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VEGETABLE RESEARCH RESULTS 2003

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INTRODUCTION

This report summarizes the results of several vegetable studies conducted during 2003.
The excellent cooperation of Sean Mueller, Stan Gahn, and the crew at the OARDC Veg Crops Branch in Fremont, OH; Shawn Wright at OSU South Centers, Piketon, OH; grower cooperators David Rimelspach and John Brown; student research assistant Kyle Inkrott; Clarence Renk and Joe Davlin at the OARDC Western Branch, South Charleston, OH; Gerardo Ramirez-Rosales; Lijie Xu; and Ted Smith, Dennis Ash and Herminio Perez at the OARDC Muck Crops Branch, Celeryville, OH is greatly appreciated. We hope that this type of information is of benefit to the vegetable industry in Ohio and the Great Lakes region. Your comments and suggestions for future efforts are always welcome.

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Sweet Corn Seed Treatment and Seedling Establishment Trial – 2003

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Objective:

Eleven seed treatment combinations plus an untreated control were tested on two cultivars of sweet corn (*sh_2* 'How Sweet It Is' and *se* 'July Gold') to determine the best seed treatments for optimum stand establishment.

Materials and Methods:

Plots were established at the Vegetable Crops Branch near Fremont, Ohio on April 16, 2003 and at the OSU Enterprise Center in Hillsboro, Ohio on April 29, 2003. Four replications of 100 seeds were planted in rows spaced 30" apart with 4-5" between seeds. Each cultivar was planted in a randomized block design. Soil type at the Veg. Crops Branch and the OSU Enterprise Center was Colwood fine sandy loam and Haubstadt silt loam, respectively. Soil temperatures at a 2" depth at planting in Fremont and Hillsboro were 58°F and 60°F, respectively. When plants reached at least the 5-6 leaf stage stand counts were taken (June 19 in Fremont, June 16 in Hillsboro) to determine effective seed treatments for optimum sweet corn stand establishment.

Results and Discussion:

Emergence of the *sh2* cultivar 'How Sweet It Is' was lowest in the untreated check plots in both locations, and all seed treatment combinations resulted in significantly higher emergence values. The emergence range in Fremont was 32% to 76% and in Hillsboro 12% to 44% (Table 1).

Seedling emergence of untreated 'July Gold' (*se*) seed was lower than any of the treatment combinations at Fremont and all but one treatment at Hillsboro. Percent emergence in Fremont ranged from 47% to 81% and in Hillsboro ranged from 12% to 58% (Table 1).

This project was part of a multi-location trial organized by the Seed Treatment Committee of the International Sweet Corn Development Association, a non-profit research organization. The information generated from this study will be of value to sweet corn producers, industry personnel, consultants, farm advisers, extension plant pathologists and others interested in identifying the best performing seed treatments for optimum stand establishment.

Laboratory cold tests were conducted in the Seed Biology Lab, OSU, Columbus. Seed lot vigor rankings (Table 1) are shown for each seed treatment on both cultivars. Vigor rankings were calculated by using the average of the field emergence from both locations and the percent germination from the cold test. The lower the vigor ranking number, the higher percent germination and seedling emergence for that seed treatment.

Acknowledgements:

We would like to thank the *Ohio Vegetable and Small Fruit Research and Development Program (ODA Specialty Crop Grant Program)* for their financial support of this research.

Table 1. Sweet Corn Seed Treatment for Stand Establishment, OH - 2003

Seed Treatment	FREMONT 'How Sweet It Is' (sh2) CULTIVAR A	FREMONT 'July Gold' (se) CULTIVAR B	HILLSBORO 'How Sweet It Is' (sh2) CULTIVAR A	HILLSBORO 'July Gold' (se) CULTIVAR B	COLD TEST RESULTS CULTIVAR A	COLD TEST RESULTS CULTIVAR B	vigor ranking* CULTIVAR A	vigor ranking* CULTIVAR B
	% stand				% germ			
Untreated check	32	47	12	12	73	48	8	11
Captan 400 (3 fl oz/cwt) Thiram 42S (2.5 fl oz/cwt) Allegiance (.75 fl oz/cwt)	62	74	26	38	77	74	7	4
Captan 400 (3 fl oz/cwt) Thiram(42S 2.5 fl oz/cwt) Allegiance (.75 fl oz/cwt) Flo Pro Imz(.5 fl oz/cwt)	75	70	28	36	79	83	5	3
Captan 400 (3 fl oz/cwt) Thiram 42S(2.5 fl oz/cwt) Allegiance (.75 fl oz/cwt) Topsin 4.5 (4.2 fl oz/cwt)	76	81	33	50	77	73	3	1
Captan 400 (3 fl oz/cwt) Thiram 42S (2.5 fl oz/cwt) Allegiance (.75 fl oz/cwt) L1115-A1 (100 ppm ae)	69	70	37	38	79	77	4	5
Captan 400 (3 fl oz/cwt) Thiram 42S (2.5 fl oz/cwt) Allegiance (.75 fl oz/cwt) Poncho (3.2 fl oz/cwt)	67	72	44	58	81	67	1	2
Cruiser 5 FS (.0125 mgAI/seed) Maxim 4 FS (2.5 gAI/100 Kg) Apron XL 3 LS (7.5 gAI/100 Kg)	73	74	32	36	71	63	6	8
A13641 (0.134 mgAI/seed) Apron XL 3 LS (6.5 gAI/100 Kg)	75	75	40	37	73	59	2	9
Maxim 4 FS (2.5 gAI/100 Kg) Apron XL 3 LS (7.5 gAI/100 Kg)	69	67	28	26	68	56	6	10
A13641 (0.268 mgAI/seed) Apron XL 3 LS (5.5 gAI/100 Kg)	74	70	36	42	73	73	3	5
Maxim 4 FS (2.5 gAI/100 Kg) Apron XL 3 LS (1.0 gAI/100 Kg) CGA301940 (1.0 gAI/100 Kg)	74	72	36	34	75	71	4	7
Maxim 4 Fs (3.5 gAI/100 Kg) Apron XL 3 LS (4.5 gAI/100 Kg) Dividend Xtreme 0.96 FS (15.0 gAI/100 Kg)	75	71	35	31	82	76	1	6
LSD (0.05)	8.5	10.4	13.2	15.5	NS	8.1		
C.V.	19.1	14.5	34.7	40.0	10.0	16.0		

* = vigor ranking with low numbers indicate higher emergence
vigor rating is based on percent field emergence at 2 locations plus lab cold test germination results

FRESH MARKET PLUM TOMATO GERMPLASM EVALUATION

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Introduction: Most fresh market tomato trials evaluate the traditional red, round slicing tomatoes. New cultivars as well as older varieties can be grown for the fresh market while providing a variety of colors. Plum tomatoes, once thought to be for processing only, are becoming more popular with the fresh market sales because of their long shelf life, meaty flesh, excellent flavor and good yield potential. Ten varieties of red, orange and yellow plum cultivars were grown and assessed for fruit quality, average fruit size, and final marketable yield. Germplasm from Ohio (Dr. David Francis) and several commercially available cultivars were included in this trial. Replicated plots were established at the Vegetable Crops Branch (VCB), Fremont, Ohio and at the OSU Enterprise Center in Hillsboro, Ohio. Plots were established in three replications on raised beds using black plastic mulch and trickle irrigation. Single rep observation plots were also established at a grower site in Hamilton, OH. Plant selections for each location were based on plant availability at time of planting.

Objectives(s): To test varieties of plum tomatoes grown on raised beds with black plastic mulch and trickle irrigation for fresh market sales.

Materials and Methods:
Fremont: plants were seeded in the greenhouse on April 4 & 11, 2003 into 200-cell plug trays and grown in the VCB greenhouse in Fremont, Ohio. Transplants were established in the field on May 23, 2003. Raised beds with black plastic mulch and trickle irrigation were spaced 5 feet apart with plants spaced 18 inches apart in the row. Each cultivar was replicated three times. Plants were not staked and tied. Drip irrigation was applied 6 times during the growing season. Fruit was harvested twice, on August 20 and September 5.

Hillsboro: plants were seeded into 98-cell plug trays on May 5, 2003. Raised beds, trickle irrigation and black plastic mulch were used. Plants were transplanted to the field on June 16, 2003. Each plot was replicated three times using the same plant row and between plant spacing as mentioned above. Plots were harvested once on October 3, 2003.

Hamilton: plants seeded in Hillsboro were used at this location. Standard practices of raised beds, trickle irrigation and black plastic mulch were used. Plants were established in the field in a single replication observation plot on June 18, 2003. Plots were harvested three times, on September 10, 17, and 24, 2003.

Results:
Fremont**:** Marketable yields ranged from 13.7 to 33.0 T/A (Table 1). The highest yields were obtained with 'Health Kick' and 'Sunoma'. Average marketable fruit sizes ranged from 0.11 to 0.34 lbs. Culled fruit were due mainly to ground rot and sunscald. No major disease problems were observed in any of the varieties.

Hillsboro: Marketable yields ranged from 12.0 T/A to 18 8 T/A (Table 2). Although no statistical differences (0.05 level) were observed in yield, 'Plum Lemon', 'Giant Valentine', 'Sunoma', 'ACR 8625' and 'Italian Gold' had the largest biological yields. Average marketable yield and fruit size were slightly higher in Fremont, where fruit was harvested earlier and more often. Heavy rains in Hillsboro immediately after planting may have delayed fruit set and fruit maturity.

Hamilton: Marketable yields ranged from 15.6 T/A to 28.1 T/A (Table 3). 'Health Kick', 'Sunoma' and 'BHN 411' were the highest yielding cultivars. Average fruit size ranged from 0.15 to 0.33 lbs.

As fresh market plum tomatoes, varying in size and color, become more popular in markets and at roadside stands, cultivar testing provides valuable information on yield potential and potential disease problems. Yield results from all locations and photos from cultivars grown at the Fremont location will be available this winter on the OSU VegNet website at www.vegnet.osu.edu

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- Thanks to *Sean Mueller, Stan Gahn and the summer crew at the Veg Crops Branch*, and student research assistant *Kyle Inkrott* for their assistance with this project.

Table 1. Plum tomato germplasm evaluation, Fremont, OH - 2003					
Cultivar	Seed Source	Fruit Color	Marketable T/A	Average Marketable Fruit size (lb)	Culls T/A
'Health Kick'	SM	red	33.0	0.16	1.8
'Giant Valentine'	SM	red	13.9	0.34	2.7
'Ohio Bicentennial'	Francis program*	red	13.7	0.13	0.5
'2K2-7084'	Francis program*	yellow/orange	22.8	0.11	1.0
'Sunoma'	ST	red	29.4	0.17	2.5
'Italian Gold	ST	orange	19.3	0.13	1.9
'Plum Lemon'	TGS	yellow	21.8	0.14	2.0
LSD (0.05)			7.30	0.06	1.26
C.V.			47.0	47.6	51.2

Table 2. Plum tomato germplasm evaluation, Hillsboro, OH - 2003					
Cultivar	Seed Source	Fruit Color	Marketable T/A	Average Marketable Fruit size (lb)	Culls T/A
'Health Kick'	SM		12.0	0.14	1.0
'Giant Valentine'	SM		18.4	0.16	1.1
'BHN 404'	BHN	red	12.4	0.14	0.7
'BHN 411'	BHN	red	12.3	0.11	0.6
'Sunoma'	ST		18.2	0.16	0.7
'Italian Gold'	ST		16.4	0.15	0.4
'Plum Lemon'	TGS		18.8	0.10	0.9
'ACR 8625'	AC	red	17.5	0.17	1.2
LSD (0.05)			NS	0.04	NS
C.V.			29.4	16.4	78.7

Table 3. Plum tomato germplasm evaluation, Hamilton, OH - 2003 (1 rep only)				
Cultivar	Seed Source	Marketable T/A	Average Marketable Fruit size (lb)	Culls T/A
'Health Kick'	SM	28.1	0.19	0.6
'Giant Valentine'	SM	15.6	0.33	4.9
'BHN 404'	BHN	22.4	0.19	2.4
'BHN 411'	BHN	22.9	0.20	1.3
'Sunoma'	ST	23.7	0.15	0.2
'Italian Gold'	ST	16.7	0.16	0.0
'ACR 8625'	AC	18.9	0.23	1.2

* seed obtained from Dr. David Francis, The Ohio State University/OARDC

EVALUATION OF FRESH MARKET TOMATO CULTIVARS FOR SOUTHERN OHIO, 2003

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This cultivar trial evaluated 18 cultivars for their suitability in southern Ohio.

