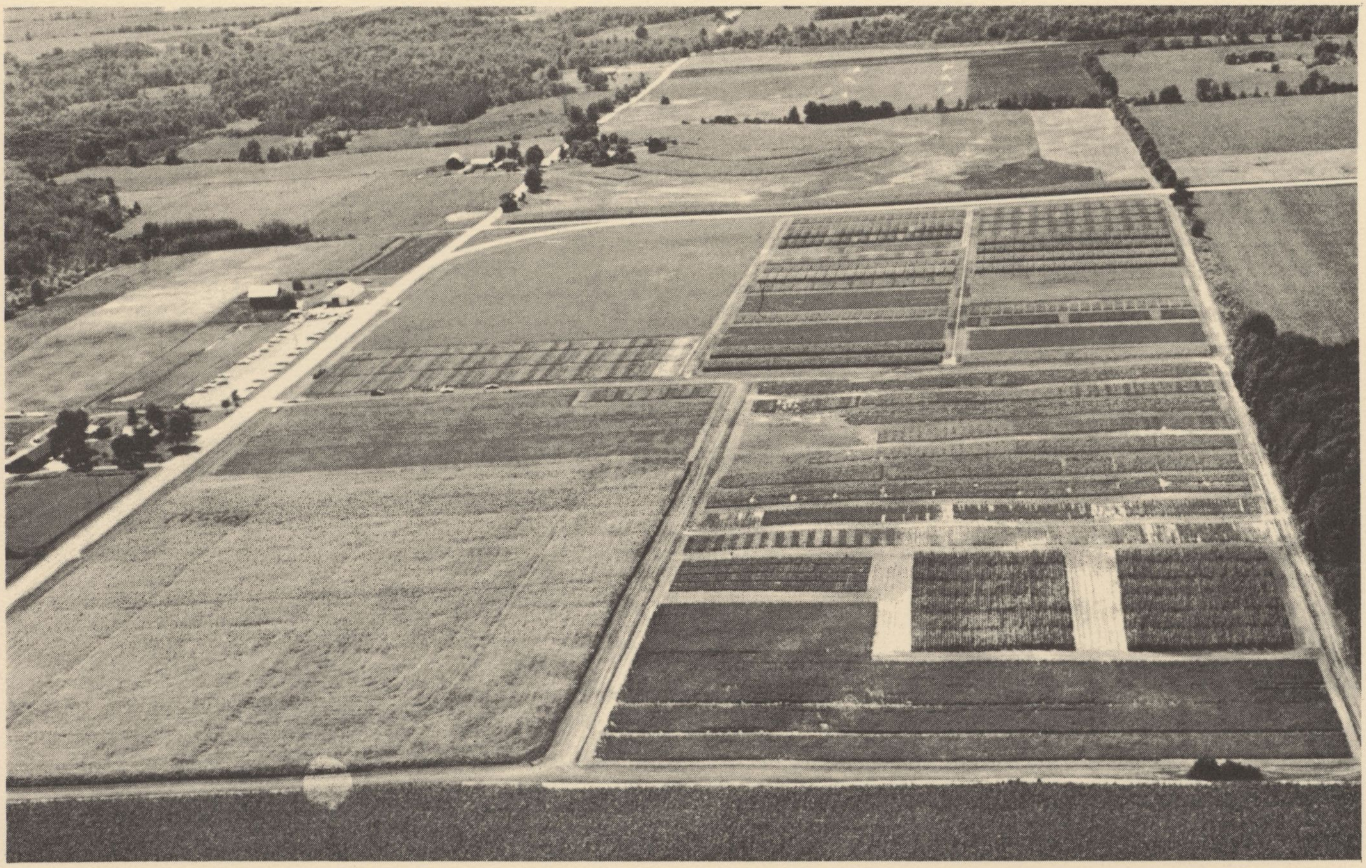
File

1980 Research Report



MONTCALM EXPERIMENT STATION

Michigan State University
Agricultural Experiment Station

ACKNOWLEDGMENTS

Research personnel working at the Montcalm Branch Experiment Station have received much assistance in various ways. A special thanks is due each of these individuals, the Michigan Potato Industry Commission, private companies and government agencies all of who have made this research possible. Many valuable contributions in the way of fertilizers, chemicals, seed, equipment, technical assistance, personal services, and monetary grants were received and are hereby gratefully acknowledged.

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TABLE OF CONTENTS

MONTCALM BRANCH EXPERIMENT STATION RESEARCH REPORT

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INTRODUCTION

The Montcalm Branch Experiment Station was established in 1966 with the first experiments initiated in 1967. This report marks the completion of fourteen years of studies. The 40-acre facility is leased from Mr. Theron Comden and is located in west-central Michigan, one mile west of Entrican. The farm is used primarily for research on potatoes and is located in the heart of a major potato producing area.

This report is designed to coordinate all of the research obtained at this facility during 1980. Much of the data herein reported 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 necessary before definite conclusions and recommendations can be made.

WEATHER

Tables 1 and 2 summarize the thirteen year temperature and rainfall data. Temperatures during 1980 were not too much different than the 13 year average. There were many cloudy and high humidity days during August and September. During the entire growing season there were only two days that the temperature reached 90°.

During the period of August through September much of the temperature and relative humidity conditions were very conducive to the development of late blight. The fungicide spray program was increased and copper was included to protect the crop from late blight. Rainfall during September was much greater than the 13 year average.

Greater amounts during September have occurred only in 1977 and 1970.

Irrigation applications of slightly less than one inch each were made eight times (June 29, July 4, 8, 12, 15, 19, August 4, 13).

SOIL TESTS

Soil test results for the general plot area were:

	Pounds per Acre				Percent
pH	P	K	Ca	Mg	organic matter
6.8	489	247	1067	213	1.8

Table 1. The 13 year summary of average maximum and minimum temperatures during the growing season at the Montcalm Branch Experiment Station.

	April		May		June		July		August		September		6-month average	
Year	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1968	61	37	62	41	74	53	80	55	81	58	74	50	73	50
1969	56	35	67	43	70	50	80	59	82	56	73	49	74	49
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
13-year Average	54	33	67	44	75	53	81	58	79	56	71	49		

Table 2. The 13-year summary of precipitation (inches per month) recorded during the growing season at the Montcalm Station.

Year	April	May	June	July	August	September	Total
1968	2.84	4.90	3.74	1.23	1.31	3.30	17.32
1969	3.33	3.65	6.18	2.63	1.79	0.58	18.16
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
13-year Average	2.62	2.73	3.78	2.27	4.45	3.33	19.18

FERTILIZERS USED

Except for the specific fertility studies where the fertilizers are specified in the report, the following fertilizers were used on the potato plot area:

Plow down	- 0-0-60	- 200 lbs/A
Banded at planting	- 19-19-19	- 500 lbs/A
Sidedressed at hilling	- 46-0-0	- 150 lbs/A

Alfalfa cover crop plowed down.

HERBICIDES

Early preemergence alachlor (Lasso) at 2 lbs/A followed by delayed preemergence of metribuzin (Sencor) at 1/2 lb/A.

DISEASE & INSECT CONTROL

Systemic insecticide Temik was applied at 3 lbs/A.

