ai/acre (based on the area of bare soil) between the plastic mulch on June 10 for weed control. Plots were thinned as close as possible to one plant per hole on June 17. The plots were furrow or drip irrigated 11 times from June 11 to August 26. Soil water potential was monitored using one granular matrix sensor (Watermark Soil Moisture Sensor Model 200X, Irrometer Co.) placed six inches deep in each plot. Soil water potential was estimated from sensor readings made four to five times per week from July 1 to August 15.

Urea-ammonium nitrate at 150 lbs N/acre was water run on June 26. Harvest occurred on September 24. All the fruit in each plot was harvested and graded. The plastic mulch was lifted with a Model SL-48 Mulch Lifter (Zimmerman Irrigation, Mifflinburg, PA) pulled by a 85 h.p. tractor and then pulled off by hand. A cost analysis was done in order to compare the cost and benefits of the different treatments.

Results and Discussion

Emergence started on June 10 (12 days after planting). After thinning all plots had a full stand of 4356 plants/acre. The plots with plastic mulch started setting fruit on July 15 and the straw and no groundcover plots started setting fruit on July 22. Leaf size measurements and leaf counts showed that the plastic mulch plots had plants with significantly larger leaves and a higher number of leaves than either the straw or no groundcover plots (Table 2). The straw plots had plants with the lowest number of leaves and the smallest leaves. This is probably due to the lower initial availability of nitrogen in the straw plots due to the uptake of N by the wheat.

Drip irrigation used 1 acre foot of water per acre and furrow irrigation used 2 acre feet of water per acre. Significant differences in soil water potential between treatments only occurred in the first half of July. The average soil water potential for all plots from July 1 to August 15 was -42 kPa (Table 1).

Plastic mulch resulted in the highest amounts of rotten fruit in terms of both percent of total fruit number and in percent of total yield (Tables 3, 4 and 5). Straw plots resulted in the lowest amount of rotten fruit (Table 3, 4 and 5). There was no significant difference in either total yield or total number of fruit between the different treatments (Table 4). The yield and number of fruit in this trial are lower than normal for the Malheur Experiment Station. The depressed yields are probably due to the late planting date (May 29). The ideal planting date is mid-May. Plastic mulch plots resulted in the lowest amount of fruit with warts in terms of both yield and percent of total yield (Table 5). Straw plots resulted in the highest amounts of fruit with warts (Table 5).

Certain assumptions were made in order to have the economic analysis better represent a commercial squash crop, but those costs deviated from the procedures of this trial. For fertilizer, 100 lbs P_2O_5 and 150 lbs of N were assumed to be used. The herbicide Prefar at 5 lbs ai/acre was assumed to be applied pre-plant to all except the wheat straw treatments. Two pounds of seed per acre (1 seed/hole) were assumed to be sufficient considering the good emergence and vigorous growth of Kabocha. The non-custom machinery and the well costs were based on 50 acres of squash. The plastic irrigation pipe for the furrow irrigation was depreciated for 25 years and the drip tubing was depreciated for 10 years. The pump and well costs include materials, installation and permits and fees and was depreciated for 20 years.

Management costs were 4 percent of cash costs and general overhead was 3 percent of cash costs. The operating capital interest was 10 percent and was assumed to be borrowed for four months. The gross profit was based on the No. 1 yields in Table 4 and on $ 0.235/lb (F.O.B. Portland), the price for export to Japan that Treasure Valley growers received for the 1991 crop.

The high incidence of skin warts (50 - 70 percent of total yield) and the depressed yields resulted in an economic loss for all treatments (Table 6). The grading standards used in this trial were according to those in Japan and a number one fruit was only allowed a small number of skin warts. The drip irrigated and plastic mulch treatment resulted in the smallest loss due to this treatment having the lowest amount of fruit with warts and the highest yield of No. 1 fruit.

Table 1. Average soil water potential in Kabocha squash with three groundcovers and two irrigation methods. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Treatments		Soil Water Potential			
		7-1 to 7-15	7-16 to 7-31	8-1 to 8-15	7-1 to 8-15
Groundcover	Irrigation	- kPa			
None	Furrow	41	40	57	46
	Drip	49	39	51	46
	Average	45	39	54	46
Straw	Furrow	18	40	67	44
	Drip	27	29	43	34
	Average	23	35	55	39
Plastic	Furrow	24	28	37	30
	Drip	64	36	52	50
	Average	44	32	45	40
All covers	Furrow	27	36	54	40
	Drip	47	35	49	43
	Average	37	35	51	42
LSD (0.05) Irrigation		14	ns	ns	ns
LSD (0.05) groundcover		18	ns	ns	ns
LSD (0.05) Irrigation x groundcover		ns	ns	ns	ns

Table 2. Vegetative characteristics of Delicata Kabocha squash as influenced by irrigation system and ground cover. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Treatment		Leaf size July 2	Leaf count* June 26
Groundcover	Irrigation	inches	#/plant
None	Furrow	3.1	3.8
	Drip	2.8	3.9
	Average	3.0	3.8
Straw	Furrow	2.5	3.0
	Drip	2.7	3.2
	Average	2.6	3.1
Plastic	Furrow	3.3	4.6
	Drip	3.8	6.3
	Average	3.6	5.4
All covers	Furrow	3.0	3.8
	Drip	3.1	4.4
	Average	3.0	4.1
LSD (0.05) Irrigation		ns	ns
LSD (0.05) Groundcover		0.3	0.8
LSD (0.05) Irrigation x groundcover		ns	ns