METHODS:

Seeds were planted on 16 May into 288-cell trays containing a peat-vermiculite soilless mix. Cells were thinned as needed to 1 plant/cell. Transplants were set into raised beds (covered with black plastic mulch with trickle irrigation under the plastic) 18" apart in the row on June 12, 2003. Rows were 5 foot apart. Experimental design was randomized complete block with 4 replications. The field is located in southwestern Ohio, Butler County 84° 39' west by 39° 18' north and the soil is a Miami Silt Loam. Four hundred lbs of K_2O was incorporated pre-plant. 157 units of N was applied through drip irrigation over the growing season. Weed control was accomplished using Treflan® (trifluralin) @ 2 pt/acre and Sencor® (metribuzin) @ 1 pt/acre. The standard commercial fungicide and insecticide program was followed, on a 7-10 day schedule. Harvest began on August 26 and final harvest was October 6, 2003.

RESULTS:

Plant health and quality remained good through the season with average fruit set and yield across cultivars. Early season harvest August 26 and September 3 ranged from 828 - 2513 25-lb cartons/acre (Table 1). SVR 1760036, SVR 0170334 and Solar Set R were the top performers showing potential for early season yields. Total marketable yield ranged from 2933 - 4060 25-lb cartons/acre. BHN 543, Florida 91 and Solar Set R had the highest total marketable yield. Average fruit weight ranged from .046 lbs. to 0.57 lbs. Solar Set R produced consistently throughout the harvest season.

DISCUSSION:

This was one of the coolest and wettest seasons in recent history. Many of these cultivars show promise and it will be interesting to see how they perform under more typical weather conditions.

The authors wish to thank the Ohio Vegetable and Small Fruit Research and Development Program for providing funding and Brown's Family Farm for providing space and for pesticide applications.

Table 1 Early and Total Season Harvest.

	Early Season Harvest					Total Season Harvest				
	Small	Medium	Large	Total	Average	Small	Medium	Large	Total	Average
Source & Cultivar	(25 lb. Cartons per acre)				**Fruit Wt.**	(25 lb. Cartons per acre)				**Fruit Wt.**
AC										
ACX 12 B	691	773	189	1654	0.55	1365	1462	576	3404	0.51
ASG										
Florida 91	343	554	303	1200	0.63	990	1762	1145	3897	0.56
BHN										
BHN 22	307	445	195	948	0.63	1377	1404	822	3603	0.50
BHN 189	267	458	102	828	0.49	1248	1526	569	3343	0.48
BHN 399	512	769	200	1481	0.57	1479	1610	724	3814	0.50
BHN 543	366	410	163	941	0.52	1432	1420	1206	4060	0.52
BHN 586	553	616	135	1306	0.50	1621	1386	535	3543	0.47
BHN 640	541	757	127	1425	0.53	1200	1670	386	3257	0.49
BHN 641	524	438	131	1094	0.48	1745	1483	604	3832	0.45
PS										
Celebrity	614	560	118	1293	0.47	1748	1584	379	3711	0.45
RG										
Mnt. Fresh	380	575	309	1265	0.53	1117	1629	1020	3767	0.51
Mnt. Spring	387	567	312	1268	0.63	1158	1350	856	3365	0.54
SM										
SVR 0170334	884	880	199	1963	0.47	1383	1200	349	2933	0.46
SVR 1412971	294	631	340	1266	0.64	865	1265	921	3052	0.56
SVR 1432427	682	760	285	1700	0.51	1313	1324	500	3138	0.47
SVR 1760036	650	1270	592	2513	0.56	865	1387	684	2937	0.53
Solar Set R	803	792	268	1864	0.51	1715	1531	638	3884	0.46
SW										
Floralina	520	600	181	1302	0.54	1601	1524	570	3695	0.48
LSD	**331**	**397**	**222**	**711**	**0.07**	**473**	**515**	**386**	**811**	**0.05**

TOMATO (*Lycopersicon esculentum* cv' Peto 696')
Anthracnose: Colletotrichus coccodes,
Septoria Blight*: S. lycopersici*

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CHEMICAL CONTROL OF ANTHRACNOSE AND SEPTORIA LEAF BLIGHT ON PROCESSING TOMATO, 2003: Plots were established on Crosby Silt Loam (pH 6.5, OM < 2%) at OARDC Western Station, Ohio State University, South Charleston, OH (Clark Co.). Plots were 25ft long single rows bordered by untreated tomato rows. Rows were 5ft apart on center with plants 12in apart in the row. Plots received 100lb/A N plowed down. Treflan 4E (1.5 pt/A) and Sencor DF (0.5lb/A) were applied for weed control. Greenhouse-grown tomato seedlings cv Peto 696 were set Jun 6 largely by hand. The fungicides were applied at 60 psi and 60 gal/A using a CO2 powered sprayer with a 5ft spray boom equipped with 5 TeeJet TXVS-12 tips. All treatments were replicated 4 times in a randomized complete block design. All fruit from the center 5ft of each treated row were hand harvested on Sep 9. Fruit was hand sorted into marketable red, marketable green and anthracnose categories. Rainfall in the test area in Jun, Jul, and Aug, was 3.67, 8.82, 6.22, 8.09in.respectively.

Wet conditions in the spring delayed planting. Traditionally the last date to plant processing tomatoes and still expect a harvest before frost is June 19. This late planting date and repeated flooding combined with cool temperatures resulted in poor fruit development and set and low yields—highest marketable yields were only about 6.3 T/A; check yield was on 0.34 T/A. In this soil under good growing conditions, Peto 696 would yield on average about 25-28T/A. The late planting date also effected disease development on the fruit. Septoria Leaf Blight appeared in late June and developed rapidly. Much of the canopy was heavily damaged by late July. This additional stress on the plants severe impacted yield.

Best yields occurred with the traditional spray program. It was evident early that the experimental materials did not control Septoria, which the strobiluron component of the traditional program did. Since Bravo doesnot control Septoria well, the experimental programs were unprotected season long. Hence the low yields. The traditional programs had minimal control of this disease since the effective strobiluron was applied only every second week.

Table 1: Control of Diseases on Tomato Peto 696; 2003; South Charleston, OH.

TRT	Mkt Red[1]	Mkt Green[2]	Anth[3]	8/22[4]	8/14[5]
KP481 6oz/A (A,C) Kocide 53.8WG 2lbs/A (A,C) Manzate 75WG 2lb/A (B) Kocide 53.8WG 2lbs/A (B) KP481 6oz/A (E,G) Bravo WS 1.5pt/A (E,G) Bravo WS 1.5pt/A (D,F,H)	0.83 b	0.40 b	0.40a	5.00 bc	5.5a
KP481 8oz/A (A,C) Kocide 53.8WG 2lbs/A (A,C) Manzate 75WG 2lb/A (B) Kocide 53.8WG 2lbs/A (B) KP481 8oz/A (E,G) Bravo WS 1.5pt/A (E,G) Bravo WS 1.5pt/A (D,F,H)	0.75 bc	0.54 b	0.22ab	4.25 c	4.25 b
KP481 10oz/A (A,C) Kocide 53.8WG 2lbs/A (A,C)	0.78 bc	0.55 b	0.45a	4.75 bc	5.00ab

Manzate 75WG 2lb/A (B) Kocide 53.8WG 2lbs/A (B) KP481 10oz/A (E,G) Bravo WS 1.5pt/A (E,G) Bravo WS 1.5pt/A (D,F,H)					
Manzate 75WG 2lbs/A (A,B) Kocide 53.8WG 2 lbs/A (A,B) Quadris 6.2floz/A (C,E,G) Bravo WS 1.5pt/A (D,F,H)	1.69a	1.58a	0.04 b	4.25 c	2.5 c
UTC	0.12 c	0.00 b	0.06 b	6.00a	5.75a

VALUES FOLLOWED BY SIMILIAR LETTERS ARE NOT SIGNIFICANTLY DIFFERENT BY DUNCANS MULTIPLE RANGE TEST.

1 MKT RED = KILOGRAMS OF MARKETABLE RED FRUIT PER 5FT OF ROW (4REPS)

2 MKT GREEN = KILOGRAMS OF MARKETABLE GREEN FRUIT PER 5FT OF ROW (4REPS)

3 ANTH = KILOGRAMS OF ANTHRACNOSE PER 5FT OF ROW (4 REPS)

4 8/22 = PERCENT SEPTORIA OF FOLIAGE. RATING SCALE=1-0 TRACE; 2=UP TO 25%; 3=UP TO 50%; 4=UP TO 75%; 5=UP TO 100%; 6=DEAD.

5 8/14 = = PERCENT SEPTORIA OF FOLIAGE. RATING SCALE=1-0 TRACE; 2=UP TO 25%; 3=UP TO 50%; 4=UP TO 75%; 5=UP TO 100%; 6=DEAD.

( ) = APPLICATION DATES: A=15 Jul; B=24 Jul; C=30 Jul; D=8 Aug; E=14 Aug; F=21 Aug; G=28 Aug; H=8 Sep

Plant Date: 6/6/2003; Harvest date: 9/9/2003; Rating dates for Septoria 8/14/2003; 9/9/2003

2003 Green Pepper Cultivar Evaluation

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In Cooperation with Wiers Farms Inc., Willard, OH

Summary of Results:
Seven varieties were transplanted on June 2 at a grower's location in Celeryville, OH. The experiment was conducted as a randomized complete block design with 4 replications. Plots were double rows, 25 feet long. Eight plants from the middle were harvested to determine yield and quality.

Despite cool, wet weather, early yield, defined as the first harvest, was five days earlier than in 2002 and similar to 2001. Even with large amounts of blossom drop, Aristotle produced 323 boxes per acre of extra large plus large fruit (see Table 1.) and exceeded 2002 by about 100 boxes. Other varieties with good early yield were: Revolution and Paladin which also performed well in previous years. The top 3 varieties for total yield in the large size categories were: Aristotle, Crusader and Paladin. Crusader has not been in the trials since 2001 where it performed in the middle of the pack.

Total marketable yield is presented in Table 2. This includes all size categories from extra large to select or all sizes that can be put in a box and sold. However, profits are made with the amount of fruit produced in the extra large and large size categories. For early yield, those varieties which had nearly 80 percent of higher of their fruit in the large size categories were: Aristotle, Revolution, Olympus, and Colossal. For total yield, 3 harvests, Aristotle had the highest percentage (73%) of its fruit in extra large and large sizes. Most other varieties were in the mid sixties in terms of percent large sizes marketable. This is the first year where all varieties tested were above 50% large size.

Table 1. Yield of Extra Large[1] plus Large Fruit, (First Harvest and Total)

Early (First Harvest) Cultivar	Boxes/A	Total (3 Harvests) Cultivar	Boxes/A
Aristotle	323	Aristotle	972
Revolution (HMX 1660)	256	Crusader VP	858
Olympus	200	Paladin	841
Paladin	159	Karma	800
Karma F1	158	Colossal	783
Crusader VP	143	Olympus	766
Colossal	102	Revolution (HMX 1660)	764
LSD 0.05	125		234

1. The extra large category includes Jumbo and extra large fruit sizes.

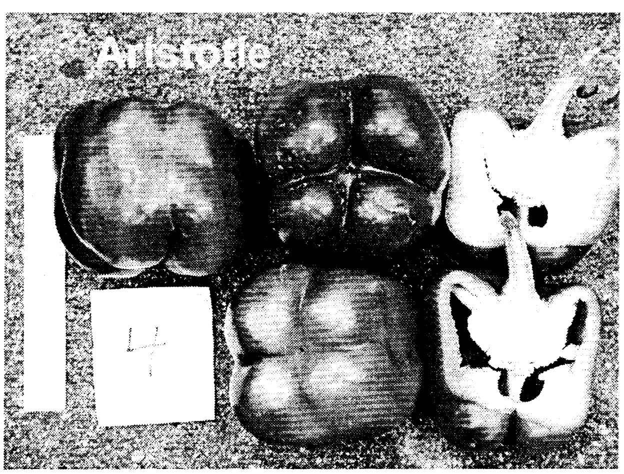
Table 2. Marketable Yield (Extra Large + Large + Medium + Small + Select)

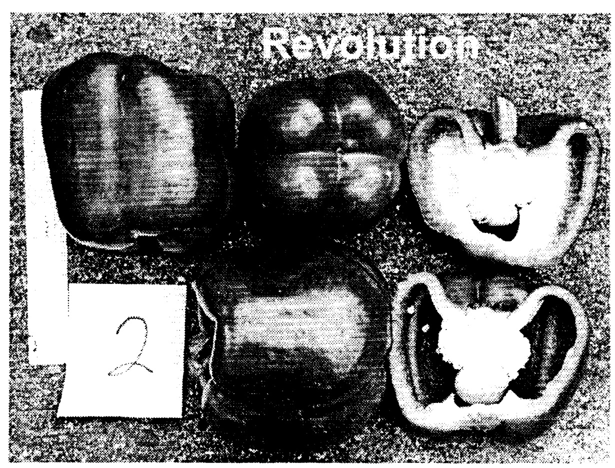
Early (First Harvest) Cultivar	Boxes/A	% Marketable L (Extra L + Large)	Total (3 Harvests) Cultivar	Boxes/A	% Marketable (XL+L+M+S)	% Marketable L (Extra L + Large)
Aristotle	387	85	Aristotle	1256	92	73
Revolution (HMX 1660)	316	80	Crusader	1235	92	63
Olympus	243	79	Olympus	1166	94	59
Paladin	235	63	Karma	1164	87	62
Crusader	234	55	Paladin	1160	93	65
Karma F1	212	69	Revolution	1079	86	63
Colossal	126	78	Colossal	1052	93	67
LSD 0.05	163	18		272	7	9

% Marketable = the number of Extra Large + Large + Medium + Small fruit divided by the number of Extra Large + Large + Medium + Small + Select + Cull fruit times 100.