Foliar fungicide and insecticide sprays were as follows:

June 11	Sevin
June 27	Thiodan
July 11	Bravo
July 18	Bravo
July 25	Bravo
August 2	Bravo + Monitor
August 9	Bravo ± Thiodan
August 12	Bravo
August 23	Bravo + Thiodan
August 30	Bravo + Copper
Sept. 5	Bravo + Copper

Top killed prior to harvest with Paraquat one quart/A plow X77 at 8 oz/100 gallons

1980 INTRODUCTION OF NEW POTATO VARIETIES

R.W. Chase & R.B. Kitchen

The introduction program conducted at the Lennard Farm in Levering was maintained at approximately the same level as in 1979. Forty-seven named varieties and advanced selections plus 35 new Michigan selections were included in the 1980 introduction program. Single tubers are cut once and the two seed pieces are planted as a tuber unit. This procedure minimizes differences in seed piece variation yet still provides two plants for evaluation. Frequent rogueings are made to eliminate undesirable selections. Top killing and harvest are timed so that late season disease infestations are minimized.

A major and continuing source of cultivars is from the USDA-Beltsville program with 6 names varieties and 12 advanced selections. Many of these selections show potential suitability to the Michigan area. Virus free tubers of Denali, Atlantic and Onaway were obtained from Vancouver, B.C. and these were increased in 1980. The performance of several of these selections in the 10 hill observation plot planted at the Montcalm Research Farm is shown in Table 1.

Of the 35 new selections from the Michigan potato breeding program, 16 were judged as being worthy of further evaluation based on their performance at the Montcalm Research Farm. The parentage and performance of these selections is summarized in Table 2.

Table 3 provides an inventory of the current selections. Attempts will be made to obtain the maximum results from the seed produced in this program. All selections will be included in performance studies at the Research Farm and certain selections will be used in the overstate trials. Offerings will also be made to seed producers who wish to introduce new varieties into their seed plot program and insofar as possible these tubers will be indexed in the greenhouse before the 1981 planting.

Table 1 - 10 Hill Observation Trials - Montcalm Research Farm

Selection	Total cwt/A	No. 1 cwt/A	% No. 1	% Over 3 1/4	Specific Gravity	Chip Rating	
USDA-Beltsville							
B7154-10	390	312	80.0	0	1.053	1.5	Good type; growth cracks
B7516-7	398	351	88.2	11.8	1.073	2.5	Deep eyes
B7516-9	367	304	82.8	14.9	1.064	3.0	Not uniform
B7802-2	296	265	89.5	0	1.056	2.5	Very smooth skin; rough
B7805-1	406	390	96.1	26.9	1.064	3.5	Smooth; Good type; Some scab
B7859-2	429	367	85.5	7.3	1.078	2.0	Some deep scab
B8528-3	328	218	66.5	0	1.070	3.0	Good type; very small
B8934-4	374	281	75.1	8.3	1.069	3.0	Good type; Some growth crack
B8943-4	265	133	50.2	0	1.062	4.0	Deep scab; small
B8972-1	328	164	50.0	0	1.069	2.5	Good appearance; small
Delta Gold	476	445	93.5	32.8	1.083	2.5	Some scab
MSU							
MS2-302	475	374	78.7	0	1.077	2.5	Good type, some scab; yellow
MS4-439	287	242	84.3	10.8	1.083	1.5	Very rough
MS401-2	289	226	78.2	0	1.071	3.0	Small; some scab
MS402-4	211	109	51.7	0	1.077	1.5	Too small-discard
MS402-5	320	250	78.1	4.9	1.073	2.5	Good type; small
Aberdeen-Idaho							
A66107-12	413	287	69.5	5.7	1.064	3.0	Type not uniform
A68678-1	523	460	88.0	23.9	1.081	2.0	Good type
A72687-11	335	296	88.4	0	1.074	2.5	Very pointed; discard
Campbell 13	445	359	80.7	17.5	1.072	2.0	Good type; smooth skin
Maine CA027	601	546	90.8	14.3	1.083	2.5	Smooth; good type
Guelph 670-11	663	632	95.3	16.5	1.090	3.5	Some scab

Table 2 - New MSU Selections

Selection	Fleshcolor	Total cwt/A	No. 1 cwt/A	% No. 1	% Over 3 1/4	Specific Gravity	Chip Rating	Comments
Atlantic x Michibonne								
700-70	White	530	491	92.6	8.8	1.081	1.5	Late
700-79	White	413	343	83.1	3.8	1.081	1.5	Early
700-83	White	523	468	89.5	16.4	1.075	1.5	Late
700-88	White	460	359	78.0	5.1	1.070	1.5	Late
Atlantic x Michigami								
701-22	White	530	460	86.8	10.3	1.078	1.5	Late
Atlantic x Wischip								
702-80	White	476	452	95.0	13.1	1.073	1.0	Early
702-91	White	530	452	85.5	13.2	1.077	1.5	Early
Atlantic x Wischip								
704-3	Yellow	445	374	84.0	0	1.075	1.5	Early
704-10	Cream	507	406	80.1	0	1.084	2.0	Early
704-17	White	554	499	90.1	25.4	1.077	3.0	Early
Michigami x Atlantic								
709-21	White	382	367	96.1	8.2	1.080	3.5	Early
2-171 x Michigami								
714-10	White	484	367	75.8	0	1.075	1.0	Early
3-22 x Atlantic								
716-15	White	468	390	83.3	0	1.088	1.0	Late
3-69 x Wischip								
718-6	Cream	413	382	92.5	32.1	1.083	2.0	Late
718-11	Cream	406	343	84.5	0	1.075	1.5	Early
4-198 x Atlantic								
719-38	White	414	374	90.3	18.9	1.070	1.5	Early

1980 POTATO VARIETY EVALUATIONS

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Department of Crop & Soil Sciences

A. Dates of Harvest of Several Potato Varieties

One of the research projects funded by the MPIC is the intensive dates-of-harvest study conducted at the Montcalm Research Farm. Three blocks each containing 104 ten foot plots were planted on May 5. Each block contained 26 varieties and advanced selections planted in a randomized complete block design with four replications. One block was harvested August 11, a second on August 27 and the third on September 24. At each date, yields of marketable tubers (over 2 inches), specific gravity, chip scores and internal evaluations were determined.

The plot area received 200 pounds/A plow down of 0-0-60, 500 lbs/A 19-19-19 in the planter and 150 lbs/A 45-0-0 sidedressed. The plow down crop was a one year old stand of alfalfa. Temik at 20 lbs/A was applied at planting. Alachlor (Lasso) 2 lb/A was applied early preemergence and metribuzin (Sencor) 0.5 lbs/A was applied delayed preemergence. The plots were irrigated.

Results

The yield performance for each date of harvest is summarized in Table 1. Over all the varieties there was a general increase in yield with the later harvests, however, there was no change in specific gravity. Varieties which reached their optimum yields early and could therefore be considered as having an earlier marketable yield were Yukon, Onaway, Oceania, MS 402-1, Superior, MS 403-2 and MS 402-6. Varieties which performed as being intermediate were Crystal, Dakchip, B7516-9, Buckskin, Monona and Allagash Russet. Varieties considered as late were B6987-184, Rideau, Lemhi, Russette (B7583-6), Croatan, Michimac, Belchip, Katahdin, Atlantic, Denali, CA-027 and Russet Burbank. Table 2 summarizes the internal defects based on a randomly selected 25 tuber sample.

Variety observations:

Yukon is a Canadian yellow flesh variety. It has a very attractive appearance, uniformity, smoothness and appears to mature early. Specific gravity is medium. It did produce acceptable chips when harvested.

