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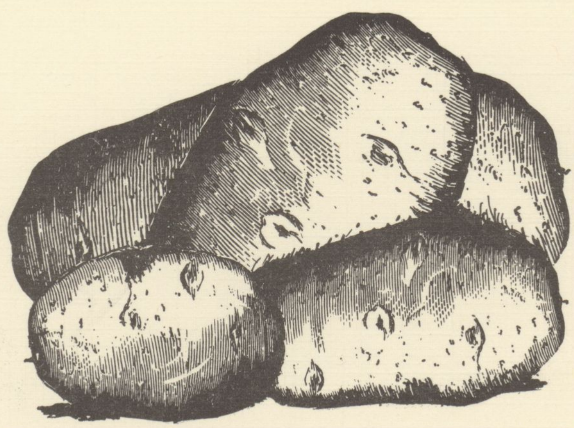
1984 MONTCALM FARM RESEARCH REPORT



MICHIGAN STATE UNIVERSITY AGRICULTURAL EXPERIMENT STATION

IN COOPERATION WITH

THE MICHIGAN POTATO INDUSTRY COMMISSION

THE MICHIGAN POTATO INDUSTRY COMMISSION

April 5, 1985

TO All Michigan Potato Growers and Shippers:

This Potato Research Report is the result of the research that was carried on by Michigan State University at the Montcalm Research Farm, Entrican, Michigan as well as other potato research projects conducted during 1984.

The continued research on Michigan potatoes is a direct result of the monies that growers and shippers have paid into the Michigan Potato Industry Commission. Only through this support can the potato industry in Michigan continue with similar research in the future.

Thank you.

Sincerely,

Roy H. Kaschyk
Executive Director

RHK:cc

THE MICHIGAN POTATO INDUSTRY COMMISSION • 241 E. SAGINAW, STE. 403 • EAST LANSING, MI 48823 • (517) 373-3783

ACKNOWLEDGEMENTS

Research personnel working at the MSU Montcalm Branch Experiment Station have received considerable assistance in various ways. The Michigan Potato Industry Commission has granted substantial research dollars to support many of the projects included in this report. A special thanks is given to the MPIC, private companies, and government agencies who have made this research possible. Many contributions in the way of fertilizers, chemicals, seed, equipment, technical assistance, personal services, and monetary grants were also received and are hereby gratefully acknowledged. Contributions of Russet Burbank seed and the processing of samples for bruise determinations were provided by Ore-Ida Foods, Inc. and we gratefully acknowledge their continued support of MSU potato research.

Recognition is also given to Mr. Theron Comden for his dedicated cooperation and assistance in many of the day-to-day operations. Acknowledgement is also made to Dick Kitchen for his fine leadership in coordinating the production management needs of the Station throughout the planting, growing and harvest season.

TABLE OF CONTENTS

1984 POTATO RESEARCH REPORT

R.W. Chase, Coordinator
Department of Crop and Soil Sciences

INTRODUCTION

The Montcalm Branch Experiment Station was established in 1967. This report marks the completion of 18 years of potato research studies at this facility. This report is designed to summarize all of the research conducted at the Montcalm Research Farm during 1984 plus that conducted at other locations. Much of the data reported herein represents projects in various stages of progress, so results and interpretations may not be final. RESULTS PRESENTED HERE SHOULD BE TREATED AS A PROGRESS REPORT ONLY as data from repeated trials are usually necessary before definite conclusions and recommendations can be made.

WEATHER

Tables 1 and 2 summarize the 15 year temperature and rainfall data recorded at the Research Farm. Temperatures during May were substantially below the 15 year average by 7 F on the maximum and 4 F on the minimum. For the balance of the growing season, temperatures were very near the 15 year average, actually slightly above the average maximum. The overall average for the 6 months growing season was very similar to the 15 year average. The cool May did contribute to a slower emergence, similar to the 1983 experience.

Rainfall patterns were very similar to the 15 year average for the growing season. During May the rainfall was 77% above the 15 year average. June was 16% below the average and August was 54% below the average. April, July and September were very similar or slightly above the long term average. All in all, 1984 was a good growing season at the research farm.

Supplemental irrigations were applied 17 times during the growing season at the rate of 3/4 inch per application. Total rainfall during the six months growing season was very near the 15 year average, however, May was substantially above the normal, 5.14" vs. 2.91". August was 2.3" below normal.

SOIL TESTS

Soil test results for the general plot area were:

pH	P	K	Ca	Mg
5.9	426	213	1095	209

Table 1. The 15 year summary of average maximum and minimum temperatures during the growing season at the Montcalm Research Farm.

Year	April		May		June		July		August		September		6-Month Average	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1970	54	35	65	47	72	55	80	60	80	57	70	51	73	45
1971	53	31	65	39	81	56	82	55	80	53	73	54	76	48
1972	47	30	70	47	72	50	79	57	76	57	69	49	73	48
1973	54	36	63	42	77	58	79	60	80	60	73	48	74	51
1974	57	36	62	41	73	52	81	57	77	56	68	45	70	48
1975	48	28	73	48	75	56	80	57	79	58	65	44	70	49
1976	58	35	63	41	79	57	81	58	80	53	70	46	71	48
1977	62	37	80	47	76	50	85	61	77	52	70	53	75	50
1978	50	31	67	45	78	50	81	56	82	57	75	52	72	49
1979	50	33	66	44	74	55	82	57	77	55	76	47	71	49
1980	49	31	69	42	73	50	81	58	81	58	70	49	71	48
1981	56	35	64	39	73	50	77	51	78	53	67	47	69	46
1982	53	28	72	46	70	44	80	53	76	48	66	44	70	44
1983	47	28	60	38	76	49	85	57	82	57	70	46	70	46
1984	54	34	60	39	77	54	78	53	83	55	69	45	70	47
15-YR. AVG.	53	33	67	43	75	52	81	57	79	55	70	48	72	48

Table 2. The 15 year summary of precipitation (inches per month) recorded during the growing season at the Montcalm Research Farm.

Year	April	May	June	July	August	September	Total
1970	2.42	4.09	4.62	3.67	6.54	7.18	28.52
1971	1.59	0.93	1.50	1.22	2.67	4.00	11.91
1972	1.35	1.96	2.51	3.83	7.28	2.60	19.53
1973	3.25	3.91	4.34	2.36	3.94	1.33	19.13
1974	4.07	4.83	4.69	2.39	6.18	1.81	23.97
1975	1.81	2.05	4.98	2.71	11.25	3.07	25.87
1976	3.27	4.03	4.22	1.50	1.44	1.40	15.86
1977	1.65	0.46	1.66	2.39	2.61	8.62	17.39
1978	2.34	1.35	2.55	1.89	5.90	2.77	16.80
1979	2.58	1.68	3.77	1.09	3.69	0.04	12.85
1980	3.53	1.65	4.37	2.64	3.21	6.59	21.99
1981	4.19	3.52	3.44	1.23	3.48	3.82	19.68
1982	1.43	3.53	5.69	5.53	1.96	3.24	21.38
1983	3.47	4.46	1.19	2.44	2.21	5.34	19.11
1984	2.78	5.14	2.93	3.76	1.97	3.90	20.48
15-YR. AVG.	2.65	2.91	3.50	2.58	4.29	3.71	19.64

FERTILIZERS USED

The previous crop was a sorghum-sudan hybrid followed by a seeding of winter rye which was plowed down prior to potato planting. Except for the specific fertility studies where the fertilizers are specified in the report, the following fertilizers were used on the potato plot area:

plowdown	0-0-60	250 lbs/A
banded at planting	20-10-10	500 lbs/A
sidedress prior to hilling	46-0-0	225 lbs/A

HERBICIDES AND HILLING

Most of the hillings were completed by the end of May. The procedure used was to delay the herbicide application until the potatoes were just cracking the ground. The potatoes were then hilled by building a wide and flattened hill and placing just enough soil over the plants to protect them and then the tank mix of metolachlor (Dual) 2 lbs/A plus metribuzin (Lexone 4L) ½ lb/A was applied. The sidedress urea was applied at the same time as hilling. This practice required no further tillage until harvest and as a consequence weed control was excellent.

INSECT AND DISEASE CONTROL

Aldicarb (Temik 15G) was applied at planting at 20 lbs/A. The foliar fungicide applications were initiated on July 2 with nine applications of Bravo. Foliar insecticides used were Imidan on July 24 and August 14, and Cygon on August 22.

Diquat at 1½ pints/A + X77 at 8 ounces per 100 gallons was used as a topkiller.

1984 POTATO VARIETY INTRODUCTIONS AND EVALUATIONS

R.W. Chase, R.B. Kitchen, and R. Hammerschmidt
Department of Crop and Soil Sciences and Botany and Plant Pathology

A. DATES OF HARVEST

The 1984 dates-of-harvest study was conducted at the Montcalm Research Farm with 20 varieties and numbered selections. Three complete plantings of all varieties were made on May 7 in plots 23 feet x 34 inch rows and 4 replications. Plant spacings were 12 inches within the row. Harvests were made on August 7 (92 days), August 30 (115 days) and September 17 (133 days after planting).

The previous crop was a sorghum-sudan hybrid, disked in the fall of 1983 and seeded to winter rye. Fertilizers used were 250 lbs/A 0-0-60 plowdown, 500 lbs/A 20-10-10 in the planter, and 225 lbs/A 46-0-0 sidedressed. Aldicarb (Temik 15G) was applied at 20 lbs/A at planting. The sidedress application of urea, hilling and herbicide application were completed just as the potatoes were ready to emerge which is a change from our usual management. Most of the hillings were completed by the end of May. The procedure used was to delay the herbicide application until the potatoes were just cracking the ground. The potatoes were then hilled by building a wide and flattened hill and placing just enough soil over the plants to protect them and then the tank mix of metolachlor (Dual) 2 lbs/A plus metribuzin (Lexone 4L) ½ lb/A was applied. The sidedress urea was applied at the same time as hilling. This practice required no further tillage until harvest and as a consequence weed control was excellent. The early hilling did affect some varieties, however, in some cases this was influenced by rains which occurred soon after the hilling with a slight crusting which interfered with the emergence of some varieties (700-79, 701-22, 718-6 and Atlantic). As the season progressed nearly all plants emerged, however, some were weak. In general, this practice was very beneficial in terms of weed control and it did not show any adverse effects in terms of yield. The plots were irrigated and foliar insecticides and fungicides were applied as needed.

Results:

Yields and quality were much improved over those of 1983 and more nearly like those of 1982 (Table 1). The average total yields at the first date of harvest were 44% higher in 1984 than in 1983 and at the second date of harvest (August 30) they were 16% higher. Specific gravity readings were also substantially higher in 1984; 1.084 at the first date of harvest in 1984 vs. 1.075 in 1983. These higher values reflect the advanced maturity of the 1984 crop compared with that of 1983. This is also reflected in the yields obtained at our last date-of-harvest. In 1983 we had an average total yield increase of 4% from August 31 to September 23 whereas we had no increase in 1984.

Yankee Supreme and Conestoga were the only varieties with the greatest yields at 92 days, the first date-of-harvest. On the other extreme, Monona, Russet Burbank, Islander and MS718-6 needed the full season of 133 days to produce their maximum yield of U.S. No. 1's. Most of the other varieties were at their optimum yields by early September.

Table 2 summarizes the internal defects, chip score and black spot damage. Samples for black spot determinations were collected from the second date-of-harvest (August 30) and were processed and scored through the Ore-Ida Foods, Inc. inspection line. Vascular discolorations were not major and those scored as slight would be of no grade concern. Hollow heart was noted as substantial on some selections, however, it was most prominent on tubers harvested on August 30.

Variety Observations:

MS700-79 - Yielded below average at all dates of harvest with satisfactory dry matter for chip processing. Hollow heart significant at August 30 harvest.

MS700-83 - Early emergence with good growth and vigor. An attractive round white. Yielded well above average, good dry matter and few internal defects. Mid-season maturity and good chip score even when held until December.

MS701-22 - Round white, medium-late maturity but below average yields. Very few internal defects and good chip color.

MS702-80 - Round white with good early emergence and vigor. Medium-late maturity, very few internal defects and very good chip color.

MS702-91 - A round to oblong white skin seedling with considerable tendency to pointed tubers. Good yields with medium-late maturity. No further testing because of lack of uniformity in tuber shape and appearance.

MS704-10(Y) - A round and somewhat flattened tuber with golden flesh. Mid-season maturity with above average yields. Sets heavy resulting in uniform sizing and smaller percentage of oversized tubers when compared to Yukon Gold. High specific gravity and very few internal defects. Tubers have a deeper eye than Yukon Gold.

MS714-10 - Selection deleted from further testing because of lack of good appearance, lower specific gravity and susceptibility to greening.

MS716-15 - Round white, shallow eyes, medium-late maturity and very high specific gravity. Yields slightly below average, very few internal defects and good chip color.

MS718-6 - Selection deleted from further testing because of later maturity, tendency to oversize and susceptibility to skinning.

G670-11 - A round white advanced seedling from Agriculture Canada-Guelph. Late maturity, very vigorous growth and very high yields and specific gravity. Considerable hollow heart noted, some growth cracks and chip color not as desirable as in previous years.

Atlantic - A standard variety with very good yields, specific gravity and appearance. Very good chip color, however, hollow heart noted at all dates of harvest.

Conestoga - An early maturing (Agriculture Canada-Guelph) round to oblong, white skin variety with deep eyes and some growth crack noted. Well above average yields at first date of harvest, good specific gravity and good chip score. Most suitable as an early maturing, out-of-the-field variety.

Islander - An elongated white tuber and late maturing variety from University of Maine and Cornell. Below average yields, medium specific gravity, some hollow heart and not dependable as a consistent chipper.

Monona - A standard chipping variety.

Onaway - A standard, early maturing, fresh market variety.

Russet Burbank - A standard fresh market and frozen processing variety.

Shepody - A medium-late maturing long, white variety (Agriculture Canada-Fredrickton) for frozen processing. Matures 2-3 weeks earlier than Russet Burbank, similar specific gravity, sets few tubers than Russet Burbank, but sizes them very quickly. Some susceptibility to scab.

Simcoe - A round white variety (Agriculture Canada-Guelph), medium-early maturity with below average yields. Few internal defects except hollow heart at August 30 harvest. Very good chip color, but appears very susceptible to scab.

Yankee Chipper - A round to elongated white, released from Maine with above average yields at 92 days. Medium-high specific gravity, few internal defects and good chip color.

Yankee Supreme - A round to oblong white variety, released from Maine. Medium-late maturity although it sized tubers early in our studies. Some hollow heart noted at all 3 harvests and chip color not as desirable at later harvests or after 3 months storage.

Samples of all selections were collected from the third date of harvest and stored at 40 F for further studies on after cooking darkening, out-of-storage chip quality and reconditioning.

TABLE 1. Yield, size distribution and specific gravity of several potato varieties harvested on three different dates in 1984.

	August 7 (92 days)								August 30 (115 days)								September 17 (133 days)							
	Yield cwt/A		Percent Size Distribution						Yield cwt/A		Percent Size Distribution						Yield cwt/A		Percent Size Distribution					
Variety	Total	No. 1	No. 1	<2"	2-3¼	Over 3¼	Pick Outs	Specific Gravity	Total	No. 1	No. 1	<2"	2-3¼	Over 3¼	Pick Outs	Specific Gravity	Total	No. 1	No. 1	<2"	2-3¼	Over 3¼	Pick Outs	Specific Gravity
Onaway	497	453	91	8	76	16	1	1.072	571	530	93	6	72	21	2	1.072	535	503	94	5	68	26	2	1.069
Yankee Supreme	412	378	92	8	86	6	1	1.091	415	377	91	9	78	13	1	1.086	396	364	92	8	82	10	1	1.085
Yankee Chipper	380	311	81	18	75	7	1	1.085	466	391	84	16	79	5	1	1.088	426	359	85	14	81	4	1	1.086
MS704-10	364	308	85	15	79	6	1	1.093	503	429	86	14	75	11	1	1.089	437	370	84	16	79	5	0	1.091
MS700-83	362	314	86	14	73	13	0	1.083	497	441	89	11	71	18	0	1.083	450	411	91	9	78	14	0	1.083
MS702-91	360	325	90	10	68	22	1	1.083	478	449	94	5	77	17	1	1.086	481	452	94	6	73	22	1	1.084
Conestoga	359	310	86	12	68	18	2	1.084	400	340	85	13	73	12	2	1.081	357	310	86	13	70	16	1	1.080
MS714-10	350	287	81	15	65	16	5	1.077	427	371	87	12	74	13	2	1.078	396	352	89	10	72	17	1	1.077
Atlantic	346	276	79	21	61	18	0	1.092	515	444	86	13	77	10	1	1.097	482	440	91	9	73	18	0	1.098
MS716-15	332	282	85	15	75	10	1	1.094	411	365	89	11	81	9	0	1.097	404	345	86	14	78	8	0	1.095
Monona	325	279	86	12	76	10	2	1.074	382	348	91	8	72	20	1	1.075	416	391	94	6	76	18	1	1.074
Russet Burbank	299	129	44	52	41	3	5	1.081	458	285	62	32	54	8	6	1.088	446	303	68	31	60	7	1	1.087
Shepody	298	240	81	17	50	31	2	1.082	478	417	87	11	47	40	2	1.087	392	327	83	16	58	25	2	1.087
G670-11	293	231	78	21	75	3	1	1.093	534	480	90	8	73	17	2	1.098	511	472	92	7	76	16	1	1.098
Islander	288	225	78	20	72	6	2	1.082	416	336	80	19	74	6	1	1.087	419	354	85	15	82	2	1	1.089
MS702-80	278	239	87	13	75	11	1	1.081	438	405	92	8	79	14	0	1.082	358	330	92	8	79	13	0	1.082
Simcoe	277	256	93	7	84	8	0	1.086	357	327	92	8	77	15	1	1.092	308	293	95	5	73	23	0	1.086
MS700-79	268	241	90	10	72	18	0	1.086	358	332	93	7	67	26	1	1.090	351	333	95	4	69	26	1	1.088
MS701-22	221	196	88	10	56	32	3	1.083	388	365	94	6	59	35	0	1.088	360	339	94	5	56	39	1	1.089
MS718-6	192	171	87	13	72	15	1	1.078	402	374	93	7	63	31	1	1.094	417	397	95	4	52	43	1	1.086
AVERAGE	325	273						1.084	448	390						1.087	417	372						1.086

TABLE 2. Internal defects[1], chip scores and bruising damage of several potato varieties grown at the Montcalm Research Farm.

	August 7 Harvest				August 30 Harvest					September 17 Harvest				December 11[4]
Variety	VAS DIS	INT NEC	H H	Chip[2] Score	VAS DIS	INT NEC	H H	Chip[2] Score	%[3] Bruise Free	VAS DIS	INT NEC	H H	Chip[2] Score	Chip[2] Score
MS700-79	2 sl	1 bc	1	1.5	1 sl	2 bc	4	1.5	71	2 sl	0	1	1.0	2.0
MS700-83	2 sl	1	0	1.5	2 sl	1 bc	1	1.5	70	1 sl	1 bc	0	1.0	1.5
MS701-22	0	0	0	1.5	1 sl	0	0	1.5	50	0	1 bc	0	1.0	2.0
MS702-80	0	2 bc	1	1.0	0	5 bc	2	1.0	68	1 sl	1 bc	0	1.0	1.5
MS702-91	0	0	0	1.0	0	0	1	1.5	88	1 sl	0	0	1.0	1.5
MS704-10	0	0	0	2.0	0	0	1	1.5	49	1 sl	0	0	1.5	2.5
MS714-10	0	0	2	2.0	1 sl	1 bc	3	1.0	65	1 sl	1 bc	1	2.5	3.5
MS716-15	0	0	0	1.0	1 sl	0	0	1.0	71	1 sl	2 bc	1	1.0	2.0
MS718-6	0	0	2	1.5	1 sl	0	2	2.0	57	1 sl	0	0	1.0	1.5
G670-11	0	0	2	2.5	1 sl	0	10	1.5	51	4 sl	0	0	2.0	2.5
Shepody	0	0	0	2.0	4 sl; 4 sev	0	1	2.0	82	3 sl	0	0	1.5	2.5
Simcoe	0	0	0	1.5	1 sl	0	3	1.5	44	0	0	0	1.0	1.0
Conestoga	0	1	3	1.5	1 sl	0	2	3.5	77	1 sl	0	0	1.0	2.5
Yankee Chipper	0	0	0	1.5	2 sl	0	0	1.0	83	2 sl	1 bc	0	1.0	1.5
Yankee Supreme	0	0	2	1.5	0	0	1	2.0	50	0	0	1	2.0	3.0
Islander	0	0	0	2.0	1 sl	0	6	2.5	73	5 sl	0	2	1.0	2.0
Atlantic	1 sl	1 bc	2	1.5	2 sl	0	2	1.5	48	1 sl	0	1	1.0	1.5
Onaway	0	0	0	3.0	2 sl	0	1	3.5	76	2 sl	0	0	3.0	4.5
Monona	0	0	1	1.5	1 sl	0	1	1.5	70	2 sl; 1 sev	0	0	1.0	2.0
Russet Burbank	0	0	0	3.5	0	0	3	2.5	81	0	1 bc	1	1.5	3.0

[1]20 tubers cut to determine internal defects.
VAS DIS = vascular discoloration
INT NEC = internal necrosis
H H = hollow heart
sl = slight; sev = severe; bc = brown center

[2]Chip score based on PC/SFA 1-5 scale. 1 = lightest, 5 = dark, not acceptable.

[3]Percent of tubers with no black spot damage.

[4]Samples stored at 52° F since harvest and processed on December 11, 1984.

B. *NORTH CENTRAL REGIONAL TRIAL*

Thirteen advanced seedlings from Wisconsin, North Dakota, Nebraska, Minnesota and Louisiana were entered in the 1984 trials and compared with Norland, Norchip, Norgold Russet and Red Pontiac. Plot size, fertilizers and production management were similar to the dates-of-harvest study. Planting date was May 8 and harvest was September 21 (136 days after planting).

Table 3 summarizes the yield and quality results. Yields were above average for many of the selections. Selections which did not size tubers well were Russet Burbank, MN11373, MN10874 and MN11795. Those producing the best tuber sizing were Red Pontiac, LA01-38, NE9.72-1, LA82-119, Norland and BN9803-1. Internal necrosis was severe on NE26.72-2 and vascular discolorations was greatest on LA82-119, MN11795 and W855. Hollow heart did not exceed 5% which was noted on ND860-2. Based on sprouts observed at the December 20 date when chips were processed, the MN11795, ND860-2, W855 and Norgold Russet had a very short rest period.

Merit ratings were placed on the top five selections in terms of overall worth as a variety. The ratings in Michigan were: 1. W779, 2. LA01-38, 3. ND534-4, 4. Norland and 5. ND388-1. The selection BN9803-1 has Onaway as one of its parents.

C. *NORTHEAST REGIONAL TRIAL*

Sixteen selections were evaluated in the Northeast regional trials which represents selections being evaluated in 14 locations. Plot design, fertilizers and production management were similar to the dates-of-harvest study. Planting date was May 9 and harvest was October 2, 147 days after planting.

Table 4 summarizes the yield and quality results. Hampton (NY63) is late maturing, similar to Katahdin, primarily for fresh market and does have some scab susceptibility. F7300-8 is an oblong, very late maturing yellow flesh variety. Tuber shape and appearance was not desirable and there was a high percentage of pick-outs. Alasclear is a recent release from Alaska which has good resistance to scab, however, tuber shape was not uniform and attractive at harvest. It's primary use would be for tablestock.

Selections which show the greatest values for further evaluations were Hampton, Alasclear, Sunrise (CF7358-14), WF564-3, G654-2, CF7587-5 and CF7789-1.

TABLE 3. Yield, size distribution, specific gravity and chip scores of selections evaluated in North Central Regional Trial.

	Yield cwt/A		Percent Size Distribution						Chip Scores	
Cultivar	Total	No. 1	No. 1	<2"	2-3¼	>3¼	Pick Outs	Specific Gravity	October 15	December 20
Red Pontiac	561	536	96	3	68	28	1	1.072	4.0	-
LA01-38	485	476	98	2	63	36	0	1.085	1.5	1.5
R. Burbank	484	262	54	44	47	7	3	1.087	2.5	-
W779 (Russ.)	467	375	80	17	65	16	3	1.080	1.5	1.5
Shepody	442	374	84	11	49	35	4	1.085	-	2.5
ND388-1 (Russ.)	441	348	79	18	68	19	3	1.083	2.0	2.5
MN11373	434	307	71	30	64	6	0	1.078	3.0	3.5
NE9.72-1	415	378	91	7	61	30	2	1.066	2.5	3.0
W855	413	355	86	14	79	7	0	1.094	1.0	1.0
LA82-119 (Red)	406	368	91	9	85	6	0	1.080	2.5	3.0
ND534-4 (Russ.)	398	327	82	17	69	13	1	1.075	2.0	2.5
Norchip	396	326	82	15	82	1	3	1.082	1.5	1.5
Norland	387	366	95	5	90	5	0	1.062	3.0	-
MN10874 (Russ.)	369	261	70	30	67	4	0	1.079	4.0	4.0
NE26.72-2	367	312	85	14	81	4	1	1.081	2.5	1.5
Norgold Russet	348	281	81	19	63	18	1	1.071	4.0	4.0
BN9803-1	344	320	93	6	62	32	1	1.083	1.5	1.5
MN11795 (Russ.)	333	167	50	50	50	0	1	1.073	2.0	2.0
ND860-2	292	238	81	18	77	4	1	1.079	1.0	1.0
AVERAGE	410	336						1.079		

TABLE 4. Yield, size distribution, specific gravity and chip scores of selections evaluated in the Northeast Regional Trial.