* Other than cotyledons

Table 3. Size distribution of Delicata Kabocha squash as influenced by irrigation system and ground cover. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Treatments		Number by size class				
Groundcover	Irrigation	Small	Medium	Large	Extra large	Rot
		%				
None	Furrow	16.1	32.4	27.5	22.2	1.8
	Drip	23.7	25.9	22.9	24.9	2.7
	Average	19.9	29.2	25.2	23.5	2.2
Straw	Furrow	18.2	32.3	29.5	19.5	.5
	Drip	16.9	27.5	31.8	22.5	1.4
	Average	17.5	29.9	30.6	21.0	.9
Plastic	Furrow	16.4	29.2	24.2	26.4	3.8
	Drip	17.0	23.6	29.6	23.7	6.0
	Average	16.7	26.4	26.9	25.1	4.9
All Covers	Furrow	16.9	31.3	27.1	22.7	2.0
	Drip	19.2	25.7	28.1	23.7	3.3
	Average	18.0	28.5	27.6	23.2	2.7
LSD (0.05) Irrigation		ns	4.0	ns	ns	ns
LSD (0.05) Groundcover		ns	ns	ns	ns	2.9
LSD (0.05) Irrig x grndcvr		ns	ns	ns	ns	ns

Table 4. Size class yield distribution of Delicata Kabocha squash as influenced by irrigation system and ground cover. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Treatments		Yield by size class					
Groundcover	Irrigation	Small	Medium	Large	Extra large	Rot	Total yield
		Tons/acre					
None	Furrow	1.3	3.9	4.0	4.3	0.18	13.7
	Drip	1.8	3.0	3.3	4.8	0.27	13.3
	Average	1.5	3.4	3.7	4.6	0.23	13.5
Straw	Furrow	1.62	4.2	4.8	4.5	0.04	15.2
	Drip	1.4	3.4	4.9	4.7	0.16	14.6
	Average	1.5	3.8	4.9	4.6	0.10	14.9
Plastic	Furrow	1.4	3.6	3.8	5.3	0.43	14.5
	Drip	1.4	3.2	5.1	5.6	0.80	16.1
	Average	1.4	3.4	4.4	5.4	0.62	15.3
All covers	Furrow	1.4	3.9	4.2	4.7	0.22	14.4
	Drip	1.6	3.2	4.5	5.0	0.42	14.7
	Average	1.5	3.6	4.3	4.9	0.32	14.6
LSD (0.05) Irrigation		ns	0.55	ns	ns	ns	ns
LSD (0.05) Groundcover		ns	ns	0.95	ns	0.35	ns
LSD (0.05) Irrig x grndcvr		ns	ns	ns	ns	ns	ns

Table 5. Market grade distribution of Delicata Kabocha squash as influenced by irrigation system and ground cover. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Treatments		Yield				% Yield		
Groundcover	Irrigation	Rot	Warts	Num. 1	Total	Rot	Warts	Num. 1
		Tons/acre				%		
None	Furrow	0.19	8.8	4.6	13.7	1.35	64.6	33.8
	Drip	0.28	8.3	4.5	13.3	1.96	63.7	33.6
	Average	0.23	8.6	4.6	13.5	1.65	64.1	33.7
Straw	Furrow	0.04	10.2	4.8	15.2	0.35	68.5	30.5
	Drip	0.16	9.2	5.2	14.6	1.17	63.0	35.2
	Average	0.10	9.7	5.0	14.9	0.76	65.8	32.8
Plastic	Furrow	0.44	7.9	6.0	14.5	2.89	55.0	40.9
	Drip	0.81	7.3	7.9	16.1	4.99	44.8	48.8
	Average	0.62	7.6	6.9	15.3	3.94	49.9	44.9
All covers	Furrow	0.22	9.0	5.1	14.4	1.52	62.7	35.0
	Drip	0.42	8.3	5.9	14.7	2.71	57.1	39.2
	Average	0.32	8.6	5.5	14.6	2.12	59.9	37.1
LSD (0.05) Irrigation		ns	ns	ns	ns	ns	ns	ns
LSD (0.05) Groundcover		0.35	1.4	1.7	ns	2.21	9.1	8.6
LSD (0.05) Irrig x grndcvr		ns	ns	ns	ns	ns	ns	ns

Table 6. Estimated costs and income per acre for production of Kabocha squash with three ground-covers and two irrigation methods. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1992.

Costs *	No groundcover		Straw		Plastic	
	Furrow	Drip	Furrow	Drip	Furrow	Drip
<u>Operations and Machinery</u>	$/acre					
Rip (custom)	50.00	50.00	50.00	50.00	50.00	50.00
Fertilize (custom)	5.00	5.00	5.00	5.00	5.00	5.00
Plow (custom)	16.00	16.00	16.00	16.00	16.00	16.00
Groundhog (custom)	20.00	20.00	20.00	20.00	20.00	20.00
Bed (custom)	9.00	9.00	9.00	9.00	9.00	9.00
Triple K with herbicide (cu-	7.00	7.00			7.00	7.00
stom)					11.25	11.25
Lay plastic (Tractor)					7.00	7.00
Mulch layer	11.25	11.25	11.25	11.25	11.25	11.25
Plant (Tractor)	12.77	12.77	12.77	12.77	12.77	12.77
Mulch planter	70.00	70.00	70.00	70.00	70.00	70.00
Truck for harvest					43.00	43.00
Lift plastic (Tractor)					6.00	6.00
Mulch lifter					25.00	25.00
Plastic removal (truck)			8.00	8.00		
Plant wheat (custom)			5.75	5.75		
Spray Roundup (custom)						
<u>Materials</u>						
Fertilizer	90.00	90.00	90.00	90.00	90.00	90.00
Herbicide	45.25	45.25			45.25	45.25
Plastic					155.00	155.00
Seed	98.00	98.00	98.00	98.00	98.00	98.00
Irrigation water	18.00		18.00		18.00	
Dump fee					10.00	10.00
Plastic pipe (150 ft)	12.00		12.00		12.00	
Drip tubing and emitters		87.00		87.00		87.00
Well, pump and tubing		32.00		32.00		32.00
Electricity to pump		4.50		4.50		4.50
Wheat seed			12.00	12.00		
Roundup (1.5 qt/ac)			16.00	16.00		
<u>Labor</u>						
Lay plastic					32.00	32.00
Plant	16.00	16.00	16.00	16.00	16.00	16.00
Hand weed	40.00	40.00	40.00	40.00	40.00	40.00
Irrigate	66.00	48.00	66.00	48.00	66.00	48.00
Remove plastic					70.00	70.00
Sub total	586.27	661.77	575.77	651.27	945.52	1021.02