B6987-184 is an advanced selection from the USDA-Beltsville program and may soon be officially released. Tubers are elongated and it has a very high specific gravity. Yields at the Montcalm Farm were very good, however, at some of the farmer locations it did not size as well.

Pioneer is a long, red skin variety. It is included because of its potential as an early maturing, long tuber which is suitable for frozen processing before the maincrop of Russet Burbank.

Crystal is a recent release from North Dakota. Its tubers are elongated and it does have a vigorous vine growth. It has yielded above average; however, specific gravity readings were medium low. At some outstate locations scab was noted and it was often the deeper, pitted type.

Onaway included as a check variety.

Rideau is a red skin variety released by Canada in 1979. Tubers are round, smooth, shallow eye and have a bright red skin which holds its color well. It matures medium late and yields very well.

Dakchip is a recent release from North Dakota with a mid season maturity. It yielded slightly above average, however, specific gravity is medium low and the tubers are not as uniform and smooth particularly for tablestock use. Also in both 1979 and 1980 vascular discolorations have been significant.

Lemhi a recent release from Idaho is a long smooth russet which produces a higher percentage of number ones than does Russet Burbank. Maturity is similar to Russet Burbank. A major concern is the high incidence of hollow heart noted in most of our plots and also reported in other states.

Russette (B7583-6) is a recent release from the USDA-Beltsville. It is a late maturity, oblong russet which is slow to establish early in the growing season. Some hollow heart was noted in 1980 but this had not been noted in earlier tests.

Croatan was released from North Carolina and is a late maturing round white. It has not shown any improved features over existing varieties and will be deleted from further trials.

Oceania is an early maturing round white variety released by USDA-Beltsville. Specific gravity is low and there were reports of serious blackleg susceptibility in certain 1980 plantings. Tubers are very smooth and uniform in type.

Michimac is a late maturing round white from the Michigan program. It has a high yield potential and its greatest suitability would be for out of storage fresh pack. It should not be grown on fields which scab is known to be a problem.

Belchip is a late maturing variety released from USDA-Beltsville. It yields above average, medium specific gravity and appears to have fewer internal defects than does Atlantic. Tubers are not as uniform and attractive as Atlantic and so it may not be as desirable for freshpack. Chip performance has been acceptable.

B7516-9 is an advanced selection from USDA-Beltsville which matures early. Yields are about average and dry matter is similar to Oceania.

Katahdin is included as a late maturing check variety.

MS402-1 is an advanced selection from Michigan. It matures early and yield potential appears to be below average. Internal defects are minimal and tubers are well shaped, and shallow eyed and specific gravity was low.

Atlantic continues to yield well with desirable specific gravity and good chip quality. Hollow heart and internal necrosis continue to be its greatest limitations.

Denali is a late maturing variety with high specific gravity. It yields well above average and internal defects have not been serious. Vascular discoloration has been noted at some locations. Scab has also been observed at certain locations and growers should avoid fields where scab is known to be a problem. Tubers are oval to oblong and fairly smooth.

Superior is included as an early maturing variety.

Buckskin is a variety released from Pennsylvania which we have had in our tests for 3 years. Yields have been below average and it is a variety which is slow to establish early in the growing season. It is being deleted from further testing.

CA 027 is an advanced round white seedling from Maine which was first added to our trials this year. It is a late maturing variety which is well shaped, smooth and yielded above average at the late harvest.

Russet Burbank and Monona are included as standard check varieties.

MS 403-2 and MS 402-6 are two advanced selections from Michigan which will be deleted from further testing. Yields are too low to offer any potential.

Allagash Russet is an oblong to round russet released in 1980 from Maine. Yields were well below average and dry matter was low. Maturity is early so potential may be similar to Belrus as an early fresh russet potato.

Table 3 summarizes the results of the sucrose analysis for each variety at the different harvests. Studies are currently underway with Dr. Cash to determine the feasibility of determining the sucrose level as a predictor of maturity for harvest and its processing potential from storage. At this time, the relationship under our Michigan growing conditions has not been fully established. Table 3 also shows the chipping performance of these several varieties stored at 55^{o} since harvest. Several varieties remained in good chipping condition throughout the storage period. Ratings of a 2.0 or less are producing very acceptable chips. Similar samples have been stored at 42^{o} and these will be reconditioned in February to determine those varieties which will recondition.

Table 4 summarizes the chip performance of several varieties from the 1979 variety testing program. These selections were stored at 40^{o} until January 22, 1980 when the reconditioning was initiated. The samples were held at 65^{o} and chip samples were made at 0, 2, 4 and 6 weeks.

Table 1. The yield and specific gravity of several potato varieties harvested on three different dates. (Montcalm Research Farm - 1980)

	Aug. 11				Aug. 27				Sept. 24				
Variety	Total	No. 1*	S.G.	Chip Color**	Total	No. 1*	S.G.	Chip Color**	Total	No. 1*	S.G.	Chip Color**	Maturity***
Yukon	418	378	1.072	1.0	407	384	1.072	1.0	408	382	1.072	1.5	1
B6987-184	412	357	1.089	1.0	449	410	1.088	1.0	532	497	1.090	1.0	3
Pioneer	418	353	1.074	2.0	459	421	1.068	1.5	527	481	1.070	2.0	2
Crystal	404	337	1.068	1.5	487	449	1.070	1.0	472	415	1.068	1.5	4
Onaway	382	329	1.063	3.0	378	356	1.062	3.0	365	318	1.064	4.0	2
Rideau	367	329	1.070	2.0	423	412	1.071	2.0	484	462	1.071	3.0	3
Dakchip	381	321	1.071	1.0	415	385	1.071	1.5	431	378	1.068	1.0	2
Lemhi	367	315	1.082	1.5	445	374	1.079	1.0	503	445	1.076	2.0	4
Russette	343	312	1.075	1.5	343	326	1.074	1.5	431	398	1.072	3.0	4
Croatan	388	312	1.060	1.5	410	357	1.061	2.0	458	398	1.062	1.5	3
Oceania	385	310	1.065	2.0	357	334	1.059	2.5	375	330	1.059	1.5	1
Michimac	367	307	1.067	2.0	382	353	1.065	2.0	501	460	1.064	2.5	4
Belchip	332	300	1.072	1.0	406	382	1.075	1.0	478	433	1.077	1.5	5
B7516-9	351	298	1.063	1.0	359	323	1.061	1.5	338	283	1.063	1.5	3
Kathadin	345	290	1.067	1.5	314	281	1.060	1.5	396	353	1.064	2.0	5
MS 402-1	312	279	1.066	1.0	328	304	1.062	1.0	308	269	1.065	1.5	2
Atlantic	324	276	1.083	1.0	401	368	1.082	1.0	437	396	1.086	1.0	4
Denali	329	275	1.083	1.0	415	373	1.088	1.0	497	451	1.087	1.5	4
Superior	307	273	1.070	1.0	285	265	1.065	1.5	300	263	1.068	1.5	1
Buckskin	309	267	1.074	1.0	424	406	1.073	1.0	415	386	1.070	1.0	4
CA 027	301	265	1.071	1.0	340	317	1.073	1.0	460	415	1.072	1.5	5
Russet Burbank	357	256	1.079	2.0	446	357	1.077	1.5	470	326	1.076	3.0	4
Monona	290	231	1.064	1.5	353	317	1.064	1.0	369	341	1.060	1.0	3
MS 403-2	264	231	1.073	1.0	206	189	1.071	1.0	271	236	1.070	1.5	2
Allagash	265	207	1.062	1.0	290	253	1.062	1.0	310	277	1.060	1.0	2
MS 402-6	304	206	1.065	1.0	303	240	1.064	1.0	248	189	1.064	1.0	1
Average	347	293	1.071		378	344	1.070		415	369	1.070		

*Pickouts and tubers under 2" diameter excluded.