Variety	Yield cwt/A		Percent Size Distribution					Specific Gravity	Chip Score	
	Total	U.S. No. 1	U.S. No. 1	<2	2-3¼	>3¼	Pick Outs		September 24	December 12
Hampton	541	512	95	5	60	35	1	1.074	2.5	3.0
F7300-8(Y)	538	428	80	6	53	27	15	1.081	2.0	2.5
CF74135-3	505	436	86	12	75	11	2	1.063	2.0	2.5
WF564-3	469	314	67	33	63	3	1	1.069	3.0	4.0
B6949-WV3	468	438	94	6	66	27	1	1.074	2.5	2.5
Alasclear	464	425	92	6	85	8	2	1.083	3.0	3.0
BR7088-18	451	423	94	5	83	11	2	1.088	1.5	1.5
AF92-3	440	401	91	6	66	26	3	1.071	2.0	2.0
G654-2	409	334	82	19	78	4	0	1.063	2.5	2.5
CF7358-14	408	377	93	8	80	13	0	1.074	1.0	1.5
CF7587-5	388	324	83	16	82	2	1	1.081	2.5	2.5
CF7789-1	375	346	92	8	73	19	0	1.068	2.5	2.5
CF7722-19	369	315	85	15	80	5	0	1.070	2.0	3.5
AF330-1	363	333	92	7	70	22	2	1.081	1.0	1.5
CF7719-6	335	295	88	11	78	11	1	1.065	2.0	2.0
GoldRus	311	230	74	25	61	12	1	1.074	1.5	1.5
AVERAGE	427	371						1.074		

D. *USDA-BELTSVILLE TRIALS*

Three separate trials evaluating selections from the USDA-Beltsville potato breeding program were conducted in 1984. Cultural, fertility and management practices used were the same as described in the dates of harvest study. Planting date was May 9 and harvested on October 2, 147 days after planting. Table 5 summarizes the data from the preliminary trials which represents selections with limited data in Michigan. Tubers from the russets, B9539-9 and B8687-3 did not size well with high percentages of tubers under 2 inches. B8687-3 also had scab and the tubers were pointed and did not have good general appearance. Scab was also noted on B9792-119, B9540-29, B9539-9 and B9752-7. Hollow heart was noted on 4 of 20 tubers of B9540-29, 2 of 20 for Atlantic and 1 each for B9752-7, B9581-10 and B9792-84. Internal browning or necrosis was noted in 5 of 20 tubers of B8682-4.

Table 6 summarizes the results of the selections entered in the USDA-Beltsville Inter-Regional trial. Similar trials are conducted in the northeast and eastern states along the coast and into Florida. As noted in other trials, the russet selections did not size their tubers well with a high percentage of tubers under 2 inches. The WF31-4, 46-3 and 46-4 selections are white flowered "Atlantic" types which are being evaluated for internal defects as compared with Atlantic. Yields, size distribution, specific gravity and chip scores are very similar. Of the 20 tubers selected at random and used for the chip sample on September 24, WF31-4 had 2 hollow, WF46-3 had 1 and Atlantic and WF46-4 had none. When 8 large tubers (over 3¼ inch) were selected and cut, Atlantic had 3 hollow, WF31-4 had 5, WF46-3 had 3 and WF46-4 had 4 which suggests very little predictive difference among the 3 selections and Atlantic. There was no internal browning or necrosis in any of these selections. Internal defects were minimal in all of these selections and all produced very acceptable chips except B9400-5, B9596-2, B9553-6 and B9569-2. WF46-3 did have considerable growth crack as did GoldRus, B9648-9 and B9553-5. B9540-62 is scheduled for release as NemaRus. This long russet selection has produced best in Hastings, Florida.

Table 7 summarizes the yield data for the five tuber samples which were selected at harvest from the screening trial. A total of 42 selections were evaluated and compared to Atlantic, Monona and Superior in the same trial. These data represent a single 8-hill plot which is not replicated. Nearly all selections were fully mature when harvested. It is intended that the most promising of these selections will be entered into larger and replicated plots in 1985.

TABLE 5. Yield, size distribution, specific gravity and chip scores of preliminary selections from the USDA-Beltsville breeding program.

Variety	Yield cwt/A Total	Yield cwt/A U.S. No. 1	Percent Size Distribution U.S. No. 1	<2	2-3¼	Over 3¼	Pick Outs	Specific Gravity	Chip Scores November 6	Chip Scores December 19
B9792-84	556	513	92	7	70	22	1	1.099	1.5	1.5
Atlantic	522	492	94	5	71	23	0	1.101	1.5	1.5
B8682-4	497	438	88	11	79	9	2	1.079	2.0	2.5
B9581-10	481	424	88	9	74	14	2	1.080	2.0	2.5
B9638-11	470	428	91	8	81	10	1	1.095	2.5	2.5
B8687-3(Y)	448	283	63	35	55	8	3	1.074	2.5	3.0
B9792-119	421	382	91	7	57	34	3	1.088	1.5	2.5
B9752-7 (Russ.)	373	268	71	27	56	15	1	1.070	3.0	3.0
B9540-55 (Russ.)	356	219	62	37	57	4	2	1.075	2.0	2.5
B9539-9	345	202	59	41	55	4	0	1.085	1.5	3.0
B9540-29 (Russ.)	290	210	72	23	58	15	4	1.080	2.0	2.5
AVERAGE	433	351						1.084		

TABLE 6. Yield, size distribution, specific gravity and chip scores of potato varieties in the USDA-Beltsville Inter-Regional Trial.

Variety	Yield cwt/A		Percent Size Distribution					Specific Gravity	Chip Scores	
	Total	U.S. No. 1	U.S. No. 1	<2"	2-3¼	Over 3¼	Pick Outs		September 24	December 13
WF31-4	491	446	90	9	73	18	1	1.102	1.5	1.5
Atlantic	484	451	93	7	66	28	0	1.099	1.5	1.5
WF46-4	470	426	91	8	73	18	1	1.095	1.5	1.0
WF46-3	449	397	89	9	70	19	3	1.097	1.5	1.5
B9192-1	424	396	93	5	48	45	2	1.077	1.5	2.0
B9140-32	419	383	92	9	88	4	0	1.092	1.0	1.0
B9400-5 (Russ.)	408	358	88	11	58	29	1	1.075	2.5	3.0
B9384-4	408	302	74	26	74	0	0	1.076	1.0	1.5
B9596-2 (Russ.)	405	312	77	24	68	9	0	1.075	3.0	4.0
B9553-6 (Russ.)	389	304	78	18	56	22	5	1.074	2.0	2.5
B9340-13	368	348	92	7	79	14	1	1.081	1.5	1.5
B9569-2 (Russ.)	363	257	71	28	61	10	2	1.075	3.0	1.5
B9648-9 (Russ.)	347	241	69	29	64	6	2	1.070	2.0	1.5
GoldRus (Russ.)	327	235	72	25	60	12	3	1.078	1.5	1.5
B9540-62 (Russ.)	316	243	76	23	66	11	1	1.075	2.0	2.0
B9398-2 (Russ.)	309	239	70	20	64	14	3	1.082	1.5	2.0
AVERAGE	399	334						1.083		

TABLE 7. Yield, size distribution and specific gravity of several seedlings selected at harvest from eight-hill plantings of USDA-Beltsville selections.

Cultivar	Yield cwt/A		Percent Size Distribution				Specific Gravity	Chip Scores		Comments
	Total	No. 1	<2"	2-3¼	>3¼	Pick Outs		November 2	December 17	
B9988-23	616	578	3	85	9	3	1.081	1.5	1.0	short dormancy
B9581-10	559	521	7	64	29	0	1.085	2.0	1.5	long dormancy
B9933-20	530	483	7	82	9	2	1.082	1.5	1.5	
B9988-14	521	502	2	82	15	1	1.079	1.0	1.0	short dormancy
B9956-14	511	474	7	70	23	0	1.078	3.0	2.0	
B9582-18	492	455	8	81	11	0	1.083	2.0	2.0	
Atlantic	492	455	6	73	19	2	1.097	1.0	1.5	
B9934-51	426	407	4	78	18	0	1.060	1.5	1.5	long dormancy
B9967-1	417	388	7	84	9	0	1.092	1.0	1.5	short dormancy
B9581-2	407	388	2	67	28	3	1.077	1.0	1.0	sl. growth crack
B9959-20 (Russ.)	407	388	5	58	37	0	1.069	1.5	1.5	long, dark russet
B9955-21	398	379	5	79	16	0	1.080	1.0	1.0	short dormancy
B9999-3 (Russ.)	398	360	7	76	14	3	1.077	2.5	3.0	oblong russet
B0019-2 (Russ.)	369	313	15	85	0	0	1.071	3.0	3.5	oval russet
MS002-171(Y)	360	303	6	63	21	10	1.079	1.5	2.0	knobs and off type
B0016-13 (Russ.)	350	284	14	68	13	5	1.065	2.0	2.5	long russet
Superior	341	294	8	83	3	6	1.072	1.5	2.0	
Monona	294	265	10	87	3	0	1.068	1.0	1.0	

Planted: May 9, 1984 Harvested: September 11, 1984

E. *OVERSTATE DEMONSTRATION TRIALS*

Yield data were collected from three commercial farms in 1984. These were established as demonstration plantings and were not replicated. Locations were at Ray Bourdo and Sons in Allegan County, Wilk Farms in Presque Isle County, and Keilen Farm in Ingham County.

The planting date at the Bourdo Farm in Allegan County was May 12 and harvest was completed October 16. The plots were located on a muck soil and were fertilized with 200 lbs of urea plowdown, 150 lbs K_2O and 200 lbs of urea topdressed. Foliar nitrogen was applied at 5 lbs/acre on each of 4 applications. Table 8 summarizes the yield data. The soil moisture was above optimum at harvest as a result of frequent rains. Specific gravity readings are below normal likely because of the later maturity and wet soil conditions, chip colors, however, were very acceptable.

Plots located at the Wilk Farm in Presque Isle County were planted on May 23 and harvested on October 1. Fertilizers used were 150 lbs/A 0-0-60 plowdown and 400 lbs/A 19-19-19 in the planter. Yield results are shown in Table 9. These plots were not irrigated and yields are below normally expected. Some selections also had poor stands which did contribute to reduced yields. There was a high percentage of sun green tubers, particularly Snowchip and MS700-83, however, the degree and incidence in all the varieties suggests it was a shallow tuber set and/or an inadequate soil cover which affected all of the varieties.

Table 10 summarizes the results at the Keilen Farm in Ingham County. Fertilizers applied to this muck soil were 400 lbs/A 0-0-60 at plowdown and 400 lbs/A of 6-24-6 in the planter. From mid June through August, a foliar application of 1 lb/acre of "Nutraleaf" 20-20-20 was applied.

TABLE 8. The yield, size distribution, specific gravity, chip quality and internal defects of several potato varieties grown at the Bourdo Farm, Allegan County.

Variety	Yield		Percent Size Distribution				Specific Gravity	Chip* Score	Internal Defects**		
	Total cwt	No. 1 cwt	No. 1	Under 2"	2-3¼"	Over 3¼"			Vascular Discoloration	Internal Necrosis	Hollow Heart
Shepody	540	481	89	11	59	30	1.076	2.0	8 sl	-	2
Chipbelle	498	471	95	5	60	35	1.087	1.0	4 sl	-	1
MS700-79	335	301	90	10	57	33	1.073	1.5	1 sl	-	1
MS700-83	302	287	95	5	48	47	1.069	1.0	1 sl	-	-
MS716-15	277	259	94	6	56	38	1.080	1.5	-	-	-
MS701-22	249	226	91	9	58	33	1.071	1.5	-	-	-

Planted: May 12, 1984 Harvested: October 16, 1984

*Rated on a 1-5 scale.

**Internal defects were determined by cutting 20 randomly selected tubers.

TABLE 9. The yield, size distribution, specific gravity and internal defects of several potato varieties grown at the Wilk Farm, Presque Isle County.

	Yield cwt/A		Percent Size Distribution							Internal Defects**			
Variety	Total	U. S. No. 1	U. S. No. 1	Under 2"	2-3¼	Over 3¼	Pick Outs	Specific Gravity	Maturity Rating* Aug. 14	Vascular Discol-oration	Internal Browning	Hollow Heart	Comments
Snowchip	371	296	80	3	53	26	17	1.070	1.0	4 slight	0	0	Considerable greening and off type
Shepody	305	269	88	3	55	33	9	1.076	2.0	7 slight	0	0	Some green, slight scab, some off type
Katahdin	288	265	92	1	40	52	7	1.071	1.0	1 slight	0	0	Some scab, sun green
Atlantic	279	266	95	3	73	22	2	1.089	2.5	1 slight	0	0	
Sebago	259	237	91	5	78	13	4	1.069	-	11 slight	1	0	
MS700-83	246	200	81	5	68	13	14	1.080	3.0	1 slight	0	0	Considerable greening
MS704-10(Y)	221	197	89	5	80	10	5	1.085	2.5	3 slight	0	0	Slight greening
Yukon Gold	198	192	97	3	75	22	0	1.083	3.5	1 slight	0	0	
MS702-80	158	128	81	2	79	18	-	1.078	2.5	2 slight	0	0	Smooth, good type
MS716-15	143	125	87	4	53	34	9	1.087	2.0	4 slight	0	0	Very poor stand, good tuber type
G654-2	68	58	86	14	86	0	0	1.064	5.0	5 slight	0	0	Very poor stand
AVERAGE	231	203						1.077					

*Maturity Rating: 1 = active growth, mostly green vine
5 = completely mature, vines dead

**Internal defects were determined by cutting 30 randomly selected tubers.

TABLE 10. The yield, size distribution, specific gravity and internal defects of several potato varieties grown at the Keilen Farm, Ingham County.

	Yield		Percent Size Distribution						Internal Defects*		
Variety	Total cwt/A	U. S. No. 1 cwt/A	U. S. No. 1	Under 2"	2-3¼	Over 3¼	Pick Outs	Specific Gravity	Vascular Discoloration	Internal Necrosis	Hollow Heart
G670-11	513	469	91	7	59	32	2	1.079	0	0	4
Shepody	450	393	87	5	45	42	8	1.073	5 slight	0	0
MS700-83	396	371	94	6	76	17	1	1.077	2 slight	0	0
Superior	381	289	76	15	72	9	4	1.061	2 slight	0	0
G654-2	364	304	84	15	75	2	2	1.053	8 slight	0	0
Islander	328	282	86	13	69	17	1	1.069	3 slight	0	1
MS700-79	319	304	95	5	64	31	0	1.077	4 slight	0	0
MS716-15	317	295	93	7	74	19	0	1.083	0	0	0
C-13	314	284	90	3	49	42	6	1.070	2 slight	0	0
MS701-22	296	282	95	4	63	32	1	1.080	1 slight	0	0
AVERAGE	368	327						1.072			

Planted: May 21, 1984 Harvested: October 9, 1984

*Internal defects were determined by cutting 25 randomly selected tubers.

1984 POTATO VARIETY EVALUATIONS

DELTA COUNTY, MICHIGAN

R.H. Leep, J.R. Lempke, D.L. Pellegrini, R.W. Chase, and R.W. Hammerschmidt

A potato variety evaluation was conducted in Delta County, Michigan on the John VerBrigghe farm. The varieties were planted in a randomized complete block design with four replications. The plots were harvested on October 16, 1984. Yields, specific gravity and internal defects were determined.

The plot area received a total of 129-60-120 lbs/A fertilizer. The soil test was pH 6.8, P-272, K-224.

The plowdown crop was a one-year old stand of alfalfa. Temik was applied at planting. 0.25 lbs/A Lexone was applied postemergence. The plots were irrigated and managed in a similar manner as the cooperator maintained the entire field.

RESULTS

The yield performance, specific gravity and internal defects are summarized in Table 1. The total yield ranged from 224 to 446 cwt/acre with MS-718-6 recording the highest yield. The average total yield over 19 varieties was 333 cwt/acre. MS-718-6, Shepody, Yukon, Gold and MS-702-91 varieties recorded significantly higher yields of large tubers. Overall quality and appearance of tubers was excellent. Specific gravity ranged from 1.072 to 1.092. The only significant internal defect found was hollowheart. Only one variety had an appreciable amount of hollowheart, MS-718-6. Scab severity was high in replication 1 and less in replications 2, 3 and 4. Road salts apparently ran off and affected scab intensity on tubers in replication 1 which was nearest the roadway.

Table 1. Potato variety trial yields. Delta County, Michigan. 1984.

VARIETY	TOTAL	NO. 1	UNDER 2"	OVER 10 oz. OR 3¼"	PICKOUT	SG	INTERNAL DISORDER
	-----------------	-----------------	YIELD cwt/A	-----------------	-----------------		
MS-718-6	446a[1]	201	18	226a	1	1.084	111*
Islander	309ef	213	27	68def	1	1.077	
MS-716-15	319def	274	17	28ef	0	1.092	
MS-701-22	270efg	177	9	81cde	3	1.079	
700-83	280efg	202	18	60def	0	1.077	
704-10	405abc	311	15	79cde	0	1.081	1*
Yankee Supreme	315def	185	24	90cd	26	1.078	
Connestoga	291dg	187	24	78cde	2	1.076	1*
702-80	224g	161	20	43def	0	1.072	
Yankee Chipper	336cde	253	23	60def	0	1.080	
MS-700-79	297def	232	10	54def	1	1.081	1*
MS-714-10	357bcd	274	37	46def	0	1.074	
Shepody	439a	231	20	182ab	6	1.083	1*
Yukon Gold	353cd	180	13	160b	0	1.082	1*
SG-70-11	353cd	250	17	86cd	0	1.091	1*
MS-702-91	351cd	208	13	130bc	1	1.079	
Simcoe	260fg	216	7	37def	0	1.083	
Superior	282efg	219	46	16f	1	1.076	
Russett Burbank	424ab	329	39	26ef	30	1.087	
	333	226	20	82	4	1.081	

[1]Column means followed by the same letter are not significantly different as determined by the Least Significant Difference Test (.05)

*Hollowheart

CONTROL OF SCAB AND RHIZOCTONIA DISEASES

R. Hammerschmidt
Department of Botany and Plant Pathology

Introduction

Scab and Rhizoctonia diseases of potatoes continue to be a problem in Michigan potato production. Experiments were performed this year in the field and greenhouse to examine some known methods of control for these diseases. In addition, preliminary experiments on foliar applied chemicals directed at controlling scab were carried out.

Variety Evaluations for Scab Resistance

Disease resistance is perhaps the best method for controlling a particular disease. This is one approach which has been implemented in an attempt to control scab. Twenty-eight varieties and number selections were evaluated for scab resistance at two locations. Each variety was replicated four times in ten foot plots at each location. Approximately ten pound samples of uniformly sized tubers were taken from each plot and examined for type of scab and per cent tuber coverage by scab lesions. Due to uneven scab pressure in the plot at location 2, each replicate is listed individually.

Results:

Several named varieties and numbered selections showed very good scab resistance at both locations (Table 1). Varieties which exhibited consistently high resistance were: Islander, Onaway, Russet Burbank, Superior, MS 700-79, MS 703-80, MS 702-91, and MS 714-10. Varieties with an intermediate level of resistance were: Snowchip, MS 700-83, and MS 718-6. The other varieties all are classified as susceptible.

Soil Treatments for Scab Control

Soil treatments designed at killing the scab organism have generally been ineffective or too costly to use. There is evidence from other research that certain nutritional variables and/or soil pH may have a direct relationship to the severity of scab. Several of these reported control methods were tried in the greenhouse and in the field.

Soil treatments (non-fungicide) reported to control scab were tested in the field and in the greenhouse using the Atlantic and Katahdin varieties, respectively. Materials used in the field were applied to the furrow and worked in by hand just prior to planting. Rates are given in Table 2. Tuber samples were taken after plants had reached full maturity. Each treatment was replicated four times in ten foot plots. Tuber sample sizes for scab analysis were ten pounds per plot. For greenhouse tests, plants were grown in five inch pots which contained a bilayer of greenhouse potting mixture and infested soil. Seed pieces were placed on a three inch layer of the potting mix and covered with infested soil. The infested soil was either left untreated prior to adding to the pots or treated as described in Table 3. All pots were top watered until one week after emergence of the plants. At this time, all pots, except those in the "heavy irrigation" treatment, were bottom watered. This allowed development of the semi-dry conditions that favor scab development. The soil in the "heavy irrigation" treatment was never allowed to dry out. Tubers (over one cm in diameter) were harvested at seven weeks after planting.

Results

In the field, none of the treatments gave complete control (Table 2). However, marked reductions in the amount of scab were observed with the manganese treatments. The decrease in symptoms was characterized by not only fewer scabs but also more shallow scabs. In the greenhouse, good control was obtained with all treatments except P_2O_5 (Table 3). This suggests that scab control might be possible by a proper balance of certain soil nutrients.

Foliar Treatments for Scab Control

There is little doubt that a foliar applied treatment for scab control would be very useful. Research by McIntosh in England has demonstrated that foliar applications of 3,5-diphenoxyacetic acid (a growth retardant) and ethionine (an antimetabolite could reduce scab significantly. Greenhouse and field experiments based on this idea were carried out.

Katahdin potatoes were grown in the greenhouse as described above. When the plants were beginning to set tubers, they were sprayed with a water soltuion of one of the materials listed in Table 5. In the field, the Atlantic variety was used. Plants were sprayed at about two weeks after emergence. Small tubers and swollen stolon ends were visible at this time.

Results

The greenhouse work confirmed the results of McIntosh which suggested that a foliar applied chemical could be effective against scab. In addition CCC (a growth retardant known to enhance disease resistance in other plants against pathogens) and phenylserine (an amino acid analog which also has resistance promoting properties) decreased the amount of scab in both greenhouse and field trials (Tables 4 and 5). D-phenylalanine, another amino acid with some reported disease resistance promoting activity, was far less effective than the other compound tested.

Seed Treatment for Rhizoctonia Control

Seed pieces of Onaway potato, selected for the presence of Rhizoctonia sclerotia were used to further test the effectiveness of certain seed piece treatments in the control of the Rhizoctonia disease. Infected seed was treated with 2% formaldehyde (5 min), one of three fungicides or left untreated. Tubers were harvested at maturity and evaluated for total yield and size distribution.

Results

Treatment of seed pieces with formaldehyde to kill all of the Rhizoctonia, Tops 2.5, or NTN 19701 resulted in an increase in the yield of #1 tubers and a reduced number of small tubers and culls as compared to the control or Captan treated seed pieces. The culls exhibited a high degree of deformation, russetting and some tuber pitting. The results are shown in Table 6.

TABLE 1

SCAB VARIETY EVALUATIONS

VARIETY	LOCATION 1	LOCATION 2a	LOCATION 2b	LOCATION 2c	LOCATION 2d
Atlantic	3.95[a]	----	----	----	----
Chipbelle	2.42	----	----	----	----
Connestoga	2.11	2.31	1.12	1.18	0.71
Denali	3.81	----	----	----	----
Islander	0.53	0.84	0.50	1.06	0.52
Jemseg	3.40	----	----	----	----
Katahdin	4.80	----	----	----	----
Oceania	3.01	----	----	----	----
Onaway	0.41	----	----	----	----
Russet Burb.	0.18	0.21	0.00	----	0.00
Simcoe	----	3.00	3.20	2.65	1.78
Snowchip	1.33	----	----	----	----
Superior	0.68	0.36	0.11	0.21	0.17
Shepody	----	3.35	1.50	2.90	1.10
Yankee Chipper	2.33	2.67	1.32	1.07	0.91
Yankee Supreme	4.01	4.50	4.40	1.25	0.56
Yukon	2.53	3.93	2.86	2.11	1.35
G 670-11	1.50	2.25	2.80	2.51	1.63
700-83	1.51	1.25	1.05	0.76	0.36
700-79	0.41	0.38	0.31	0.47	0.00
701-22	1.57	2.54	2.38	1.56	0.75
702-80	----	0.04	0.00	0.00	0.00
702-91	0.53	1.18	0.19	0.18	0.10
704-10	----	4.33	3.05	1.58	1.58
704-17	4.63	----	----	----	----
714-10	0.24	0.37	0.25	0.22	0.06
716-15	3.00	3.30	3.00	0.92	1.00
718-6	2.25	1.50	0.65	0.95	0.13

[a]Evaluations based on the following: 0=no scab; 1=1-5% coverage; 2=5-10% coverage; 3=10-20% coverage; 4=20-35% coverage; 5=over 35% coverage.

TABLE 2

EFFECT OF SOIL AMENDMENTS ON SCAB

TREATMENT	RATE APPLIED	SCAB RATING[a]
Manganese sulfate	40 lb Mn/A	1.75 a
Manganese sulfate	20 lb Mn/A	2.20 b
Manganese chloride	40 lb Mn/A	1.92 a
Sulfur	500 lb S/ A	4.15 c
Control		4.58 c

[a]Scab rating scale same as in table 1. Means followed by different letters are significantly different, p=0.05

TABLE 3

EFFECT OF SOIL AMENDMENTS ON SCAB

TREATMENT	RATE APPLIED[a]	SCABBY TUBERS/TOTAL TUBERS[b]
Sulfuric acid	to pH 5.2	8/36
Phosphoric acid	to pH 5.2	7/39
$MnSO_4$	40 lb Mn/A	3/32
$MnSO_4$	20 lb Mn/A	5/26
P_2O_5	150 lb Mn/A	15/28
Control	----	23/30
Heavy irrigation	Saturation	5/42

[a]Materials were mechanically mixed into infested soil prior to potting. lb/A values are estimates.

[b]Ten pots per treatment. Only tubers over 1cm in diameter were counted.

TABLE 4

FOLIAR TREATMENTS FOR SCAB CONTROL

TREATMENT	SCAB RATING[a]
CCC	2.2a
D-Phenylalanine	3.5b
Phenylserine	1.8a
Control	4.6c

[a]Rating scale as in Table 1. Means followed by different letters are significantly different, p=0.05.

TABLE 5

FOLIAR TREATMENTS FOR SCAB CONTROL

TREATMENT[a]	SCABBY TUBERS/TOTAL
CCC	3/42
D-Phenylalanine	29/31
Phenylserine	4/49
Ethionine	2/38
Control	25/39

[a]Materials sprayed on foliage at time of tuber set. Materials used at a concentration of 1mM.

[b]Ten pots per treatment. Only tubers over 1 cm in diameter were counted.

TABLE 6

SEED TREATMENT FOR RHIZOCTONIA CONTROL

TREATMENT[a]	YIELD (CWT/A)				
	B	1	OVER	CULL	TOTAL
Control	13.3	164.5	35.7	102.2	315.7
NTN 17901	9.8	204.8	26.6	57.4	298.6
Tops 2.5	10.8	194.2	44.2	42.3	291.5
Formaldehyde	12.8	189.3	38.3	89.6	330.0
Captan	8.3	146.9	25.5	88.9	269.6

[a]All treatments are averages of five replicates except Captan treatment which is from three.

BIOLOGY AND CONTROL STRATEGIES FOR INSECT PESTS OF POTATOES

E. Grafius, E. Morrow, and A. May
Department of Entomology

Research in 1984 included:

1) Laboratory evaluation of the effect of temperature on toxicity of synthetic pyrethroids to Colorado potato beetle.

2) Insecticide screening at the Montcalm Potato Research Farm in Entrican. This trial included IGR's and biological insecticides.

3) A preliminary field study of the effects of IGR's and biological insecticides on Colorado potato beetle egg mortality.

4) Pheromone trapping at two locations.

5) Development of an on-farm assay for use in determining tolerance to different insecticides in localized populations of Colorado potato beetle.