(Continued on next page)

(Table 6. Continued)

Costs *	No groundcover		Straw		Plastic	
	Furrow	Drip	Furrow	Drip	Furrow	Drip
	$/acre					
Fixed costs						
Interest on land (10%)	200.00	200.00	200.00	200.00	200.00	200.00
Taxes on land	20.00	20.00	20.00	20.00	20.00	20.00
Management	85.86	83.43	91.73	90.83	101.61	115.34
General overhead	64.39	62.57	68.8	68.12	76.21	86.51
Operating capital interest	70.83	68.83	75.68	74.93	83.83	95.16
Total cost (excluding variable)	1027.35	1096.6	1031.98	1105.15	1427.17	1538.03
Variable costs	$/lb					
Harvest labor	0.016	0.016	0.016	0.016	0.016	0.016
Cleaning	0.020	0.020	0.020	0.020	0.020	0.020
Storage facility	0.009	0.009	0.009	0.009	0.009	0.009
Packing labor	0.003	0.003	0.003	0.003	0.003	0.003
Totes	0.031	0.031	0.031	0.031	0.031	0.031
Hauling to town	0.007	0.007	0.007	0.007	0.007	0.007
Shipping to Portland	0.015	0.015	0.015	0.015	0.015	0.015
	$/acre					
Total variable costs	1748.20	1701.00	1905.60	1896.40	1977.00	2333.80
Total cash costs	2146.45	2085.75	2293.35	2270.65	2540.25	2883.55
Total costs	2775.55	2797.6	2937.58	3001.55	3404.17	3871.83
Gross profit	2162.00	2115.00	2256.00	2444.00	2820.00	3713.00
Net profit	-613.55	-682.60	-681.58	-557.55	-584.17	-158.83

* Cost assumptions:

1) 100 lb P_2O_5 and 150 lb N
2) 2 lbs/ac (1 seed/hole)
3) depreciated for 25 years.
4) depreciated for 10 years.
5) includes materials, installation and permits and fees. Is depreciated for 20 years.
6) 4% of cash costs
7) 3% of cash costs
8) 10% (assumed to be borrowed for 4 months)
9) based on #1 yields in Table 4 and $ 0.235/lb (F.O.B. Portland)

STORAGE CONDITIONS FOR WINTER SQUASH

Erik Feibert and Clint Shock
Malheur Experiment Station
Oregon State University
Ontario, Oregon, 1991

Introduction

Growers have produced limited amounts of hard winter squash for sale to local markets and export to Japan. Export markets demand a high quality product requiring that squash be harvested, handled, stored, and shipped in a manner to guarantee that the importer will receive an excellent product. Varieties of interest in Japan include Kabocha, Sugar Loaf, and Honey Boat.

Information on optimal temperature and relative humidity conditions for squash storage is limited. Many squash storage trials in the literature were conducted prior to the development of currently used market varieties. Consequently, a storage trial was designed to examine squash storability over time at 41, 50, and 59° F and 50, 60, and 70 percent relative humidity using currently popular varieties.

Procedures

Eight varieties of winter squash were grown on an Owyhee silt loam that had been planted to potatoes the previous season. The field was worked into 72 inch beds on April 2, 1991. Black plastic mulch was laid on April 30 using a Model 90 Mulch Layer (Mechanical Transplanter Co., Holland , MI). Seed was treated with Thiram 50 WP fungicide. The squash was direct seeded May 2, at 2 seeds per 20 inches, using a Model 900 Mulch Planter (Mechanical Transplanter Co., Holland, MI). The field was furrow irrigated 11 times from May 3 to August 26.

The strips between the plastic mulch were rototilled before and after the application of ethalfluralin herbicide at 1.5 pounds ai/acre (based on the area of bare soil) between the plastic mulch on June 10. Plots were thinned as close as possible to one plant per hole on June 17. Uran was water run at 150 lbs N/acre on June 26. The field was hand weeded on July 2. Squash were harvested September 24 - 26. All fruit in each plot were cut by hand and placed into 700 lb totes. Totes were transported to a packing shed and held at ambient temperature until the storage trial began October 12.

Before storage, nine fruit from each variety were weighed, and Brix sugar and fruit oven dry weight were determined. The fresh weight of 243 squash of each variety was recorded individually for use in the storage treatments. Squash from each variety were stored for 9, 15, and 21 weeks at 41, 50, and 59°F (5, 10, and 15°C) and 50, 60, and 70 percent humidity. Consequently, there were 9 treatment combinations and three durations. The 243 squash from a given variety were divided equally into 27 sets (the nine treatment combinations and three durations).

Squash were removed from storage on December 10, January 28, and March 16. Squash were individually weighed and ranked for spoilage and discoloration. Brix sugar and fruit oven dry weight were determined.

The proportion of marketable fruit after storage was determined for each storage treatment, variety, and duration by weighing each squash individually after storage and summing the weights of all perfect, unblemished fruit. The percent of marketable fruit was calculated by comparing the total weight of perfect fruit after storage with the total weight of the squash initially stored in the particular treatment and duration.

Results and Discussion

Winter squash placed into storage ranged from 1.2 to 7.2 pounds depending on variety (Table 1). Spaghetti squash had low dry weight and low sugars while Kabocha, Sugar Loaf, and Honey Boat had high dry weight and high sugars.

Squash of all varieties suffered high spoilage when stored at 41°F (Table 2). Water losses increased with temperature (Table 3) or storage at 50 percent relative humidity. Considering both spoilage and water loss, marketable fruit was highest when squash was stored at 50 or 59°F and 60 to 70 percent relative humidity (Table 4). Fruit discoloration occurred with the prolonged storage of Table Ace Acorn, Sweet Dumpling, Honey Boat, and Sugar Loaf squash at 50 and 59°F (Table 5). Discoloration was aggravated at 59°F. Squash sugars were maintained with storage at 41 and 50°F.