**Based on scale of 1-5. 1 = lightest, 5 = darkest and not acceptable

***1 = early maturity, similar to Norland; 5 = a late maturity, similar to Russet Burbank

Table 2. Internal defects* of several potato varieties grown at the Montcalm Research Farm - 1980.

	Aug 11			Aug 27			Sept 24		
Variety	Hollow	Internal Necrosis	Vascular	Hollow	Internal Necrosis	Vascular	Hollow	Internal Necrosis	Vascular
Yukon	---	---	1 slight	---	---	3 slight	---	---	2 slight
B6987-184	---	---	2 slight	---	---	4 slight	---	---	8 slight
Pioneer	---	---	---	---	---	2 slight	1	---	4 slight
Crystal	---	---	---	---	---	1 slight	---	---	3 slight
Onaway	---	---	5 slight	---	---	4 slight	---	---	3 slight
Rideau	---	---	1 slight	---	---	1 slight	---	---	4 slight
Dakchip	---	1 slight	3 severe	---	---	1 severe	---	---	7 severe
			4 slight						3 slight
Lemhi	4	---	---	4	1 slight	---	---	1 slight	1 slight
Russette	---	---	---	1	---	---	4	---	1 slight
Croatan	---	---	2 slight	---	---	---	---	---	---
			1 severe						
Oceania	---	---	---	---	---	---	---	---	---
Michimac	---	---	2 slight	---	1 slight	2 slight	---	---	4 severe
									8 slight
Belchip	---	---	1 severe	---	---	1 severe	---	---	1 severe
						2 slight			4 slight
B7516-9	---	---	5 slight	---	---	4 slight	---	---	3 slight
Kathadin	1	---	2 slight	---	---	1 slight	---	1 slight	5 slight
MS 402-1	---	---	---	---	---	---	1	---	---
Atlantic	1	---	2 slight	---	---	2 slight	---	---	1 slight
Denali	---	---	---	---	---	2 slight	---	---	4 severe
									5 slight
Superior	---	---	2 slight	---	---	1 slight	---	2 brown center	3 slight
Buckskin	---	---	2 slight	---	---	3 slight	---	---	7 slight
CA 027	---	---	1 slight	---	1 slight	1 slight	---	---	5 severe
									4 slight
Russett Burbank	---	---	---	---	1 slight	1 slight	1	---	2 slight
Monona	---	---	1 slight	---	---	1 slight	---	1 slight	4 slight
MS 403-2	---	2 slight	1 slight	---	---	---	---	---	---
Allagash	---	---	---	---	---	1 slight	---	---	1 slight
MS 402-6	---	---	1 slight	---	---	---			

*Based on 25 tuber sample selected at random

Table 3. The sucrose and chip ratings of several potato varieties harvested on 3 different dates. (Montcalm Research Farm - 1980)

Variety	Sucrose Rating[1] Aug. 11	Aug. 27	Sept. 24	Chip Rating[2] (Jan. 8, 1981)
Yukon	1.62	0.61	0.64	4.0
B6987-184	0.10	0.25	0.61	1.0
Pioneer	----	0.25	----	1.5[3]
Crystal	1.74	0.45	0.85	1.5
Onaway	0.98	0.38	0.58	4.0
Rideau	1.12	0.52	1.35	2.0[3]
Dakchip	1.85	0.37	0.73	1.5[3]
Lemhi	2.32	0.85	0.82	1.5
Russette	0.81	0.42	0.70	3.0
Croatan	1.19	0.47	0.73	----
Oceania	0.47	0.50	0.47	1.5
Michimac	0.73	0.83	0.52	3.0[3]
Belchip	1.01	0.46	0.38	1.5
B7516-9	0.99	1.05	0.67	2.0
Katahdin	1.00	0.48	1.17	2.5
MS 402-1	0.83	0.60	0.29	2.0[3]
Atlantic	0.70	0.17	0.79	1.0[3]
Denali	0.05	0.36	0.85	2.0
Superior	1.80	0.40	0.52	2.5
Buckskin	1.22	0.60	0.29	----[3]
CA027	0.09	0.75	0.50	2.0
Russet Burbank	2.02	0.62	0.58	2.5
Monona	1.11	0.32	0.82	1.0
MS403-2	1.28	0.60	0.85	----
Allagash Russet	0.81	0.35	0.50	1.0
MS402-6	1.21	0.45	0.47	----

[1] Sucrose determinations made by Dr. Jerry Cash, Department of Food Science and Human Nutrition.

[2] Chip score based on a 1-5 scale. 1 = lightest, 5 = darkest. Samples stored at 55° since harvest.

[3] Some individual slices showed dark stem ends.

Table 4. The chip ratings of several varieties grown in 1979 and reconditioned in Feb-Mar, 1980.

Variety	Chip Rating[11] Jan. 22, 1980 40°	Reconditioned at 65° 2 weeks	4 weeks	6 1/2 weeks
Oneida	4.5	3.5	3.0	3.0
Belrus	5.0	3.5	4.0	4.0
Superior	5.0	4.0	4.0	3.5
Kennebec	4.5	3.5	3.5	3.0
Michimac	5.0	4.0	4.0	3.5
Atlantic	4.5	3.0	2.5	2.0
Oceania	5.0	4.5	4.5	3.5
Belchip	4.5	4.0	3.0	2.0
Denali	5.0	3.5	3.5	3.0
Russet Burbank	5.0	4.5	4.0	3.5
B6987-184	5.0	---	---	2.0
Dakchip	4.5	---	---	4.0
Crystal	5.0	---	---	3.5

[11] Based on a 1-5 scale. 1 = lightest, 5 = darkest

B. Overstate Potato Variety Trials

Result-demonstrations of several potato varieties were conducted on three cooperating farms during 1980. The locations were at the Woloszyk Farm in Presque Isle County, Allen Anderson's Farm in Montcalm County, and Shoemaker Bros. in Allegan County. Half acre plantings of several varieties were evaluated at the Lennard Farm in Monroe County and these results were reported by Paul Marks, Monroe County Extension Agriculture Agent in the last issue of the MPIC News. Replicated yield data could not be obtained at the demonstration on the DuRussel Farm in Washtenaw County so these data are not included.

Similar to our procedure in 1979, approximately 35 pounds of seed of each variety were provided to the grower. The seed was cut in their mechanical cutter (except the Shoemaker location) and then planted with their planter so it does receive the usual commercial handling. Twelve varieties were evaluated at each location and the results are summarized in Table 1.

It is apparent that environmental conditions were substantially different at each location. Presque Isle County had an extremely dry growing season and this is reflected by the high specific gravity readings and the lower than usual total yields. The percentage of tubers over 3 1/4 inch was much lower than usual and the only varieties which had a significant amount were MS402-1, Belchip, Michimac and Ontario.

At the Anderson Farm, average yields were very good and specific gravity was medium reflecting a season of adequate moisture plus irrigation during the growing season and above average soil moisture during September and prior to harvest. At the Shoemaker location yields are favorable, however, specific gravity readings are low and this reflects an above average soil moisture environment from planting and throughout the growing and harvest season. Varieties such as Denali, B6987-184 and Atlantic which are routinely very high were only about medium.