Summary of Results:

1) Four technical grade synthetic pyrethroids, compounds commonly known as Pydrin, Cymbush, Ambush and Pay-Off were used in a laboratory evaluation of temperature effects on the toxicity of these materials when applied to Colorado potato beetle. The organophosphate, Guthion was used as a standard. All the pyrethroids exhibited significant (2-8x) decreases in toxicity between 14-30°C while toxicity of the organophosphate increased 4x from 14-23°C and 2x from 30-35°C.

2) Results from the insecticide screening trial (27 materials tested) suggest that the various IGR's and B.t. exotoxins show promise for controlling resistant populations of the Colorado potato beetle. However, the materials are specific for Colorado potato beetle and are ineffective on other pests in potatoes, ie. aphids and potato leafhopper. Temik and Baythroid both gave good control of a wide spectrum of insects as compared to other treatments. Yield was also significantly higher in these treatments.

3) Egg masses of Colorado potato beetle were collected from the insecticide trial plots directly after a spray. Egg hatch was monitored over a 10 day period. Variability was high within the treatments and no significant

differences were seen. Egg masses were hard to find and were not all the same age so it is difficult to draw a strong conclusion from the data.

4) Pheromone traps were set up in Montcalm Co. and E. Lansing and monitored throughout the season. Graphs are included to show peak adult flight.

5) Standard data have been prepared for use as a guideline in determining the tolerance of Colorado potato beetle from local populations in comparison to the Montcalm Co. population. A relatively simple test has been designed for use by anyone on the farm to use as a trouble-shooting tool or to determine whether unusual tolerance exists in comparison to a standard susceptible population.

TEMPERATURE/TOXICITY STUDIES

Laboratory reared beetles originally collected from Montcalm Co. were used in this laboratory evaluation. Beetles from this location had been exposed to several different insecticides including, Temik, Sevin, Pydrin, Thiodan, and Monitor, in 1983. The population was reared for two generations on untreated foliage in the greenhouse. The objective of the test was to evaluate the effect of temperature on the toxicity of synthetic pyrethroids as compared to an organophosphate standard, Guthion. Prior to treatment the beetles were acclimated to the appropriate temperature at which they would be tested. Topical application of one drop of test material to the abdomen was done at room temperature with the beetles immedately returned to cups and placed in the respective growth chamber. Temperatures tested were 14, 23, 30, and 35°C. The pyrethroids tested were Pydrin, Ambush, Cymbush, and Pay-Off.

The results show the toxicity of Guthion increased significantly from 14 and 23°C, leveled off from 23-30°C, and increased again between 30-35 °C. All the pyrethroids showed significant decreases in toxicity from 14-30°C. These results suggest that there may be a problem with lack of control of Colorado potato beetle at higher temperatures using pyrethroids, particularly Pydrin, where the toxicity decreases dramatically from 14-30 C°(5X). Factors such as residual activity and mode of uptake affect control in the field and this study does not investigate them directly, this makes it difficult to apply this information to a field situation. However, it allows us to direct our spray programs with an increased knowledge of how we may get the best possible control with each spray applied.

POTATO INSECTICIDE TRIAL

Potatoes were planted May 9, 1984 at the MSU Montcalm Potato Research farm in Entrican. Plots were 3 rows wide (34 inch spacing) by 40 feet, with 2 untreated rows between plots. Treatments were arranged in a randomized complete block design with 4 blocks per treatment. Treatments included pyrethroids, insect growth regulators, B.t. exotoxins, carbamates, and organophosphates. The treatments were applied at planting, as a sidedress with fertilizer at hilling (May 30), or as a weekly foliar treatment from June 21 to August 16 (Table 1). Foliar treatments were applied with a tractor mounted boom sprayer at 30 gal/acre, 40 psi, with a cluster of nozzles over each of the 3 rows. One nozzle was pointed directly over the row and the other two nozzles were directed at the sides of the plants.

Weekly insect counts (June 13-August 16) were made from two randomly selected plants in the center row of each plot. Colorado potato beetle damage ratings were also made weekly (July 3-August 21) on 2 plants per plot. Damage ratings were assigned in the range of 0-3. Zero denoting no feeding injury, 2 denoting general feeding on entire plant (50 % defoliation) and 3 indicating almost complete defoliation (only stems left). Potato leafhopper damage ratings were 0-2, with 0 denoting no browning of foliage, 1 denoting general browning of plants and 2 indicating heavy necrosis and premature death of many of the plants in the plot. Yields were taken on September 12 from the center row of each plot.

Colorado potato beetle adult numbers ranged as high as 47 per plant (July 31) and larval numbers were as high as 84 per plant (August 7). Seasonal mean numbers (ave. over 10 dates) of large potato beetle larvae exceeded the economic threshold of 2 beetles per plant in many of the treatments (Figures 1-2). Seasonal mean numbers of potato leafhoppers (ave. over 9 dates), ranged from .05/plant in the Temik standard (3 lb ai/a at planting) to 10/plant in the high rate of the IGR: CME 13406 (Figure 3). In general, all the soil treatments held potato beetle damage to a minimum throughout the season and all the foliar treatments showed less damage than the untreated except for Pounce and Kryocide.

In general, the treatments designed for Colorado potato beetle control (eg. IGR's and B.t. exotoxins) did not adequately control potato leafhopper. Although only moderate potato beetle control was obtained in these plots, the damage ratings show that the potato beetle foliar feeding was not generally a significant problem. However, serious leafhopper injury occurred and the damage is reflected in the yield data (Figure 4). The various IGR's and B.t. exotoxins may show promise in controlling resistant populations of Colorado potato beetle. However, they may not be competitive in price or efficacy for non-resistant populations. Their role in Michigan will probably be as supplemental materials, to alternate with traditional materials and slow the rate of resistance build-up.

FIELD STUDY OF EGG MORTALITY WITH IGR'S

Potato insecticide trial plots at the M.S.U. Montcalm Expt. farm were also used for a preliminary field study on the effects of insect growth regulators and B.t. exotoxins on potato beetle egg mortality. After the last spray date, on August 16, 2-5 egg masses were collected from each treatment and placed in paper cups. Egg masses were brought back to the lab and placed in a growth chamber at 16 hr. photoperiod and held at a constant temperature of about 75°F. Egg masses were observed every 1-2 days to count and remove any newly hatched larvae (to prevent cannabilism). After a 10 day period, eggs had either hatched or were considered inviable. No significant differences were observed between treatments. One IGR (CME 13406) showed 18 % hatch and another IGR (RH 4971) showed 96 % hatch. Age of egg masses was not monitored and is one of the reasons we will do this study again in 1985.

PHEROMONE TRAPPING

Two locations were monitored during 1984. Traps were located at the Montcalm Co. Research farm and at the Entomology research farm in East Lansing. Traps set included: black cutworm (BCW), variegated cutworm (VCW), European corn borer (ECB), corn earworm (CEW), and cabbage looper (CL). The number of moths caught in CEW and CL traps were so few that graphs would not be practical. Figures 5-7 show a graphical presentation of adult male moth flight at the two locations.

ON-FARM TEST FOR INSECTICIDE RESISTANCE

The objectives of the study were to develop a standardized, on-site technique for toxicity assays and a set of standard data for comparisons. The test will not specifically determine whether resistance is or is not a significant problem in the field but will indicate if the test beetles show unusual tolerance to a given chemicei)
The test might be used prior to treatment, as an aid to selection of an insecticide. Used post-treatment, this test will help assess possible reasons for lack of control.

Colorado potato beetles were collected from the M.S.U. Montcalm Co. Potato Research Farm within 3 weeks of first appearance of summer (non-overwintered) adults and held in the laboratory for 1 week. Trials with some of the insecticides were repeated using 1-3 week old beetles from a laboratory culture originally collected from nightshade in Antrim Co. Tests were run with Furadan, Guthion, Imidan, Monitor, Parathion, Pounce, Pydrin, Sevin, Thiodan, and Vydate. A range of concentrations (usually .001% to 1%) of commercial formulations was prepared for each insecticide. Beetles (in groups of 10) were dipped into the insecticide solution for 1 minute, using a tea strainer. The beetles were then placed on paper towel to remove the excess solution and placed in paper cups with untreated potato foliage as food. The beetles were kept at room temperature and mortality was assessed at 24, 48 and 120 h after treatment.

Approximate concentrations required to kill 50% of the beetles (1-day LC50) ranged from 0.004% for Furadan 4F to 1.54% for Monitor (Figure 8). This does not necessarily reflect the relative effectiveness of the insecticides. For example, a material with low contact toxicity, as measured in this test, might have high ingestion toxicity or long residual effectiveness. The data do serve as a basis for assessing tolerance to a particular material. In general, if 5 to 10 times more chemical is required to kill your test beetles than was needed to kill our standard beetles, a significant resistance problem may be present and a different material should be chosen. Also, if even a few of your test beetles survive the very highest doses, resistance may be beginning to show up in the field and a change in material and adoption of other control means such as crop rotation are recommended.

If you choose to try this test:

(1) Use fresh adults, if possible (overwintered adults will be more susceptible).

(2) Hold beetles at room temperature - 70-75F. Toxicities may vary 5-10x between 60 and 85F.

Choice of an alternate material is recommended if:

(1) 5-10x concentration is required to kill your beetles compared with the standard results.

or (2) Some of your beetles survive even the highest concentration tested.

Remember - many factors, including weather, timing, application, and crop stage affect control. Possible resistance is only one factor to be considered.

A detailed, step-by-step extension leaflet, including tablespoon/gallon concentrations, will be prepared and distributed through CES offices and published in the Potato Industry News.

Table 1.
Potato Insecticide Trial
Montcalm Research Farm, Entrican MI

Treatment	Rate	Code name
Soil treatments		
Temik 15G	3 lb ai/A in furrow	Temik 3f
Temik 15G	3 lb ai/A side dressed	Temik 3sd
Temik 15G	2 lb ai/A side dressed	Temik 2sd
Lance 20G	2.4 oz ai/1000' in furrow	Lance 2.4f
Lance 20G	4.8 oz ai/1000' in furrow	Lance 4.8f
Lance 20G	2.4 oz ai/1000' in furrow +2.4 oz ai/1000' side dressed	Lance 2.4fsd
Thimet 20G	3.5 oz ai/1000' in furrow	Thimet
+ Pay-Off 2.5EC	.1 lb ai/A as needed	
Foliar treatments		
CME-13406 15SC	.015 lb ai/A	CME .015
CME-13406 15SC	.03 lb ai/A	CME .03
RH-4971 1EC	.06 lb ai/A	RH .06
RH-4971 1EC	.12 lb ai/A	RH .12
RH-4971 1EC	.25 lb ai/A	RH .25
UBI-B3445-1548 50WP	.25 lb ai/A	UBI .25WP
UBI-B3445-1548 50WP	1.0 lb ai/A	UBI 1.0WP
UBI-B5438-1548 6EC	.25 lb ai/A	UBI .25EC
UBI-B5438-1548 6EC	1.0 lb ai/A	UBI 1.0EC
Lance 480 g/l	.5 lb ai/A	Lance .5f
Baythroid 2EC	.05 lb ai/A	Baythroid
ABG-6162	10 g ai/A (1 pt)	ABG 10g
ABG-6162	20 g ai/A (2 pt)	ABG 20g
ABG-6162	40 g ai/A (4 pt)	ABG 40g
SAN-410	1 pt form/A	SAN 1pt
SAN-410	2 pt form/A	SAN 2pt
SAN-410	4 pt form/A	SAN 4pt
Kryocide 96WP	8 lb form/A	Kryocide
Imidan 50WP	1 lb ai/A	Imidan
Pounce 3.2EC	.1 lb ai/A	Pounce
Untreated	--	Untreated

Table 2.

Mean CPB Damage Ratings for the Different Sample Dates

	Mean Damage Rating:*						
	July					August	
Soil treatments	3	10	17	24	31	8	14
Temik 3f	.00	.00	.25	.13	.50	.56	.56
Temik 3sd	.13	.13	.38	.44	.63	.63	.69
Temik 2sd	.00	.13	.25	.13	.50	.69	.81
Lance 2.4f	.25	.38	.94	.81	.75	.81	.69
Lance 4.8f	.00	.38	.44	.44	.56	.69	1.25
Lance 2.4fsd	.00	.00	.25	.13	.31	.44	.44
Thimet	.13	.25	.63	.63	.56	.50	.69
Foliar treatments							
CME .015	1.13	.63	.88	.75	.88	.88	1.31
CME .03	.63	1.06	1.31	.63	.38	.81	1.06
RH .06	.88	.63	.88	.44	.69	.56	.75
RH .12	.38	.50	.63	.63	.81	.81	.81
RH .25	.63	.38	.50	.31	.38	.25	.44
UBI .25 WP	1.13	1.31	1.56	---	---	---	---
UBI 1.0 WP	.75	1.25	1.19	---	---	---	---
UBI .25 EC	1.38	1.56	1.00	---	---	---	---
UBI 1.0 EC	1.31	1.69	1.44	---	---	---	---
Lance .5f	1.63	1.69	.81	.94	1.06	.63	1.06
Baythroid	.63	.63	.88	.38	.31	.63	.94
ABG 10g	1.25	1.88	1.75	1.19	1.00	.94	1.25
ABG 20g	1.00	1.50	1.25	1.00	1.00	1.00	1.19
ABG 40g	1.00	1.44	1.06	.75	1.44	.81	.94
SAN 1pt	1.00	1.25	1.69	1.19	1.38	1.50	1.94
SAN 2pt	1.00	1.00	1.13	.81	1.19	.69	1.00
SAN 4pt	1.00	1.06	1.19	1.06	.94	1.25	1.31
Kryocide	1.44	1.56	1.44	1.50	1.63	1.44	2.13
Imidan	.63	1.00	1.00	.69	.44	.69	.81
Pounce	1.69	1.94	1.69	1.56	1.81	1.88	2.25
Untreated	1.50	1.88	1.75	1.81	2.25	1.88	2.31

* 0- No damage, 1-slight feeding; leaflets, 2-moderate feeding; leaves, 3-defoliation; stalks left

Season long CPB counts
Soil and foliar treatments

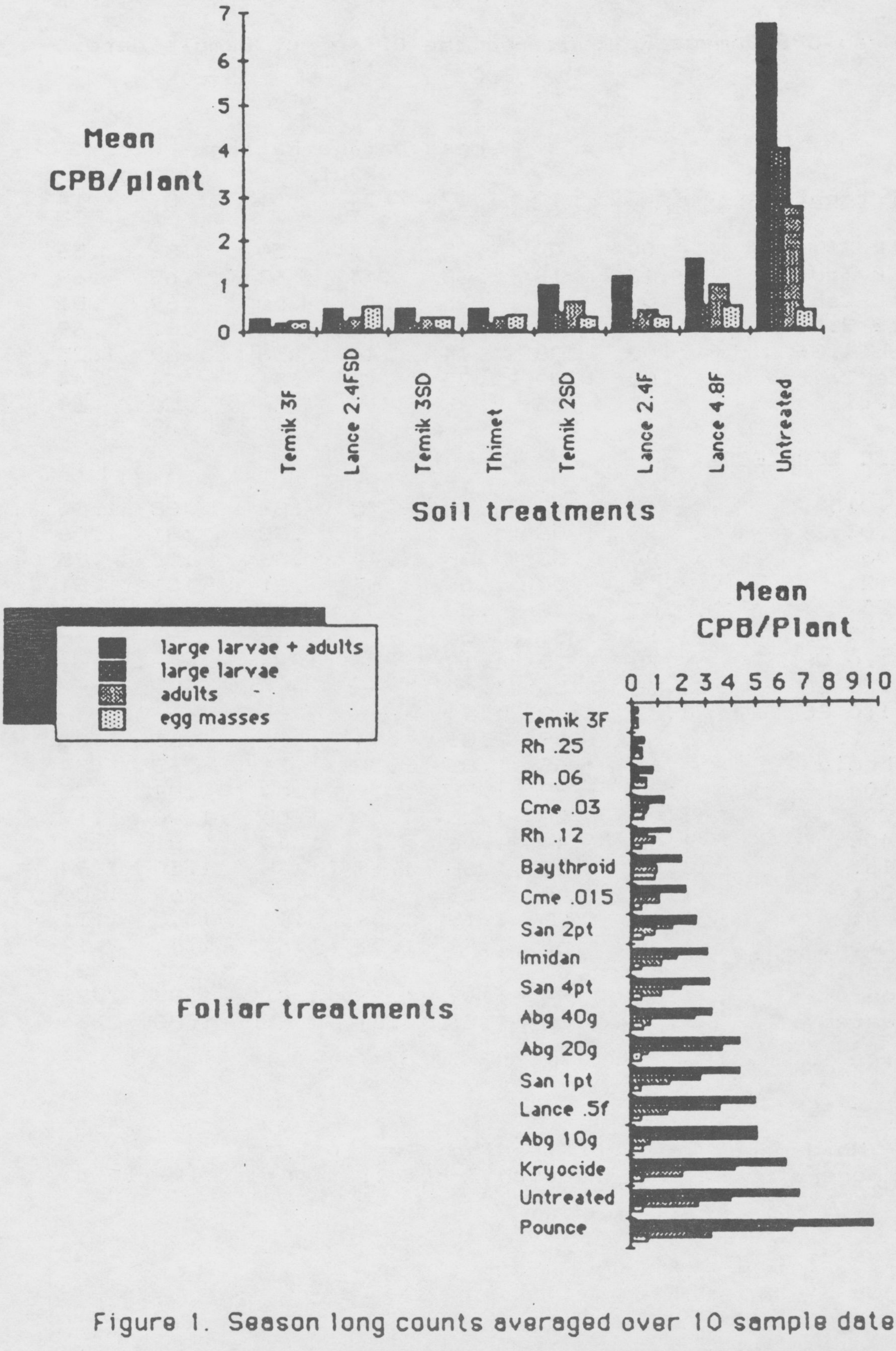


Figure 1. Season long counts averaged over 10 sample dates.

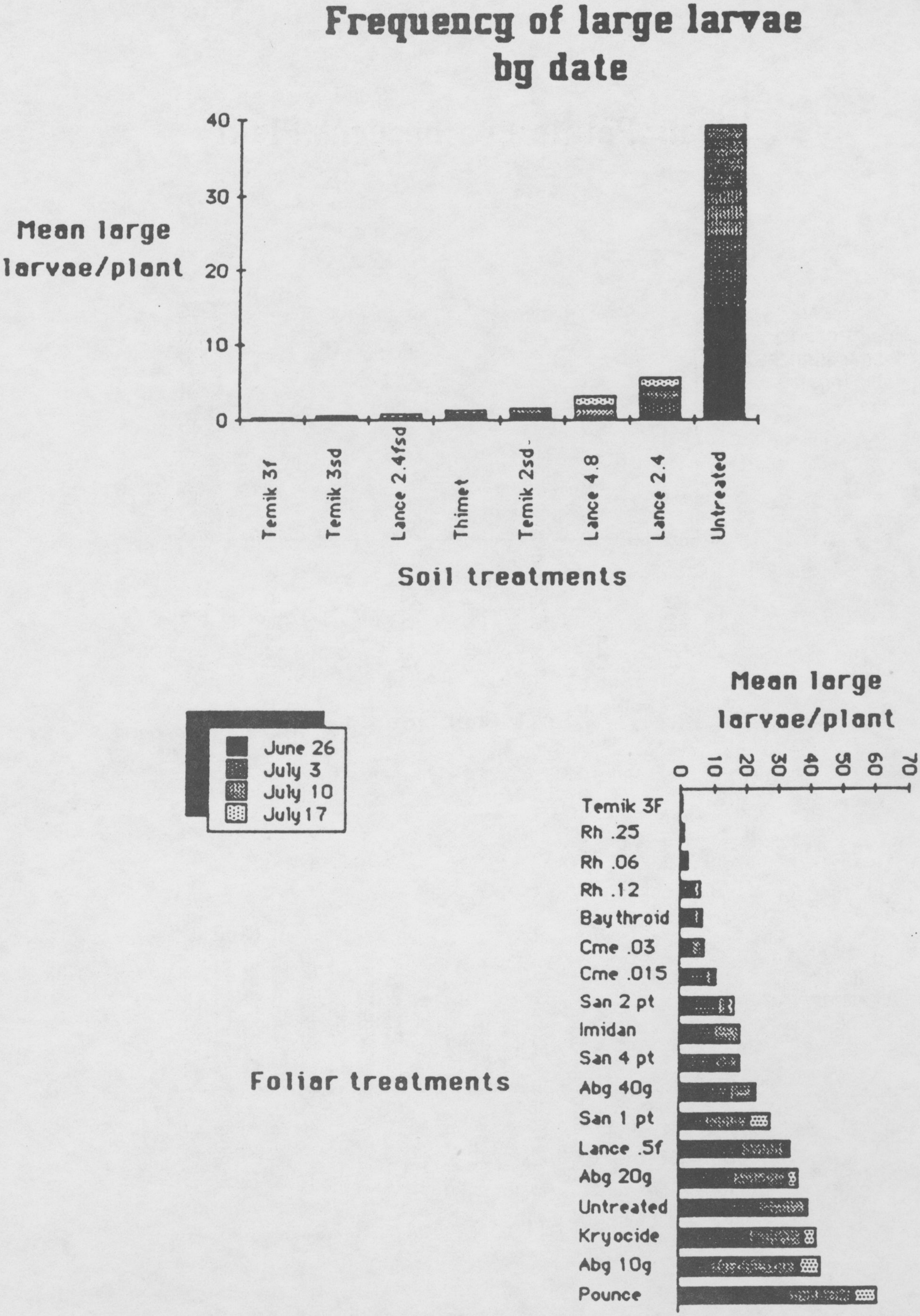


Figure 2. Number of large larvae per plant during peak larval development.

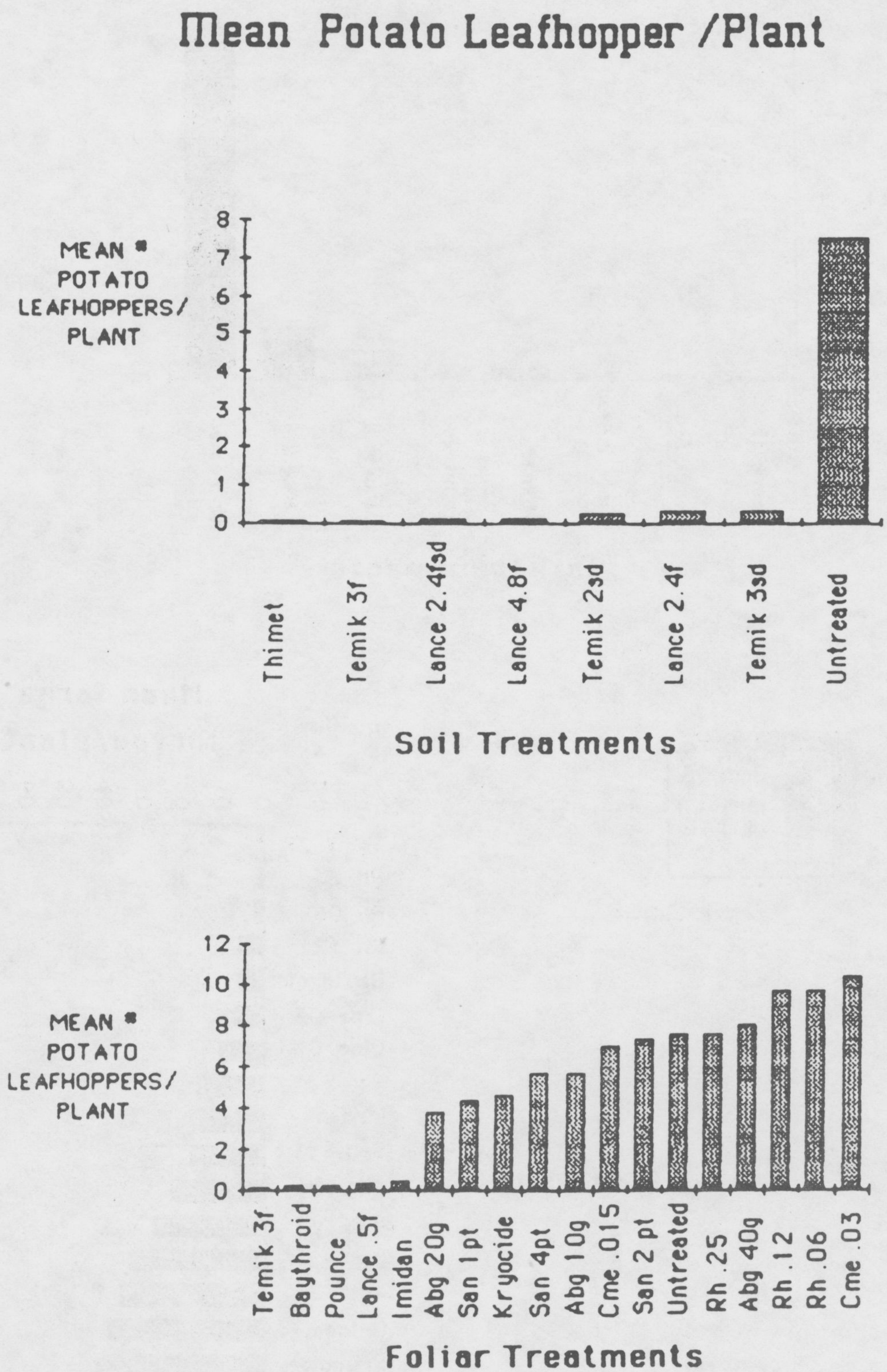


Figure 3. Mean potato leafhopper per plant averaged over 9 dates.