Squash can be stored at 50°F and 60 to 70 percent relative humidity with little loss of quality or sugar. The marketing season can be extended for several months after harvest.

Table 1. Characteristics of eight winter squash varieties used in storage trials. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1992.

Variety	Average weight	Skin color	Flesh color	Initial dry weight	Initial sugar	Marketable fruit*
	lbs			%		
Table Ace Acorn	1.9	dark green	orange	15	10	76
Sweet Dumpling	1.3	cream w/ green stripes	beige	17	10	85
Waltham Butternut	3.9	tan	orange	13	6	76
Honey Boat	1.2	orange w/ green stripes	light yellow	19	9	86
Sugar Loaf	1.2	orange w/ green stripes	light yellow	20	11	86
Spaghetti	3.5	yellow	off white	7	5	84
Goldkeeper	7.2	dark orange	orange	12	6	72
Kabocha	3.6	green w/ green stripes	orange	24	8	79
LSD (0.05)	0.2			3	2	8

* after storage at 50° F averaged over 9, 15, and 21 weeks, (12 to 24 weeks after harvest) and over 50, 60, and 70 percent relative humidity.

Table 2. Unspoiled fruit of eight winter squash varieties as influenced by storage temperature. Unspoiled ratings are the averages over three storage durations (9, 15, and 21 weeks) and three storage relative humidities (50, 60, and 70 percent). Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1992.

Variety	Storage temperature °F		
	41	50	59
	% Unspoiled		
Table Ace Acorn	49	83	99
Sweet Dumpling	63	93	95
Waltham Butternut	40	83	96
Honey Boat	74	98	96
Sugar Loaf	65	96	93
Spaghetti	35	90	100
Goldkeeper	22	78	73
Kabocha	63	88	78
Averages	51	88	91

LSD (0.05) Variety = 5 percent
LSD (0.05) Temp = 3 percent
LSD (0.05) Variety x temp = 9 percent

Table 3. Water loss from the fruit of eight winter squash varieties as influenced by storage temperature. Water losses are the averages over three storage durations (9, 15, and 21 weeks) and three storage relative humidities. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1992.

Variety	Storage temperature °F		
	41	50	59
	- - - - - - - % Water loss - - - - - -		
Table Ace Acorn	8	9	19
Sweet Dumpling	6	8	11
Waltham Butternut	5	8	13
Honey Boat	9	12	15
Sugar Loaf	7	11	13
Spaghetti	3	7	9
Goldkeeper	4	7	7
Kabocha	7	9	12
Averages	6	9	12

LSD (0.05) Variety = 0.7 percent
LSD (0.05) Temperature = 0.4 percent
LSD (0.05) Variety x temp = 1.2 percent

Table 4. Marketable squash after storage as influenced by storage duration, temperature, and relative humidity. Data are averages over eight winter squash varieties. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1992.

Storage	Temperature	Relative humidity			
		50	60	70	Average
weeks	°F	------------- % Marketable -------------			
9	41	91	95	85	90
	50	94	92	95	94
	59	92	91	93	92
	Average	92	93	91	92
15	41	39	47	36	41
	50	86	86	87	86
	59	85	78	75	q79
	Average	70	70	66	69
21	41	9	17	11	12
	50	61	54	69	62
	59	67	70	71	69
	Average	46	47	50	48

LSD (0.05) Temperature = 2.3 percent
LSD (0.05) Duration = 2.3 percent
LSD (0.05) Rel. humidity = ns
LSD (0.05) Temp x duration = 4.1 percent

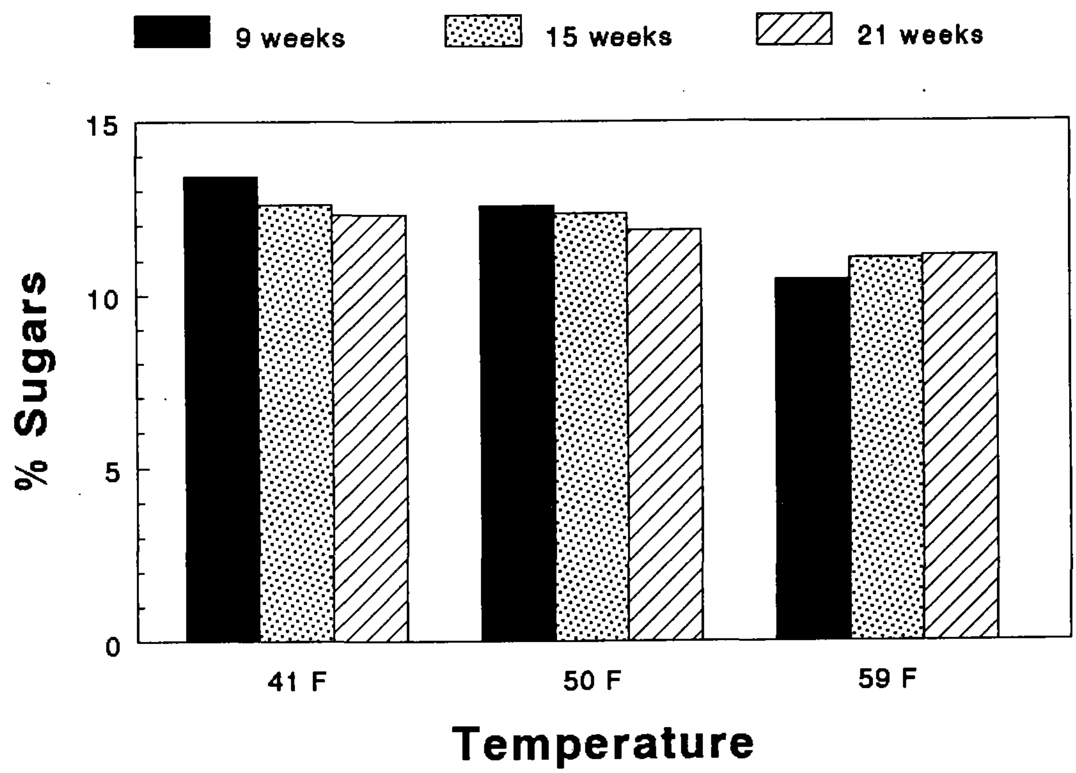


Figure 1. Effect of storage temperature and duration on the brix sugars in unspoiled storage squash. Sugar levels were averaged over eight varieties and three storage relative humidities. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1992.