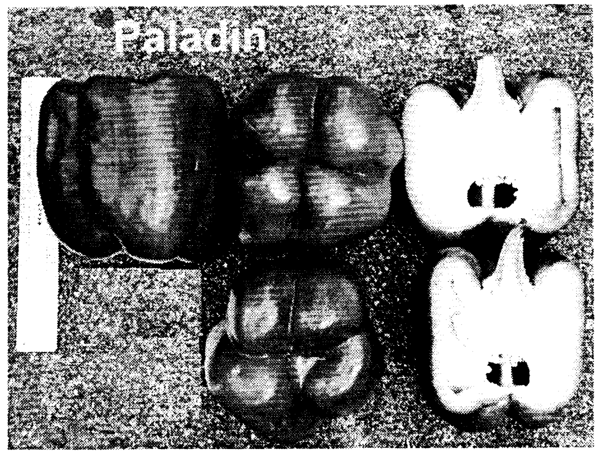
% Marketable L = the number of Extra Large + Large fruit divided by the number of Extra Large + Large + Medium + Small + Select + Cull fruit times 100.

The following are the seven green pepper varieties in the trial. Use the 6 inch ruler on the left side for a size reference






3
Crusader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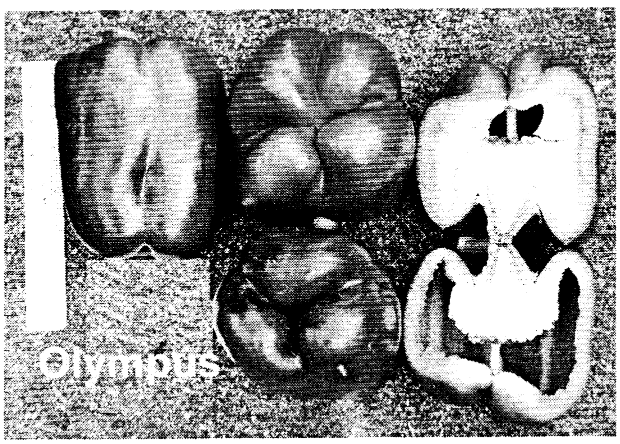
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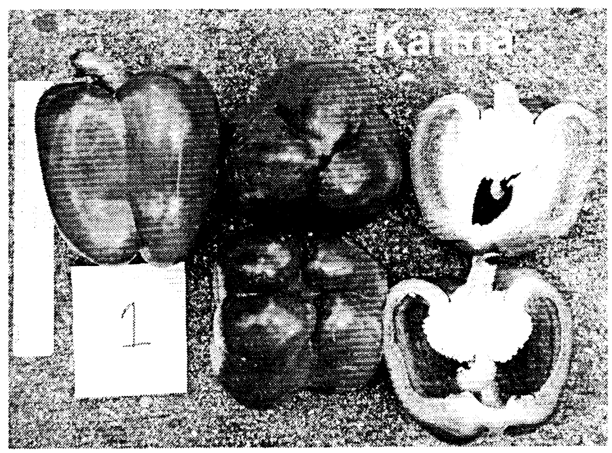
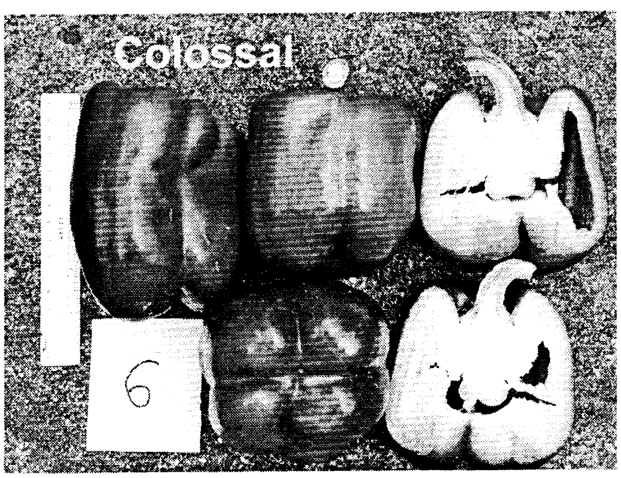

Karma
1


Colossal
6

Pumpkins 2003

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Summary of Results at South Charleston

This project was supported in part by a research grant from the Ohio Vegetable and Small Fruit Research and Development Fund.
In South Charleston, the 23 cultivars were evaluated for yield and quality and rated for possible disease resistance. Each cultivar was planted by direct seeding or transplants in plots 30 feet long with 10 feet between rows. All plots were sprayed with a standard chemical disease control program and received standard insecticide applications during the season.

In late August and early September, extremely cold and wet weather (5-8 Inches) caused rapid development of powdery and downy mildew. Only varieties HMX2689 and HMX0683 had a foliar infection rating of 25 to 50%. There was an early season outbreak of Anthracnose and varieties were rated for foliar infection, see Table 1.

The best large sized varieties in terms of tons per acre were: Harvest Time, RPX0307, Dependable (ACX103), and Pro Gold 510. The largest average fruit size (> 27 lbs per fruit) was observed in varieties: Harvest Time, RPX0307 and Dependable. The best medium sized pumpkins were Gold Medal, RPX03509, HMX2689, RPX03517 and HMX0683.

New and appealing small varieties with an average fruit size from 1 to 4 pounds were HMX 2690, HMX 3693, HMX 5682 and RPX03102. Features include dark green handles, good orange color and a hard fruit rind.

Individual pictures plus comparison views among varieties are available at the VegNet website:

http://vegnet.osu.edu

Table 1, 2003 Pumpkin Cultivar Evaluation, South Charleston, OH

ID #	Variety	Marketable Orange Fruit/A	Marketable Orange Tons/A	Average Fruit Size (lbs)	Fruit Diameter (in)	Downy Mildew [3]	Virus [3]	Foliar Powdery Mildew Rating [1]	Powdery Mildew on Handle [3]	Anthrac -nose [2]	Source
2	Harvest Time	2069	28.6	33	13	1	1	5	1.8	7.5	AC
10	RPX 03507	1416	23.3	33	14	1	1	5.3	1.3	8.5	RP
4	ACX 103 Dependable	1706	23.3	27	14	1	1	5.8	1.5	8.3	AC
22	HMX 3692	1207	14.6	23	12	1.5	1	5	2	10	HM
1	Pro Gold 510	2033	23.0	22	13	1	1	5.3	1	8	AC
16	Gold Gem	1815	19.7	21	13	1	1	5.8	1.5	8.5	RP
11	RPX 03509	1488	15.3	20	12	1	1	6	2	7.	RP
3	ACX 102 (Reliable)	2251	22.1	19	11	1	1	4.7	2	10	AC
15	Gold Medal	1379	13.7	19	13	1	1	5.5	1.8	9	RP
20	HMX 2689	1525	14.6	19	13	1.8	1.5	3.8	1.8	7.3	HM
7	REX 1002	1125	9.9	18	12	1	1	5.3	1	7.5	RP
13	RPX 03517	1997	18.9	18	12	1	1.3	5	2	4	RP
6	13024469	2686	20.5	15	11	1	1.3	5.8	1.5	7	SEM
8	REX 1006	2033	15.6	15	12	1.5	1	5.8	1.5	10	RP
19	HMX 0683	2468	18.7	15	12	1.8	1	3.8	2	7.5	HM
12	RPX 03515	1742	11.5	13	10	1.3	1	4.8	1.8	7.8	RP
14	RPX 03516	2468	19.4	12	11	1	1	5	2	7.5	RP
5	1302442	1960	11.1	11	11	1	1	5.5	1.3	7.5	SEM
21	HMX 2690	4320	7.6	3.5	6.5	1.8	1.3	4.3	1.5	7.8	HM
23	HMX 3693	5590	7.0	2.5	6	2	1.8	4.3	2	3.3	HM
18	HMX 5682	9184	5.1	1.1	4.4	1.3	1	5.5	1.5	3	HM
9	RPX 03102	10128	5.1	1	5	1.3	1.3	5.3	1.3	2	RP
17	Wee-Be-Little	7696	2.2	0.5	3.6	1	1	4.3	2	1.3	RP
	LSD 0.05%	2473	7.6	4.5	1.3			0.8		4.8	

Key To Disease Ratings in Table 1.

1. PM: 1 = no or a trace of mildew, 2=1-25%, 3=26-50%, 4=51-75%, 5=76-100% foliage with fungal colonies and 6= necrotic leaves.
2. Anthracnose: 1 = no or a trace of mildew, 2=1 to 20%, 3=21 to 30, and so on to 10= all foliage affected and/or dead foliage.
3. Downy Mildew, Powdery Mildew on handle and Virus Rating:1 = presence of downy mildew on foliage; powdery on handle; or virus on foliage 2=. no powdery mildew on handle, downy mildew or virus on foliage.

Key To Sources

AC = Abbott Cobb
HM = Harris Moran
RP = Rupp Seeds, Waseon, OH
SEM = Seminis

Brief Descriptions of Pumpkins 2003, South Charleton, OH

The following is a brief description of each pumpkin cultivar in the 2003 evaluation trial. Some of the comments are provided by the company or source. The format below is: Variety ID Number – 1; Variety Name – Pro Gold 510; Source (AC) followed by a brief description.

1. Pro Gold 510, (AC)
   This variety has become a standard in OH and one of the most consistent performers over the years. Average fruit size is between 18- 20 lbs and usually yields 17 to 19 tons/A.
2. Harvest Time, (AC)
   Introduced last year. Fruits are elongated, large with a flattened tear drop shape. Good yields. Desirable for retail markets but maybe not wholesale because of elongated shape.
3. ACX 102 (Reliable), (AC)
   This is the first year in our trial. Fruit seems to be a thinner and smaller version of Harvest Time. Handles are very short or stubby. Color is lighter than Harvest Time.
4. ACX 103 (Dependable), (AC)
   Large, round fruit with good yields and color. Handles are nice.
5. 1302442, (SEM)
   An experimental variety with WMV Tolerance. Not available on the market.
6. 13024469, (SEM)
   An experimental variety with WMV Tolerance. Not available on the market. Good handles.