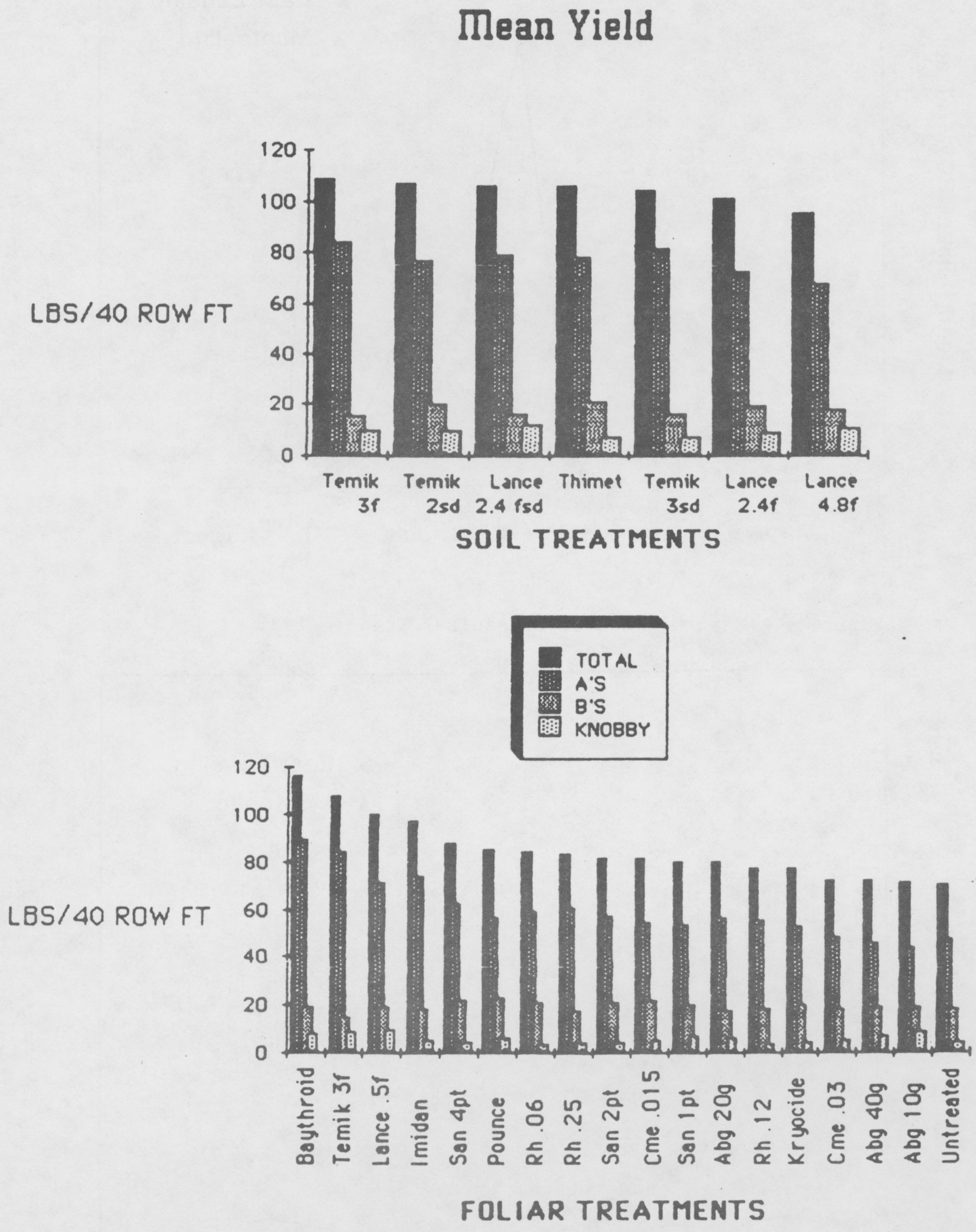


Figure 4. Mean yield per treatments (lbs/40 row ft)

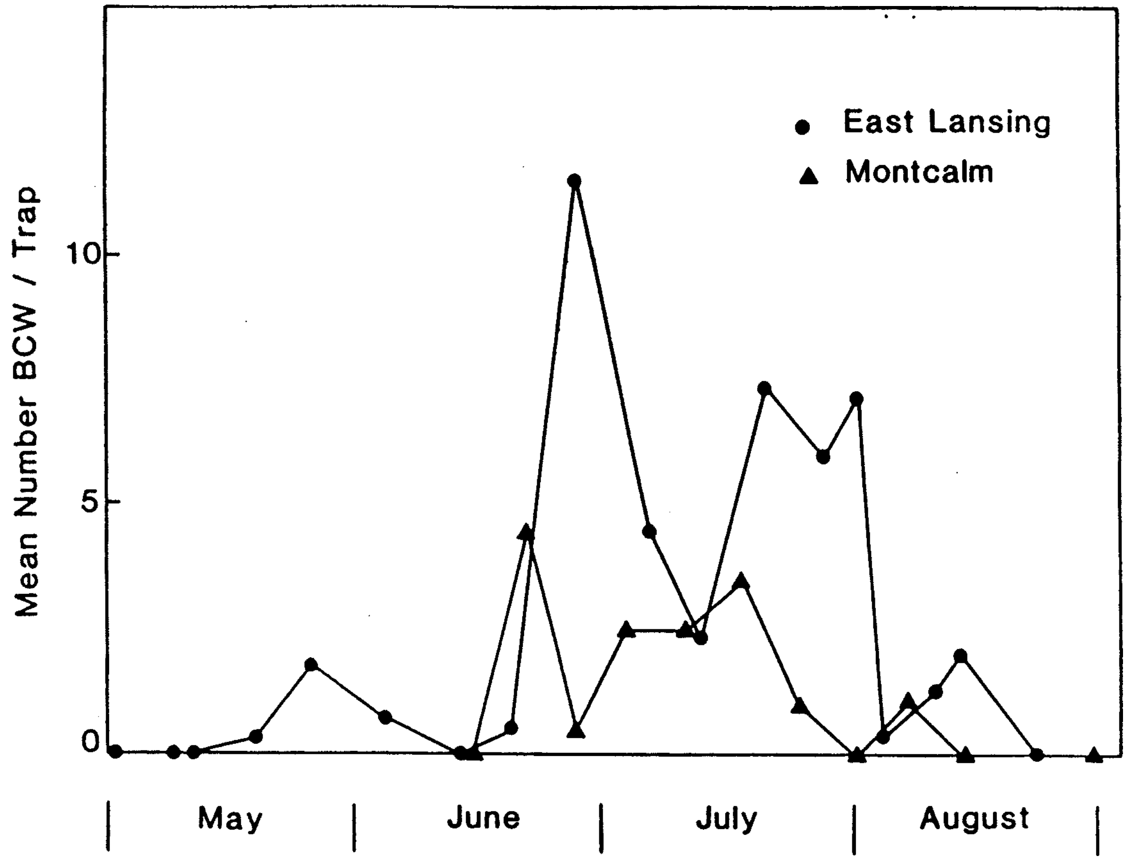


Figure 5. Mean Black Cutworm Adults/ Trap in 1984

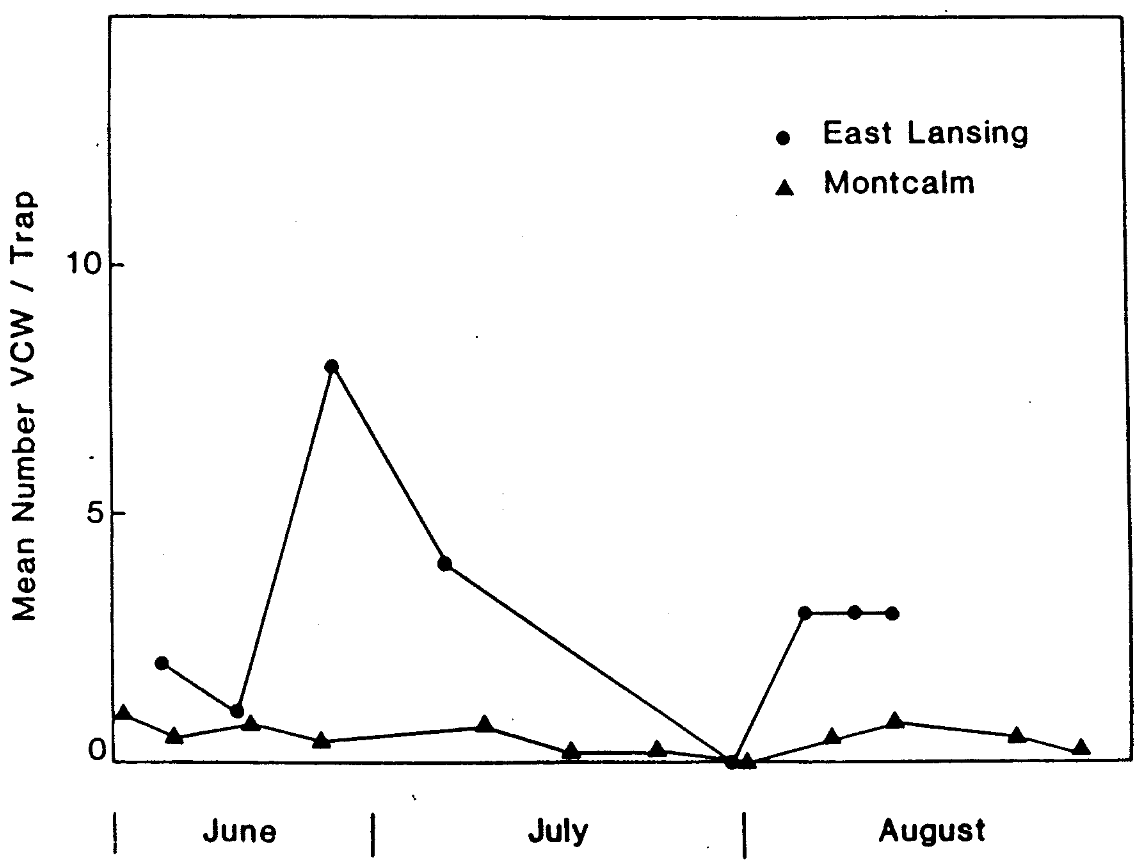


Figure 6. Mean Variegated Cutworm Adults/ Trap during 1984

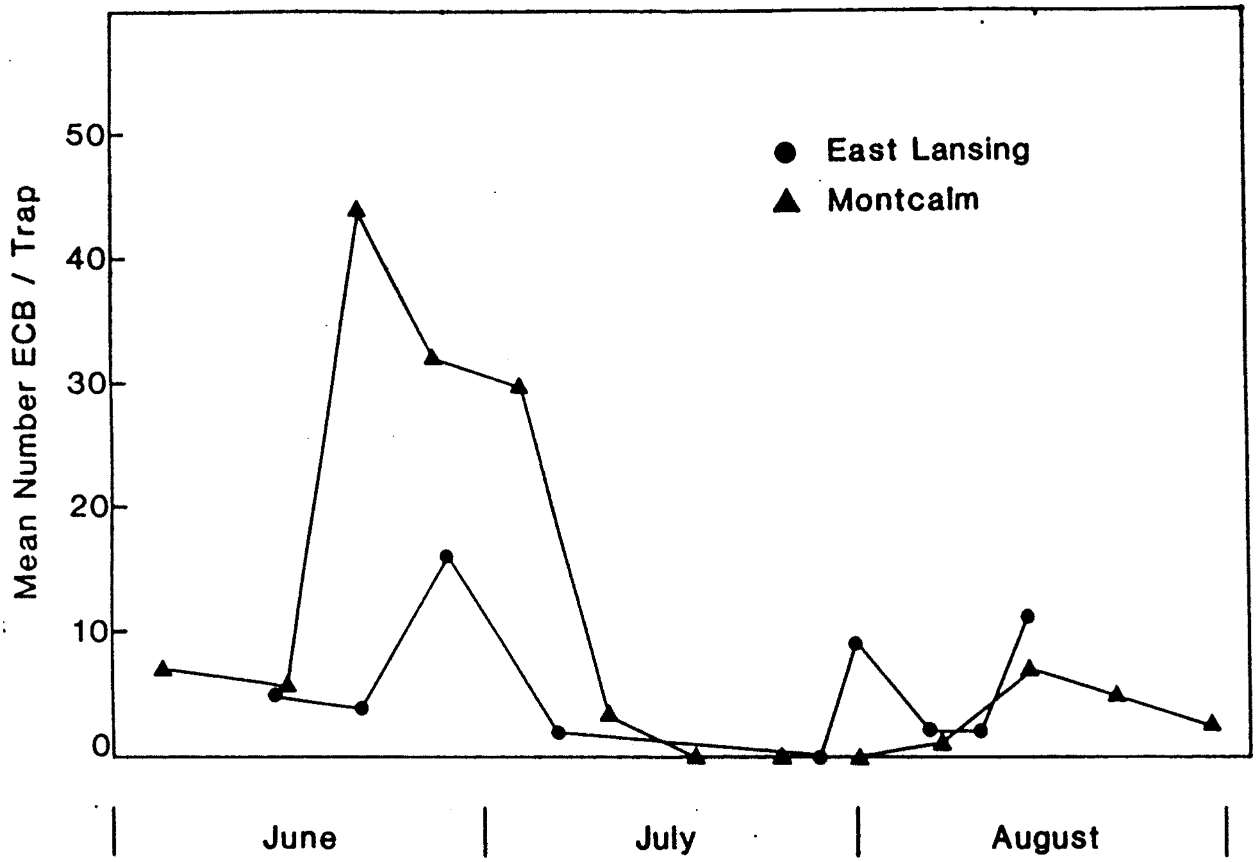


Figure 7. Mean European Corn Borer Adults/ Trap in 1984

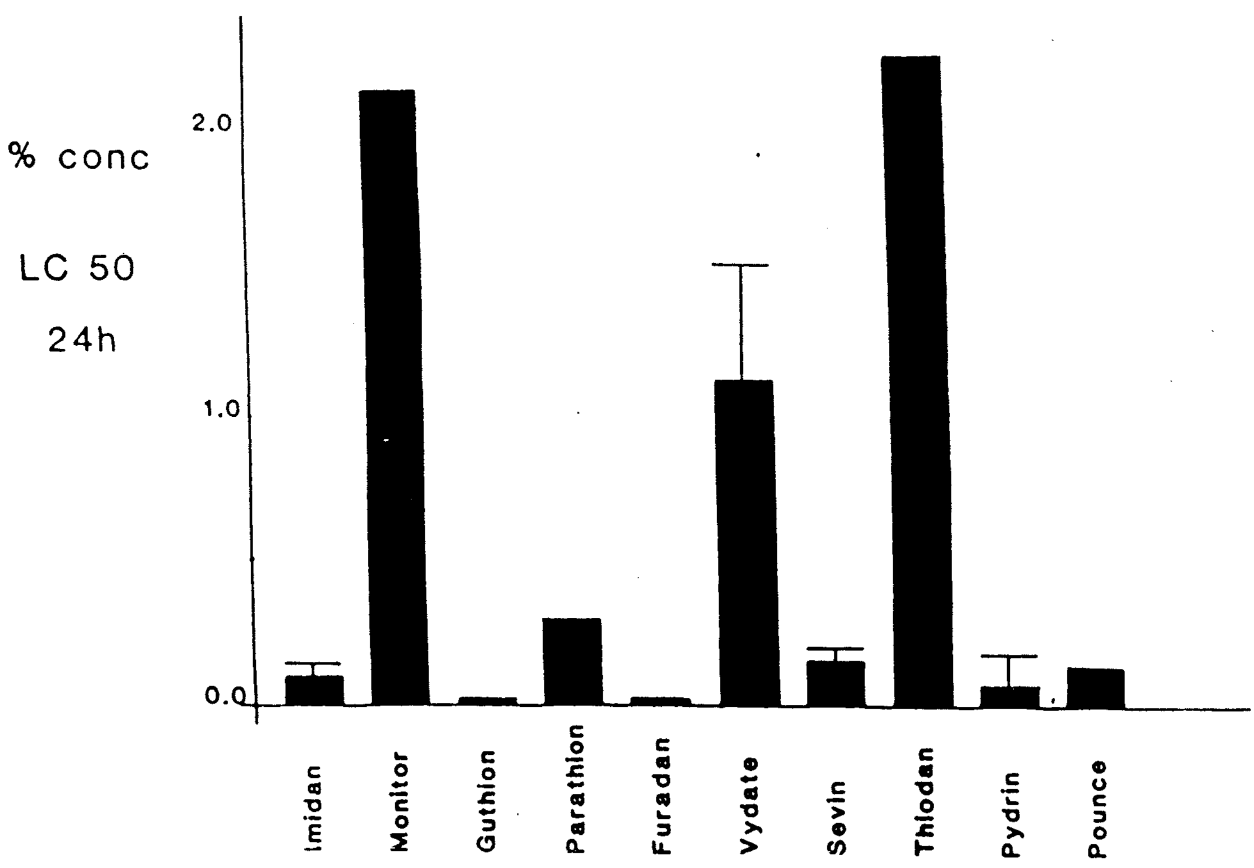


Figure 8.

1984 NEMATOLOGY RESEARCH

G.W. Bird, Nematologist
Department of Entomology

In 1984 potato microplot experiments were conducted to evaluate the joint influence of Pratylenchus penetrans and Verticillum dahliae on the growth and yield of Superior and Atlantic potatoes in relation to the early-die disease complex. Although root-lesion nematode population densities increased, they had no significant impact on tuber yields. The results of the early-die index were inconclusive (Table 1). It is highly probable that the seed pieces of both varieties were a source of V. dahliae infection.

Twenty potato varieties were evaluated for susceptibility to the early-die disease complex and the root-lesion nematode (P. penetrans). The results could be divided into three groups of varieties based on nematode reproduction and tuber yield in the absence of a nematicide, compared to the yield in the presence of a nematicide. Seven of the varieties were relatively tolerant to the early-die disease complex (Table 2), and similar to Russett Burbank in response. Three were very susceptible, and similar to Superior. Eight varieties were intermediate in their susceptibility to the early-die disease complex.

In Range 3 at the Montcalm Potato Research Farm, tuber yield increases resulting from the control of the root-lesion nematode were almost as great with Mocap applied on a broadcast basis as with Temik applied on an in-furrow basis (Table 3). This experiment was irrigated throughout the growing season. It appears that Mocap can be a substitute for Temik for root-lesion nematode control in Michigan potato production. The in-furrow treatment of Mocap, however, was not satisfactory.

Dry land potatoes were grown at the Montcalm Potato Research Farm in 1984 in Ranges 11 and 12. The yields were greater than anticipated (Tables 4 & 5). Ranges 11 & 12 had not been planted with potatoes for approximately ten years. Although the nematicides evaluated provided control of P. penetrans, there were no potato tuber yield responses.

During the past 11 years, the Michigan State University Nematology Program has completed 29 potato nematicide research trials. These were conducted with five different varieties. Yield increases associated with the combination of Temik and Vorlex averaged 120 cwt greater than the nontreated controls (Table 6). Temik is the only nematicide that provide season long control of P. penetrans. populations. Profit increases associated with these trials ranged from $172 per acre for Temik, to $520 per acre for the combined application of Temik and Vorlex (Table 7). Although Vapan was not included in these trials, it is estimated that the profit increase associated with this pesticide would be approximately $290 per acre.

Table 1. Influence of *Pratylenchus penetrans* and *Verticillium dahliae* on Superior and Atlantic tuber production in microtiles.

P_i (Variety)	P_f		Tuber Yield (lbs)		Index		Tubers (no.)		Tuber Size (lbs)	
	+	-	+	-	+	-	+	-	+	-
0										
Superior	0a	0a	1.7a	1.8a	4.0cd	4.3cd	9a	9a	0.19ab	0.21ab
Atlantic	1a	1a	1.8a	1.9a	1.7abc	0.7a	8c	8a	0.27b	0.24ab
10										
Superior	38b	16b	1.8a	1.7a	3.6bcd	4.3cd	11ab	12ab	0.35b	0.14a
Atlantic	44b	37b	2.3a	2.4a	1.6abc	2.1abcd	9a	10ab	0.29b	0.27b
100										
Superior	67b	82b	2.2a	1.6a	4.6d	3.4bcd	15b	9a	0.16a	0.16a
Atlantic	71b	103b	1.8a	2.1a	2.1abcd	1.3ab	12ab	8a	0.18ab	0.26b

Table 2. 1984 potato early-die disease complex variety microplot trial[1].

Group I (Russet Burbank)
Islander
Oceania
Simcoe
702-91
704-10
002-171
G670-11
Group II (Onaway/Katahdin/Onaway/Denali)
Snowchip
Conestoga
Island Chipper
714-10
Group III (Superior)
Chipbelle
Tukon
701-22

[1]Groups based on one-year of microplot observations. Rankings not to be used as commercial recommendations.

Table 3. Influence of nematicides on root-lesion nematode control and Superior tuber yields.

Treatment (rate of method)	Root-lesion nematodes			Tuber Yield (cwt.)			
	5/16	8/8	8/31	Total	A	J	B
Check	5a	50ab	74b	306a	262ab	9ab	30ab
Mocap 6EC 6.0 lb-B	4a	12a	64ab	332ab	290abc	9ab	32bc
Mocap 6EC 9.0 lb-B	2a	9a	42ab	361bc	313bcd	11ab	37cd
Mocap 6EC 12.0 lb-B	5a	7a	61ab	373bc	328cd	6a	39d
Mocap 15G 3.0 lb-IF	7a	44ab	79b	319ab	275abc	13ab	30ab
Temik 15G 3.0 lb-IF	5a	2a	5a	405c	345d	30c	31ab
AR 150867 1.0 lb-6B	3a	16ab	28ab	297a	251a	20bc	25a
AR 15086 2.0 lb-6B	7a	22ab	26ab	365bc	317bcd	19abc	28a
F 3843 2.0 lb-AP	4a	64b	65ab	322ab	280abc	11ab	30ab
F 3843 4.0 lb-AP	4a	63b	58ab	297a	260ab	8ab	28ab

Table 4. Montcalm potato nematicide trial.

Treatment, Rate (ai/A) and Application	*Pratylenchus penetrans* Pre-treatment Soil (5/1/84)	Midseason (8/8/84) Soil	Midseason (8/8/84) Roots	Midseason (8/8/84) Soil+Roots	Harvest Soil (8/31/84)	Yield (cwt.) A	Yield (cwt.) B	Yield (cwt.) Jumbo	Yield (cwt.) Total	Specific Gravity
Check	2a	10ab	51a	63ab	14ab	248a	22a	15a	285a	1.078a
Temik 15G, 3.0 in furrow	3a	0a	8a	8a	1a	226a	25ab	8a	259a	1.080a
F 3843, 12.0 14 days preplant	2a	14ab	108a	124b	10ab	228a	31b	5a	264a	1.076a
F3843, 4.0 14 days preplant	2a	5ab	60a	65ab	19b	231a	29ab	8a	268a	1.078a
F 3843, 2.0 14 days preplant	4a	5ab	59a	64ab	13ab	240a	28ab	12a	280a	1.079a
F 3843, 12.0 7 days preplant	3a	13ab	45a	59ab	8ab	229a	25ab	8a	262a	1.079a
F 3843, 4.0 7 days preplant	6a	14ab	69a	83ab	11ab	233a	25ab	9a	267a	1.078a
F 3843, 2.0 7 days preplant	5a	17b	77a	94ab	10ab	259a	26ab	5a	280a	1.078a
F 3843, 12.0 at planting	4a	12ab	73a	85ab	12ab	213a	28ab	6a	253a	1.080a
Vorlex 10 gal/A broadcast	2a	1a	34a	36ab	4ab	276a	24ab	15a	320a	1.081a

Table 5. 1980 potato nematicide trial.

	Yield (cwt.)					*Pratylenchus penetrans*				
	A	B	J	Total	Spec. Gravity	Pretreatment (5/1/84)	Soil (8/8/84)	Roots (8/8/84)	Soil+Roots (8/8/84)	Harvest (8/29/84)
Disyston Check	273a	31a	15a	319a	1.080a	4a	3a	22a	24a	20a
Temik 15G, 3.0	294a	29a	12a	335a	1.079a	2a	0a	1a	1b	0.4b
Temik 15G, 3.0 Vorlex 1.0 g/A	290a	32a	26a	348a	1.081a	1a	0a	0a	0a	0b
Vorlex + Disyston	257a	29a	15a	303a	1.082a	1a	1a	1a	2b	2b
SN556 10 g + Disyston	280a	32a	12a	324a	1.082a	0.4a	2a	8a	10ab	0.8b
SN556 15g + Disyston	280a	35a	9a	324a	1.081a	4a	0.2a	1a	1b	0.2b
SN556 10g + Temik	260a	32a	15a	307a	1.082a	2a	0a	0a	0b	0b
SN556 15g + Temik	206a	34a	17a	357a	1.079a	2a	0a	0.2a	0.2b	0b
Soilex 10g + Disyston	260a	29a	11a	300a	1.080a	2a	3a	9	12ab	6b

Table 6. Summary of 29 Potato nematicide trials conducted at the Michigan State University Montcalm Potato Research Farm from 1974-1984.

Variety (No. expts.)	Tuber yield (cwt/A)				*Pratylenchus penetrans*/100cm^3 soil and 1.0g root (P_m)			
	Check	Temik	Vorlex	Temik & vorlex	Check	Temik	Vorlex	Temik & Vorlex
Russet Burbank (7)	275	295	368	379	95	9	27	13
Superior (15)	229	284	312	367	118	21	69	1
Atlantic (4)	382	410	470	---	57	1	1	--
Onaway (2)	169	199	206	---	91	2	42	--
Monona (1)	187	209	180	---	131	40	42	--
Mean (29)	254	291	337	374	104	16	47	8

Table 7. Influence on potato production system profit based on 29 experiments between 1974 and 1984).

Nematicide	Cost/A	Yield Increase/A	Profit Increase/A[1]
Temik	$ 50	37 cwt	$ 172
Vorlex	150	83 cwt	348
Temik + Vorlex	200	120 cwt	520
Vapam[2]	250	90 cwt	290

[1]Based on a gross return of $6/cwt.

[2]Expert opinion (Vapam estimates not based on research data).

THE INFLUENCE OF FOLIAR FERTILIZERS AND A SOIL FUMIGANT ON PLANT NUTRITION, YIELD AND TUBER QUALITY OF POTATOES

M.L. Vitosh, G.W. Bird, R. Leep, R. Hammerschmidt,
R.W. Chase and E. Grafius
Department of Crop and Soil Sciences, Entomology and Botany and Plant Pathology

The objectives of these studies were to evaluate the effects of foliar fertilizer and a soil fumigant on potato plant nutrition, disease control, tuber yield and quality. Two studies were conducted. One at the Montcalm Research Farm and another on the John Verbrigghe farm in Delta county in the Upper Peninsula.

The experiment at the Montcalm Research Farm was conducted on two potato varieties, Atlantic and Superior with and without Vorlex, a soil fumigant. The experiment in the Upper Peninsula was conducted only on the Superior variety without the soil fumigant treatment. The foliar fertilizer treatments were the same at both locations. Treatment two was a 2% nitrogen solution made from urea. Treatment three was a 2% nitrogen, phosphate and potash solution made from a water soluble 20-20-20 fertilizer. Both materials were applied in 12.3 gallons of water per acre, 5 times during the growing season, suppling a total of 10 lb of N in the case of the urea treatment and 10 lbs of N, P_2O_5, and K_2O in the case of the N-P-K treatment. At the Montcalm Research farm, Vorlex was applied 8-10 inches below the soil surface as a broadcast rate of 10 gallons per acre on May 1st. Other cultural and management practices for the two studies are shown in Table 1.