LSD (0.05) Temperature = 0.3 percent
LSD (0.05) Duration = 0.3 percent
LSD (0.05) Temp x duration = 0.5 percent

Table 5. Quality of eight winter squash varieties stored at three temperatures. Data are averages from three storage durations (9, 15, and 21 weeks) and three storage humidities (50, 60, and 70 percent). Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1992.

Variety	Storage temperature	Sugars	Discoloration	Unspoiled	Water loss	Marketable fruit
	°F	%		----------	%	----------
Table Ace Acorn	41	12.7	no	49	8	45
	50	11.0	yes*	83	9	76
	59	8.5	yes**	99	19	80
Sweet Dumpling	41	15.8	no	63	6	59
	50	14.3	yes*	93	8	85
	59	12.4	yes*	95	11	84
Waltham Butternut	41	12.3	no	40	5	38
	50	11.3	no	83	8	76
	59	9.9	no	96	13	84
Honey Boat	41	16.0	no	74	9	68
	50	15.3	yes*	98	12	86
	59	14.4	yes*	96	15	82
Sugar Loaf	41	16.0	no	65	7	61
	50	16.6	yes*	96	11	86
	59	15.8	yes*	93	13	80
Spaghetti	41	7.2	no	35	3	33
	50	6.8	no	90	7	84
	59	5.6	no	100	9	91
Goldkeeper	41	10.2	no	22	4	15
	50	8.0	no	78	7	73
	59	7.1	no	73	7	68
Kabocha	41	15.4	no	63	7	57
	50	15.1	no	88	9	79
	59	13.6	no	78	12	69
LSD (0.05) Variety		0.5	-	5	1	4
LSD (0.05) Variety x temp		0.8	-	9	1	8

* Discolored after first six weeks of storage.

** Discolored during first six weeks of storage.

OPTIMUM PLANT POPULATION OF SUPERSWEET CORN

Erik Feibert[1], Clint Shock[1], Jim Zalewski[2], and Monty Saunders[1]
[1]Malheur Experiment Station
Oregon State University and
[2]Ore-Ida Foods, Inc.
Boise, Idaho, 1991

Objective

Few studies have been done to determine the range of ideal plant populations for supersweet corn. Ideal plant populations to maximize grain yield of field corn and useable ear yield of sweet corn are well established based on production area, cultivar maturity, soil, and fertility status. For sweet corn ideal plant populations are lower than for field corn because ear size and quality are primary considerations. Ideal plant population for the normal sweet corn cultivar Golden Jubilee grown in the Treasure Valley of eastern Oregon and southwestern Idaho is thought to be 25,000 plants per acre.

Materials and Methods

The trial was located on a Greenleaf silt loam soil following sugar beets. One hundred pounds of phosphate per acre as triple superphosphate was broadcast and then the field was ripped and chisel-plowed in November, 1990. The field was corrugated into 30-inch rows. Roundup at 1 qt. ai/acre and 2,4D at 1 qt. ai/acre were applied preplant on
April 22 to kill remaining weeds. The field was preirrigated on May 4, and treated with the preplant application Lasso at 3 lbs ai/acre on May 14. The Lasso was incorporated with a bed harrow and roller.

Abbott and Cobb 7710 supersweet corn seed treated with Thiram-Benomyl-Apron was planted May 15 in four row plots twenty-five feet long. Seed was planted at 30, 40, 50, 60, and 70 thousand plants per acre and thinned to final plant stands of 15, 20, 25, 30, and 35 thousand plants per acre. When plants were thinned, plants were not selected for removal based on size or vigor. Each population treatment was replicated five times in a randomized complete block design.

Weedar (2,4 D) was sprayed for weed control at 2 lbs ai/acre on June 19. The field was sidedressed with 150 lbs N/acre as urea June 28 and cultivated on July 2. After planting, the trial received seven irrigations in alternating furrows starting on June 12.

Before harvest the middle 17 feet of the two center rows of each plot were flagged and the number of plants in the harvest area counted to determine the final plant population. Ears from the plants in this interior part of the plot were harvested, weighed, and counted.

A 20-ear subsample from each plot was husked. Ear length, ear diameter at the base, and ear diameter six inches from the base were measured and averaged for each plot. Ears were evaluated for kernel row number and maturity, and cobs were graded as A, B, or C according to processing standards. Population treatment effects on all parameters were based on regression using the actual plant population in each harvest area.

Results and Discussion

Supersweet corn unhusked ear yields increased and then decreased with plant population to a maximum of 7.50 tons/acre at 24,900 plants per acre in 1991 according to the relationship in Figure 1 as follows:

$$Y = -2.09 + 7.71 \times 10^{-4} P - 1.55 \times 10^{-8} P^2 \qquad R^2 = 0.84$$

Where Y = yield in tons per acre
P = plant population in plants per acre.

In 1990 the maximum yield was 7.43 tons/acre at 23,200 plants/acre.

The number of marketable ears also increased and then decreased with plant population with a maximum at 31,200 plants per acre (Figure 2). In 1990 the number of marketable ears increased until 28,000 plants per acre. There is a clear trade-off of total cob yield and yield of marketable cobs. The number of marketable ears peaks at a higher population than total yield.

On the other hand, ear quality measurements showed declines with increasing plant population. Average ear length declined with population, dipping below eight inches at 32,300 plants per acre (Figure 3). Basal-end ear diameter and ear diameter at six inches also decreased with increasing plant population (Figure 4). Average ear weight declined with increasing plant population (Figure 5). Ear maturity, kernel row number, and the proportion of the different ear grades were unaffected by plant population.