7. REX 1002, (RP)
   Medium to large fruit (~18lbs) nice color, good handle and ribbing..
8. REX 1006, (RP)
   Medium size fruit (~15 lbs). – Nice round shape with good ribbing. Fruit has a dark orange color with dark green handles.
9. RPX 03102, (RP)
   Wee-Be-Little hybrid
10. RPX 03507, (RP)
    Larger Gold Medal type, average fruit size, ~33 lbs.
11. RPX 03509, (RP)
    Smaller Gold Medal type, average fruit size, ~20 lbs. Semi fragile handles.
12. RPX 03515, (RP)
    Medium size fruit with nice round shape, PMT.
13. RPX 03517, (RP)
    Slightly upright, medium size fruit (~18 lb) with wide ribbing and mostly dark color. Nice handle attachment. PMT.
14. RPX 03516, (RP)
    Slightly upright, medium size fruit with PMT.
15. Gold Medal, (RP)
    Large fruit with good color (~20-25 lbs) and yields around 15 to 20 tons per acre. Consistent in size and shape in several years in our trial.
16. Gold Gem, (RP)
    Produces fruit of consistent size and shape around 15 to 18 lbs. Nice thick handles.
17. Wee-Be-Little, (RP)
    Nice small fruit which when bunched together,look excellent in displays. Dark green stem forms nice cap on fruit. All America Selection winner.
18. HMX 5682, (HM)
    Strong, sturdy, dark green handles. Smooth skin with dark color. Hard 1 lb fruit similar to Lil' Ironsides..
19. HMX 0683, (HM)
    Medium size Howden type fruits on a semi bush. Tolerant to some strains of ZYMV. Strongly PMT.
20. HMX 2689, (HM)
    Semi-bush. Medium size (19 lbs) with large, well attached, dark green handle. Strong tolerance to PM. Nice dark color. Good, solid 2-3 inch handle.
21. HMX 2690, (HM)
    Semi-bush. Small size with hard shell. PMT. Solid, hard fruit; nice color and handles.
22. HMX 3692, (HM)
    Large fruits on semi-bush. Blocky tall shape with thick attractive handles. Tolerant to PM. Big handles.
23. HMX 3693, (HM)
    Small pumpkin (~2.5 lb) on semi-bush. Hard shell, long dark handle, prolific. Tolerant to PM. Round, hard fruit, good handles.

Table 2. Additional 2003 Pumpkin Cultivar Information (Bins per Acre), South Charleston, OH

ID #	Variety	Marketable Orange Fruit/A	Marketable Orange Tons/A	Average Fruit Size (lbs)	Fruit Diameter (in)	Bins/A	Fruit/Bin	Source
1	Pro Gold 510	2033	23.0	22	13	60	33	AC
2	Harvest Time	2069	28.6	33	13	62	36	AC
3	ACX 102 (Reliable)	2251	22.1	19	11	45	50	AC
4	ACX 103 (Dependable)	1706	23.3	27	14	69	25	AC
5	1302442	1960	11.1	11	11	46	47	SEM
6	13024469	2686	20.5	15	11	64	46	SEM
7	REX 1002	1125	9.9	18	12	33	36	RP
8	REX 1006	2033	15.6	15	12	48	44	RP
9	RPX 03102	10128	5.1	1	5	13	744	RP
10	RPX 03507	1416	23.3	33	14	58	24	RP
11	RPX 03509	1488	15.3	20	12	41	42	RP
12	RPX 03515	1742	11.5	13	10	25	85	RP
13	RPX 03517	1997	18.9	18	12	50	42	RP
14	RPX 03516	2468	19.4	12	11	46	53	RP
15	Gold Medal	1379	13.7	19	13	43	37	RP
16	Gold Gem	1815	19.7	21	13	64	29	RP
17	Wee-Be-Little	7696	2.2	0.5	3.6	6	1345	RP
18	HMX 5682	9184	5.1	1.1	4.4	12	770	HM
19	HMX 0683	2468	18.7	15	12	62	40	HM
20	HMX 2689	1525	14.6	19	13	50	30	HM
21	HMX 2690	4320	7.6	3.5	6.5	17	242	HM
22	HMX 3692	1207	14.6	23	12	38	37	HM
23	HMX 3693	5590	7.0	2.5	6	16	355	HM
	LSD).05%	2473	7.6	4.5	1.3			

'EVALUATION OF THE METHOD AND TIMING OF KILL OF A WINTER RYE + HAIRY VETCH COVER CROP MULCH FOR THE CONTROL OF FUSARIUM FRUIT ROT (FUSARIUM SOLANI F. SP. CUCURBITAE R1) IN PUMPKIN PRODUCTION.'

Christian A. Wyenandt, Graduate Student, L.H. Rhodes, Assistant Professor, R.M. Riedel, Professor, Dept. of Plant Pathology, and M.A. Bennett, Professor, Dept. of Horticulture and Crop Science, The Ohio State University

INTRODUCTION:

Many pumpkin growers with roadside markets in Ohio operate U-Pick operations where pumpkins are sold directly to consumers in the field. Pumpkins grown for U-Pick operations must be clean for sale. In U-Pick operations, it is vital that customers be able to access fields under a variety of weather conditions in the fall. Growers want pumpkin fields close to their roadside markets for convenience and to draw in customers. These fields in many cases are planted continually to pumpkin or in short rotation with other non-cucurbit vegetable crops. The short rotation of pumpkin crops allows soil-borne fungal disease, such as Fusarium fruit rot (*Fusarium* spp.), to become extremely damaging. In some years, loss to Fusarium fruit rot can be 100 percent. Present mulching systems for pumpkins do not adequately address the need for producing cleaner pumpkin crops or control of soil-borne fungal diseases under inadequate crop rotations. Black plastic mulch is often used for U-Pick pumpkins to help conserve soil moisture and reduce in-row weeds, but it does nothing to increase fruit cleanliness, reduce overall weed populations and soil-borne disease, nor does it allow customers to enter U-Pick fields under extremely muddy conditions. Growers in Ohio are seeking alternative production practices that allow them to incorporate cover crops into pumpkin production for increasing fruit cleanliness and reducing soil-borne fungal disease.

Cover crops are used in high-input agronomic and vegetable production systems to reduce soil erosion, increase soil organic matter, conserve water, reduce fungicide use, control weeds, and reduce plant disease. Traditional cover crops such as hairy vetch (*Vicia villo*sa Roth) and winter rye (*Secale cereale* L.), have been used in pumpkin production with limited commercial success. When killed and left on the soil surface these cover crops may help to conserve soil moisture, increase fruit cleanliness and yield, and reduce weeds and soil-borne fruit disease. Pumpkin growers who plant fall-sown cover crops, such as winter rye and/or hairy vetch, are often concerned about the timing and method of cover crop kill in the spring prior to pumpkin planting. The objectives of this study are as follows:

OBJECTIVES:

1. To evaluate the method (mechanical or chemical) and timing (early or late) of kill of a winter rye + hairy vetch cover crop mulch on pumpkin yield.

2. To evaluate the method (mechanical or chemical) and timing (early or late) of kill of a winter rye + hairy vetch cover crop mulch for ground cover production and increasing fruit quality.

3. To evaluate the method (mechanical or chemical) and timing (early or late) of kill of a winter rye + hairy vetch cover crop mulch for control of Fusarium fruit rot (*Fusarium solani* f. sp. *cucurbitae* R1) in pumpkin production.

MATERIAL AND METHODS:

On 3 October 2002 a cover crop mix consisting of hairy vetch (*Vicia villosa* Roth) + winter rye 'wheeler' (*Secale cereale* L.) at 56 kg/ha each was established at Western Branch, Ohio Agricultural Research and Development Center (OARDC) in South Charleston, OH. On 17 December 2002 fruit of mature pumpkin infected with *Fusarium solani* f. sp. *cucurbitae* R1 were disseminated uniformly across field with a manure spreader. On 1 May 2003 research plots 25 ft wide and 50 ft long (four reps) were designated in a randomized block design for cover crop kill. Five cover crop treatments included: early mowing (20 May)followed by plow down (6 June) to produce bare soil (conventional); early mowing (20 May), late mowing (6 June), early herbicide kill (15 May), late herbicide kill (10 June) in which cover crop mulch was allowed to lay on soil surface during production season. Establishment of bare soil, early and late mowing treatments was done with a 15 ft. rear-mounted PTO driven brushhog. Early and late herbicide kill of cover crop was done with a 2,4D (Weedone Lo Vol, 66%) at 1 pt/A + Round-up (glysophate, 51%) at 22 oz/A at 60 psi using a 25' boom. On 6 June the early herbicide kill and 24 June the late herbicide cover crop mulch were rolled flat on the soil surface with a 12' wide cultipacker. On 25 June Round-Up (glysophate, 51%) at 22 oz/A was applied to all cover treatments for the control of weeds that may have developed between the time of cover crop kill and pumpkin planting. On 26 June nitrogen (34-0-0) at 65 lb actual N/A was broadcast over all cover crop treatments. On 27 June pumpkin cultivar "Magic Lantern' transplants were planted by hand. Transplants received 8 oz water with 20-20-20 liquid fertilizer (1.5 lb/25 gal) stock solution. To control cucumber beetles Admire 2F (Imidacloprid) at a rate 2.2 oz/25 gal was added to the stock solution. On 30 June and 3 July transplants received additional water to aid establishment. On 18 July nitrogen (34N-0P-0K) was banded at 50 lb actual N/A. On 1 August and 8 September an 8' wide ATV mounted wick with a 2:1 ratio of 2 gal water to 1 gal glysophate (51%) was used to help control weed populations in all treatments. On 14 July an application of Quadris 2F^R (azoxystrobin, Zeneca) at 12.3 oz/A was applied to control Anthracnose. Starting on 21 July Bravo Ultrex WDG 82.5^R (chlorothalonil, Syngenta) at

2.75 lbs/A plus Nova 40 WP[R] (myclobutanil, Rohm and Haas) at 5 oz/A was alternated with Quadris 2F on a weekly schedule to control powdery mildew. On 24 October all pumpkin fruit were harvested.

RESULTS AND DISCUSSION:

The effects of percent ground cover and biomass production on fruit cleanliness:

At pumpkin transplanting and harvest percent ground cover and cover crop biomass was calculated. Average percent ground cover for each cover crop treatment at pumpkin transplanting and harvest were determined by visually rating a ½ m^2 area in each treatment (Table 3). Biomass production was determined by collecting 1/8 m^2 area of cover crop from each treatment. Collected biomass was dried at 75°C for 48 hrs and weighed to determine an estimated MT/ha (Table 3). At pumpkin planting percent ground cover were significantly higher in the late mowing treatment (74%) and late herbicide kill (76%) cover crop treatment when compared to early mowing treatment (54%) and early herbicide kill treatment (59%). At pumpkin harvest, percent ground cover in early mowing treatment (26%), late mowing treatment (23%) and early herbicide kill treatment (29%) were similar, and significantly less, than late herbicide kill treatment (69%). The large reduction in percent ground cover at pumpkin harvest in late mowing treatment compared to late kill herbicide treatment was most likely due to the destruction of plant material during the mowing process. This is most evident in the amount of biomass produced and collected at pumpkin planting and harvest (Table 3). In late mowing treatment the average weight of biomass collected was 4.29 MT/ha compared to 7.27 MT/ha in the late herbicide kill treatment. This is also apparent in the amount of biomass production in the early mowing treatment at 3.13 MT/ha compared to early herbicide kill treatment at 4.39 MT/ha. At pumpkin harvest, remaining biomass in the late herbicide kill treatment and was significantly higher than early and late mowing treatments and early herbicide kill treatments (Table 3).

At harvest all fruit were visually rated for the presence of soil. The effects of method and timing of cover crop kill were examined to determine their influence on fruit cleanliness. The percentage of clean fruit at harvest was greatest in the late herbicide kill cover crop treatment (54%) when compared to early herbicide kill (27%) and early mowing (25%) and late mowing (34%) and bare soil (0%) treatments. The higher percentage of clean fruit at harvest can be attributed to the amount of ground cover and cover crop biomass remaining at pumpkin harvest and to the timing and method of cover crop kill at pumpkin planting.

The effects of timing and method of cover crop kill on pumpkin yield.

At harvest all fruit were harvested, graded and weighed according to color (orange or green), cull, and for symptoms of Fusarium fruit rot (FFR). The number of orange, green, cull, FFR infected fruit and average fruit weight and marketable orange fruit per treatment was calculated (Table 1). Presence of mulch, either mowed or herbicide kill, significantly increased the total number of fruit per treatment when compared to bare soil. Average total number of fruit was highest in late herbicide kill treatment (14.8) and nearly double that of bare soil (7.5). Average total number of fruit were similar for early mowing (10.3), late mowing (11.1) and early herbicide kill (11.6) treatments. There were no significant differences in the number of green, culled and FFR infected fruit (Table 1). The percent of marketable orange fruit was highest in the bare soil (99%) and late herbicide kill (100%) treatments when compared to early mowing (83%), late mowing (82%) and early herbicide kill (71%) treatments. These finding suggest and are similar to our other findings that suggest the presence of a cover crop mulch in this study, either mowed or chemically-killed, may delay pumpkin development.