Tuber Yield, Quality and Economic Analysis

Montcalm Study

Tuber yield, quality and economic analysis data for the Montcalm study are shown in Table 2. The Atlantic variety produced significantly higher total yields, U.S. No. 1's and large size tubers (those over 3¼ inches), than Superior. Vorlex significantly increased yields in all size categories measured. Neither the N or the N-P-K foliar fertilizer treatments had any affect on yields. Tuber specific gravity was considerably higher for the Atlantic variety, but was reduced slightly by the soil fumigant. A similar type of response was observed with Atlantic's in 1982, however, the negative response does not appear to be large enough to be of great concern in light of the increased yields for the soil fumigant.

Detailed observations of the tubers did not show any significant amount of hollow heart, internal browning, or scab which could be associated with the treatments. Estimates of plant foliage and ground cover on August 10th showed that there was slightly more foliage associated with the soil fumigant treatment and considerable more foliage associated with the Atlantic variety. The foliar fertilizer treatments did not exhibit any improved growth, color or cover at this time.

The economic analysis indicates that tuber size and yield are the important factors in determining net income. Greater net income (income after subtracting the cost of the treatments in this study) was associated with the Atlantic variety and the soil fumigant even though this treatment was prorated at a cost of $120 per acre. Net income was not significantly affected by the foliar fertilizer treatments.

Upper Peninsula Study

The effects of the two foliar fertilizer treatments upon tuber yield and specific gravity for the study in Delta county are presented in Table 3. Potato yield and size were not significantly affected by the foliar treatments. Specific gravity was significantly lower with the N foliar treatment when compared to the other treatments.

Foliar Disease Ratings

Montcalm Study

Observations on the development of foliar disease symptoms were made at four times during the growing season. Early blight (Alternaria solani) was the primary focus of these observations due to the relationship between this disease and general plant health. Disease symptoms were first recorded at a significant level on July 3 and July 17 for the Superior and Atlantic varieties, respectively. Among the foliar fertilizer treatments, a significant decrease in disease symptoms was found with the N-P-K treatment as compared to both the N and no foliar fertilizer treatments on July 17 and August 1 for Atlantic plots receiving no soil fumigant and on July 17 and August 1 and 10 for Atlantics receiving Vorlex. No foliar fertilizer effect was observed with Superior. In addition, Vorlex treated Atlantic's exhibited a significantly lower level of disease as compared to non-fumigated Atlantic plots on August 1 and 10. This relationship was also found for Superiors on July 3 and 17 and August 11. Atlantics exhibited less disease than Superior at all dates. This is probably due to differences in varietal maturity. The disease ratings for this study are presented in Table 4.

Upper Peninsula Study

Early blight ratings made on August 20 indicated little difference between the treatments. Total leaf area affected in all treatments was 40 to 44 percent.

Insect Activity

Montcalm Study

All plots of this experiment were monitored for insects periodically throughout the growing season. The plant density of Colorado Potato Beetle, Potato Leafhopper (PLH) and Aphid is presented graphically in Figures 1-4. All levels are considered to be low and plant damage was minimal. All plots were sprayed with insecticides according to the regular schedule established for the research farm.

Nutrient Analysis of Potato Petioles

Montcalm Study

Potato petioles were sampled 5 times during the growing season just prior to the application of the foliar fertilizers. Replications 1 and 4, 2 and 5, and 3 and 6 were combined after sampling to reduce the cost of the nutrient analysis. The samples were oven dried, ground and sent to The Ohio State University plant analysis laboratory for nutrient analysis. The data for the Montcalm location are shown in Tables 5-9. The overall nutrient mean values shown at the bottom of the tables can be seen in most cases to decline steadily throughout the season, particularly nitrate-nitrogen (NO_3-N) and potassium (K). The exceptions are calcium (Ca) and magnesium (Mg) which are usually balanced by K uptake. As the K concentration decreased throughout the season, the Ca and Mg concentration increased.

The nitrate nitrogen levels for both varieties dropped below 10,000 ppm some time between July 12 and July 23. The 10,000 ppm level has often been used as the critical level at which time the addition of nitrogen fertilizer would have been expected to give a yield increase. Two of the five foliar applications were applied after the nitrate level was below 10,000 ppm, but no response in yield or increase in nitrate content of the petioles was observed. We would conclude that the amount of N that can be added in foliar applications is insufficient to have any affect on the plant and the enhancement of yield. The plant requirements on a daily basis are estimated to be greater than the amount supplied in any one foliar treatment which was applied approximately every 10 days.

Vorlex initially had a negative affect on the level of nitrate nitrogen in the petioles but on July 12 the response was positive. No significant differences in nitrate levels were found at the other sampling dates. Vorlex had a positive affect on phosphorus uptake in 3 out of the 5 sampling dates. Calcium levels were found to be significantly lower at all of the sampling dates. Much of the decrease can be explained by the increase in K uptake and the balancing affect described earlier, however, the K content was found to be significant only on the last sampling date.

Vorlex significantly reduced the uptake of manganese (Mn) at all sampling dates. In all previous studies we have observed this depressing affect of Vorlex, but we still do not fully understand why this is occurring and whether it has any significant relationship to the yield increases observed.

The foliar fertilizer treatments in general did not affect the nutrient composition of the potato petioles. On June 20, before any foliar treatments were applied, the zinc (Zn) content was found to be significantly higher in those plots which were to receive the N foliar applications. On August 2 the Mg content was found to be significantly lower in these same plots. It is doubtful that either of these significant differences have any agronomic implications and must be considered to be due to field and sample variation.

Upper Peninsula Study

Potato petioles at this site were sampled in the same manner as those at the Montcalm location except that all 4 replications were used for the analysis. The data for this study are presented in Table 10. Although the soil phosphorus level at this site is considered high, analysis of the petioles indicated very low levels throughout the growing season. At the present time we do not have an explanation for the extremely low values. The two foliar fertilizer treatments, however, did result in increased P concentrations of potato petioles at the July 18 and August 9 sampling dates.

Analysis for all other nutrients appear to be normal but were unaffected by the foliar fertilizer treatments. Nitrate nitrogen levels appeared to stay well above the 10,000 ppm critical level throughout the growing season. Again, we would conclude that foliar fertilizer treatments such as these do not add enough nutrients to significantly affect the nutrient composition of the plant or yield and would discredit certain claims of greater efficiency for foliar applied nutrients.

Nematode Evaluations

Montcalm Study

Pre-plant application of Vorlex broadcast at 10 gallons per acre resulted in a significant increase in tuber yields of both Superior and Atlantic potatoes. Although the application of Vorlex did not result in statistically significant lower root-lesion nematode population densities for the individual foliar nutrient treatments (Table 11), the Vorlex treatment resulted in a significant decrease in the combined soil and root populations of *Pratylenchus penetrans* (root-lesion nematode) on August 7, 1984, compared to the nontreated control plots (Table 12). This decrease, however, was not reflected in the final population densities of *P. penetrans* on September 20, 1984.

The potato varieties did not have a significant ($P = 0.05$) impact on the population dynamics of *P. penetrans*. The population density of *P. penetrans* on August 7, 1984, however, was significantly greater in the plots receiving foliar application of N or N-P-K than in the nontreated controls.

Table 1. 1984 cultural and management practices for the Montcalm and Upper Peninsula studies.

Montcalm Study

Soil type: McBride sandy loam
Previous crop: Rye cover
Plowdown potash: 250 lb/acre
Soil fumigant: 10 gal/acre applied May 1
Planted: May 10, 1984
Row spacing: 34 inches
Seed spacing: 10 inches
Starter fertilizer: 750 lb 10-20-20 per acre
Soil applied insecticide: 3 lb a.i./acre Disyston
Herbicide: Dual at 2 lb/acre + Lexone 4L at .5 lb/acre pre-emergence
Sidedress nitrogen: 110 lb N/acre May 31
Foliar application dates: June 21, July 2, 13, 23, and August 3
Foliar application rate: 12 gallons of solution per acre
Harvested: September 19 and 20, 1984
Rainfall: 5.1, 2.9, 3.8, and 2.0 inches for May-August, respectively
Irrigation: 12 inches total for the season
Soil test information sampled May 10, 1984:
- pH = 5.6
- Bray P1 = 621 lb/acre
- Exch. K = 294 lb/acre
- Exch. Ca = 680 lb/acre
- Exch. Mg = 128 lb/acre

Upper Peninsula Study

Soil type: Onaway loam
Planted: May 24, 1984
Starter fertilizer: 750 lb 10-20-20 per acre
Sidedress nitrogen: 100 lb N/acre July 7
Foliar application dates: July 7, 18, 30, August 9, and 20
Foliar application rate: 23 gallons of solution per acre
Harvested: October 2, 1984
Soil test information:
- pH = 6.8
- Bray P1 = 272 lb/acre
- Exch. K = 224 lb/acre

Table 2. Potato tuber yield, quality, plant growth and net income as affected by variety, soil fumigant and foliar fertilizers.

Treatments[1]			Tuber Yield and Quality											
Variety	Soil Fumigant	Foliar Fertilize	Over 3 1/4"	U.S. No. 1	Under 1 7/8"	Total Yield	Specific Gravity	Net[3] Income	Net Income[4] Over Check	Hollow Heart	Internal Browning	Pitted Scab	Surface Scab	Plant Foliage
			------------cwt/A------------				--g/cc--	--------$/A--------		----rating[5]----		rating[6]	--%[7]--	rating[8]
Atlantic	None	None	40	411	23	434	1.090	2,835	695	0.2	0.3	0.2	0.2	8.3
		N	41	413	26	439	1.092	2,856	680	0.0	0.8	0.5	0.3	8.5
		N-P-K	35	397	25	422	1.092	2,704	528	0.2	0.3	0.2	0.2	8.2
	Vorlex	None	66	449	29	478	1.088	3,025	849	0.2	0.2	0.2	0.2	8.3
		N	61	449	28	477	1.090	3,017	841	0.2	0.2	0.0	0.0	8.7
		N-P-K	55	456	31	486	1.090	3,022	846	0.3	0.3	0.3	0.3	8.7
Superior	None	None	19	318	25	343	1.075	2,176	0	0.3	0.5	0.0	0.0	4.2
		N	31	335	24	359	1.073	2,310	134	0.0	0.5	0.0	0.0	4.2
		N-P-K	24	339	25	364	1.075	2,295	119	0.0	0.2	0.0	0.0	3.8
	Vorlex	None	34	374	29	403	1.073	2,466	290	0.0	0.2	0.0	0.0	5.0
		N	37	373	28	401	1.074	2,459	283	0.2	0.2	0.2	0.2	5.0
		N-P-K	29	362	26	388	1.072	2,343	167	0.0	0.7	0.2	0.2	4.8
Overall Means[2]														
Variety	Atlantic		50 b	429 b	27	456 b	1.090 b	2,980 b	569 b	0.2	0.4	0.2	0.2	8.4 b
	Superior		29 a	350 a	26	376 a	1.074 a	2,412 a	0 a	0.1	0.4	0.1	0.1	4.5 a
Fumigant	None		32 a	369 a	25 a	394 a	1.083 b	2,540 a	0 a	0.1	0.4	0.1	0.1	6.2 a
	Vorlex		47 b	410 b	28 b	439 b	1.081 a	2,853 b	193 b	0.1	0.3	0.1	0.1	6.7 b
Foliar Fertilizer	None		40	388	27	414	1.081	2,685	0	0.2	0.3	0.1	0.1	6.3
	N		43	393	27	419	1.082	2,723	65	0.1	0.4	0.2	0.1	6.6
	N-P-K		36	388	27	415	1.082	2,681	-34	0.1	0.4	0.2	0.2	6.4

[1]Foliar N was applied in 5 applications as urea in 5 gallons of water to supply 2 lb N/A in each application. Foliar N-P-K was applied in 5 applications as a 20-20-20 foliar fertilizer in 5 gallons of water to supply 2 lb N, P_2O_5, and K_2O /A in each application.

[2]Any two treatment means followed by different letters are significantly different ($p = .05$).

[3]Net income after expenses: N @ $.20/lb, Foliar N-P-K @ $.60/lb, Vorlex @ $120/A, Tubers over 3 1/4" @ $8.65, Tubers 2-3 1/4" @ $6.65, and Tubers under 2" @ $1.00.

[4]Check = Superior, no fumigant and no foliar fertilizer.

[5]Ratings of 0-5, where 0 = no incidence and 5 = high incidence.

[6]Ratings of 0-10, where 0 = no incidence and 10 = high incidence.

[7]Percent of surface covered with scab.

[8]Ratings of 0-10, where 0 = no ground cover and 10 = complete ground cover as measured on August 10.

Table 3. Potato tuber yield, quality, plant growth and net income as affected by foliar fertilizers (Upper Peninsula).

Treatments[1]		Tuber Yield and Quality						Economics	
Variety	Foliar Fertilize	Over 3 1/4"	U.S. No. 1	Under 1 7/8"	Total Yield	Specific Gravity	Plant Foliage	Net[3] Income	Net Income[4] Over Check
		cwt/A				g/cc	rating[2]	$/A	
Superior	None	45	321	28	349	1.076	44	2,524	0
	N	26	342	37	379	1.072	44	2,534	10
	N-P-K	32	321	36	357	1.076	40	2,441	-83

None of the treatment means are significantly different ($p = .05$).

[1]Foliar N was applied in 5 applications as urea and supplied 2 lb N/A in each application. Foliar N-P-K was applied in 5 applications as 20-20-20 foliar fertilizer and supplied 2 lb N, P_2O_5, and K_2O/A in each application.

[2]Total percent leaf area as observed on August 20.

[3]New income after expenses: N @ $.20/lb, Foliar N-P-K @ $.60/lb, Tubers over 3 1/4" @ $8.65, Tubers 2-3 1/4" @ $6.65, and Tubers under 2" @ $1.00.

[4]Check = No foliar fertilizer.

Table 4. Foliar disease ratings taken periodically throughout the growing season (Montcalm Study).

Treatments[1]			Disease Rating[1]			
Variety	Soil Fumigant	Foliar Fertilize	July 3	July 17	August 1	August 10
Atlantic	None	None	1.01	1.21	1.66	2.02
		N	1.03	1.18	1.66	2.10
		N-P-K	1.00	1.05	1.25	1.75
	Vorlex	None	1.01	1.25	1.58	1.79
		N	1.00	1.20	1.50	1.78
		N-P-K	1.00	1.00	1.00	1.23
Superior	None	None	1.33	2.10	3.83	4.12
		N	1.32	2.20	3.00	3.87
		N-P-K	1.42	2.18	3.17	3.77
	Vorlex	None	1.21	1.75	2.92	3.56
		N	1.25	1.60	2.17	3.43
		N-P-K	1.24	1.63	2.50	3.22

[1] 1 = 0-5% lesion coverage
2 = 6-10% lesion coverage
3 = 11-25% lesion coverage
4 = 26-50% lesion coverage
5 = over 50% lesion coverage

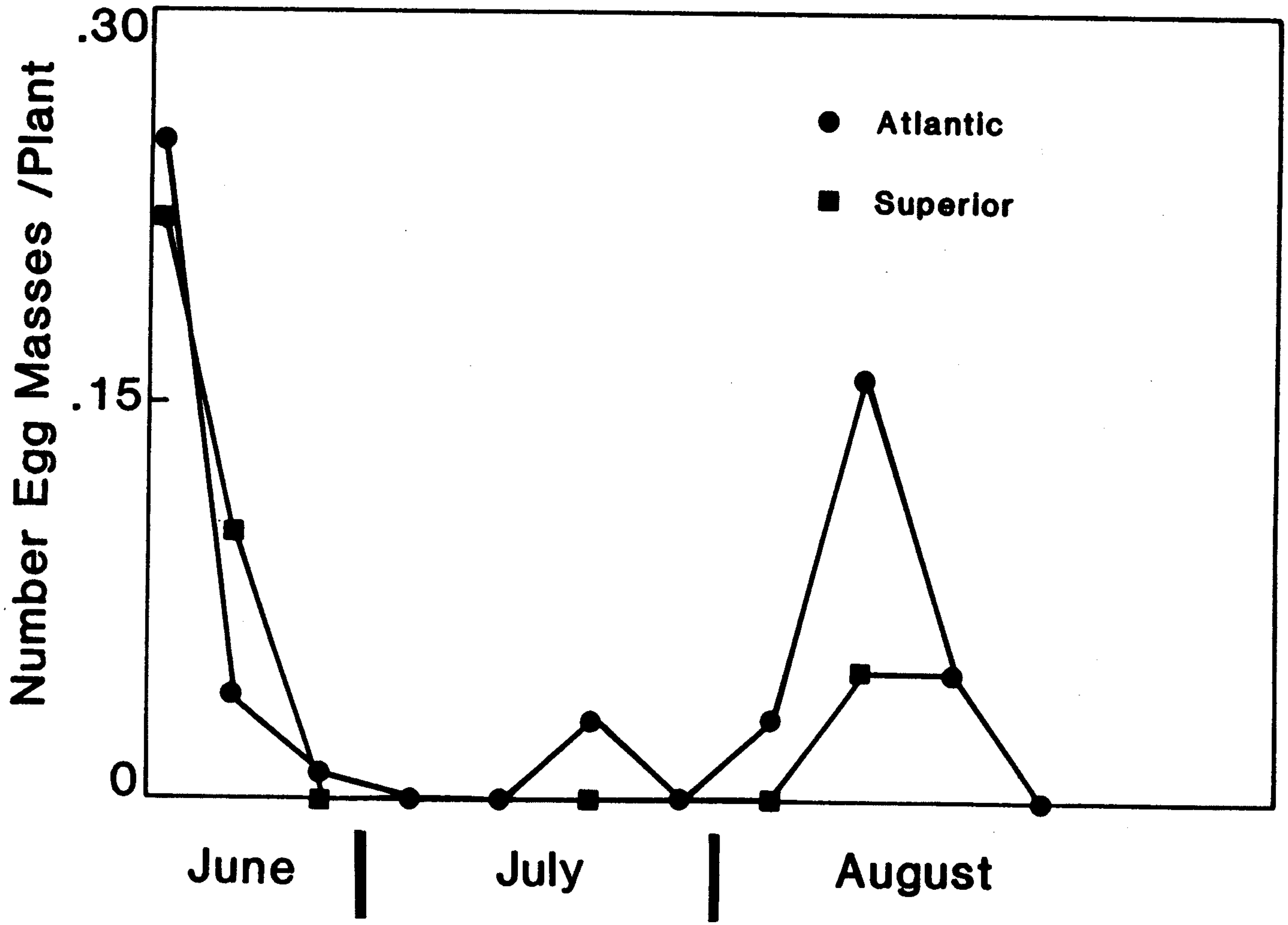


Figure 1. Egg masses of Colorado Potato Beetle per plant throughout the growing season

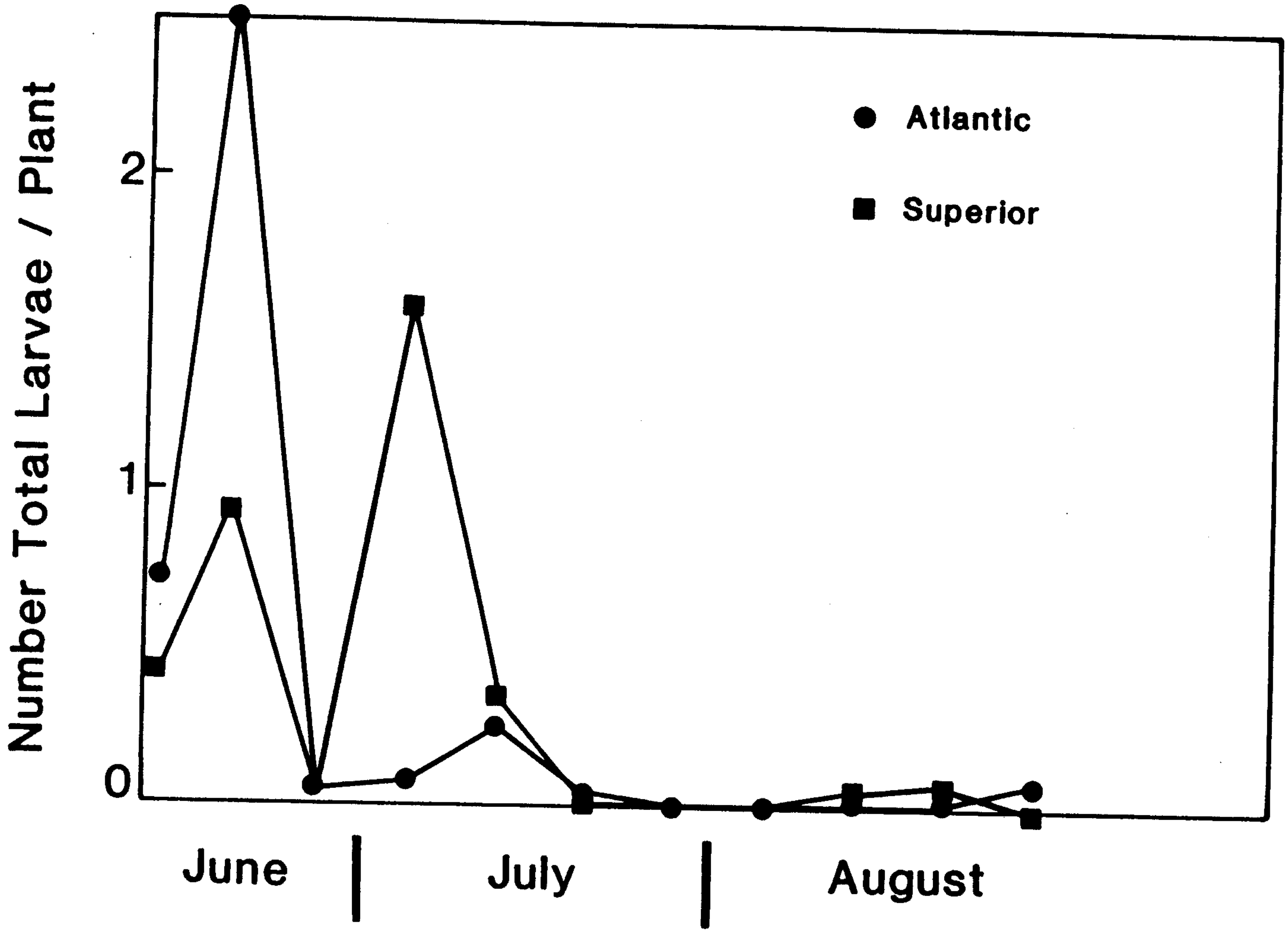


Figure 2. Larvae of Colorado Potato Beetle per plant throughout the growing season.

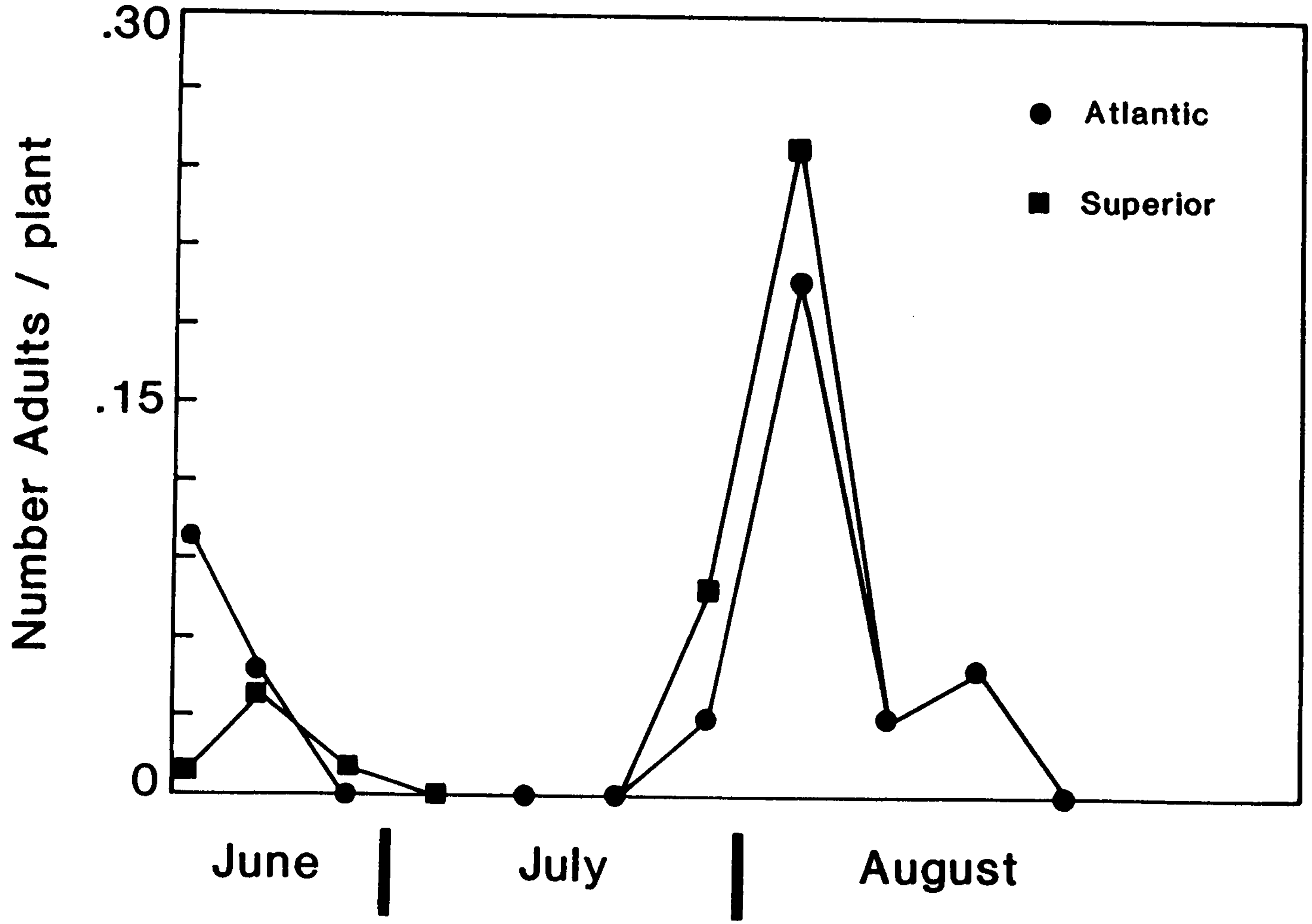


Figure 3. Colorado Potato Beetle Adults per plant throughout the growing season.