Internal defects were greater than desired with several selections show-in varying degress of vascular discoloration. Hollow heart was very severe on Lemhi, B6987-184 and Atlantic at Allegan County, whereas Russette (B7583-6) had the greatest amount of hollow heart at the Anderson Farm. Varieties showing the greatest amount of internal necrosis and vascular discoloration were Atlantic, Crystal and CA027 at the Anderson Farm. The incidence of internal defects at the Woloszyk Farm was very minimal.

Crystal and Dakchip are the two latest releases from North Dakota. Of the two, Crystal seems to be a more vigorous plant with a greater yield potential. Dakchip is less uniform in tuber type and there has been considerable vascular discoloration noted in both 1979 and 1980. Crystal is an elongated to oval shaped potato.

MS1085 and MS402-1 are two Michigan seedlings which exhibit good tuber type. MS402-1 is medium early in maturity and does have a medium to medium-low specific gravity.

Altantic, Belchip, Oceania, Russette (B7583-6) and B6987-184 are all products of Dr. Ray Webb at USDA-Beltsville. Hollow heart continues to be of concern in Atlantic, however, it does yield well, chip color is very desirable and it does have a high specific gravity. Belchip is a high yielding variety with less internal defects than Atlantic, medium specific gravity, however, it is deeper eyed than Atlantic and exhibits a rougher general appearance. Russette is an attractive elongated to blocky russet which yields above average. Specific gravity is medium and it does not appear to be a chipping variety, however, it may have a potential for frozen processing. Oceania is an early maturing variety, low specific gravity and a very smooth potato but appears to be very susceptible to blackleg. B6987-184 is a recent selection which has very high specific gravity. More testing will be needed to determine its adaptability but it does appear promising.

Denali continues to yield well above average and consistently has a high specific gravity. Tuber type was very desirable at all locations and it appears to be a variety which sizes uniformly with a small percentage under 2 inches and it does not excessively oversize.

Croatan and Buckskin are two selections we have evaluated for at least 3 years and will delete from further testing. Thus far they have not shown any distinct advantages and Buckskin has consistently been a below average yielder. Lemhi is a recent release from Idaho and although it yields well and has a smooth and blocky shape, hollow heart appears to be a major defect. Ontario is a popular variety in the Presque Isle County area and has produced very well. Michimac is a potential consideration for that area and other tablestock areas because it yields well above average; it matures earlier than Sebago or Ontario; it has a vigorous vine growth and it is a smooth and shallow eyed potato. It sets tubers deeper than Katahdin and thereby results in less greenheads. CA027 is a Maine seedling and this is our first year of testing. It appears to be a late maturing round white potato.

Table 1. The yield and specific gravity and chip score of several potato varieties grown at 3 out-state locations.

	Woloszyk Presque Isle County			Anderson Montcalm County				Shoemaker Allegan County			
Variety	Total (cwt/A)	Over 2" (cwt/A)	Specific gravity	Total (cwt/A)	Over 2" (cwt/A)	Specific gravity	Chip* Score	Total (cwt/A)	Over 2" (cwt/A)	Specific gravity	Chip* Score
Crystal	293	273	1.084	423	396	1.066	2.0	230	202	1.058	2.0
Michimac	292	281	1.077	412	392	1.066	3.5	306	292	1.058	3.0
MS-1085	285	230	1.091	---	---	-----	---	319	293	1.063	2.0
Ontario	284	271	1.082	---	---	-----	---	---	---	-----	---
Atlantic	273	260	1.092	423	396	1.082	1.5	249	226	1.074	1.5
MS402-1	273	257	1.077	---	---	-----	---	---	---	-----	---
Dakchip	268	252	1.077	301	275	1.066	1.5	288	271	1.057	1.5
Belchip	254	241	1.085	379	356	1.068	1.5	279	265	1.068	1.5
Denali	254	230	1.096	410	379	1.089	2.0	373	352	1.078	2.0
Oceania	236	217	1.080	339	306	1.061	1.5	---	---	-----	---
B6987-184	218	198	1.096	275	251	1.088	2.0	313	281	1.081	2.5
Russette (B7583-6)	201	190	1.088	379	359	1.073	4.0	300	281	1.068	4.0
Croatan	---	---	-----	354	320	1.063	1.5	315	292	1.058	1.5
Buckskin	---	---	-----	303	282	1.071	1.0	275	249	1.067	2.0
Lemhi	---	---	-----	---	---	-----	---	262	228	1.064	2.5
CA027	---	---	-----	395	374	1.075	2.0	---	---	-----	---
Average	261	242	1.085	366	341	1.072	---	292	269	1.066	---
	Planted May 23/Harvested Sept 29			Planted May 20/Harvested Oct 9				Planted May 16/Harvested Sept 26			

*Based on a 1-5 scale. 1 = lighest, 5 = darkest and not acceptable.

EARLY VARIETY - SPACING TRIAL

R.W. Chase & R.B. Kitchen
Department of Crop and Soil Sciences

Procedure

A study designed to evaluate the effect of spacing on several new varieties was conducted at the Montcalm Research Farm. Spacings of 7, 9 and 11 inches were compared for Belrus, Oceania, Allagash Russet and Atlantic in comparison with the standard early varieties, Onaway and Superior. Cut seed was used for all plantings except Allagash Russet.

Results

For all varieties except Oceania the greatest total yield was obtained at the 7 inch spacing (Table 1). This was particularly true with Allagash, Onaway and Superior when compared with the 11 inch spacing. In terms of total yield, spacing had little effect on Atlantic.

Belrus has been in our test plots for the past 3 years and in most lower Michigan tests it has not yielded well. It is an early maturing long russet with excellent type and a high percentage of US No. 1s. Its market advantage is as an early maturing (early August) long russet which would allow it to compete as a fresh market russet as compared to Russet Burbanks still being marketed out of storage. Its yield potential appears to be greater in Northern Michigan. The effect of spacing had little effect on the total yield, however the yield and percent No. 1s were higher at the 11 inch spacing. At the closer spacing there was a high percentage of B size tubers. There was no effect on the percent over 10 ounce.

Oceania produced the greatest total yield and US No. 1s at the 11 inch spacing. Oceania is an early maturing round white which when compared to Onaway is suitable for chip processing, which allows it to be marketed either way. It is very smooth and has a low specific gravity. It may have some susceptibility to black leg and serious stand problems were reported in 1980.

Allagash Russet is a recent release from Maine. It is a roundish to oblong russet with a lighter russet than Belrus. In 1980, our first year of testing, it was early maturing and below average in yield. The greatest yield occurred at the 7 inch spacing, however in terms of U.S. No. 1s the 9 inch space seems best.

Onaway and Superior were included as standard early maturing varieties and performance of both was best at the 7 inch space.

Atlantic is a variety which unlike many varieties seems to have a wide range of marketable maturity. In our dates-of-harvest study, this variety has yielded well at the earliest harvest and it continues to increase with later harvests. Its yields at the August 27 harvest date were greater than for Onaway, specific gravity is much higher and it produces a very acceptable chip. This variety appears to perform best at the closer spacing where it seems to have less incidence of hollow heart and the percentage of tubers under 3 1/4 inch is considerably reduced.