Yield of orange fruit was greatest in late herbicide kill (57.5 kg/plot) and significantly higher than bare soil (19.8) treatment. Yield of orange fruit were similar in early mowing (48.7), late mowing (43.9) and early herbicide kill (46.0) treatments (Table 2). There were no significant differences in the weights of green and culled fruit between cover crop treatments (Table 2). Interestingly, average fruit weight was higher in early mowing (5.7 kg) and early herbicide kill (5.4) when compared to late mowing (4.7) and late herbicide kill (3.8) and bare soil (2.6) treatments. The slight decrease in fruit size may be partly attributed by differences in the number of fruit set among treatments and to method and timing of cover crop kill. On average there were approximately 3 more fruit in the late herbicide kill than early herbicide kill treatment and approximately 1 more fruit in early mowing than late mowing treatment. The higher number of fruit in the late herbicide kill treatment than the early herbicide kill treatment may be attributed to the increase in soil moisture due to the greater amount of ground cover in those plots during the growing season.

Effects of timing and method of cover crop kill on development of Fusarium fruit rot.

There were no significant differences in the number of Fusarium infected fruit between cover crop treatments (Table 1). In general, cool summer temperatures in South Charleston, OH were not conducive for the development of Fusarium fruit rot. The average total weight of fruit infected with FFR was lowest in bare soil (2.36 kg) when compared to early mowing (9.61), late spring mowing (4.72), late spring herbicide kill (10.1). The average total weight of fruit infected with FFR was highest in early herbicide kill (12.7) and was significantly higher than bare soil (2.36). The higher average total weight of FFR-infected fruit in all cover crop treatments when compared to bare soil may be a result of i) total number of fruit and ii) size of fruit per treatment when compared to the bare soil treatment. There were no significant differences in the percentage of fruit infected with FFR and percent yield loss due to FFR between cover crop treatments.

CONCLUSIONS:

In this study the effects on the method and timing of kill of a hairy vetch + winter rye cover crop on pumpkin yield, fruit cleanliness and soil-borne fruit rot control was examined. Pumpkin yield was highest when a late spring herbicide application to kill the cover crop was done. Although not significantly different, pumpkin yields were similar when the cover crop was either i) rotary mowed early ii) rotary mowed late or iii) or with an early spring herbicide application. In all cases, the presence of a cover crop mulch, either mechanically or chemically-killed resulted in higher pumpkin yield and average fruit weight when compared to pumpkin grown conventionally on bare soil. The method and timing of cover crop kill greatly affected the amount of ground cover and biomass production at the beginning and end of the pumpkin season. A late cover crop kill either mechanically by mowing or with a herbicide application resulted in more percent ground cover at pumpkin planting than either the early mowing or early herbicide application. More importantly, the method and timing of cover crop kill affected the amount of ground cover at the end of the production season. Since percent ground cover and cover crop biomass present on the soil surface at pumpkin harvest are extremely important for potentially increasing fruit cleanliness and reducing FFR in pumpkin production (Wyenandt et al, unpubl.); the method and timing of cover crop kill will significantly affect its effectiveness in increasing fruit cleanliness and reducing FFR. In this study percent ground cover and fruit cleanliness at harvest was highest in the late herbicide killed cover crop treatment (69% ground cover, 54% clean fruit) when compared to early (26%, 25%) and late mowed (23%, 34%) and early herbicide (29%, 27%). Pumpkin growers who are interested in improving fruit cleanliness at harvest should consider using an herbicide application over mowing to kill a winter rye + hairy vetch cover crop and delay the killing of the cover crop until later in the spring. One important benefit of chemically killing a cover crop mulch, such as winter rye + hairy vetch, is that the cover crop is more uniformly distributed on the soil surface after rolling. During rotary mowing cover crop litter can become unevenly distributed on the soil surface leaving areas with to much biomass or too little litter, thereby greatly reducing the ability of the cover crop to increase fruit cleanliness and reduce fruit rot by preventing pumpkin fruit from coming into direct contact with soil.

Although there were no significant differences in the number or percentage of fruit infected with FFR other data shows that certain cover crop mulches can reduce FFR in pumpkin production (Wyenandt et al, unpubl.).A fall-sown rye + hairy vetch cover crop can be successfully incorporated into pumpkin production in Ohio although integration and success will depend on fall-planting date, seeding rates, spring kill date, and method of pumpkin planting.

Cover Crop	Method of Kill	Time of cover crop kill	Average number of fruit per treatment				
			Total	Orange	Green	Culls	with FFR
Bare Soil	none	NA	7.5	7.4	0	0.25	1
WR + HV	Rotary Mow	Early Spring	10.3	8.5	0	0.38	1.9
WR + HV	Rotary Mow	Late Spring	11.1	9.1	0	0.75	1.3
WR + HV	Herbicide	Early Spring	11.6	8.5	0	0.75	2.4
WR + HV	Herbicide	Late Spring	14.8	14.8	0	1.12	2.4
		LSD (*P*=0.05)	2.04	2.34	NS	NS	NS

Table 1.Average total number of orange, green, culled and Fusarium fruit rot infected fruit and percent marketable orange fruit of *C. pepo* 'Magic Lantern' transplants grown in bare soil or a winter rye (WR) + hairy vetch (HV) cover crop mulch killed in early or late spring by mowing or by herbicide application.

Cover Crop	Method of Kill	Time of cover crop kill	Average total wt (in Kg) of fruit per cover crop treatment					
			Orange	Green	Culls	FFR	Total wt treatment	Avg mrkt. fruit wt
Bare Soil	none	NA	19.76	0.00	0.55	2.36	22.68	2.6
WR + HV	Rotary Mow	Early Spring	48.70	0.00	1.69	9.61	59.99	5.7
WR + HV	Rotary Mow	Late Spring	43.84	0.00	2.07	4.72	50.62	4.7
WR + HV	Herbicide	Early Spring	45.96	0.00	1.86	12.70	60.62	5.4
WR + HV	Herbicide	Late Spring	57.46	0.00	3.54	10.17	71.16	3.8
		LSD (*P*=0.05)	17.43	NS	NS	9.17	15.35	1.2

Table 2.Average weight (in kg) of orange, green, culled and Fusarium fruit rot infected fruit, total weight and average weight of marketable orange fruit of *C. pepo* 'Magic Lantern' transplants grown in bare soil or a winter rye (WR)+ hairy vetch (HV) cover crop mulch killed in early or late spring by mowing or by herbicide application.

Cover Crop	Method of Kill	Time of cover crop kill	Percent GC		Biomass dry wt (MT/ha)		Percent Clean Fruit	Percentage of fruit with FFR	Percent Yield Loss
			Planting	Harvest	Planting	Harvest			
Bare Soil	none	NA	0	0	0.00	0.00	0	17	17
WR + HV	Rotary Mow	Early Spring	54	26	3.13	3.08	25	17	17
WR + HV	Rotary Mow	Late Spring	74	23	4.29	3.69	34	11	10
WR + HV	Herbicide	Early Spring	59	29	4.39	2.40	27	23	24
WR + HV	Herbicide	Late Spring	76	69	7.27	6.49	54	16	18
		LSD (*P*=0.05)	9	10	1.68	2.33	17	19	19

Table 3. Average percent ground and biomass dry weight (in MT/ha) of a winter rye + hairy vetch cover mulch at pumpkin planting and harvest, percent clean fruit, and percent of fruit infected with Fusarium fruit rot and percent yield loss due to Fusarium fruit rot of *C. pepo* 'Magic Lantern' transplants grown in bare soil or a winter rye (WR) + hairy vetch (HV) cover crop mulch killed in early or late spring by mowing or by herbicide application.

PUMPKIN (*Cucurbita pepo* 'Magic Lantern')
Downy mildew; (*Pseudoperonospora cubensis)*

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CHEMICAL CONTROL OF DOWNY MILDEW ON PUMPKIN, 2003: Plots were established on Crosby Silt Loam (pH 6.5, OM < 2%) at OARDC Western Station, Ohio State University, South Charleston, OH (Clark Co.). Pumpkins were seeded 10ft apart in single 30ft rows on 5 June. Pumpkin plugs were planted on 16 June because of mouse damage to germinating seeds. Treatments were replicated 4 times in a randomized complete block design. Plots received 80 N lb/A and Curbit 3E 3pt/A post plant. Fungicides were applied at 60 psi and 60 gal/A using a PTO powered three-point hitch sprayer with a 15ft spray boom equipped with 6 TeeJet TXVS-12 tips. Fruit was harvested from 30ft of row for each plot on 16 Sep. and sorted into Orange, Green and Disease categories. Rainfall for Jun, Jul, Aug, and Sept was 3.67, 8.82, 6.22, 8.09in., respectively.
Powdery Mildew development at this site was heavy in unsprayed plots. It destroyed much of the check foliage by harvest. Downy Mildew developed early in the growing season, and because of the late planting of the crop and slow crop development caused by excessive rain and cool weather had a main effect on yield. While Treatments had no significant effect on any of the evaluated yield categories, treatments that exercised some control of Downy Mildew development tended to give the highest yields of orange fruit. Complicating the yield picture was the fact that Powdery Mildew was not adequately controlled in any of the treatments and the earlier mouse damage to the first and second direct seedlings. Pumpkins sprayed with quinoxyfen looked very good in the foliar ratings thoughout the season, but the treatments yielded very poorly. No explanations for this were apparent.

Table 1: Control of Disease on Pumpkin cv. Magic Lantern, 2003; South Charleston, OH

Treatments	Orange[1]	Green[2]	Anth[3]	Micro[4]
KP481 6.0oz/A (A,C,E,G) Kocide 53.8WG 1.5lbs/A (A,C,E,G) Bravo WS 2pt/A (B,D,F,H)	104.55a	4.85 bc	0.00a	2.53a
KP481 8.0oz/A (A,C,E,G) Kocide 53.8WG 1.5lbs/A (A,C,E,G) Bravo WS 2pt/A (B,D,F,H)	95.17a	2.68 bc	4.50a	0.00a
KP481 10.0oz/A (A,C,E,G) Kocide 53.8WG 1.5lbs/A (A,C,E,G) Bravo WS 2pt/A (B,D,F,H)	78.74a	4.85 bc	0.34a	0.70a
KQ667 1.5lbs/A (A,C,E,G) Bravo WS 2pt/A (B,D,F,H)	81.46a	3.12 bc	6.04a	3.45a
Quadris 11floz/A (A,C,E,G) Bravo WS 2pt/A (B,D,F,H)	88.88a	3.03 bc	0.50a	2.20a
Bravo WS 2pt/A (A,B,C,D,E,F,G,H)	70.47a	5.93 b	0.83a	3.20a
Quinoxyfen 4floz/A (A,B,C,D,E,F,G,H)	87.99a	11.32a	2.51a	1.24a
UTC	78.53a	1.13 c	4.40a	3.45a

VALUES FOLLOWED BY SIMILAR LETTERS ARE NOT SIGNIFICANTLY DIFFERENT BY DUNCAN MULTIPLE RANGE TEST.
1. ORANGE = KILOGRAMS OF ORANGE FRUIT; Kgs/30ft of row; 4 REPS

2. GREEN = KILOGRAMS OF GREEN FRUIT; Kgs/30ft of row; 4 REPS
3. ANTH= KILOGRAMS OF FRUIT WITH ANTHRACNOSE; Kgs/30ft of row; 4 REPS
4. MIRCO= KILOGRAMS OF FRUIT WITH MICRODOCHIUM BLIGHT; Kgs/30ft of row; 4 REPS
( ) =Application dates: A=15 Jul; B=24 Jul; C=30 Jul; D=8 Aug; E=14 Aug; F=21 Aug; G=28 Aug; H=8 Sep. Plant Date: 6/5/2003 & 6/16/2003; Harvest Date: 9/16/2003;Rating Date(s): 9/9/2003 and 9/16/2003

Table 2: Control of Disease on Pumpkin cv. Magic Lantern, 2003; South Charleston, OH

Treatments	PM[5]	DM[6]	Anth[7]	MB[8]	PM16[9]	DM16[10]	MB16[11]
KP481 6.0oz/A (A,C,E,G) Kocide 53.8WG 1.5lbs/A (A,C,E,G) Bravo WS 2pt/A (B,D,F,H)	2.0 bc	2.0abc	1.0 b	1.0a	3.0 cd	4.0 c	1.0 b
KP481 8.0oz/A (A,C,E,G) Kocide 53.8WG 1.5lbs/A (A,C,E,G) Bravo WS 2pt/A (B,D,F,H)	2.0 bc	1.8 bc	1.5 b	1.0a	3.5 bc	4.5abc	1.3ab
KP481 10.0oz/A (A,C,E,G) Kocide 53.8WG 1.5lbs/A (A,C,E,G) Bravo WS 2pt/A (B,D,F,H)	2.3 bc	2.3abc	1.3 b	1.0a	3.5 bc	3.8 c	1.0 b
KQ667 1.5lbs/A (A,C,E,G) Bravo WS 2pt/A (B,D,F,H)	2.5 b	3.0ab	1.0 b	1.0a	4.0abc	4.5abc	1.0 b
Quadris 11floz/A (A,C,E,G) Bravo WS 2pt/A (B,D,F,H)	1.5 bc	1.0 c	1.8ab	1.0a	3.5 bc	4.3 bc	1.3ab
Bravo WS 2pt/A (A,B,C,D,E,F,G,H)	1.8 bc	2.0abc	1.3 b	1.0a	4.0abc	5.3ab	1.8a
Quinoxyfen 4floz/A (A,B,C,D,E,F,G,H)	1.0 c	1.0 c	2.5a	1.5a	1.8 d	2.0 d	1.3ab
UTC	5.0a	3.3a	1.0 b	1.0a	5.5a	5.5a	1.5ab

VALUES FOLLOWED BY SIMILAR LETTERS ARE NOT SIGNIFICANTLY DIFFERENT BY DUNCAN MULTIPLE RANGE TEST.