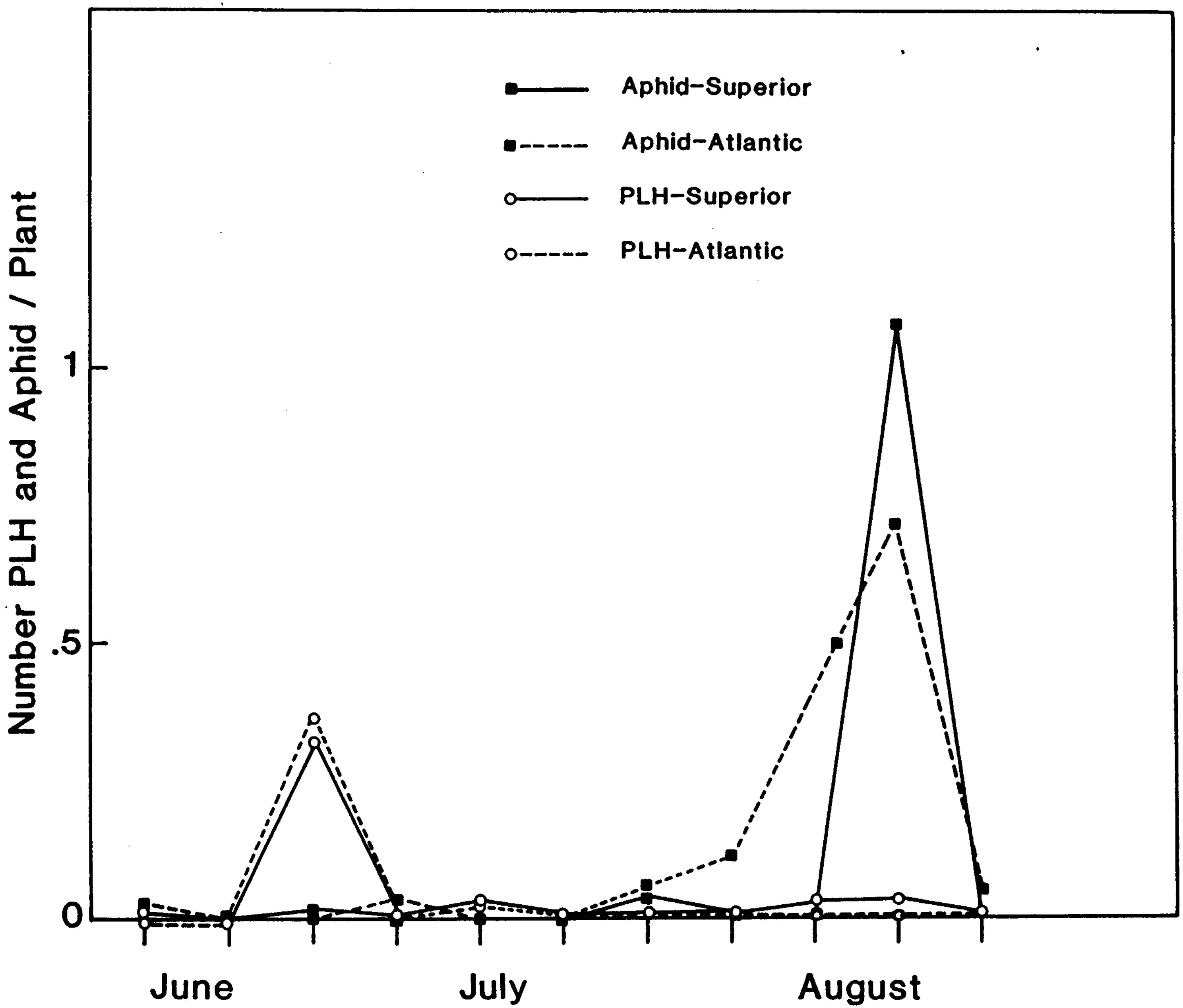


Figure 4. Aphids and Potato Leaf Hoppers per plant throughout the growing season.

Table 5. Elemental composition on potato petioles as affected by variety, soil fumigant and the application of foliar fertilizers.

Treatments[1]			Elemental Content of Potato Petioles[3]									
Variety	Soil Fumigant	Foliar Fertilizer	NO3-N	P	K	Ca	Mg	Mn	Fe	B	Cu	Zn
			-ppm--	--%				--ppm--				
Atlantic	None	None	24,433	0.68	13.46	0.57	0.30	278	222	35	25	105
		N	20,560	0.68	13.35	0.57	0.31	260	421	37	33	108
		N-P-K	22,833	0.66	13.39	0.56	0.30	268	213	35	21	97
	Vorlex	None	21,767	0.72	13.53	0.47	0.29	129	184	36	24	109
		N	21,067	0.76	13.24	0.48	0.30	129	269	35	27	110
		N-P-K	21,033	0.77	13.56	0.47	0.31	140	258	37	28	108
Superior	None	None	26,667	0.56	12.05	0.59	0.28	242	324	33	30	98
		N	25,333	0.60	12.32	0.59	0.28	289	371	34	28	133
		N-P-K	25,860	0.61	13.15	0.67	0.32	281	366	35	30	126
	Vorlex	None	23,500	0.66	12.14	0.49	0.29	89	379	35	31	113
		N	24,000	0.67	12.47	0.54	0.29	126	475	34	39	134
		N-P-K	22,833	0.66	11.90	0.46	0.27	106	400	33	35	113
Overall Means[2]												
Variety	Atlantic		21,949 a	0.71 b	13.42 b	0.52 a	0.30	201	261 a	36 b	26 a	106 a
	Superior		24,699 b	0.63 a	12.34 a	0.56 b	0.29	189	386 b	34 a	32 b	119 b
Fumigant	None		24,281 b	0.63	12.95	0.59 b	0.30	270 b	320	35	28	111
	Vorlex		22,367 a	0.71	12.81	0.49 a	0.29	120 a	328	35	31	114
Foliar Fertilizer	None		24,092	0.65	12.79	0.53	0.29	185	277 a	35	28	106 a
	N		22,740	0.68	12.85	0.54	0.30	201	384 b	35	32	121 b
	N-P-K		23,140	0.67	13.00	0.54	0.30	199	309 a	35	28	111 a

[1] Foliar N was applied in 5 applications as urea in 5 gallons of water to supply 2 lb N/A in each application. Foliar N-P-K was applied in 5 applications as a 20-20-20 foliar fertilizer in 5 gallons of water to supply 2 lb N, P_2O_5, and K_2O/A in each application.

[2] Any two treatment means followed by different letters are significantly different (p = .05).

[3] Sampled on June 20.

Table 6. Elemental composition on potato petioles as affected by variety, soil fumigant and the application of foliar fertilizers.

Treatments[1]			Elemental Content of Potato Petioles[3]									
Variety	Soil Fumigant	Foliar Fertilizer	NO3-N	P	K	Ca	Mg	Mn	Fe	B	Cu	Zn
			-ppm--	---------------	%	--------------		-------------	ppm	-------------		
Atlantic	None	None	14,667	0.43	12.70	0.62	0.33	297	96	34	13	58
		N	14,167	0.49	13.74	0.67	0.37	288	109	38	15	61
		N-P-K	13,000	0.48	13.09	0.66	0.36	329	109	35	13	56
	Vorlex	None	15,000	0.53	14.19	0.58	0.33	200	101	36	15	71
		N	15,167	0.52	14.18	0.57	0.34	202	95	36	13	68
		N-P-K	13,833	0.54	13.83	0.59	0.36	223	98	36	14	64
Superior	None	None	17,333	0.48	14.37	0.77	0.37	275	120	40	17	58
		N	17,000	0.48	14.32	0.71	0.35	306	126	40	18	69
		N-P-K	17,167	0.49	14.14	0.74	0.37	291	112	38	17	67
	Vorlex	None	19,167	0.51	13.96	0.65	0.36	125	122	38	19	69
		N	17,333	0.56	13.98	0.64	0.37	128	127	39	21	74
		N-P-K	18,333	0.50	13.50	0.60	0.32	137	121	36	21	71
Overall Means[2]												
Variety	Atlantic		14,306 a	0.50	13.62	0.62 a	0.35	257 b	101 a	36 a	14 a	63
	Superior		17,722 b	0.50	14.04	0.68 b	0.36	210 a	121 b	39 b	19 b	68
Fumigant	None		15,556	0.47 a	13.72	0.69 b	0.36	298 b	112	38	16	62 a
	Vorlex		16,472	0.53 b	13.94	0.61 a	0.35	169 a	111	37	17	70 b
Foliar Fertilizer	None		16,542	0.49	13.80	0.66	0.35	224	110 a	37 ab	16	64
	N		15,917	0.51	14.05	0.65	0.36	231	114 b	38 b	17	68
	N-P-K		15,583	0.50	13.64	0.65	0.35	245	110 a	36 a	16	65

[1]Foliar N was applied in 5 applications as urea in 5 gallons of water to supply 2 lb N/A in each application. Foliar N-P-K was applied in 5 applications as a 20-20-20 foliar fertilizer in 5 gallons of water to supply 2 lb N, P_2O_5, and K_2O/A in each application.

[2]Any two treatment means followed by different letters are significantly different (p = .05).

[3]Sampled on July 2.

Table 7. Elemental composition on potato petioles as affected by variety, soil fumigant and the application of foliar fertilizers.

Treatments[1]			Elemental Content of Potato Petioles[3]									
Variety	Soil Fumigant	Foliar Fertilizer	NO3-N	P	K	Ca	Mg	Mn	Fe	B	Cu	Zn
			-ppm--	%				ppm				
Atlantic	None	None	11,583	0.47	11.21	0.64	0.38	289	69	36	10	37
		N	11,500	0.43	11.26	0.71	0.41	265	63	35	9	37
		N-P-K	11,750	0.42	11.14	0.70	0.40	290	74	34	12	41
	Vorlex	None	12,417	0.54	12.09	0.55	0.35	191	68	36	13	51
		N	12,083	0.50	11.53	0.57	0.38	216	63	33	10	55
		N-P-K	14,750	0.45	11.85	0.62	0.40	224	66	32	11	40
Superior	None	None	16,167	0.38	11.54	0.73	0.31	241	70	33	12	40
		N	14,917	0.42	11.69	0.65	0.31	232	74	32	12	41
		N-P-K	14,333	0.44	11.24	0.68	0.30	236	83	33	13	37
	Vorlex	None	17,500	0.51	11.39	0.63	0.33	158	77	33	15	43
		N	17,417	0.55	11.65	0.56	0.29	138	87	34	17	57
		N-P-K	16,333	0.49	11.82	0.63	0.31	199	116	35	19	53
Overall Means[2]												
Variety	Atlantic		12,347 a	0.47	11.51	0.63	0.39 b	246 b	67	34	11 a	43
	Superior		16,111 b	0.47	11.56	0.65	0.31 a	201 a	84	33	15 b	45
Fumigant	None		13,375 a	0.43 a	11.35	0.68 b	0.35	259 b	72	34	11	39 a
	Vorlex		15,083 b	0.51 b	11.72	0.59 a	0.34	188 a	79	34	14	50 b
Foliar Fertilizer	None		14,417	0.47	11.56	0.64	0.34	220	71	34	13	43
	N		13,979	0.48	11.53	0.62	0.35	212	72	33	12	47
	N-P-K		14,292	0.45	11.51	0.65	0.35	237	85	34	14	43

[1]Foliar N was applied in 5 applications as urea in 5 gallons of water to supply 2 lb N/A in each application. Foliar N-P-K was applied in 5 applications as a 20-20-20 foliar fertilizer in 5 gallons of water to supply 2 lb N, P_2O_5, and K_2O/A in each application.

[2]Any two treatment means followed by different letters are significantly different (p = .05).

[3]Sampled on July 12.

Table 8. Elemental composition on potato petioles as affected by variety, soil fumigant and the application of foliar fertilizers.

Treatments[1]			Elemental Content of Potato Petioles[3]									
Variety	Soil Fumigant	Foliar Fertilizer	NO3-N	P	K	Ca	Mg	Mn	Fe	B	Cu	Zn
			-ppm-	-----	%	-----		-----	-----	ppm	-----	-----
Atlantic	None	None	4,917	0.18	8.96	0.92	0.72	428	51	34	6	27
		N	4,775	0.19	9.50	0.93	0.72	419	55	34	6	28
		N-P-K	4,808	0.19	9.08	0.92	0.74	442	54	34	6	28
	Vorlex	None	4,092	0.23	9.44	0.78	0.64	315	47	33	5	34
		N	4,142	0.23	8.90	0.76	0.65	344	55	33	6	31
		N-P-K	4,233	0.23	9.58	0.79	0.68	323	56	33	6	26
Superior	None	None	6,108	0.17	9.01	0.99	0.53	376	58	34	5	20
		N	7,733	0.18	9.67	0.90	0.47	364	51	34	4	20
		N-P-K	6,833	0.17	9.11	0.92	0.47	359	52	34	4	18
	Vorlex	None	8,125	0.22	9.64	0.81	0.45	252	54	34	4	22
		N	6,250	0.21	9.47	0.80	0.44	264	54	33	5	25
		N-P-K	7,500	0.21	9.26	0.78	0.44	299	57	35	6	27
Overall Means[2]												
Variety	Atlantic		4,494 a	0.21	9.24	0.85	0.69 b	376 b	53	33	6	29
	Superior		7,092 b	0.19	9.36	0.87	0.47 a	319 a	54	34	5	23
Fumigant	None		5,862	0.18 a	9.22	0.93 b	0.61 b	398 b	53	34	5	23
	Vorlex		5,724	0.22 b	9.38	0.79 a	0.55 a	297 a	53	33	5	28
Foliar Fertilizer	None		5,810	0.20	9.26	0.87	0.59	343	52	34	5	26
	N		5,725	0.20	9.39	0.85	0.57	345	54	34	5	26
	N-P-K		5,844	0.20	9.26	0.82	0.58	355	55	34	6	25

[1]Foliar N was applied in 5 applications as urea in 5 gallons of water to supply 2 lb N/A in each application. Foliar N-P-K was applied in 5 applications as a 20-20-20 foliar fertilizer in 5 gallons of water to supply 2 lb N, P_2O_5, and K_2O/A in each application.

[2]Any two treatment means followed by different letters are significantly different (p = .05).

[3]Sampled on July 23.

Table 9. Elemental composition on potato petioles as affected by variety, soil fumigant and the application of foliar fertilizers.

Treatments[1]			Elemental Content of Potato Petioles[3]									
Variety	Soil Fumigant	Foliar Fertilizer	NO3-N	P	K	Ca	Mg	Mn	Fe	B	Cu	Zn
			-ppm--	%				ppm				
Atlantic	None	None	1,970	0.17	7.99	1.33	1.47	624	86	41	11	36
		N	2,060	0.18	8.06	1.31	1.44	568	108	38	13	34
		N-P-K	2,317	0.18	8.66	1.32	1.44	638	88	40	12	28
	Vorlex	None	2,010	0.21	9.24	1.15	1.22	418	98	43	12	33
		N	2,060	0.20	8.58	1.17	0.80	492	68	41	10	26
		N-P-K	1,777	0.20	8.82	1.14	1.34	527	65	39	10	25
Superior	None	None	3,433	0.16	8.52	1.60	1.00	587	84	40	12	19
		N	5,033	0.16	9.48	1.50	0.92	621	79	39	9	22
		N-P-K	4,400	0.17	9.38	1.70	0.93	535	90	44	14	20
	Vorlex	None	3,733	0.20	9.22	1.34	0.90	420	98	41	13	22
		N	3,667	0.19	9.84	1.38	0.97	416	132	42	18	30
		N-P-K	4,600	0.17	9.28	1.33	0.89	478	155	39	18	37
Overall Means[2]												
Variety	Atlantic		2,032 a	0.19	8.56 a	1.24 a	1.29 b	544	86	40	11	30
	Superior		4,144 b	0.17	9.29 b	1.47 b	0.94 a	510	107	41	14	25
Fumigant	None		3,202	0.17	8.68 a	1.46 b	1.20 b	595 b	89	40	12	26
	Vorlex		2,974	0.19	9.16 b	1.25 a	1.02 a	458 a	103	41	14	29
Foliar Fertilizer	None		2,787	0.18	8.74	1.36	1.15 b	512	92	41	12	28
	N		3,205	0.18	8.99	1.34	1.03 a	524	97	40	12	28
	N-P-K		3,273	0.18	9.03	1.37	1.15 b	544	100	41	14	27

[1]Foliar N was applied in 5 applications as urea in 5 gallons of water to supply 2 lb N/A in each application. Foliar N-P-K was applied in 5 applications as a 20-20-20 foliar fertilizer in 5 gallons of water to supply 2 lb N, P_2O_5, and K_2O/A in each application.

[2]Any two treatment means followed by different letters are significantly different (p = .05).

[3]Sampled on August 2.

Table 10. Nutrient composition of potatoes as affected by fertility treatments.

	Sampling Dates			
Treatment #	July 18	July 30	August 9	August 20
	%P			
1	.113 a[1]	.091 a	.093 a	.091 a
2	.123 b	.091 a	.106 b	.095 a
3	.123 b	.097 a	.104 b	.095 a
	%K			
1	8.55 a	8.47 a	8.12 a	5.95 a
2	8.46 a	8.97 a	8.27 a	6.16 a
3	8.76 a	9.19 a	8.64 a	6.83 a
	%Ca			
1	2.35 a	2.18 a	2.20 a	2.11 a
2	2.14 a	2.22 a	2.28 a	2.15 a
3	2.25 a	2.24 a	2.24 a	2.07 a
	%Mg			
1	1.32 a	1.64 a	2.03 a	2.39 a
2	1.21 a	1.56 a	2.09 b	2.41 a
3	1.22 a	1.53 a	1.94 a	2.17 b
	Mn ppm			
1	165 a	182 a	207 a	232 a
2	157 a	179 a	205 a	240 a
3	162 a	195 a	214 a	234 a
	Zn ppm			
1	36.3 a	33.3 a	25.8 a	21.0 a
2	38.5 a	37.0 a	23.3 a	22.0 a
3	36.3 a	36.0 a	24.8 a	34.5 a
	NO_3 ppm			
1	27125 a	24125 a	20900 a	13650 a
2	26375 a	24375 a	21450 a	14925 a
3	27875 a	25250 a	21300 a	14250 a

[1]Column means followed by the same letters are not significantly different as determined by the Least Significant Different Test (.05).

Table 11. Influence of Vorlex, foliar nutrient applications and potato varieties on the root-lesion nematode.

Treatment	Pratylenchus penetrans: Pi/100 cm^3 Soil (5/1/84)	Pm (8/7/84): 100 cm^3 Soil	Pm (8/7/84): 1.0 g Root	Pm (8/7/84): Total	P_f (9/20/84)
Superior					
Vorlex					
N-P-K	22 a	43 a	69 a	112 a	73 a
N	41 a	47 a	48 a	95 a	52 a
Check	18 a	29 a	42 a	71 a	45 a
No Vorlex					
N-P-K	25 a	50 a	61 a	111 a	50 a
N	32 a	42 a	87 a	129 a	68 a
Check	38 a	39 a	98 a	137 a	62 a
Atlantic					
Vorlex					
N-P-K	23 a	43 a	68 a	111 a	62 a
N	29 a	38 a	79 a	117 a	53 a
Check	28 a	40 a	59 a	99 a	79 a
No Vorlex					
N-P-K	22 a	37 a	59 a	96 a	47 a
N	36 a	50 a	69 a	96 a	61 a
Check	40 a	53 a	65 a	120 a	61 a

Table 12. Influence of Vorlex, foliar nutrient applications and potato varieties on the root-lesion nematode.

Treatment	Pratylenchus penetrans: Pi/100 cm^3 Soil (5/1/84)	Pm (8/7/84): 100 cm^3 Soil	Pm (8/7/84): 1.0 g Root	Pm (8/7/84): Total	P_f (9/20/84)
Variety					
Superior	29 a	42 a	68 a	110 a	58 a
Atlantic	30 a	44 a	67 a	107 a	61 a
Fumigant					
Vorlex	27 a	40 a	61 a	101 a	61 a
No Vorlex	32 a	46 a	74 a	120 b	58 a
Foliar Fertilizer					
N-P-K	23 a	43 a	64 a	107 a	58 a
N	35 a	34 a	71 a	105 a	59 a
Check	31 a	40 a	51 a	91 b	62 a

EFFECT OF FIELD PRODUCTION TREATMENTS, PRESTORAGE HANDLING, CHEMICAL AND MECHANICAL TREATMENTS AND STORAGE ENVIRONMENTS OF POTATOES OUT OF EXTENDED STORAGE

B.F. Cargill, R.L. Ledebuhr, K.C. Price, T.D. Forbush and H.S. Potter
Department of Agricultural Engineering and Botany and Plant Pathology

INTRODUCTION

The following three reports contain the results of three potato storage projects that were partially funded by the Michigan Potato Industry Commission. All the potatoes in the projects were evaluated as follows:

Weight loss: All bagged samples were weighed at harvest; after two weeks suberization and at market quality evaluation dates. The weight loss during storage is represented by a percent using the following equation:

$$\text{Weight Loss (\%)} = \frac{Wi - We}{Wi} \times 100$$

Wi = harvest weight
We = evaluation weight

The weight loss factor (WLF) is the weight loss percent per day and is found by:

$$WLF = \frac{\text{weight loss (\%)}}{\text{number of days in storage}}$$

This factor is an important "marketing tool" for the grower. The WLF can be used to help the grower determine the economics of when to market potatoes based only on the loss of weight during storage. Other factors such as loss in quality, market price, and storage operation costs influence when to market potatoes.

Market quality: Market quality evaluations involved removing the respective bagged samples from storage, examining each individual tuber, and classifying them as follows:

A. Marketable

B. Non-marketable

1. 0 to 5.0% dry rot
2. 5.1% - 10% dry rot
3. 10.1% - 25% dry rot
4. over 25% dry rot
5. 0-5% soft rot
6. 5.1% - 10% soft rot
7. 10.1% - 25% soft rot
8. over 25% soft rot
9. non-storage related problems and defects (scab, insects, nemotodes, etc.)

After potato classification, the non-marketable potatoes were counted and weighed.

Market quality is a percentage of the total sample and is determined by two methods:

1. By number of tubers:

$$\text{Market quality (\%)} = \frac{Mn}{Tn} \times 100$$

Mn = number of marketable potatoes in each sample
Tn = total number of potatoes in each sample

2. By weight of tubers:

$$\text{Market quality (\%)} = \frac{Mw}{Tw} \times 100$$

Mw = weight of marketable potatoes in each sample
Tw = total weight of each sample

Chip color: Potatoes for chip color evaluation were taken at each market quality evaluation period. Potato samples were fried in vegetable oil at 365°F for 105 - 135 seconds. Samples that did not get a 60 or higher on the Agtron index reading were reconditioned by increasing the storage temperature 5°F/week. Chip color evaluations were made weekly during reconditioning until the desired 60 Agtron was reached. Storage temperatures were never elevated above 60°F.

EFFECT OF FIELD PRODUCTION TREATMENTS ON THE MARKET QUALITY OF POTATOES OUT OF EXTENDED STORAGE (1983 MSU INTEGRATED PROJECT - STORAGE PHASE)

INTRODUCTION

This report contains data on the effects of various field production treatments on the quality of MSU grown Atlantic potatoes out of extended storage.

PROCEDURE

Potato Samples

For the storage phase of the 1983 integrated project, Atlantic potatoes were grown under controlled conditions at the Michigan State University Potato Research Farm at Entrican, Michigan. These potatoes were harvested with the one-row MSU research plot harvester on September 27, 1983.

Treatments

Four field production treatments were used in this phase of the integrated potato project: 1) check, 2) Temik, 3) Temik and Vorlex applied with a broadcast spreader and 4) Temik and Vorlex applied per row. Each of the four treatments were planted on both alfalfa and corn crop rotations. Each treatment also received 225 lb/a of nitrogen. See Table 1.

Table 1. Field production treatments for the Atlantic potatoes used in the storage phase of the 1983 integrated project.

Treatment number[1]	Crop rotation	Chemical treatment[2]
5A	Alfalfa	Check
6A	Alfalfa	Temik
7A	Alfalfa	Temik & Vorlex - broadcast
8A	Alfalfa	Temik & Vorlex - row
5C	Corn	Check
6C	Corn	Temik
7C	Corn	Temik & Vorlex - broadcast
8C	Corn	Temik & Vorlex - row

[1]For a detailed discussion of the field production treatments used in this study refer to the 1984 MSU Montcalm Potato Research Report
[2]All treatments received 225 lbs/a of nitrogen

Storage Environment

After harvest all potato samples were bagged, tagged and placed into controlled environment cubicles on the MSU campus. The potatoes were suberized at 60°F and 95% r.h. for one week and 55°F and 95% r.h. for a second week. Following suberization the potatoes were dropped in temperature 5°F/wk until the desired storage environments of 40°, 45°, 50°F, and 95% r.h. was reached.

RESULTS AND DISCUSSION

Weight Loss

Tables 2 - 4 show the weight loss data for the Atlantic potatoes for the storage phase of the 1985 integrated project.

A preliminary statistical analysis on the data complied in Tables 2 - 4 indicates that there is no significant differences between the weight losses of various field treatments. However, temperature effects weight loss during the 194 day storage duration. There is a 5.1% weight loss difference between the 40° and 50°F storage temperatures. Reduced respiration of tubers at the lower storage temperature may effect weight loss.

Table 2. Weight loss percentage for Atlantic potatoes of the 1983 integrated project stored at 40° and 95% r.h.

Treatment[1] number	15 Weight loss	15 WLF	86 Weight loss	86 WLF	194 Weight loss	194 WLF
	Days in storage					
5A	1.9	.126	4.0	.047	7.7	.040
5C	1.9	.126	4.9	.057	8.1	.042
Avg.	1.9	.126	4.5	.052	7.9	.047
6A	3.0	.200	5.0	.058	9.1	.047
6C	2.0	.133	5.1	.059	7.8	.040
Avg.	2.5	.167	5.1	.059	8.5	.044
7A	2.4	.180	6.3	.073	9.1	.047
7C	2.6	.173	5.3	.062	8.8	.045
Avg.	2.5	.167	5.8	.067	8.9	.046
8A	2.6	.173	5.2	.061	8.7	.045
8C	2.3	.153	5.0	.058	8.1	.042
Avg.	2.5	.167	5.1	.059	8.4	.043
Total Ave.	2.3	.157	5.1	.059	8.4	.043

[1]See table 1 for a detailed description of the field treatments

Table 3. Weight loss percentage for Atlantic potatoes of the 1983 integrated project stored at 45°F and 95% r.h.