As indicated by the results this year and last year, there are clear trade-offs of number of marketable ears per acre and ear quality. Populations targeted well below the population resulting in maximal number of marketable ears (31,200 plants per acre) are desirable to assure the market quality of the ears. Abbott and Cobb, the supplier of 7710, recommend a population of 22,000 to 24,000 plants per acre for this variety. This research indicates an optimal plant population of 23,200 to 24,900 for supersweet corn yields in the Treasure Valley. Given the sensitivity of supersweet stands to planting conditions and the year to year variation in seed vigor, a target seeding rate considerably above 25,000 seed per acre may be advisable to obtain a final plant stand of 23,000 to 25,000 plants per acre.

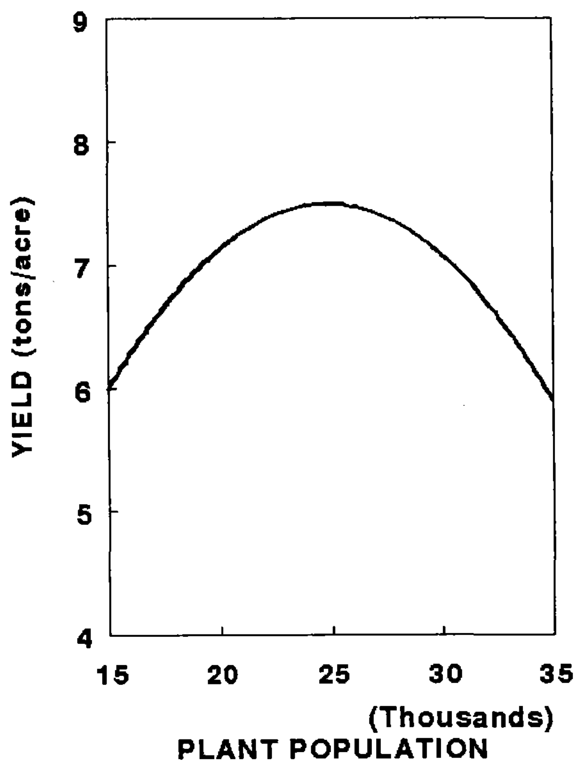


Figure 1. Primary ear yield of Abbott and Cobb 7710 supersweet corn in response to increasing plant population, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

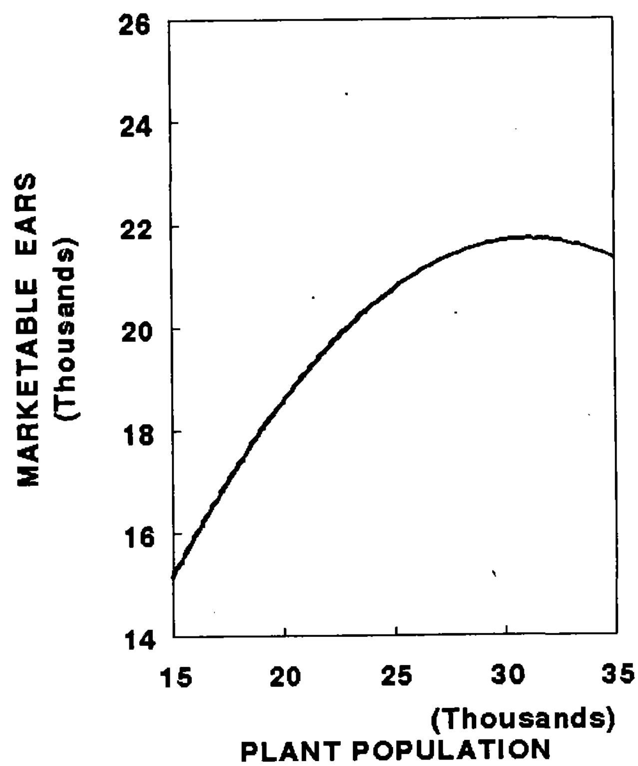


Figure 2. Marketable ears of Abbott and Cobb 7710 supersweet corn in response to increasing plant population, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

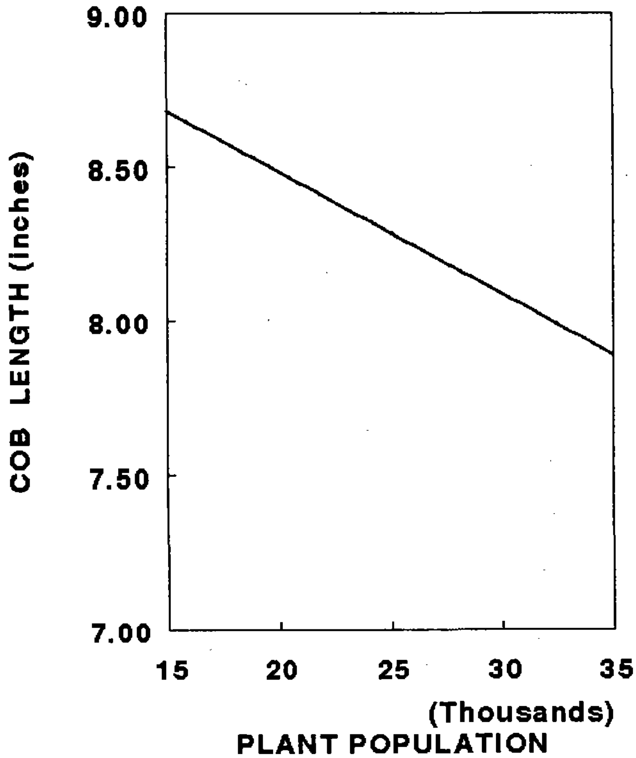


Figure 3. Cob length in inches decreased with plant population, r^2 = 0.73. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