5.PM= PERCENT OF POWDERY MILDEW OF FOLIAGE, RATED ON 9/9/2003. RATING SCALE= 1-0 TRACE; 2 UP to 25%; 3=UP to 50%; 4=UP to 75%; 5 UP to 100%; 6=DEAD.
6.DM= PERCENT OF DOWNY MILDEW OF FOLIAGE, RATED ON 9/9/2003. BASED ON RATING SCALE ABOVE.
7. ANTH=PERCENT OF ANTHRACNOSE ON FOLIAGE, RATED ON 9/9/2003. BASED ON RATING SCALE ABOVE.
8. MICRO= PERCENT OF MICRODOCHIUM BLIGHT ON FOLIAGE, RATED ON 9/9/2003. BASED ON RATING SCALE ABOVE.
9.PM16= PERCENT OF POWDERY MILDEW OF FOLIAGE, RATED ON 9/16/2003. RATING SCALE= 1-0 TRACE; 2 UP to 25%; 3=UP to 50%; 4=UP to 75%; 5 UP to 100%; 6=DEAD.
10.DM16= PERCENT OF DOWNY MILDEW OF FOLIAGE, RATED ON 9/16/2003. BASED ON RATING SCALE ABOVE.
11. MICRO= PERCENT OF MICRODOCHIUM BLIGHT ON FOLIAGE, RATED ON 9/16/2003. BASED ON RATING SCALE ABOVE.

( ) =Application dates: A=15 Jul; B=24 Jul; C=30 Jul; D=8 Aug; E=14 Aug; F=21 Aug; G=28 Aug; H=8 Sep.
Plant Date: 6/5/2003 & 6/16/2003; Harvest Date: 9/16/2003
Rating Date(s): 9/9/2003 and 9/16/2003

Evaluation of New Herbicide Formulations and Production Strategies for Improved Weed Control in Pumpkin Production

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Introduction

This report will outline the general cultural practices of the research site, objectives of the grant, and detail any significant findings concerning the interactions of field planting conditions (no till bare soil v. winter rye) and herbicide selection on yield, weed and disease pressure.

Cultural Practices

The research was conducted at the OARDC Western Branch field crops station in South Charleston, Ohio. The field was 1.1 A in size, half planted (drilled) with winter rye at 90 pounds / A in October, 2002. After germination and emergence of rye, Roundup was used to kill off specific rows that would be planted to pumpkins in 2003.

Fertilizer was broadcast over the field in the spring prior to planting at the rate of 100# N, 150# P, 100# K. The design was a split plot, with the no till bare ground and rye mulch running the long dimension of the field (400 ft), and the four herbicide treatments running across the field (120 ft). The three herbicide treatments were applied over both bare soil and rye grass, and are briefly outlined in Table 1. There were four replications of four treatments; individual plot size measured 25' x 60'. Magic Lantern pumpkins were direct seeded on June 10th under wet and cool soils. Row spacing was 5' and in row spacing was 2'. Admire (imidacloprid) 2F was applied in furrow at 16 oz /A to protect seedlings against primarily cucumber beetle feeding.

Pre-emerge herbicides Strategy (clomozone and ethalfluralin) and Sandea (halosulfuron-methyl) were applied at 4 pints and 2/3 oz per acre respectively immediately after seeding. Sandea was applied post at 1/3 of an ounce on July 8th, along with Poast at 1.5 pints and a non-ionic surfactant across the proper treatments. Roundup was wicked on July 25 in the appropriate treatments.

Weed ratings were taken on three occasions, June 25, July 8, and July 23. The check strips in each half of the field (bare soil v. rye) were inspected for abundance of dominant weeds. The weed pressure in each of the treated plots was compared only to the check plots in that half of the field, i.e., bare soil checks were compared only to other bare soil treatments. Commercially acceptable weed control was set at 85%.

Three fungicide applications were made to the entire field beginning at the detection of powdery mildew in early August. The fungicide Quadris was rotated with Nova and Bravo on a 10 day schedule. All of the fruit (orange and green) were harvested from the plots on September 11th, 12th, and 19th. Each fruit was weighed and graded for disease and insect feeding.

Results and Discussion
The first objective of the study was to compare the effect of herbicide treatments over bare soil or rye mulch on yield. There were significant differences in fruit weight, with treatments 1, 5, 7, and 8 producing the heaviest fruit (Table 1). The herbicides in treatments 1 and 5 are identical, only the bare ground or rye mulch component differed. There were also significant differences between the numbers of fruit per plot, with treatment 1 clearly producing the most fruit. Combining the weight and number of fruit factors, the highest yielding treatment was 1, Strategy followed by a Roundup wick over bare soil. Not far behind in yield was the same treatment over rye mulch, followed by Strategy and Sandea over rye mulch. In general, the yields from herbicide treatments over bare ground were not dramatically different from the rye mulch.

Table 1. Herbicide and field condition treatment effects on weight, average fruit number, and projected yield of pumpkins.

Treatment	Herbicide	Field condition	Fruit Wt. (KG)	No. of Fruit	Projected Yield (T/A)
1	Strategy[1], Roundup[2] wicked on	Bare soil	4.2 d	60.0 f	13.8 e
2	Sandea[1], Sandea[2] and Poast[2]	Bare soil	2.7 b	27.0 c	4.0 bc
3	Strategy[1], Sandea[2]	Bare soil	3.3 c	31.0 cd	5.6 c
4	Untreated check plot	Bare soil	1.7 a	10.0 ab	0.9 ab
5	Strategy[1], Roundup[2] wicked on	Rye	4.3 d	45.2 e	10.6 d
6	Sandea[1], Sandea[2] and Poast[2]	Rye	3.6 c	22.0 bc	4.3 c
7	Strategy[1], Sandea[2]	Rye	4.1 d	42.8 de	9.6 d
8	Untreated check plot	Rye	3.7 cd	1.8 a	0.4 a

Data in columns followed by the same letter are not statistically different.
1 – pre-emerge
2 – post emerge

The second objective of the study was to look at weed control effects produced by various herbicide programs over bare soil and rye mulch. The evaluations occurred roughly 2 weeks, 4 weeks, and 6 weeks after pre-emerge applications. The third evaluation was performed 2 weeks after the herbicide post applications. Evaluations consisted of observing the size, number, and health of dominant weeds in all four checks in either bare soil or rye mulch plots, then comparing those estimates with emerged weeds in the remaining treatments. Commercially acceptable control was designated at 85%.

In general, there was a wider range of weeds in the bare soil plots compared to the rye mulch plots for all three observation periods. Control during the first evaluation period revealed acceptable to excellent control of all weeds present except for pigweed in the Strategy treatments, while that was the only dominant weed Sandea controlled over bare soil (Table 2). In rye mulch, all treatments controlled weeds well except for Sandea, which was weak on Eastern black nightshade.

The second observation two weeks later provided a much wider spectrum of emerging weeds. Over bare soil, Strategy controlled dandelion, purslane, and bedstraw well, but was weak on barnyard grass. Sandea was strong against all broad leaves except Eastern black nightshade, and it too was weak on barnyard grass. These same treatments over rye mulch faced fewer weeds. Strategy barely held against the broadleaves and grasses present, while Sandea struggled against dandelions. It is only an odd circumstance that Sandea appears to be controlling barnyard grass; this material is known to have no activity on grasses. Plot averages begin to indicate Sandea's continued weakening against Eastern black nightshade. After this observation, post applications of Sandea and Poast were made to the appropriate treatments.

Table 2. Percent weed control from three evaluation dates, June 25, July 8, and July 23. Percent control visually estimated from weed pressure in untreated checks with bare soil treatments compared only against bare soil check, likewise for rye mulch plots. Highlighted areas indicate weeds where at least 85% control is achieved.

Herbicide Treatments	Date	Field	EBN	PW	Dand	Purs	Fox	BYG	Bed
			% Control						
1. Strategy[1], Roundup[2] wicked on	6-25	Bare	90	81	-	-	-	89	-
2. Sandea[1], Sandea[2] and Poast[2]	6-25	Bare	59	94	-	-	-	75	-
3. Strategy[1], Sandea[2]	6-25	Bare	90	76	-	-	-	91	-
5. Strategy[1], Roundup[2] wicked on	6-25	Rye	93	-	86	-	-	-	-
6. Sandea[1], Sandea[2] and Poast[2]	6-25	Rye	75	-	90	-	-	-	-
7. Strategy[1], Sandea[2]	6-25	Rye	93	-	85	-	-	-	-
1. Strategy[1], Roundup[2] wicked on	7-8	Bare	81	69	86	86	-	81	88
2. Sandea[1], Sandea[2] and Poast[2]	7-8	Bare	60	93	90	85	-	68	85
3. Strategy[1], Sandea[2]	7-8	Bare	83	73	81	86	-	81	91
5. Strategy[1], Roundup[2] wicked on	7-8	Rye	88	-	79	-	-	85	-
6. Sandea[1], Sandea[2] and Poast[2]	7-8	Rye	73	-	86	-	-	85	-
7. Strategy[1], Sandea[2]	7-8	Rye	85	-	84	-	-	83	-
1. Strategy[1], Roundup[2] wicked on	7-23	Bare	68	55	78	78	89	79	78
2. Sandea[1], Sandea[2] and Poast[2]	7-23	Bare	50	91	89	86	94	94	88
3. Strategy[1], Sandea[2]	7-23	Bare	63	79	91	83	94	95	88
5. Strategy[1], Roundup[2] wicked on	7-23	Rye	69	81	60	-	81	76	-
6. Sandea[1], Sandea[2] and Poast[2]	7-23	Rye	66	91	88	-	95	95	-
7. Strategy[1], Sandea[2]	7-23	Rye	75	90	88	-	95	95	-

- = Not Present, EBN=Eastern black nightshade, PW=Pigweed, Dand=Dandelion, Purs=Purslane, Fox=Foxtail, BYG=Barnyard grass, Bed=Bedstraw

The third and final evaluation period occurred roughly six weeks after pre-emerge herbicide applications and two weeks after post applications; weed pressure and spectrum continue to increase. Strategy (without Roundup yet) is only controlling foxtail at this point over bare soil. The pre Sandea and post Sandea and Poast treatment is performing well over bare soil, only showing Eastern black nightshade as a weakness. Strategy followed by Sandea is performing moderately well, picking up some extended grass control from the pre-emerge application while staying strong on dandelion and bedstraw. This combination is weakening against pigweed and Eastern black nightshade. Strategy alone (without Roundup yet) over rye mulch is not holding up against any of the weeds present. Strategy followed by Sandea appears to be holding against all weeds present, including pigweed, except for Eastern black nightshade. Sandea followed by Sandea is exhibiting almost identical characteristics, holding on to all broad leaves and grasses minus Eastern black nightshade.

After this evaluation, Roundup was wicked on the appropriate treatment. The plots which had Roundup wicked on as a post treatment went on to have the lowest weed competition and highest yields of all treatments regardless if over bare soil or rye mulch. The other three herbicide treatments continued to decay and weaken to the point where overwhelming competition between the pumpkins and weeds significantly reduced yield.