Treatment[1] number	15 Weight loss	15 WLF	86 Weight loss	86 WLF	194 Weight loss	194 WLF
	Days in storage					
5A	1.2	.080	3.1	.036	9.9	.051
5C	1.7	.113	3.7	.043	11.3	.058
Avg.	1.6	.107	3.4	.040	10.6	.055
6A	2.2	.147	4.4	.051	10.6	.055
6C	2.1	.140	4.1	.048	10.0	.052
Avg.	2.2	.147	4.3	.050	10.3	.053
7A	1.7	.113	4.2	.049	10.6	.055
7C	2.0	.133	4.1	.048	10.9	.056
Avg.	1.9	.127	4.2	.049	10.8	.056
8A	1.9	.127	3.6	.042	11.0	.057
8C	2.2	.147	4.5	.052	9.8	.050
Avg.	2.1	.140	4.1	.048	10.4	.054
Total Ave.	1.9	.127	4.0	.046	10.5	.054

[1]See Table 1 for a detailed description of the field treatments

Table 4. Weight loss percentage for Atlantic potatoes of the 1983 integrated project stored at 50°F and 95% r.h.

Treatment[1] number	15 Days in storage: Weight loss	WLF	86 Days in storage: Weight loss	WLF	194 Days in storage: Weight loss	WLF
5A	1.9	.127	3.9	.045	12.2	.063
5C	2.0	.133	3.6	.042	13.1	.068
Avg.	2.0	.133	3.8	.044	12.7	.066
6A	2.7	.180	5.3	.062	14.8	.076
6C	2.5	.167	5.0	.058	14.3	.074
Avg.	2.6	.273	5.2	.061	14.6	.075
7A	1.5	.100	4.7	.055	13.5	.070
7C	2.7	.180	3.6	.042	14.4	.074
Avg.	2.1	.140	4.2	.049	14.0	.072
8A	2.4	.160	4.9	.057	14.5	.075
8C	2.5	.167	4.6	.053	10.7	.055
Avg.	2.5	.167	4.8	.056	12.6	.065
Avg.	2.3	.153	4.5	.052	13.5	.070

[1]See Table 1 for a detailed description of the field treatments

Market Quality

The market quality data (% by weight) of the Atlantic potatoes of the 1983 integrated project are shown in Table 5.

A preliminary statistical analysis on the market quality data compiled into Table 5 suggests that the different field production treatments used in the 1983 integrated project have no significant affect on market quality of potatoes out of extended storage.

However, there is a slightly significant difference (5.7%) between the 40°F and 50°F storage temperatures at the 194 day storage duration.

Table 5. Market quality (% by weight) of MSU grown Atlantic potatoes stored at 40°, 45°, and 50°F and 95% r.h. for 86 and 194 days.

Treatment[1] number	Days in storage 86 40°	45°	50°	194 40°	45°	50°
5A	98.7	97.3	97.8	99.2	96.2	94.9
5C	95.8	97.6	99.5	97.6	95.2	92.0
Avg.	97.3	97.5	98.7	94.8	95.7	93.5
6A	96.0	96.3	95.3	96.8	95.0	92.4
6C	95.5	95.1	97.5	99.1	95.6	90.0
Avg.	95.8	95.7	96.4	98.0	95.3	91.2
7A	94.1	96.7	96.3	98.5	91.7	90.7
7C	97.4	95.7	94.7	98.9	94.9	89.9
Avg.	95.8	96.2	95.5	98.7	93.3	90.3
8A	94.2	96.8	95.1	99.5	93.8	90.7
8C	97.8	93.3	96.3	97.3	95.6	93.3
Avg.	96.0	95.1	95.7	98.4	94.7	92.0
Avg.	96.2	96.1	96.6	97.5	94.8	91.8

[1]See Table 1 for a detailed description of the field treatments

Chip Color

Tables 6 - 7 present the chip color data for the 1983 Atlantic potatoes stored in the MSU cubicles.

The 40° and 50°F cubicles had mechanical problems several times during their storage duration and storage temperatures were found to be ±5°F than the desired storage temperature and thus the reconditioning time for these potatoes is much greater than those stored at 45°F.

Apart from mechanical problems the data in Table 7 shows that the different field treatments had no affect on chip color quality.

Table 6. Agtron chip color data for 1983 Atlantic potatoes stored at 40°, 45° and 50°F for 86 days.

Original Storage temperature[1] F	After 86 days storage	Reconditioning Time 1 week	2 weeks	3 weeks
40°	50	50-55	55-60	60+
45°	60+	-	-	-
50°	50	55	55-60	60+

Table 7. Agtron chip color for the eight different field treatments of the 1983 Atlantic potatoes stored at 40°, 45°, and 50°F for 194 days.

Original storage temp. °F and treatment[1] number	After 194 days storage	Reconditioning time 1 week	2 weeks	3 weeks[2]
40°F				
1	50	50-55	55	55-60
4	45-50	50-55	55	55-60
7	50	50	50-55	55-60
45°F				
1	60+	-	-	-
2	60+	-	-	-
3	60+	-	-	-
4	60+	-	-	-
5	60+	-	-	-
6	60+	-	-	-
7	60+	-	-	-
8	60+	-	-	-
50°F				
1	50	50-55	55	55-60
4	50	50-55	55	55-60
7	50	50-55	55	55-60

[1]See Table 1 for a detailed description of the field treatments.
[2]All potatoes had an agtron chip color rating of 60+ after 4 weeks of reconditioning.

CONCLUSIONS

1. Field production treatments of Temik, a broadcast application of Temik and Vorlex, a row application of Temik and Vorlex and alfalfa and corn crop rotations have no significant affect on weight loss of potatoes out of extended storage. However, the weight loss of the potatoes in the 40°F storage environment is slightly less (5.1%) than those stored at 50°F for the 194 day storage duration.

2. Field production treatments of Temik, a broadcast application of Temik and Vorlex, and alfalfa and corn crop rotations have no significant affect on the market quality of potatoes out of storage. However, the market quality of the potatoes in the 40°F storage environment have slightly higher market quality (5.7%) than those stored at 50°F for the 194 day storage duration.

3. Field production treatments used in the 1983 integrated project were found to have no significant affect on chip color of potatoes out of extended storage. However, large variations (above ±5°F) in storage temperature were found to greatly influence the chip color reconditioning time.

QUALITY/MARKETABILITY OF POTATOES OUT OF EXTENDED STORAGE DUE TO PRESTORAGE HANDLING, CHEMICAL AND MECHANICAL TREATMENTS AND STORAGE ENVIRONMENTS

INTRODUCTION

The following report contains the results of the effect of prestorage mechanical and chemical treatments on potato market quality out of extended storage.

PROCEDURE

Potato Samples

The 1983 Atlantic potatoes were harvested from the integrated plot at Michigan State University's Potato Research Farm at Entrican, Michigan using the one row plot harvester.

Equipment

The Lockwood bin piler at Sandyland Farms was used for all potato treatments; chemical and mechanical. For chemical treating the Microtec, an application system supplied by Micron, Inc., Houston, Texas, was used. The significant components of this system being a diaphragm pump and a Micromax nozzle.

Treatments

Four prestorage treatments were used: 1) a check sample collected right off the plot harvester, 2) a second check sample collected after the potatoes had run over the bin piler, 3) chemical treating of the potatoes on the bin piler using .42 oz/ton Mertect 340F, .64 oz/ton chlorine (6% active ingredient), and 1.94 oz/ton of water for a 3 oz/ton solution rate, and 4) chemical treatment using the same methods and solution in #3 except using 1.94 oz/ton of soybean oil as a carrier instead of water. See Table 1.

Table 1. Chemical and mechanical treatments of the Atlantic potatoes for the 1983 storage phase.

Treatment	Mechanical	Chemical
1	Plot harvester	Check
2	Plot harvester and bin piler	Check
3	Plot harvester and bin piler	.42 oz/ton Mertec 340F, .64 oz/ton chlorine, 1.94 oz./ton H_2O
4	Plot harvester and bin piler	.42 oz/ton Mertect 340F, .64 oz/ton chlorine, 1.94 oz/ton soybean oil

Storage Environment

Immediately after treatment, bagging, tagging, etc. potato samples from treatments 1 - 4 were placed into cubicles on the MSU campus and samples from treatments 2 - 4 were placed into bulk storage at Sandyland Farms.

The cubicles stored potatoes were suberized for two weeks; one week at 60°F and 95% r.h,. and one week at 55°F and 95% r.h. After suberization the potatoes were lowered 5°F/week until the desired storage environments of 45° and 50°F and 95% r.h. were obtained.

The potato samples in the bulk storage had 24 hour ventilation and were dropped in temperature approximately 1°F every 2 days until the desired storage temperature of 45°F was reached.

Residue Evaluation

Ten pounds of randomly selected tubers were removed from each treatment for evaluation of TBZ residue. The potato assay for thiabendazole was performed from opposite quarters of each tuber. This chemical evaluation was performed in the chemical laboratories of Merck and Company, Rahway, New Jersey.

RESULTS AND DISCUSSION

Weight Loss

The weight loss for the 1983 Atlantic potatoes stored at 45° and 50°F at the MSU cubicles and at Sandyland Farms is shown in Table 2.

Table 2. Weight loss for the 1983 treated Atlantic potatoes stored at 45° and 50°F and 95% r.h. at the MSU cubicles and Sandyland Farms.

Treatment[2]	Storage duration[1] and storage temperature					
	83 days		125 days		184 days	
	45°F	50°F	45°F	50°F	45°F	50°F
1	3.9	4.8	-	-	-	-
2	5.0	5.6	5.7	-	9.5	12.7
3	4.9	6.3	5.9	-	10.6	12.3
4	4.5	5.4	5.7	-	8.8	11.0

[1]Potatoes were stored in the MSU cubicles for the 83 and 184 day storage duration. Potatoes at the 125 day storage duration were stored at Sandyland Farms.

[2]See Table 1 for a detailed description of the treatments

A preliminary statistical analysis shows that there is a slightly significant difference (at the 25% level) in weight loss for treatment 4 for the 45°F storage temperature at the 125 and 184 day storage duration. This suggests the possibility that the potatoes treated with the 3 oz/ton solution with soybean oil carrier may have a slightly lower weight loss at longer storage durations.

The preliminary statistical analysis also showed a slightly significant difference (at the 25% level) between treatment 1 and treatments 2 - 4 at the 83 day storage duration.

Treatment 1 is a check from the MSU plot harvester and it would be expected to have a slightly lower weight loss than treatments 2 - 4 which due to more mechanical handling had a lower bruise-free percentage than treatment 1.

Market Quality

The market quality of the treated 1983 Atlantic potatoes stored at 45° and 50°F at the MSU cubicles and at Sandyland Farms is presented in Table 3 and Figures 1 and 2.

Table 3. Market quality (% marketable weight) and deposition for the 1983 treated Atlantic potatoes stored at 45° and 50°F and 95% r.h. at the MSU cubicles and Sandyland Farms.

	Storage duration[1]						Chemical deposition (ppm)
	83 days		125 days		184 days		
Treatment[1]	45°F	50°F	45°F	50°F	45°F	50°F	
1	95.9	96.7	-	-	-	-	-
2	92.0	91.6	92.6	-	89.6	94.3	-
3	93.7	92.2	91.0	-	86.8	91.9	.42 - .45
4	95.0	94.7	89.2	-	94.2	88.7	2.46 -2.50

[1]Potatoes for the 83 and 184 day storage duration were stored at the MSU cubicles. Potatoes for the 125 day storage duration were stored at Sandyland Farms.
[2]See Table 1 for a detailed description of treatments

A preliminary statistical analysis on treatment 1 vs. treatment 2 stored at 45° and 50°F for 83 days shows that there is a significant difference (at the 10% and 2.5% level respectively) in market quality between these treatments. Treatment 1 vs. treatment 2 at the 45°F and 154 day storage duration is significant to the 5% level.

Treatment 1 is a check from the MSU plot harvester and treatment 2 is a check taken after the potatoes had run over the bin piler at Sandyland Farms. Treatment 2 has a lower bruise-free percentage so it is expected that it would have a decrease in market quality due to the increased bruising from mechanical handling.

The statistical analysis also showed that there is a significant difference (at the 25% level) between treatment 2 and treatment 4 at the 45°and 50°F temperatures stored for 83 days. For the 45°F temperature storage at the 184 day storage duration there is a significant difference (at the 10% level) between treatment 2 and treatment 4.

Since the chemical residue of treatment 4 is 2.46 - 2.5 ppm the data would suggest that a significant increase in market quality may occur when chemical deposition reaches or exceeds 2.46 - 2.5 ppm.

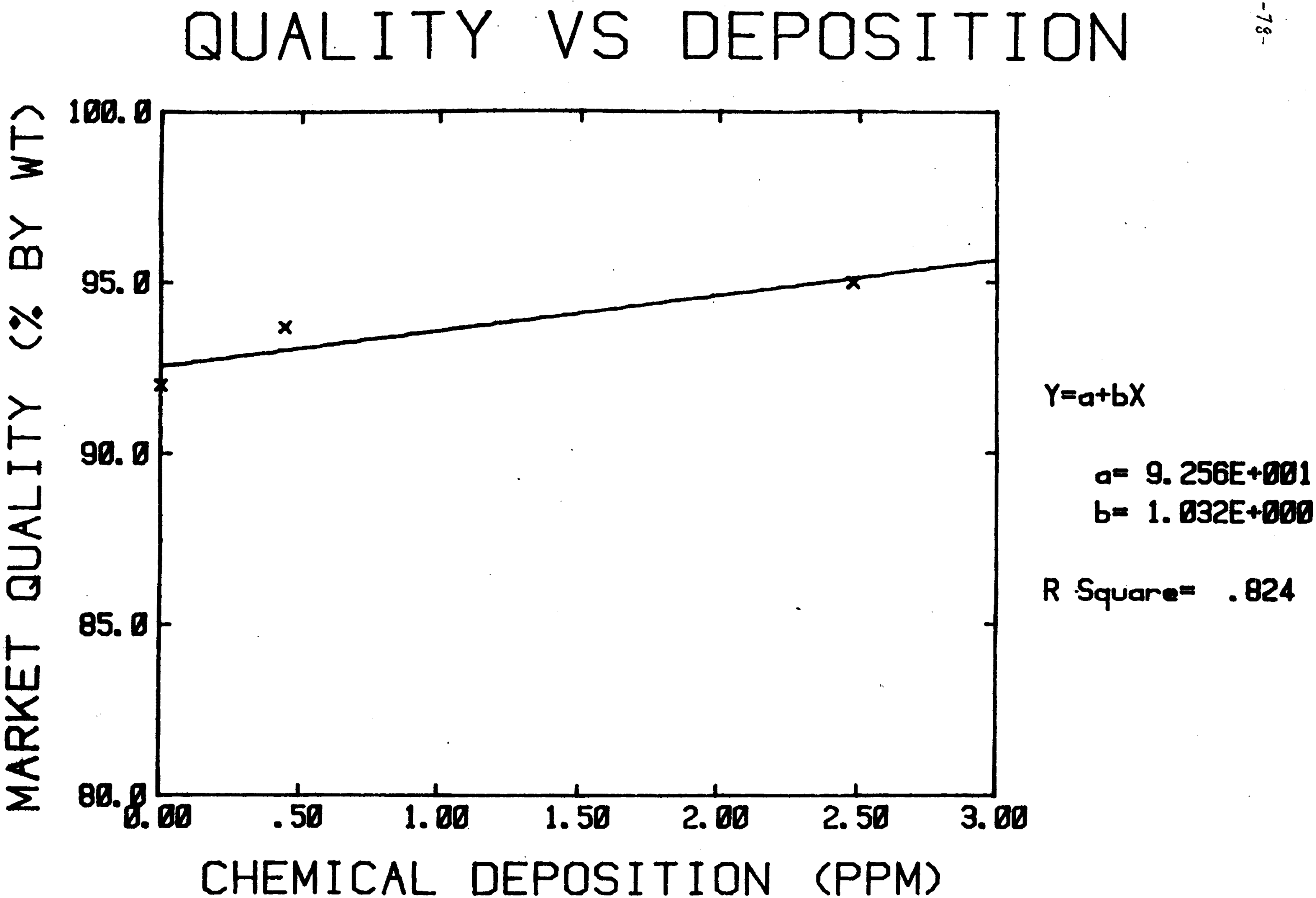


Fig. 1. Market Quality vs Chemical (TBZ) Deposition for the 1985 Atlantic Potatoes Stored at 45°F and 95% r.h. for 83 days.

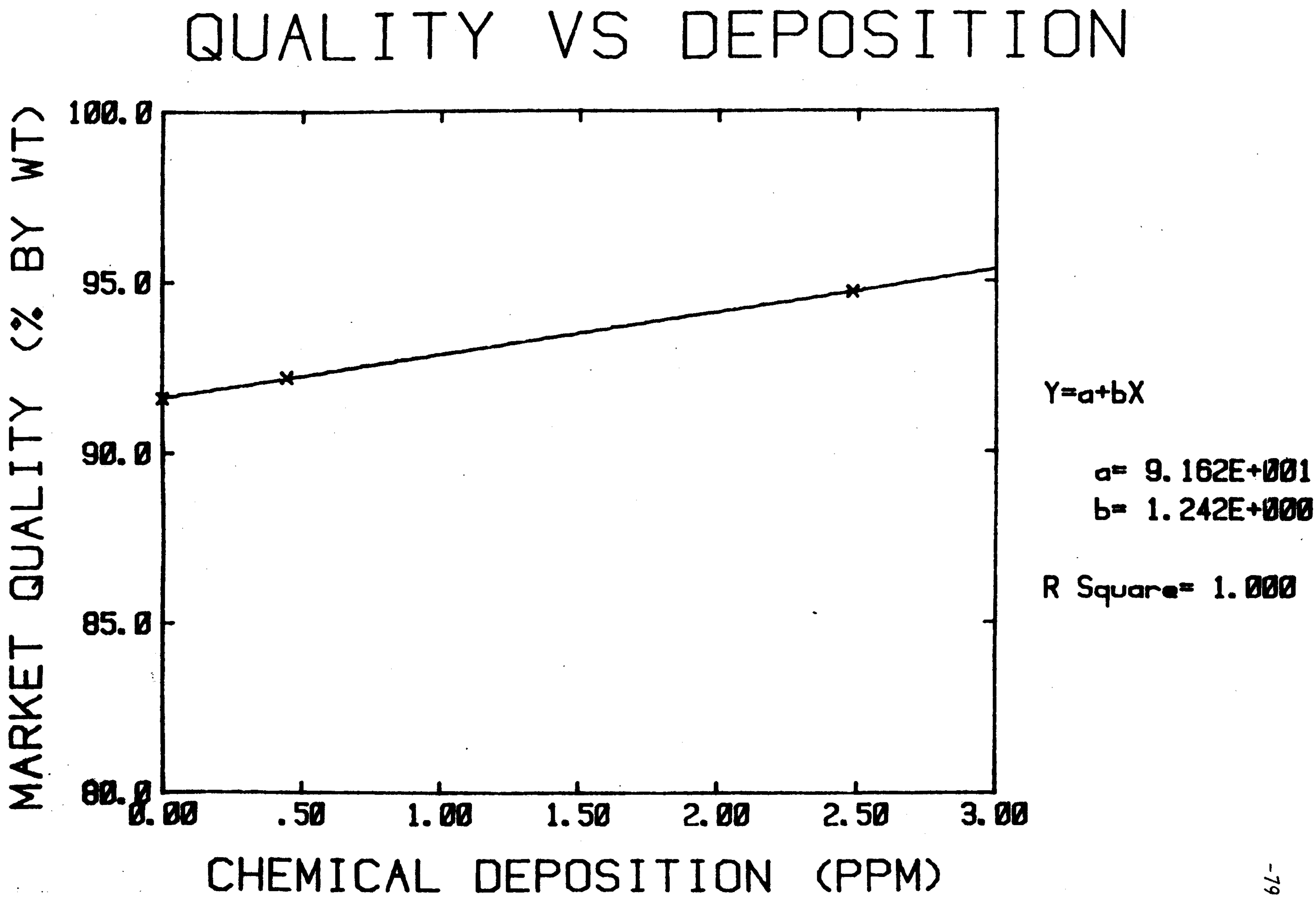


Fig. 2. Market Quality vs Chemical (TBZ) Deposition for the 1983 Atlantic Potatoes Stored at 50°F and 95% r.h. for 83 days.

Chip Color

Table 4 presents the chip color data for the 1983 Atlantic potatoes stored at Sandyland Farms, Howard City, MI for 125 days.

This data shows that chemical treatments have no affect on the quality of chip color out of storage. See Table 4.

Table 4. Chip color data for potatoes stored at 45°F at Sandyland Farm for 125 days.

Treatment[1]	125 days storage	Reconditioning time 1 week	2 weeks	3 weeks
2	60+	-	-	-
3	60+	-	-	-
4	60+	-	-	-

[1]See Table 1 for a detailed description of the treatments

CONCLUSIONS

1. Reducing bruise levels will reduce weight loss and increase market quality of potatoes out of storage.

2. Prestorage chemical treatments have no significant affect on weight loss or chip color of potatoes out of storage.

3. Low volume prestorage chemical treatments with a deposition of 2.46 - 2.5 or more show a significant increase in market quality over non-treated equivalently handled potatoes.

INFLUENCE OF LOW VOLUME PRESTORAGE CHEMICAL TREATMENT ON THE MARKET QUALITY OF COMMERCIALLY PRODUCED POTATOES

INTRODUCTION

This phase of the storage project reports on the affects of low volume prestorage chemical treatments on potatoes at the commercial level. All potato production, harvest, handling and chemical treating was performed at Sackett Ranch, Inc., Stanton, Michigan.

PROCEDURE

Chemical Treatment

Two treatments were used for the commercial treatment phase of the storage project: 1) a check with no chemical applied and 2) a chemical treatment with a 3 oz/ton solution consisting of .42 oz Mertect 340F, .64 oz chlorine and 1.94 oz water. See Table 1.

Table 1. Prestorage chemical treatments used on commercially produced and handled potatoes.

Treatment	Chemical solution
1	Check
2	3 oz/ton solution consisting of .42 oz Mertect 340F, .64 oz chlorine and 1.94 oz water

Storage

Immediately after treating, samples from the two treatments were weighed, bagged, tagged and put into the MSU cubicles. The potatoes were suberized for one week at 60°F and 95% r.h. and 95% r.h. and a second week at 55°F and 95% r.h. From there the storage temperature was lowered 5°F/week until the desired storage environment of 45°F and 95% r.h. was reached.

RESULTS AND DISCUSSION

Table 2 presents the data for the low volume commercial prestorage chemical treatment at Sackett Ranch, Inc., Stanton, Michigan.

Table 2. Market quality (% by weight) for non-treated vs low volume prestorage chemically treated potatoes.

Treatment[1]	Market quality (% by weight)
Check	81.3
Treated	92.7

[1]See Table 1 for a detailed description of treatments.

A statistical analysis shows that there is a very significant difference, (11.4%), (at the 1% level) between the treated and non-treated potatoes. The market quality percentage of the check samples is influenced less than 2% by bacterial soft rot. Treated samples had no bacterial soft rot.

An 11.4% increase could mean a gross savings of approximately $10,260.00 for a 15,000 cwt storage bin (at $6/cwt).

CONCLUSIONS

1. The 3 oz/ton solution consisting of .42 oz Mertect 340F, .64 oz chlorine and 1.94 oz of water used in the prestorage treatment of potatoes can significantly increase the market quality of potatoes out of extended storage.

CORN HYBRIDS, PLANT POPULATIONS AND IRRIGATION

E.C. Rossman and Keith Dysinger
Department of Crop and Soil Sciences

Performance data for 62 commercial corn hybrids evaluated in 1984 with and without irrigation are presented in Table 1 along with two- and three-year averages for those tested in 1983 and 1982.

One inch of water was applied through a sprinkler system on each of 8 dates (July 2, 10, 19, 27, August 8, 17, 25 and September 4) for a total of 8 inches of irrigation. Rainfall was: April = 2.78", May = 5.14", June = 2.93", July = 3.76", August = 1.97", September = 3.90" and October = 2.88".

Irrigated yields averaged 83.7 bushels more than nonirrigated - 152.3 vs. 68.6, an increase of 122%. Hybrids ranged from 114.4 to 186.5 with irrigation and 43.2 to 87.2 without irrigation. Hybrids significantly better than average yield (arranged in order of increasing grain moisture content at harvest) are listed below. Seventeen of the twenty hybrids were in the highest yielding group for both irrigated and nonirrigated plots.

Irrigated	Not Irrigated
Pioneer 3901	Pioneer 3901
Funk G-4256	Funk G-4256
Super Crost 2288	Super Crost 2288
Stauffer Seeds S4402	Stauffer Seeds S4402
Pioneer 3744	Pioneer 3744
Super Crost 1940	Great Lakes GL-466
Great Lakes GL-466	Pioneer 3737
Pioneer 3737	Jacques 5400
Jacques 5400	Funk 3012X
Funk 3012X	P-A-G SX193
P-A-G SX193	P-A-G SX195
P-A-G SX195	DeKalb-Pfizer DK484
Funk G-4342	Funk G-4342
Andersons PSX-100	Golden Harvest H-2448
Golden Harvest H-2448	DeKalb-Pfizer T1000
DeKalb-Pfizer T1000	MFI 1812
Payco 872	Great Lakes GL-516
MFI 1812	MFI 1776
MFI 1776	Golden Harvest H-2480
Golden Harvest H-2480	

The correlation of irrigated with nonirrigated yields was highly significant, .773, indicating that hybrids tended to respond alike in both situations. During the 17-year period, 1968-1984, the correlations have ranged between .7 and .9 except for 1976 when it was .490. All correlations have been highly significant.

Average, highest and lowest yields for corn hybrids irrigated and not irrigated for the 17-year, 1968-1984, are given in Table 2. The average yielding hybrids have yielded 49 more bushels when irrigated. The highest yielding hybrids have responded with 63 bushels added yield while the lowest yielding hybrids have given only 33 bushels added yield when irrigated. These results demonstrate the importance of choosing high yielding hybrids to maximize returns from irrigation with little, if any, additional cost.

There was twice as much stalk lodging (2.7 vs. 5.3%) on nonirrigated plots. This agrees with most (but not all) of the previous years when there has been less lodging on the irrigated plots. Generally, stressed weaker plants on nonirrigated plots have been more susceptible to lodging.

Plant Population x Hybrids

Five adapted hybrids at four plant populations irrigated and not irrigated have been grown in each of 17 years, 1968-1984, Table 3. Over the 17-year period, a harvest plant population of 23,300 has given the highest average yield (167 bushels per acre) when irrigated while 19,290 has given the highest yield (106 bushels) without irrigation. The 23,300 population has given the highest yield in 14 out of 17 years (1973, 1979 and 1981 being the exceptions). The irrigated yields in 1984 were 160, 168, 179 and 176 for harvest populations of 15,300, 19,290, 23,300 and 27,460, respectively. The 17-year average increase due to irrigation is 69 bushels per acre at the 23,300 population. Nonirrigated yields were 76, 78, 71 and 63 for the same four populations in 1984.