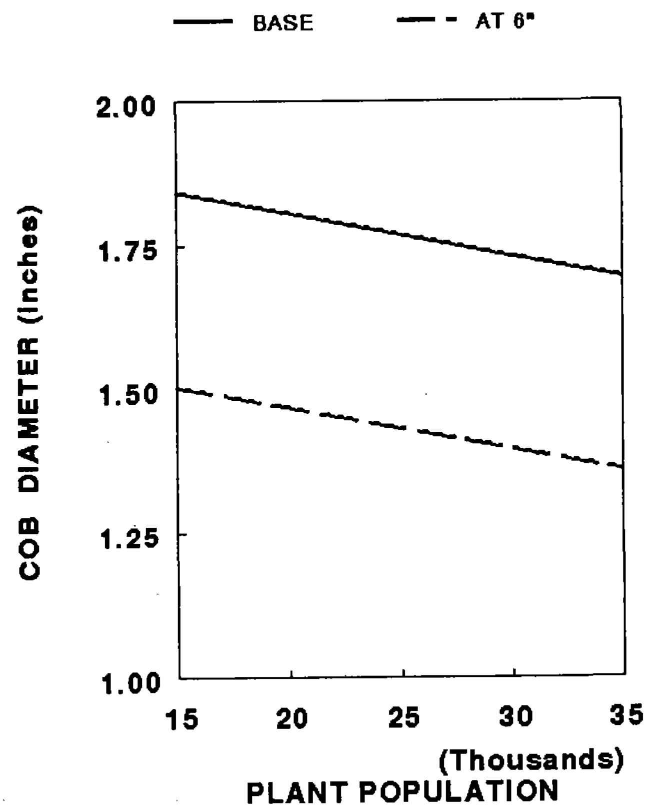


Figure 4. Both cob diameter at the base (upper line), r^2 = 0.43, and cob diameter at 6 inches (lower line), r^2= 0.45, decreased with plant population. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

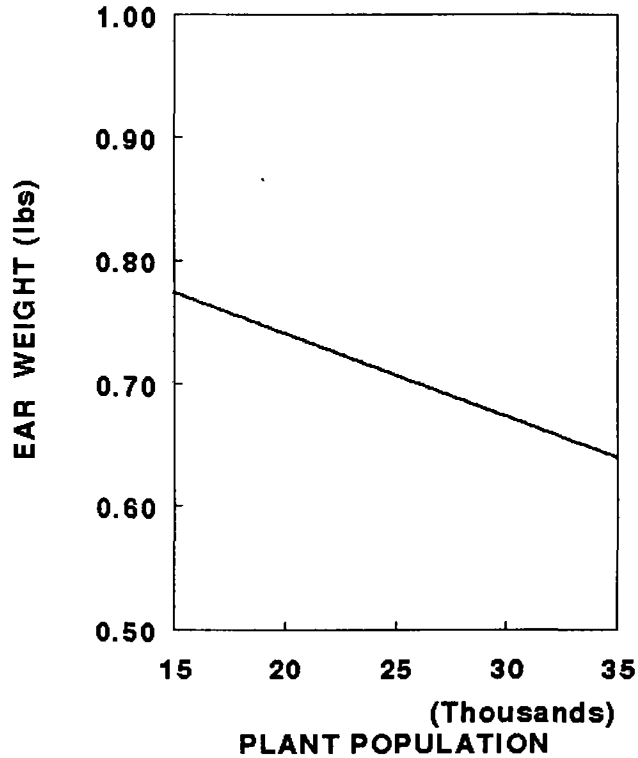


Figure 5. Ear weight decreased in response to increasing plant population, r^2 = 0.26. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

COMMERCIAL SORTING OF SUPERSWEET CORN SEED FOR ASSURED YIELD

Erik Feibert[1], Clint Shock[1], Bob Trent[2] and Monty Saunders[1]
[1]Malheur Experiment Station
Oregon State University
Ontario, Oregon,
[2]Crookham Seed Company, Caldwell, Idaho

Objective

The effects of seed class and seed density on supersweet corn plant stand, plant development, and yield were examined using a single lot of Crisp 'N Sweet 710. Seed class and seed density can be controlled in packaging supersweet corn seed and could provide a means for more reliable plant stand establishment.

Introduction

Emergence and performance of supersweet corn can be unpredictable. The roles of pathogens, genotypes, seed lots, fungicides, and bactericides in stand and vigor loss are being investigated. Within any commercial lot of supersweet corn seed, variation exists as to seed size, type, and weight. The seed industry and growers have a mutual interest in understanding what fractions of supersweet corn seed are of high quality and what fractions have marginal quality. Results of the 1990 trials showed the negative influence of low seed density and the extra large round class of seed on plant stand and on yield and ear quality.

Materials and Methods

A supersweet corn trial was located on a Greenleaf silt loam soil following sugar beets. One hundred pounds of phosphate per acre as triple superphosphate was broadcast and then the field was ripped and chisel plowed in November, 1990. The field was then corrugated into 30 inch rows. Roundup at 1 qt. ai/acre and 2,4D at 1 qt. ai/acre were applied preplant on April 22. The field was preirrigated on May 4, and treated with a preplant application of Lasso at 3 lbs ai/acre on May 14. The Lasso was incorporated with a bed harrow and roller.

A single lot of Crisp 'N Sweet 710 seed was divided by seed industry equipment into seed classes as follows:

1. Large flat
2. Extra large flat
3. Large round
4. Extra large round

Each of the four seed classes based on seed size and shape was divided by seed density. First the seed was divided into thirds based on density using a gravity table to obtain low, medium, and high density seed. The high density seed was further divided into thirds to yield low, medium, and high density fractions. The density divisions on each class resulted in five density fractions as follows:

1. Low
2. Medium
3. High - lower
4. High - middle
5. High - upper

The four seed classes times five density fractions resulted in twenty seed fractions which were then used as the treatments. All seed was treated with Thiram plus Difolitan plus Apron. Seed was planted May 15 with treatments arranged in a randomized complete block design with five replicates. Each plot consisted of four rows of corn 25 feet long. Seedling emergence and plant stand counts were made June 4, 7, 11, 14, and 18. Average plant heights were measured July 19 and vigor was judged subjectively for each plot based on a scale of 0-10.