The third objective of the study was to evaluate any differences in disease pressure between the bare soil and rye mulch halves of the field. The bare soil half of the field had 11.3% of the fruit infected with anthracnose versus 9.3% for the rye half. The bare soil half was also higher in virus detections at 23.4 % of fruit with 14.3% for the rye half. There was no statistical difference between these two field halves for either disease. Due to the relative earliness of the harvest, very few cases of Fusarium fruit rot were detected in either section of the field. Previous work at OSU has shown that rye mulch cover can significantly reduce the incidence of Fusarium fruit rot.

Summary

This growing season began with abnormally wet and cool temperatures during June that led to reduced germination and sub standard seedling emergence. Initially weed control in both bare soil and rye mulch plots looked excellent, but gave way to late season flushes that took their toll on pumpkin development and yields. Strategy herbicide with Roundup wicked on later in the season over either bare soil or rye mulch had the fewest weeds and produced the highest yields. Since this technique is very labor intensive and not practical for large scale operations, it is not likely to be widely recommended by Extension specialists or adopted by growers. It does demonstrate the extreme importance of good weed control in growing pumpkins. Based on observations made this year, the other herbicide treatments were not acceptable for recommendation.

The weed spectrum and pressure was very different between the bare soil and rye mulch halves of the field. In the case of the rye mulch, a tremendously thick and competitive carpet of dandelion prevented other weeds or even pumpkins from developing normally. In the bare soil plots, the sheer biomass of Eastern black nightshade overshadowed other weeds and stunted pumpkin development. Disease control in either half of the field was not significantly different.

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Vegetable Transplants as a Delivery System for Biocontrol Agents

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Introduction:

Ohio vegetable growers often use transplants ('plugs') to permit earlier harvest of several important Solanaceous crops (tomatoes, peppers, eggplants) that require longer growing seasons. Use of transplants vs. direct seeding can also (1) reduce seed costs, (2) overcome adverse weather conditions in the spring, and (3) reduce weed control costs. In recent years, several microbial products (beneficial bacteria, fungi, etc.) have been marketed for crop production and disease management. Research and demonstration studies at a grower location and university facility tested biocontrol performance under Ohio's environmental conditions and range of cultural practices. Biocontrol compounds included Companion™ (*Bacillus subtilis* GB03), and PlantShield® HC (*Trichoderma harzianum*). Biocontrol compounds were evaluated alone, and in combination. Research/demo plots were featured at various summer meetings and tours in 2003, with summary presentations and reports available at winter 2004 grower meetings and on the OSU VegNet.

Objectives:

(1) Evaluate effects of commercial biocontrol agents on seedling quality (plant height, stem diameter) of greenhouse-produced tomato, pepper and eggplant transplants,

(2) Determine if biocontrol agents (alone, or in combination) are effective in controlling key early season root diseases of the Solanaceous crops listed above, and

(3) Compare effects of biocontrol treatments on fruit characteristics (average fruit size, culled fruit) and marketable yields.

Methods and Materials:

Tomato ('OX150'), pepper ('Merlin') and eggplant ('Santana') were seeded into 288-cell plug trays on April 4, 2003. Transplants were grown in the OARDC Veg Crop Branch (VCB) greenhouse until field establishment on May 29, 2003. Plots were established on raised beds with black plastic mulch spaced 5 feet apart. Tomatoes were spaced 12 inches apart with peppers and eggplants spaced 24 inches apart in the rows. Plots were placed in ground where solanaceous crops (processing tomatoes) were grown the previous year to help establish disease pressure. No disease inoculants were applied to the field. Biocontrol agents were applied to tomato, pepper and eggplant transplants prior to field establishment at the recommended greenhouse application rates (Companion 16 oz /100 gallons H_2O; PlantShield HC 4 oz/100 gallons H_2O). Plant heights and stem diameter were measured one month after transplant/initial biocontrol application. A second application of Companion and PlantShield HC were applied after plant measurements were recorded. Applications were made based on the recommended field rates of 4 oz/1,000 sq ft (Companion) and 2 oz/100 gallon/800 sq ft (PlantShield HC).

A small demonstration plot of tomatoes, peppers, and eggplant were also established at a grower site, near Fremont, Ohio. Biological controls were applied in the same manner as mentioned above. Plots were used for demonstration and field day presentations. Peppers and eggplants were harvested once at this location. Cultural practices used were according to standard practices used by the grower.

Results and Discussion:
Tomatoes were once-over hand harvested and graded at the Veg Crops Branch (VCB) on September 3, 2003. There were no differences in plant height or stem diameter one month after transplant and no differences in marketable red, green and cull fruit, or average fruit weight at harvest (Table 1).

Peppers were harvested three times at the VCB (Aug 14, Sept 3, 25) and once at the grower site on Aug. 14. Plant heights and stem diameter measured one month after field transplanting at the VCB showed a slight increase for the untreated check vs. Companion alone or the combination treatment with PlantShield (Table 2). No differences in plant height were noted in plots at the grower site (Table 3). There were no yield differences for the three harvests or season totals at the VCB, and no differences due to treatment for the one-time harvest at the grower site.

Eggplant was harvested three times at the VCB (Aug 14, Sept 3, 25) and once at the grower site on Aug. 14. No differences in stem diameter or plant height were noted at either location when measured one month after transplant (Tables 4,5). No differences in yield were observed at the VCB, but there was a difference in marketable T/A at the grower site with the untreated check plots having a higher yield of marketable fruit.

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Table 1. Processing Tomato Transplants as Delivery Systems for Biological Control Agents - 2003
VCB, Fremont, OH

Cultivar: 'OX 150'	One month after transplant					
Treatment	**Plant ht. (cm)**	**Stem diam. (mm)**	**Red T/A**	**Average red fruit wt (lbs)**	**Green T/A**	**Culls T/A**
Untreated Check	36.8	13.9	25.0	0.13	4.1	6.4
Companion	36.7	13.4	22.1	0.11	4.3	6.3
PlantShield HC	36.8	13.5	25.7	0.11	3.4	4.8
Companion + PlantShield HC	36.5	13.9	19.7	0.13	3.3	7.3
LSD (0.05)	NS	NS	NS	NS	NS	NS
CV	6.1	5.0	25.1	11.5	54.2	28.1

Table 2. Pepper Transplants as Delivery Systems for Biocontrol Agents - 2003
Veg Crops Branch, Fremont, OH

Cultivar: 'Merlin'	One month after transplant		SEASON TOTALS				
Treatment	**Plant ht. (cm)**	**Stem diam. (mm)**	**Marketable T/A**	**Marketable fruit number/A**	**Average fruit wt (lbs)**	**Culls T/A**	**Cull fruit number/A**
Untreated check	19.0a	7.08a	21.1	108464	0.39	0.34	2178
Companion	16.9 b	6.55 b	19.7	104196	0.38	0.41	2701
Plant Shield HC	17.5ab	6.85ab	19.2	104283	0.37	0.23	1481
Companion + PlantShield HC	16.4 b	6.40 b	19.5	102714	0.38	0.49	3223
LSD (0.05)	1.8	0.49	NS	NS	NS	NS	NS
C.V.	8.4	5.9	20.6	20.9	5.6	72	75.3

Table 3. Pepper Transplants as Biocontrol Delivery Systems - 2003
Grower site, Fremont, OH
One harvest only

Cultivar 'Merlin'	One mth. after transplant					
Treatment	**Plant ht (cm)**	**Marketable T/A**	**Marketable fruit number/A**	**Average fruit wt (lbs)**	**Culls T/A**	**Cull fruit number/A**
Untreated check	18.1	2.8	18392	0.31	0.03	194
Companion	18.0	5.1	29040	0.35	0.19	387
PlantShield HC	18.4	2.2	14133	0.32	0.03	194
Companion + PlantShield HC	17.1	4.1	25749	0.32	0.05	387
LSD (0.05)	NS	NS	NS	NS	NS	NS
C.V.	5.5	47.9	44.7	8.7	75.8	44.0

Table 4. Eggplant Transplants as a Delivery System for Biocontrol Agents - 2003
Veg Crops Branch (VCB), Fremont, OH

Cultivar 'Santana'

	One Month After Transplant		SEASON TOTALS (3 harvests)				
Treatment	**Plant ht. (cm)**	**Stem diam. (mm)**	**Marketable T/A**	**Marketable fruit**	**Average fruit wt. (lbs)**	**Cull T/A**	**Cull fruit number/A**
Untreated	18.7	9.3	12.4	25962	0.95	0.73	2265
Companion	19.3	9.1	10.7	23435	0.92	0.52	1568
PlantShield	19.8	9.3	10.4	23871	0.87	0.83	2091
Companion + PlantShield HC	19.3	9.3	12.4	27356	0.89	0.95	2614
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS
C.V.	6.0	6.2	27.2	22.5	9.6	56.0	49.5

Table 5. Eggplant Transplants as a Delivery System for Biocontrol Agents - 2003
Grower site, Fremont, OH

Cultivar: 'Santana'
One harvest only

	One month after transplant					
Treatment	**Plant ht. (cm)**	**Marketable T/A**	**Marketable fruit number/A**	**Average fruit wt. (lbs)**	**Culls T/A**	**Cull fruit number/A**
Untreated check	20.8	15.2	20715	1.5	0.14	194
Companion	19.5	5.3	8518	1.3	0.13	194
PlantShield HC	23.2	9.1	13939	1.3	0.17	387
Companion + Plant Shield HC	20.5	9.1	12778	1.5	0.26	387
LSD (0.05)	NS	6.00	NS	NS	NS	NS
C.V.	11.4	47.4	43.9	13.1	57.8	59.5

Cabbage, Carrot, and Food Grade Soybean Seed Vigor Analysis for Improved Seedling Establishment

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Seed quality assessment is crucial to ensure excellent field performance of vegetable crops. Therefore, it is necessary to have methods that assess seed quality rapidly and accurately. Researchers at Ohio State University have developed a system using computer scanners and software to accurately assess seed quality in lettuce and soybean by imaging seedlings (Sako et al., 2001; Hoffmaster et al., 2003). Seeds are germinated and seedlings are grown for a predetermined number of days. Seedlings are then scanned using an inverted computer scanner, and these images are analyzed for vigor using specialized software. Employing this system with other crops requires new protocols be developed so seedlings can be scanned and analyzed using the appropriate software. New protocols may involve germination times and temperatures as well as methods for germinating seeds of different sizes and shapes. Other vegetable crops such as carrot (*Daucus carota* L.), cabbage (*Brassica oleracea* var. *capitata* L.), and food grade soybeans (*Glycine max*) are being investigated for the feasibility of assessing vigor using existing software.

Cabbage (*Brassica oleracea* var. *capitata*)

Two rows of 25 seeds each were planted on two moist blotters (23 x 14 cm), which were placed in plastic germination boxes (4 cm. high x 24 cm. long x 16 cm. wide). Boxes were placed in a germination chamber at 20 °C for 3 days. Boxes were placed vertically (90°) so that seedlings grow parallel to the blotter, thus facilitating the scanning and calculation of the vigor index. Since cabbage seeds are round, initial studies revealed that the seeds rolled down from the blotter. To solve this problem, two approaches were evaluated. Seeds were covered with another blotter, putting a layer of wax paper between the bottom and top blotters to prevent the growing seedlings from attaching to the top blotter. In the second approach, saran wrap instead of wax paper was used. Both approaches worked to prevent seedlings from rolling down, but wax paper was preferred because it is easier to remove from the blotter without causing damage to developing roots.

The software designed to estimate the vigor index of lettuce was also used to estimate cabbage seed vigor. For a fast and accurate estimation, this software requires an adequate contrast between the growing seedlings and blotter. This contrast facilitates recognition of seedling structures, which is essential for vigor index estimation. In our preliminary studies, better contrast was obtained when germinating cabbage seeds were placed in complete darkness. This resulted in white seedlings that markedly contrasted with the blue color of the blotters (Figure 1).

The lettuce software requires that seedlings do not overlap each other, so adequate distinction between two different seedlings can be made. In our preliminary studies, 25 seeds per row resulted in overlapping due to seedling development. This overlapping caused two or more seedlings to be recorded as a single individual seedling. To solve this obstacle, 20 seeds per row, instead of 25, were evaluated making a total of 40 seeds per blotter. We used the Seed Vigor Imaging System (SVIS) to compute growth, uniformity and vigor index parameters of cabbage seedlings and compared these to the percent stand when cabbage transplants were seeded into plug trays (Table 1).