Stalk lodging has increased with increasing plant population. In 1984, there was 2-5 times more lodging at 27,460 than there was at 15,300. Moisture content of grain at harvest has averaged 1-2% higher for the two higher populations.

TABLE 1 NORTH CENTRAL MICHIGAN ZONE 3

MONTCALM COUNTY TRIAL-IRRIGATED VS NOT IRRIGATED

ONE, TWO, THREE YEAR AVERAGES - 1984, 1983, 1982

HYBRID (BRAND-VARIETY)	% MOISTURE 1984	% MOISTURE 2 YR	% MOISTURE 3 YR	BUSHELS PER ACRE 1984 IRR	BUSHELS PER ACRE 1984 NON IRR	BUSHELS PER ACRE 2 YR IRR	BUSHELS PER ACRE 2 YR NON IRR	BUSHELS PER ACRE 3 YR IRR	BUSHELS PER ACRE 3 YR NON IRR	% STALK LODGING 1984 IRR	% STALK LODGING 1984 NON IRR	% STALK LODGING 2 YR IRR	% STALK LODGING 2 YR NON IRR	% STALK LODGING 3 YR IRR	% STALK LODGING 3 YR NON IRR
PRO-SEED HYLAND HL-2414	23.3	--	--	115.0	43.2	--	--	--	--	2.6	9.2	--	--	--	--
FUNK 2011X	23.7	--	--	156.5	71.4	--	--	--	--	0.8	3.6	--	--	--	--
KING K2203	23.9	--	--	146.3	63.1	--	--	--	--	1.4	3.7	--	--	--	--
KING K2204	23.9	--	--	146.7	57.5	--	--	--	--	2.1	4.2	--	--	--	--
PRO-SEED HYLAND LG18	24.1	--	--	152.1	69.8	--	--	--	--	3.4	8.5	--	--	--	--
STAUFFER SEEDS S2202	24.3	--	--	114.4	50.2	--	--	--	--	5.3	11.5	--	--	--	--
STANTON SX90	24.4	24	23	139.7	58.1	135	56	135	74	5.6	3.9	4	4	3	5
SUPER CROST 1621	24.7	--	--	153.4	61.7	--	--	--	--	2.2	2.5	--	--	--	--
PRO-SEED HYLAND HL-2444	24.7	--	--	118.1	49.8	--	--	--	--	2.5	5.7	--	--	--	--
FUNK 1011X	24.8	--	--	139.5	52.3	--	--	--	--	1.4	8.4	--	--	--	--
JACQUES EXP.3091	24.8	--	--	135.9	51.7	--	--	--	--	7.4	12.5	--	--	--	--
*+PIONEER 3901	24.9	25	24	174.7	79.2	173	77	169	93	0.7	4.3	4	9	4	8
GREAT LAKES GL-422	25.2	25	24	158.0	67.4	152	67	155	86	0.9	1.6	3	5	4	7
ANDERSON PSX93	25.2	25	--	128.8	53.3	135	50	--	--	0.8	4.6	3	5	--	--
GREAT LAKES GL-487	25.3	--	--	157.4	64.2	--	--	--	--	2.2	6.1	--	--	--	--
*+FUNK G-4256	25.4	--	--	172.2	78.3	--	--	--	--	1.5	4.1	--	--	--	--
LAND O"LAKES LOL-1096	25.4	--	--	123.3	60.2	--	--	--	--	1.5	0.0	--	--	--	--
DAIRYLAND DX1097	25.5	--	--	131.7	56.4	--	--	--	--	5.1	4.6	--	--	--	--
PAYCO SX620	25.5	26	--	138.9	58.0	145	59	--	--	1.7	7.0	6	10	--	--
*+SUPER CROST 2288	25.8	--	--	171.2	81.6	--	--	--	--	5.0	7.5	--	--	--	--
P-A-G SX180	25.8	--	--	152.2	67.8	--	--	--	--	4.3	8.5	--	--	--	--
*+STAUFFER SEEDS S4402	26.0	--	--	175.2	80.0	--	--	--	--	5.3	10.9	--	--	--	--
STANTON SX95	26.0	26	25	124.2	60.8	141	62	150	83	0.9	4.5	3	7	3	10
*+PIONEER 3744	26.1	27	25	168.0	80.0	176	85	171	99	2.2	4.8	4	3	3	5
DAIRYLAND DX1003	26.1	27	25	161.7	69.4	173	75	167	88	3.6	4.5	7	6	5	7
DEKALB-PFIZER DK447	26.2	--	--	142.0	64.7	--	--	--	--	4.8	6.3	--	--	--	--
STAUFFER SEEDS S3306	26.3	--	--	156.4	74.3	--	--	--	--	0.8	1.5	--	--	--	--
PRO-SEED HYLAND HL-2454	26.4	--	--	139.3	67.0	--	--	--	--	1.6	2.2	--	--	--	--
* SUPER CROST 1940	26.5	27	--	173.0	73.0	170	72	--	--	2.1	9.8	5	8	--	--
PRIDE 4422	26.5	--	--	151.6	66.2	--	--	--	--	1.6	6.7	--	--	--	--
*+GREAT LAKES GL-466	26.6	28	26	178.0	79.4	166	76	164	90	4.3	8.1	9	9	7	8
KING K4422	26.6	27	--	151.4	60.1	167	71	--	--	1.4	5.4	4	5	--	--
*+PIONEER 3737	26.7	--	--	186.3	87.2	--	--	--	--	2.9	7.0	--	--	--	--
*+JACQUES 5400	26.8	--	--	170.6	77.6	--	--	--	--	2.8	4.4	--	--	--	--
NORTHRUP KING PX9902	26.8	--	--	127.9	49.0	--	--	--	--	3.0	4.8	--	--	--	--
P-A-G SX175	26.8	--	--	165.2	75.3	--	--	--	--	3.1	6.2	--	--	--	--
PIONEER 3747	26.8	27	--	138.4	61.1	148	69	--	--	3.5	3.0	6	4	--	--
DEKALB-PFIZER DK505	26.9	--	--	147.7	66.9	--	--	--	--	3.0	2.6	--	--	--	--
GARNO S-92X	26.9	--	--	147.8	66.1	--	--	--	--	3.0	12.1	--	--	--	--
*+FUNK 3012X	27.0	--	--	186.5	84.0	--	--	--	--	2.9	4.1	--	--	--	--

TABLE 1 (CONTINUED) NORTH CENTRAL MICHIGAN ZONE 3

MONTCALM COUNTY TRIAL-IRRIGATED VS NOT IRRIGATED

ONE, TWO, THREE YEAR AVERAGES - 1984, 1983, 1982

HYBRID (BRAND-VARIETY)	% MOISTURE 1984	% MOISTURE 2 YR	% MOISTURE 3 YR	BUSHELS PER ACRE 1984 IRR	BUSHELS PER ACRE 1984 NON IRR	BUSHELS PER ACRE 2 YR IRR	BUSHELS PER ACRE 2 YR NON IRR	BUSHELS PER ACRE 3 YR IRR	BUSHELS PER ACRE 3 YR NON IRR	% STALK LODGING 1984 IRR	% STALK LODGING 1984 NON IRR	% STALK LODGING 2 YR IRR	% STALK LODGING 2 YR NON IRR	% STALK LODGING 3 YR IRR	% STALK LODGING 3 YR NON IRR
DAIRYLAND DX1096	27.0	26	25	132.6	51.8	138	58	144	77	0.0	2.9	2	6	4	7
GREAT LAKES GL-522	27.2	28	27	165.7	74.7	171	79	173	97	0.8	2.2	5	3	3	5
*+P-A-G SX193	27.2	28	--	169.0	77.0	149	70	--	--	2.8	2.8	11	7	--	--
DAIRYLAND DX1001	27.2	--	--	131.9	62.3	--	--	--	--	3.7	5.7	--	--	--	--
DEKALB-PFIZER EXP348	27.4	--	--	164.6	75.5	--	--	--	--	2.9	5.0	--	--	--	--
*+P-A-G SX195	27.4	--	--	173.7	79.2	--	--	--	--	3.4	5.1	--	--	--	--
STANTON SX100	27.5	27	27	120.4	54.3	136	60	139	80	4.0	3.6	11	6	10	8
PRO-SEED HYLAND LG22	27.6	--	--	134.9	66.7	--	--	--	--	1.7	3.9	--	--	--	--
DEKALB-PFIZER T950	27.7	28	27	155.8	63.4	160	65	150	77	2.9	8.9	5	9	5	10
+DEKALB-PFIZER DK484	27.8	28	--	165.4	77.5	180	80	--	--	3.0	5.8	7	7	--	--
*+FUNK G-4342	27.9	--	--	176.5	80.2	--	--	--	--	3.6	12.6	--	--	--	--
* ANDERSONS PSX-100	28.3	--	--	167.8	73.4	--	--	--	--	2.8	5.8	--	--	--	--
*+GOLDEN HARVEST H-2448	28.4	--	--	171.5	80.6	--	--	--	--	2.4	2.4	--	--	--	--
*+DEKALB-PFIZER T1000	28.6	29	28	177.9	79.4	173	74	171	91	3.6	8.1	7	6	6	7
GOLDEN HARVEST EX638	28.6	--	--	159.2	74.0	--	--	--	--	5.2	4.2	--	--	--	--
FUNK 3026X	29.1	--	--	155.4	68.2	--	--	--	--	2.8	0.7	--	--	--	--
GREAT LAKES GL-510	29.1	--	--	156.3	73.9	--	--	--	--	2.9	8.6	--	--	--	--
* PAYCO SX872	29.4	30	--	169.1	74.7	160	70	--	--	2.2	3.4	6	6	--	--
*+MFI 1812	29.5	31	--	174.0	80.6	173	78	--	--	3.1	5.9	5	9	--	--
+GREAT LAKES GL-516	29.6	--	--	160.0	79.4	--	--	--	--	1.4	3.6	--	--	--	--
*+MFI 1776	30.3	29	--	178.3	76.7	168	74	--	--	2.8	3.8	7	6	--	--
*+GOLDEN HARVEST H-2480	31.6	30	--	176.5	77.8	170	76	--	--	1.4	2.2	6	8	--	--

TABLE 1 (CONTINUED) NORTH CENTRAL MICHIGAN **ZONE 3**

MONTCALM COUNTY TRIAL-IRRIGATED VS NOT IRRIGATED
ONE, TWO, THREE YEAR AVERAGES - 1984, 1983, 1982

HYBRID (BRAND-VARIETY)	% MOISTURE 1984	% MOISTURE 2 YR	% MOISTURE 3 YR	BUSHELS PER ACRE 1984 IRR	BUSHELS PER ACRE 1984 NON IRR	BUSHELS PER ACRE 2 YR IRR	BUSHELS PER ACRE 2 YR NON IRR	BUSHELS PER ACRE 3 YR IRR	BUSHELS PER ACRE 3 YR NON IRR	% STALK LODGING 1984 IRR	% STALK LODGING 1984 NON IRR	% STALK LODGING 2 YR IRR	% STALK LODGING 2 YR NON IRR	% STALK LODGING 3 YR IRR	% STALK LODGING 3 YR NON IRR
AVERAGE	26.7	27	25	152.3	68.6	158	69	157	86	2.7	5.3	6	6	5	7
RANGE	23.3 TO 31.6	24 TO 30	23 TO 28	114.4 TO 186.5	43.2 TO 87.2	135 TO 180	50 TO 85	135 TO 173	74 TO 99	0.0 TO 7.4	0.0 TO 12.6	2 TO 11	3 TO 10	3 TO 10	5 TO 10
LEAST SIGNIFICANT DIFFERENCE	1.8	1.2	0.8	14.8	7.7	10	6	8	5	--	--	--	--	--	--

*SIGNIFICANTLY BETTER THAN AVERAGE YIELD, IRRIGATED, IN 1984
+SIGNIFICANTLY BETTER THAN AVERAGE YIELD, NOT IRRIGATED, IN 1984

	1984	*1983*	*1982*
PLANTED	*May 2*	*May 6*	*May 6*
HARVESTED	*October 27*	*October 24*	*November 3*
SOIL TYPE	*Montcalm-McBride sandy loam*	*Montcalm-McBride sandy loam*	*Montcalm-McBride sandy loam*
PREVIOUS CROP	*Potatoes*	*Potatoes*	*Alfalfa*
POPULATION	*21,000*	*21,400*	*21,000*
ROWS	*30"*	*30"*	*30"*
FERTILIZER	*340-125-125*	*330-125-125*	*342-139-139*
IRRIGATION	*8 inches*	*7 inches*	*4 Inches*
SOIL TEST: ph	*6.6*	*5.8*	*5.6*
p	*555(very high)*	*417(very high)*	*562(very high)*
k	*240(high)*	*202(medium)*	*251(high)*

FARM COOPERATOR: Theron Comden, Montcalm Research Farm, Lakeview

COUNTY EXTENSION DIRECTOR: William Carpenter, Stanton (1984,1983)
James Crosby, Stanton (1982)

Table 2. Average, highest and lowest yields for corn hybrids irrigated and not irrigated for 17 years, 1968-1984.

Year	No. of Hybrids Tested	AVERAGE		HIGHEST		LOWEST	
		Irrigated	Not Irrigated	Irrigated	Not Irrigated	Irrigated	Not Irrigated
1984	62	152	69	187	87	114	43
1983	59	151	66	195	91	96	37
1982	82	146	113	183	139	109	83
1981	90	115	87	141	111	85	62
1980	71	126	114	167	156	74	65
1979	83	109	67	142	92	67	42
1978	73	144	88	186	112	92	61
1977	74	125	73	158	88	89	56
1976	80	156	72	183	93	120	49
1975	75	154	125	207	157	106	80
1974	76	112	103	134	122	65	58
1973	72	114	101	138	120	78	73
1972	72	157	137	206	179	99	91
1971	56	163	28	211	42	91	11
1970	64	144	103	194	128	95	70
1969	63	146	86	185	109	97	56
1968	56	136	96	182	123	92	65
AVERAGE		139	90	177	114	92	59

Table 3. Average yield at four plant populations irrigated and not irrigated for 17 years, 1968-1984.

	15,300		19,290		23,300		27,460	
Year	Irrigated	Not Irrigated	Irrigated	Not Irrigated	Irrigated	Not Irrigated	Irrigated	Not Irrigated
1984	160	76	168	78	179	71	176	63
1983	154	69	170	74	179	66	182	52
1982	150	120	168	131	177	124	176	117
1981	122	93	132	102	130	94	119	86
1980	133	123	146	135	150	131	141	124
1979	123	77	140	87	138	83	131	78
1978	146	92	164	110	175	100	165	94
1977	141	74	152	81	160	70	150	69
1976	153	72	174	84	181	81	161	68
1975	158	136	183	164	196	151	172	146
1974	118	100	130	111	135	98	120	94
1973	108	97	134	116	128	106	108	102
1972	152	132	187	159	191	149	161	144
1971	173	37	189	35	191	20	181	11
1970	122	91	144	112	158	93	151	85
1969	126	91	158	109	173	96	148	86
1968	144	114	169	130	193	107	178	89
AVERAGE	141	95	160	106	167	98	153	92

MONTCALM FARM, 1984

COLORED BEAN BREEDING AND TESTING

M.W. Adams, J.D. Kelly, and J. Taylor

The materials evaluated consisted primarily of kidney beans, both dark and light red, and of cranberry beans (Table 1). In the case of cranberry beans, we are particularly interested in early-maturing bush beans with larger seed than is normal for standard varieties. In the series of lines numbered 422, 423, 424, and 425, we have bush plant type, early maturity (86 days average as compared to 82 for Taylor Cran and 95 for Cran 028), yield equivalent or better than the latter varieties, and seed sizes of 47 to 50 gms/100 seeds as compared to Taylor Cran with 43 and Cran 028 with 38 gms/100 seeds. In addition, these lines carry the I-gene for resistance to common bean mosaic, the same as Cran 028.

Yields were not outstanding in the nursery this year because of the prolonged period without meaningful rainfall. With an LSD of 5.0 cwt, only the bottom 5 entries, all kidney beans, were significantly lower yielding than the top ranking cranberry entries. By and large, the cranberry beans as a group outyielded the kidneys as a group, with a couple of exceptions. The earlier-maturing entries had a slight yield advantage over the later-maturing entries.

In Table 2 are presented yield and other data for a group of dark red kidney selections. Most of the 30 entries derived from a cross of Charlevoix by Montcalm, made to recombine halo blight resistance of Montcalm with the test weight of Charlevoix. Seed density scores (lbs/bu) for this group of entries show a range of values between the 56.2 lbs for Montcalm to the 59.3 lbs for Charlevoix, but unfortunately, the halo blight resistance of Montcalm seems to be genetically linked to the smaller seed size, at least to some degree, and we have not recovered high test weight lines with the halo blight resistance.

Again, average yields are low because of the dry weather. Interestingly, the top line, K83222, and the four lowest yielding lines, K83214, K83212, K83210, and K83223, all derive from the same cross, C49242 x Montcalm, backcrossed to Montcalm, which was made to incorporate the ARE-gene for anthracnose resistance into the dark red class. With an LSD of 2.4 cwt, the top and bottom-ranked lines are significantly different in yield. They also differ significantly in seed size.

Segregating Populations

We had several thousand plants in F_2 generations of crosses involving kidney and cranberry seed types, crosses made to broaden the germplasm base in these seed classes. A large number of attractive single plant selections were obtained from these populations and they will be advanced to F_3 rows in 1985.

TABLE 1.

EXPERIMENT 4215 MONTCALM STANDARD LARGE SEEDED YIELD TRIAL PLANTING DATE 5/31/84

T A B L E O F U N A D J U S T E D M E A N S

ACCESSION NO.	PEDIGREE	ENTRY NO.	CWT/A	PCT SITE MEAN	100 SEED WT.	DAYS TO FLOWER	HEIGHT	LODGING SCORE
C66001	MICRAN	1	20.5	123.3	49.9	38.5	39.0	2.3
C81001	CRAN422	3	20.2	121.5	49.4	38.5	39.8	1.8
C81003	CRAN424	5	19.2	115.4	47.5	39.0	39.0	2.3
I84015	RKLD/CHARLOTOWN,4109	13	19.0	114.1	52.6	37.0	40.3	1.3
C81004	CRAN425	6	18.8	113.3	50.4	37.5	38.3	2.0
C81009	MVR CRAN	8	18.8	112.9	42.9	45.0	33.0	4.5
C70001	CRAN028	2	17.8	107.4	38.0	41.0	43.5	2.3
C81002	CRAN423	4	17.6	106.1	49.4	39.0	38.8	2.3
C81008	T HORT	7	17.3	103.8	43.2	40.0	38.8	2.0
K77002	RKLD/MEC,ISABELLA	15	17.0	102.0	49.1	35.5	43.5	1.0
I81061	SEL-CLRK,SACRAMENTO	17	16.8	101.3	51.6	35.5	38.8	1.0
I81058	REDKLOUD	16	16.2	97.6	49.7	36.0	41.3	1.8
K66001	MANITOU	22	16.1	97.1	47.8	43.5	44.8	1.3
K74002	MDRK/CN(3)-HBR(NEB#1),MONTCALM	14	15.9	95.6	50.7	41.0	42.5	1.5
I82038	8920 (CRAN)	10	15.9	95.5	45.9	38.5	37.3	1.8
I84016	78734 (WK)	21	15.7	94.3	50.7	39.5	41.5	2.5
I82037	K07009 (CRAN)	9	15.4	92.7	45.6	44.5	46.5	1.5
K60001	DRK/BRAZ.RK,CHARLEVOIX	11	15.0	90.3	49.1	41.0	41.3	1.5
I82028	2602,CHICO	12	13.5	81.4	45.4	42.0	43.8	1.5
I82027	2204,LINDEN	20	13.5	81.4	46.5	44.0	45.8	1.0
I82033	G01562/RKLD,RUDDY	18	13.1	78.8	43.3	36.5	41.8	1.5
I81103	LRK 9482	19	12.3	74.0	43.4	43.5	41.3	1.0
AVERAGE OF PRECEDING 22 MEANS			16.6	100.0	47.4	39.8	40.9	1.8
LSD (P=.05)			5.0	30.0	3.6	0.4	2.6	0.7
(P=.01)			6.5	39.1	4.7	0.5	3.4	0.9
COEFFICIENT OF VARIATION			21.2	21.2	5.4	0.7	4.5	28.2

EXPERIMENT 4215 MONTCALM STANDARD LARGE SEEDED YIELD TRIAL PLANTING DATE 5/31/84

TABLE 1. (cont.)

EXPERIMENT 4215 MONTCALM STANDARD LARGE SEEDED YIELD TRIAL PLANTING DATE 5/31/84

T A B L E O F U N A D J U S T E D M E A N S

ACCESSION NO.	PEDIGREE	ENTRY NO.	CWT/A	DAYS TO MATURITY	DES. SCORE
			VARIABLE		
C66001	MICRAN	1	20.5	84.3	3.3
C81001	CRAN422	3	20.2	86.5	3.3
C81003	CRAN424	5	19.2	86.5	3.3
I84015	RKLD/CHARLOTOWN,4109	13	19.0	88.3	2.8
C81004	CRAN425	6	18.8	85.8	3.3
C81009	MVR CRAN	8	18.8	96.3	1.8
C70001	CRAN028	2	17.8	95.3	2.5
C81002	CRAN423	4	17.6	86.0	3.5
C81008	T HORT	7	17.3	83.0	2.8
K77002	RKLD/MEC,ISABELLA	15	17.0	87.3	2.8
I81061	SEL-CLRK,SACRAMENTO	17	16.8	83.0	3.3
I81058	REDKLOUD	16	16.2	89.0	2.5
K66001	MANITOU	22	16.1	98.3	2.3
K74002	MDRK/CN(3)-HBR(NEB#1),MONTCALM	14	15.9	93.5	2.8
I82038	8920 (CRAN)	10	15.9	82.8	2.8
I84016	78734 (WK)	21	15.7	87.3	2.8
I82037	K07009 (CRAN)	9	15.4	97.0	2.8
K60001	DRK/BRAZ.RK,CHARLEVOIX	11	15.0	92.0	2.0
I82028	2602,CHICO	12	13.5	98.5	2.0
I82027	2204,LINDEN	20	13.5	97.0	2.3
I82033	G01562/RKLD,RUDDY	18	13.1	89.0	2.5
I81103	LRK 9482	19	12.3	98.8	2.8
AVERAGE OF PRECEDING 22 MEANS			16.6	90.2	2.7
LSD (P=.05)			5.0	3.2	0.8
(P=.01)			6.5	4.1	1.1
COEFFICIENT OF VARIATION			21.2	2.5	21.4

EXPERIMENT 4215 MONTCALM STANDARD LARGE SEEDED YIELD TRIAL PLANTING DATE 5/31/84

TABLE 2.

EXPERIMENT 4216 MONTCALM PRELIM DARK RED KIDNEY YIELD TRIAL PLANTING DATE 5/31/84

T A B L E O F U N A D J U S T E D M E A N S

ACCESSION NO.	PEDIGREE	ENTRY NO.	CWT/A	PCT. SITE MEAN	100 SEED WT	DAYS TO FLOWER	DES. SCORE	DENSITY LBS/BU.
			VARIABLE					
K83222	C49242/3*MONT	9	18.1	118.5	52.3	41.5	3.0	57.5
K74002	MDRK/CN(3)-HBR(NEB#1),MONTCALM	1	17.9	117.6	51.0	42.0	3.0	56.2
K84009	MONT / CHAR	20	17.9	117.4	49.3	41.5	2.0	59.6
K84003	MONT / CHAR	14	17.3	113.7	52.2	41.0	3.0	56.5
K83215	C49242/4*MONT	8	17.1	112.2	49.5	43.5	2.0	59.1
K84004	MONT / CHAR	15.	17.0	111.3	49.9	41.5	4.0	57.4
K60001	DRK/BRAZ.RK.CHARLEVOIX	2	16.9	110.6	49.0	41.5	3.0	59.3
K83201	C49242/3*MONT	3	16.8	110.0	52.7	42.5	3.0	58.2
K84005	MONT / CHAR	16	16.7	109.6	49.2	41.0	3.0	57.4
K84018	MONT / CHAR	29	16.3	106.7	51.5	41.5	2.0	56.6
K84006	MONT / CHAR	17	15.9	104.5	48.5	42.0	3.0	56.6
K83243	C49242/2*MONT	11	15.8	103.4	49.0	41.0	3.0	56.7
K84011	MONT / CHAR	22	15.7	102.9	47.3	42.0	2.0	59.2
K84001	MONT / CHAR	12	15.4	101.1	49.5	40.5	2.0	56.7
K84002	MONT / CHAR	13	15.3	100.3	49.1	40.0	3.0	56.6
K84008	MONT / CHAR	19	15.2	99.8	49.4	42.5	3.0	56.4
K84015	MONT / CHAR	26	15.1	98.9	51.2	41.5	3.0	58.3
K84016	MONT / CHAR	27	15.0	98.6	49.2	41.5	3.0	57.8
K84010	MONT / CHAR	21	14.9	97.8	46.4	42.5	2.0	59.3
K84012	MONT / CHAR	23	14.9	97.8	45.3	42.5	2.0	58.9
K84007	MONT / CHAR	18	14.8	97.2	46.4	42.5	3.0	56.0
K83207	C49242/4*MONT	4	14.5	95.0	47.6	43.5	2.0	57.6
K84019	MONT / CHAR	30	14.2	92.9	48.0	41.5	3.0	56.9
K84014	MONT / CHAR	25	14.1	92.7	45.4	41.5	2.0	59.4
K84017	MONT/CHAR	28	14.0	92.0	47.1	42.0	3.0	56.6
K84013	MONT / CHAR	24	13.2	86.4	46.6	41.0	2.0	59.2
K83214	C49242/4*MONT	7	13.0	85.6	48.0	42.5	3.0	57.4
K83212	C49242/4*MONT	6	12.3	80.5	42.0	42.0	3.0	57.1
K83210	C49242/4*MONT	5	11.1	73.0	45.1	42.5	3.0	56.6
K83223	C49242/3*MONT	10	11.0	72.1	44.8	44.0	3.0	59.1
AVERAGE OF PRECEDING 30 MEANS			15.2	100.0	48.4	41.9	2.7	57.7
LSD (P=.05)			2.4	15.7	3.5	0.7	---	1.4
(P=.01)			3.1	20.4	4.5	0.9	---	1.9
COEFFICIENT OF VARIATION			9.6	9.6	4.4	1.0	---	1.4

EXPERIMENT 4216 MONTCALM PRELIM DARK RED KIDNEY YIELD TRIAL PLANTING DATE 5/31/84

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