Weedar (2,4-D) was sprayed for weed control at 2 lbs ai/acre on June 19. The field was sidedressed with 150 pounds N/acre as urea June 28 and was cultivated on July 2. After planting, the trial received seven irrigations in alternating furrows starting on June 12.

Plant stand was thinned as close as possible to 24,000 plants per acre on June 26. In thinning, no preference was made as to plant size, health, or vigor. Plots were thinned and carried to harvest maturity to determine if there were seed class or density effects on yield, grade, or maturity independent of their effects on plant stand alone. Before harvest the interior 17 feet of the middle two rows of each four row plot were flagged and the plants were counted. At harvest all potentially useable ears in the flagged plot interior were harvested, counted, and weighed. Fifteen ears were shucked, weighed, and rated for maturity (scale 1-5) and percent culls.

Results and Discussion

Emergence started on May 26 (11 days after planting). The average minimum soil temperature, measured at the weather station, during the period from planting to emergence was 54 °F. Average stand reached a maximum of 78.9 percent emergence June 14 then declined to 77.8 percent by June 18. Flat seed resulted in significantly higher plant stands than round seed classes at all observation dates (Table 1). Plant stand was closely related to seed density (Table 2).

Seed class and density had no significant interactive effects on plant stand on any of the observation dates. For simplicity the complete data from only June 18 are presented (Table 3).

Corn reached 74 percent moisture August 16 and was harvested on August 21. Seed class had a significant effect on yield with the large flat seed yielding significantly more than the extra large round class (Table 4). Low seed density had a negative effect on plant population, despite the plots being thinned to a uniform stand (Table 5). Neither seed class nor seed density had any significant effect on the other performance parameters (Tables 4 and 5).

Conclusions

From the 1990 and 1991 results, supersweet corn plant stands are clearly influenced by seed class and seed density. In spite of thinning to uniform stand, the negative influences from certain fractions of low density seed and from the round classes of seed can persist to harvest. Further studies could confirm these trends or determine if they are limited to this variety. Further understanding of seed lot fractions with poor performance can improve seed reliability and reduce risks to growers.

Acknowledgements

Financial support for this study was provided by the Oregon Processed Vegetable Commission.

Table 1. Seed class and plant stand over time of Crisp 'N Sweet 710 supersweet corn planted May 15. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Treatments	Plant stand counts				
Seed classifications (all densities)	June 4	June 7	June 11	June 14	June 18
	%				
Large flat	80.7	79.0	80.4	81.2	80.1
Extra large flat	80.9	80.6	81.4	80.2	79.9
Large round	74.9	75.1	76.6	77.4	75.7
Extra large round	77.5	76.1	76.7	76.8	75.3
LSD (0.05)	3.2	2.9	2.4	2.7	2.7

Table 2. Seed density and plant stand over time of Crisp 'N Sweet 710 supersweet corn planted May 15. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Treatments Seed densities (all classes)	Plant stand counts				
	June 4	June 7	June 11	June 14	June 18
	%				
1. Low	73.3	71.0	73.4	71.8	71.8
2. Medium	79.5	79.4	79.3	80.3	79.6
3. High-lower	78.3	77.5	78.1	78.8	76.5
4. High-middle	80.7	79.7	80.4	80.7	80.4
5. High-upper	80.8	81.1	82.7	82.7	80.6
LSD (0.05)	3.6	3.2	2.6	3.0	3.0

Table 3. Interactive effects of seed density and seed class on the stand of Crisp 'N Sweet 710 supersweet corn planted May 15. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Seed density fraction	Plant stand on June 18 Seed classification				
	Large flat	Extra large flat	Large round	Extra large round	Average
	%				%
1. Low	73.4	75.9	69.7	68.2	71.8
2. Medium	83.7	82.8	76.2	75.6	79.6
3. High-lower	76.3	79.1	73.8	76.9	76.5
4. High-middle	83.3	82.5	77.9	77.8	80.5
5. High-upper	84.0	79.4	80.9	77.8	80.4
Average	80.1	79.9	75.7	75.2	77.7

LSD (0.05) Density = 3.0
LSD (0.05) Classification = 2.7
LSD (0.05) Density x classification = ns

Table 4. Effects of seed class on the performance of Crisp 'N Sweet 710 supersweet corn. The effects are independent of the effects of seed class on plant stand, because plots were thinned to uniform stand. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Treatment	July 19		At harvest				
Seed classification	Average plant height	Plant vigor	Plant numbers*	Number of ears harvested	Yield	Husked ear weight (15 ears)	Percent culls
	cm	0-10			t/ac	lb	%
Large flat	156.0	6.2	33.5	35.7	9.4	11.4	7.7
Extra large flat	156.5	6.2	33.6	35.8	9.2	11.3	11.6
Large round	155.6	6.1	34.1	37.2	9.2	11.3	11.8
Extra large round	154.4	6.0	33.0	34.2	8.9	11.5	10.6
LSD (0.05)	ns	ns	ns	ns	0.36	ns	ns

* Based on 85 ft^2 in the plot interior replicated five times

Table 5. Seed density and performance of Crisp 'N Sweet 710 supersweet corn. These effects are independent from the effects of seed density on plant stand, because the plots were thinned to uniform stand. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1991.

Treatment	July 19		At Harvest				
Seed density	Average plant height	Plant vigor	Plant numbers*	Number of ears harvested	Yield	Husked ear weight (15 ears)	Percent culls
	cm	0-10			t/ac	lb	%
1. Low	153.4	5.9	32.6	35.7	9.1	11.4	11.5
2. Medium	156.2	6.2	33.1	36.0	9.2	11.3	9.2
3. High-lower	155.3	6.0	33.0	33.9	9.0	11.5	8.9
3. High-middle	155.1	6.1	34.3	36.8	9.2	11.2	13.0
5. High-upper	158.1	6.5	34.8	36.4	9.3	11.5	9.4
LSD (0.10)	ns	ns	1.48	ns	ns	ns	ns