Seedlings not having sufficient development

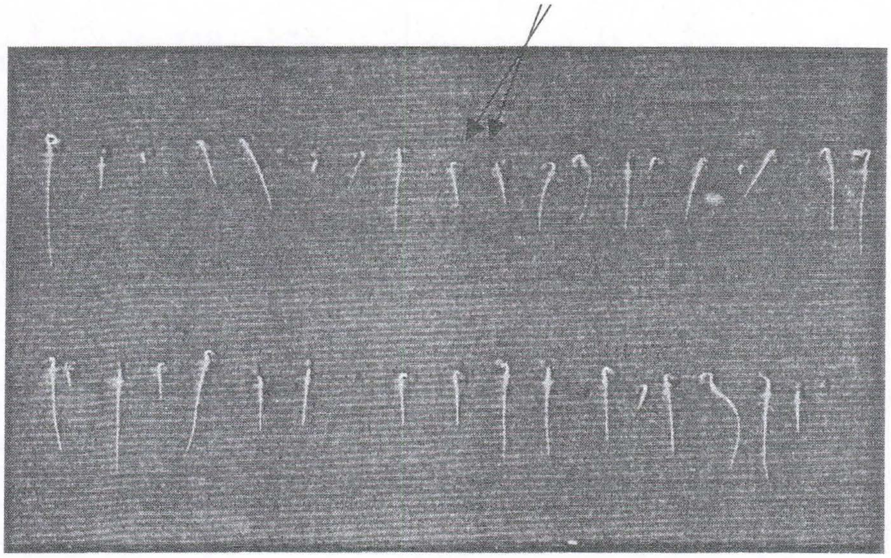

Figure 1. Scan of three day-old cabbage seedlings planted between two moist blotters at 20 ° C under darkness.

Table 1. Vigor index parameters of six cabbage varieties planted at 20°C under darkness. Each value represents the average of four replications. Cabbage seedlings were scanned three days after planting and vigor index parameters were determined using the Seed Vigor Imaging System (SVIS) lettuce software. The number of seedlings was transformed for the analysis of variance but the original data are shown. Data were analyzed using the SAS ANOVA procedure including varieties and replications as sources of variation; means were compared using LSD at 0.05 level of probability.

Variety	Vigor Index ***	Uniformity	Growth	# of Seedlings**	% plug tray Emergence
Dynasty*	534	739a	392a	48a	93
Bravo*	517	712a	322a	46a	94
Hinova	484	688a	281 b	45a	88
Almanac	451	646a	256 b	44 b	92
Genesee	175	290 b	60 c	21 c	88
Score	123	216 b	30 c	14 d	79
LSD		102.0	29.7	4.2	
CV		12.3	9.2	7.9	

*** Vigor index calculated using 50% uniformity and 50% growth

**The number of seedlings indicates seedlings that were recognized by the software (alive seedlings out of fifty) to estimate the vigor index.

*All varieties except Dynasty and Bravo were film-coated.

Carrot (*Daucus carota* L.)

Carrot was germinated under similar conditions as described above for cabbage. However, carrot seeds are flat, which enables them to stay on the blotter better when compared to cabbage seeds. As a result, it was not necessary to use an extra blotter, saran wrap or wax paper. Germination of carrot is slower than that of cabbage and lettuce (7, 5, and 4 days to the first count respectively, ISTA). As a result, scanning was performed at 5 and 6 days after planting. Additionally, carrot seedlings bend in the portion immediately before the cotyledons (Figure 2), presumably to assist in getting the cotyledons out of the soil surface. This bending makes the hypocotyl and radicle difficult to distinguish. By scanning at 4 days, most of the seedlings will not have this bending. (Figure 2). Thus, these seedlings will be ready for scanning and vigor index calculation at 4 days.

Carrot seedlings do not develop root hairs, which are essential for the SVIS lettuce module to distinguish between the radicle and hypocotyl. As a result, the carrot vigor index is calculated in terms of the whole seedling. Vigor index ratings (Table 2) will be compared to field emergence at a grower site.

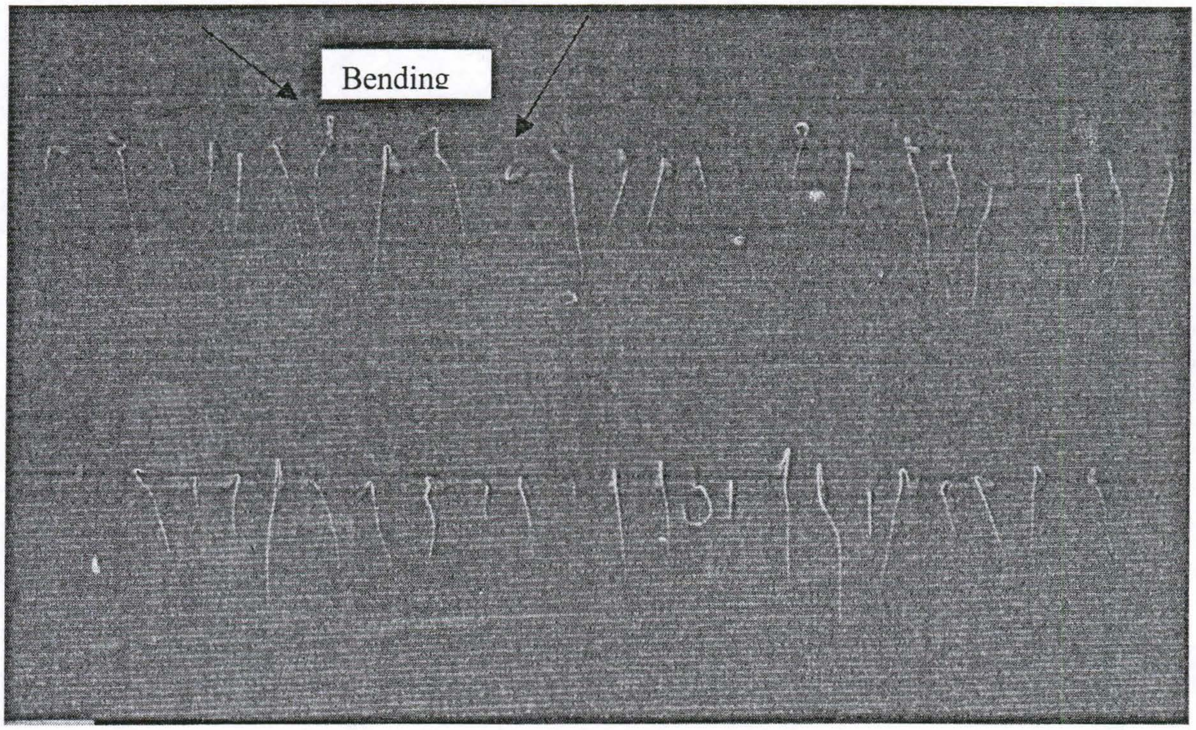

Figure 2. Five-day old carrot (*Daucus carota* L.) seeds.

Table 2. Vigor index parameters of four carrot varieties planted in a germination chamber. Four replications of fifty seeds were planted at 20°C under darkness, and scanned six days after planting. Vigor index parameters were determined using the Seed Vigor Imaging System (SVIS) lettuce software (50% uniformity and 50% growth). The number of seedlings indicates seedlings that were considered by the software to conduct the statistical analysis. Data were analyzed using the SAS ANOVA procedure; means were compared using LSD at 0.05 level of probability.

Variety	Vigor Index	Uniformity	Growth	# Seedlings
Carson	661	438a	883 b	43a
Bergen	645	388a	901 b	40a
Fayette	619	238 b	1000a	40a
Bradford	551	190 b	912ab	35 b
LSD		77.2	94.5	3.8
CV		15.4	6.4	5.1

Food Grade Soybeans (*Glycine max*)

The Seed Vigor Imaging System using software developed for soybean was used for 4 lots of food grade soybeans (Figure 3). Vigor Index values were compared to field emergence (Table 3).

Figure 3. Soybean seedlings scanned and analyzed using the SVIS for vigor rating.

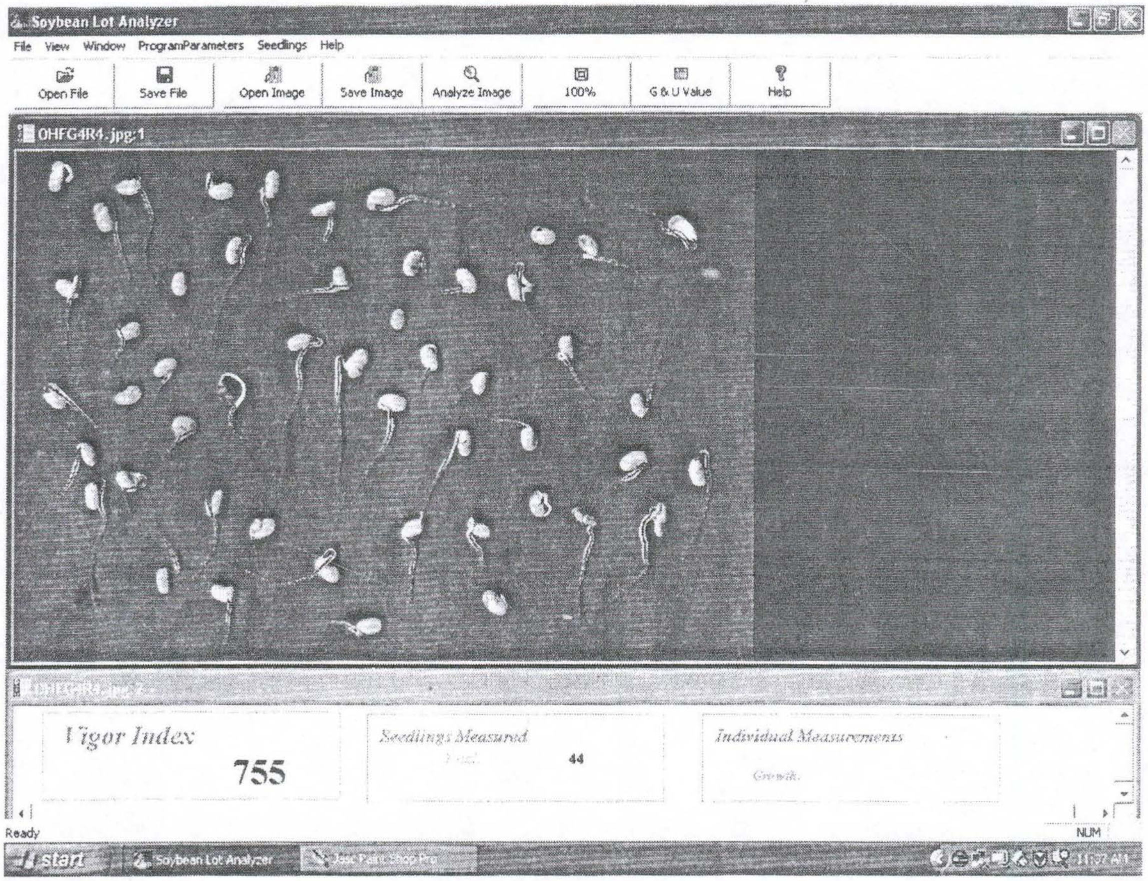

Table 3. Vigor index parameters for four food grade soybean varieties planted at 25°C under darkness. Four replications of fifty seeds each were planted in rolled germination paper. The experiment was replicated twice. Seedlings were scanned three days after planting, and vigor index parameters were determined using the Seed Vigor Imaging System (SVIS) soybean model (weighted 50% uniformity and 50% growth).

				---% field emergence---			
Variety	Vigor Index	Uniformity	Growth	14 DAP*	17 DAP	21 DAP	31 DAP
OHFG1	634	615 c	653a	23	28	34	34
OHFG3	614	693 b	535 b	12	32	41	42
OHFG4	658	771a	544 b	53	63	73	73
OHFG5	777	824a	730a	67	73	79	79
LSD (0.05)		73.4	105.3	17.3	10.8	5.6	4.8
CV		9.3	15.9	63.3	42.6	36.4	36.0

* DAP= days after planting

Summary

First year results of applying computer-aided seed vigor technology to cabbage, carrot and food grade soybean seed lots were encouraging. More studies are needed to better correlate SVIS values to greenhouse and field establishment data. Seeds of other key vegetable crop families (e.g. cucurbits) and species (tomato, pepper, etc.) will also be researched.

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