Internal defects for all varieties were very minimal except for the hollow heart noted with Atlantic. It is of interest to note that the specific gravity readings were highest at the 11 inch spacing for Belrus, Oceania and Superior, however the reverse was true for Allagash Russet, Onaway and Atlantic. Based on these results and other observations, it appears that the closer spacing of 7-8 inch (with irrigation) is most desirable for Onaway, Superior and Atlantic. Eleven inch seems best for Belrus, Oceania and 9 inch for Allagash Russet.

TABLE 1. EARLY VARIETY - SPACING TRIAL. *Montcalm Research Farm*

Planted May 7, 1980 whole seed except Allagash
Harvested August 27, 1980

Variety	Spacing	Total cwt/A	No. 1 cwt/A	Present No. 1	Present Over 3 1/4	Specific Gravity	Internal Defects Necrosis	Internal Defects Vascular	Internal Defects Hollow
Belrus	7	302	199	65.9	3.9	1.070	0	2 slight	0
Belrus	9	275	191	69.5	2.2	1.071	0	1 slight	0
Belrus	11	287	224	78.0	3.4	1.073	0	2 slight	0
Oceania	7	421	351	83.4	2.3	1.059	0	0	0
Oceania	9	414	353	85.3	6.1	1.061	0	3 slight 1 severe	0
Oceania	11	464	400	86.2	3.4	1.063	0	2 slight	0
Allagash	7	351	289	82.3	5.0	1.061	0	1 slight	0
Allagash	9	347	300	86.5	7.3	1.061	0	0	1
Allagash	11	302	250	82.8	10.3	1.060	0	1 slight	1
Onaway	7	519	460	88.6	3.0	1.066	0	3 slight	0
Onaway	9	513	456	88.9	3.0	1.066	0	2 slight 1 severe	0
Onaway	11	456	401	87.9	8.6	1.063	0	6 slight	0
Superior	7	435	393	90.3	0	1.066	1 slight	4 slight	0
Superior	9	359	324	90.3	4.3	1.063	0	7 slight	0
Superior	11	330	306	92.7	10.6	1.068	0	2 slight	1
Atlantic	7	552	509	92.2	11.7	1.084	0	3 slight	1
Atlantic	9	534	489	91.6	9.9	1.083	0	2 slight 1 severe	1
Atlantic	11	542	513	94.6	20.5	1.082	1	1 slight	4

VARIETY EVALUATIONS FOR FROZEN PROCESSING

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Each year advanced selections are evaluated for their production and suitability for the manufacture of frozen French fries. Selections that mature early and late are planted in 2 separate studies. Yields, size distribution, specific gravity, fry color, internal defects and reducing sugars are determined for each cultivar. Fertilizer treatments are the same as used for all plots as described in the Report introduction.

Results

The results of the five early maturing selections are shown in Table 1. In previous tests and in 1980 the Pioneer variety had produced favorable results. It is a long red skin tuber which is very uniform in type. All selections produced a very high percentage of tubers under 4 ounces which is not desirable for frozen French fry production. The A68599-1 had the highest specific gravity and the greatest percentage of tubers over 10 ounces. Fry colors on all were within acceptable limits. ALR 22-2 was the earliest to mature on July 30.

Table 2 summarizes the results of the late harvest. Generally there was a high percentage of tubers under 4 ounces, however, it was less than those harvested earlier with Allagash Russet and B8528-3 having the greatest. Lehmi yielded very well and had the highest percent over 10 ounce however the incidence of hollow heart was high. Those with the highest level of reducing sugars generally cooked darker. Generally speaking, the USDA-Beltsville selections B8972-1, B8528-3, Russette yielded below average and maturities were much earlier than the others.

Table 1. The yield, quality and cooking performance of five advanced selections.

	Total (cwt/A)	Percent 4-10 oz.	over 10 oz.	>4 oz.	pick outs	Specific Gravity	Chip* Color	Fry Color** 0-1	2-3	4+	Hollow heart	Vas. dis.	No. Tubers
Pioneer	404	62.4	12.1	22.6	2.9	1.072	1	21	1	0	0	3 slight	22
A68599-1	382	59.2	18.3	21.5	1.0	1.078	1	22	2	0	0	0	24
A66107-12	362	59.2	7.8	29.8	3.2	1.072	3	18	6	0	0	0	24
ALR22-2	359	63.6	9.0	24.7	2.7	1.066	3	18	5	0	0	1 slight	23
A72687-11	302	68.0	6.3	21.5	4.2	1.072	2	25	0	0	0	1 severe 4 slight 15 jelly end rot	25

Planted: May 6, 1980 Harvested: August 28, 1980

* Potato chip color rating based on 1-5 scale, 1 = light and very acceptable; 5 = dark and not acceptable

** Center slab fry evaluation on September 15. Ten pound sample; 3/8 inch slice/ fat temp. 365^{o}F and cooked for 3 minutes.

Table 2. The yield, quality and cooking performance of 12 potato selections.

	Total cwt/A	Percent 4-6oz.	6-10oz.	over 10oz.	Under 4oz.	2's	Specific Gravity	Percent Reducing Sugars	Center Slab Fry Color 0-1	2-3	4+	Internal Defects Hollow heart	Vas.	Browning
WC612-13	500	34.7	34.8	8.0	21.2	1.3	1.087	.273	23	0	0	0	1 slight	0
A68710-5	457	21.6	22.3	14.2	14.0	27.9	1.075	.279	19	5	0	0	0	0
Lemhi	438	19.0	32.3	21.7	16.1	10.9	1.079	.093	20	1	0	5	1 slight	0
A72685-2	423	26.1	33.5	15.8	15.4	9.2	1.090	.105	16	5	0	0	0	0
A67142-1	408	27.2	32.9	13.7	17.4	8.8	1.079	.087	17	6	0	0	4 slight	1
R. Burbank	402	22.1	14.3	6.7	24.1	32.8	1.079	.161	9	15	0	0	3 slight	0
Russette	342	31.0	36.4	10.4	21.7	0.5	1.079	.248	17	5	0	4	0	0
A72545-7	333	30.3	32.0	4.8	21.1	11.8	1.078	.304	0	23	0	0	2 slight	
WC521-12	291	29.5	30.7	8.4	27.6	3.8	1.093	.093	24	0	0	5	3 slight 1 severe	0
B8528-3	288	29.4	15.7	1.7	52.7	0.5	1.075	.074	24	0	0	0	0	1
B8972-1	261	22.1	10.4	0	66.1	1.4	1.073	.060	25	0	0	2	1 slight	0
Allagash Russet	245	34.5	17.5	1.3	46.3	0.4	1.059	.072	25	0	0	0	3 slight	0
Average	366						1.078							

Planted: May 6, 1980 Harvested: September 25, 1980

NORTH CENTRAL REGIONAL POTATO TRIALS

R.W. Chase & R.B. Kitchen
Department of Crop and Soil Sciences

Each year Michigan conducts a North Central Regional Potato Trial. Michigan is one of 16 locations of this trial which is designed to evaluate advanced selections under a wide range of growing conditions. Participants are the North Central states, plus Manitoba, Alberta, Louisiana, Colorado and Kentucky. Potato plant breeders are able to submit up to three advanced selections for the trials.

Thirteen advanced selections were entered in the 1980 trial and these were compared with the standard varieties Red Pontiac, Russet Burbank, Norland and Norchip. Planting was made May 7 and harvested September 24, 1980. The entries are as follows:

ELECTION NO.	PARENTAGE	MATURITY	COLOR	OTHER INFORMATION
eb.A129.69-1	Platte x 48.60-H35	Late	White	Chipper
eb.A71.72-1	A29.62-3 x 46.66-1	Medium	Russet	Chipper,Scab Resistant
eb.A219.70-3	Sioux x 49.62-1	Medium	White	Chipper,Scab Resistant
N 8742	32.63-9 x Norchief	Intermediate	Red	Late Blight Resistant; Some Scab Resistant
N 8757	32.63-9 x Chieftain	Intermediate	Red	Good Scab and Late Blight Resistance
N 9319	366.65-3 x G6743-5	Late	Russet	Good Scab and Late Blight Resistance, Blocky
isc. 723	Wisc. 634 x Kennebec	Med-Late	White	Good Solids - Chips
isc. 726	Wisc. 639 x Kennebec	Med-Late	White	Good Solids - Chips
isc. 806R	Norchief x Norland	Med-Late	Red	Good Color
a.42-38	La.12-142 x La.62-104	Med-Late	Red	Scab Resistant
K 34-2			Russet	
D146-4R	ND8987-3R x ND9403-20R	Very Early	Red	Good Color and Type
ND 14-1	Wc 285-83 x B7587-2	Medium	Russet	Good Shape
ed Pontiac	Check	Late	Red	
usset Burbank	Check	Very Late	Russet	
orland	Check	Early	Red	
orchip	Check	Medium	White	

Results

Table 1 summarizes the yield, total solids and characteristics of the different selections. Average total solids (17.7% or 1.068 specific gravity) were low which may be related to the wet soil conditions during the maturity and harvest period. Table 2 summarizes the internal and external defects of the tubers. Vascular discolorations were noted in most selections, however for most selections the incidence was minor.

Table 1. The yield, total solids and characteristics of several varieties entered in the 1980 North Central Potato Variety Trial.

Variety	Aver. Mat.[1/]	Most Representative Scab Area[2/]	Most Representative Scab Type[2/]	CWT/A Aver. Yield	CWT/A Aver. Yield US #1	Aver. Percent U.S.#1	Aver. Total Solids	Total Solids Per Acre	Gen. Merit Rat.[3/]	Chip Color[4/]	Early Blight Reading[5/]	Other Data	General Note
EARLY TO MEDIUM EARLY													
ND146-4R	2	0	0	307	290	94.5	15.8	4851	4	2.0		good	red color
Norland	2	T	1	328	307	93.6	15.1	4953		3.0		uniform	
MEDIUM TO LATE													
Neb. A129-69-1	5	1	4	444	428	96.4	18.4	8170		4.0	NOT AVAILABLE	tuber shape irregular	
Neb. A71-72-1	4	1	4	404	359	88.9	17.7	7151		3.0		pointed tubers	
Neb. A219.70-3	3	0	0	324	314	96.9	17.7	5735		1.0		deep	eye
MN 8742	3	T	4	333	310	93.1	17.3	5761		2.0		not	
MN 9319	3	0	0	238	229	96.2	18.0	4284	1	1.5		good	typo-blocky
Wisc. 723	4	T	2	356	334	93.8	19.9	7084		2.0		irregular	
Wisc. 726	4	T	3	307	292	95.1	19.9	6109		3.0		deep	eye
Wisc. 806R	4	1	4	445	424	95.3	17.7	7877	3	3.5		good	tuber color
La. 42-38	4	T	3	449	432	96.2	19.0	8531		3.0		deep	eye
AK 34-2	2	1	4	248	228	91.9	16.0	3968	5	2.5		smooth; small	
TND 14-1Russ	3	0	0	258	243	94.2	16.7	4309	2	2.0		very	smooth;smal
Red Pontiac	4	1	5	621	605	97.4	17.1	10619		4.0		deep	eye
Russet Burbank	5	0	0	436	383	87.8	19.9	8676		4.0		irregular	
Norchip	3	0	0	307	279	90.9	18.4	5649		1.5		rough; smallsize	
MN 8757	3	T	3	426	416	97.7	15.8	6731		3.0		deep	eye
Average	3.6			367	345	94.0	17.7	6496		2.6			

1/ 1-Very Early-Norland maturity; 2-Early-Irish Cobbler maturity; 3-Medium-Red Pontiac maturity; 4-Late-Katahdin maturity; 5 - Very Late-Kennebec or Russet Burbank maturity.

2/ AREA - T-less than 1%; 1 -1-20%; 2 - 21-40%; 3 - 41-60%; 4 - 61-80%; 5 - 81-100%. TYPE 1. Small, superficial; 2. Larger, superficial; 3. Larger, rough pustules; 4. Larger pustules, shallow holes; 5. Very large pustules, deep hole.

3/ Place top five among all entries including check varieties; disregard maturity classification. (Rate first, second, third, fourth, and fifth (in order) for overall worth as a variety.

4/ Chip Color - PCII Color Chart or Agtron.

5/ Early blight reading (1-5); 1 - very susceptible; 5 - highly resistant.

Table 2. The percent external and internal defects of several varieties entered in the 1980 North Central Potato Variety Trial.

Variety	Scab (3)	Growth Cracks	Second Growth	Sun Green	Total (4) Tubers Free of External Defects	Hollow Heart	Internal Necrosis	Vascular Discoloration	Normal Tubers (5)
	%	%	%	%	%	%	%	%	%
EARLY TO MEDIUM EARLY									
ND146-4R	0	0	2	0	98	0	0	4	96
Norland	2	0	0	4	94	0	0	4	96
MEDIUM TO LATE									
Neb. A129-69-1	26	0	0	0	74	4	0	20	76
Neb. A71-72-1	10	0	0	4	90	10	0	6	84
Neb. A219-70-3	0	0	0	0	100	0	0	2	98
MN 8742	4	2	0	0	94	2	0	16	82
MN 8757	8	4	0	2	86	0	4	6	90
MN 9319	0	4	4	0	92	0	0	22	78
Wisc. 723	2	2	0	2	94	0	0	18	82
Wisc. 726	6	0	0	2	92	2	0	12	86
Wisc. 806R	14	0	2	2	82	4	2	0	94
La. 42-38	6	2	0	0	92	4	2	4	90
AK 34-2	8	2	0	2	88	6	4	6	84
TND 14-1Russ	0	2	0	4	94	0	0	4	96
Red Pontiac	14	0	2	0	84	2	2	16	80
Russet Burbank	0	0	6	0	94	6	0	0	94
Norchip	0	0	4	0	96	0	2	6	92

1) Based on four 25-tuber samples (one from each replication). Percentage based on number of tubers.

2) Based on four 25-tuber samples (one from each replication). Percentage based on number of tubers.

3) Includes all tubers with scab lesions whether merely surface, pitted or otherwise and regardless of area. Be sure to count tubers with any amount of scab in this category.

4) This total - tubers free from any external defect of any sort.

5) Percentage normal tubers are those showing no internal defects. Some individual tubers will have more than one type of internal defects.

Weed Control in Potatoes

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Herbicide treatments for weed control are shown in Table 1. Applications in 1980 all provided complete control of annual broadleaved and grass weeds. The sprayule or dry flowable formulation of mettribuzin (Sencor/Sexone) performed equal to the flowable (4L) formulation. The major weeds in the test area were barnyardgrass and lambsquarter. Yields in Table 1 show no differences in yields with the exceptions of the postemergence applications of KK-80 and Hoelon. Yields were quite variable. Prowl and Dual when registered offer addition chemicals for preemergence control of annual grass.

POTATO YIELDS, 1980, MONTCALM FARM

Treatment	Rate Lb/A	Yield Cwt/A	Specific Gravity
1. Eptam + Sencor Sprayule (PPI) (Delay Pre)	4 + 1/2	268	1.078
2. Eptam + Lexone DF (PPI) (Delay Pre)	4 + 1/2	292	1.079
3. Eptam + Lorox (PPI) (Delay Pre)	4 + 1	256	1.077
4. Eptam + Sencor 4 + Sen Sprayule (PPI) (Delay Pre) (Post)	4 + 1/2 + 1/4	284	1.080
5. Lasso + Sen/Lexone 4 (Pre) (Delay Pre)	2 + 1/2	273	1.079
6. Lasso + Sen/Sprayule (Pre) (Delay Pre)	2 + 1/2	254	1.078
7. Dual + Sen/Lexone 4 (Pre) (Delay Pre)	2 + 1/2	298	1.079
8. Dual + Sen/Sprayule (Pre) (Delay Pre)	2 + 1/2	264	1.080
9. Lasso + Sencor (Pre)	2 + 1/2	293	1.077
10 Dual + Sencor (Pre)	2 + 1/2	286	1.078
11. Lasso + Lorox (Pre) (Delay Pre)	2 + 1	298	1.079
12. Dual + Lorox (Pre) (Delay Pre)	2 + 1	281	1.079
13. Prowl + Lorox (Pre) (Delay Pre)	1 + 1	257	1.081
14. Prowl + Sen/Sprayule (Pre) (Delay Pre)	1 + 1/2	277	1.080
15. Lasso + DPX 6573 (Pre) (Delay Pre)	2 + 1	284	1.077
16. Surflan + Sen/Lexone 4 (Pre) (Delay Pre)	1 + 1/2	286	1.076
17. Sen + Lasso + Sencor + Lasso (Pre) (Post)	1/2 + 2 + (1/4 + 1)	262	1.078
18. Sencor + Hoelon + oc (Delay Pre) (Post)	1/2 + 1 + 1 qt	237	1.077
19. Sencor + KK80 + oc (Delay Pre) (Post)	1/2 + 1 + 1 qt	197	1.079
20. Sencor + BASF 9052 + oc (Delay Pre) (Post)	1/2 + 1/2 + 1 qt	294	1.079
21. Lasso + Sencor (Hill before spraying Delay Pre)	2 + 1/2	274	1.076
22. Dual + Sencor (Hill before spraying Delay Pre)	2 + 1/2	267	1.079
23. NO TREATMENT		103	1.077

NITROGEN STUDIES WITH POTATOES

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Introduction

Present nitrogen recommendations by Michigan State University have been developed from research at the Montcalm Research Farm. Very little recent information is available on short season varieties such as those grown for early market in Bay County. A similar situation occurs for late potatoes grown on organic soils.

The objective of these two studies was to determine the optimum rate of nitrogen for short season varieties grown in Bay county and for Kennebecs grown on organic soil.

Procedure

A site was selected on organic soil on the Jim Shoemaker farm in Allegan County to evaluate the need for additional sidedress nitrogen. A basic fertilizer treatment consisting of 30 gallon of 14-32-0 was applied at planting time plus 150 lbs of 46-0-0 applied in early June. The basic rate of nitrogen was approximately 111 lbs per acre. The sidedress nitrogen treatments were applied on June 24, 1980 using ammonium nitrate (34-0-0). The treatments were 0, 60, 120 and 180 to make a total of 111, 171, 231 and 291 lbs N/A, respectively. Yields were harvested with the MSU Plot Harvestor on September 26, 1980.

The second study was established at the Meyers Farm in Bay County. Six varieties (Belrus, Atlantic, Oceania, Onaway, Superior and B 7516-9) were hand planted on May 2, 1980. The experimental design was a split plot where nitrogen levels (100, 150 and 200) were whole plots and varieties were subplot treatments. The nitrogen was topdressed as ammonium nitrate (34-0-0). A starter fertilizer consisting of 700 lbs 6-24-24 was put down with the farmers planter when the seed rows were opened. Ammonium nitrate was applied at rates of 58, 108 and 158 lbs N/A to bring the total N applied to 100, 150 and 200 lbs/A on May 25th. The plots were harvested on August 12, 1980. Tubers were weighed, sized and sampled for specific gravity determination.

Results

The yield, size distribution and specific gravity of Kennebec's grown in Allegan County are shown in Table 1. Nitrogen additions increase the yield of large tubers (> 3 1/4 inches diameter) however this resulted in fewer medium size tubers at the highest rate of N (180 lb N/A). The highest rate of N resulted in the lowest total yield and the lowest specific gravity. Although late blight on tubers was not specifically evaluated there appeared to be a higher incidence on tubers receiving the highest rate of N.

The data from the second study are found in Tables 2-4. The total yield and yield of U.S. No. 1 tubers for each variety and N rate are similar. One hundred lbs of N in general gave the largest yield for all varieties. The 150 lb N rate usually produced a lower yield, however the 200 lb N rate in some instances gave a larger yield for some varieties. Specific gravity was lowest with 200 lbs N/A. Not all varieties responded in this manner but Belrus and Superior showed most of the reduction. Onaway and Atlantic were the best yielding varieties. Specific gravity of Atlantic was far superior to Onaway.

Summary

The present recommendation of 120 lbs of N for late potatoes on organic soils and 150-180 lbs of N per acre on mineral soils for early potatoes appears to be very adequate. Additional rates of N did not result in larger yields in these studies but did lower quality as measured by tuber specific gravity.

Table 1. Effect of sidedress nitrogen on yield, tuber size and specific gravity of Kennebec potatoes grown on organic soil.

Sidedress Nitrogen[2]	Size Distribution Over 3 1/4"	2-3 1/4"	Under 2"	Total Yield	Specific Gravity
lb/A	cwt/A				-g/cc-
0	24.3a[1]	243.2 b	17.8a	285 b	1.069 b
60	32.6 bc	231.5 b	20.0ab	284 b	1.067ab
120	28.6ab	246.0 b	22.8 b	297 b	1.067ab
180	35.1 c	205.4a	21.8 b	262a	1.066a

1/ Values with a column followed by different letters are significantly different as determined by the Duncans Multiple Range test at the .05% confidence level.

2/ Basic rate of nitrogen at planting was 111 lbs/A. Sidedress nitrogen was applied June 24, 1980 as ammonium nitrate.

Table 2. Total yield as affected by nitrogen fertilizer with six potato varieties grown in Bay County (Meyers Farm).

Variety	Total Nitrogen Rate (lbs N/A) 1/			
	100	150	200	Mean
	cwt/A			
Belrus	275	258	269	267a 2/
Atlantic	426	410	418	418cd
Oceania	413	391	384	396bc
Onaway	450	396	469	438d
Superior	374	364	374	371b
B7516-9	415	367	366	383b
Bean	392b	364a	380ab	

1/ 700 lbs 6-24-24 was applied at planting to supply 42 bls of N. The additional N was topdressed on May 29 at emergence.

2/ Values within a column followed by different letters are significantly different (P=.05) as determined by the Duncans Multiple Range test.

Table 3. Yield of U.S. No. 1 tubers as affected by nitrogen fertilizer with six potato varieties grown in Bay County (Meyers Farm).

Variety	Total Nitrogen Rate (lbs N/A)[1]			
	100	150	200	Mean
	- - - - - - - - - - - - cwt/A - - - - - - - - - - - - - -			
Belrus	215	199	213	209a
Atlantic	383	374	387	381cd
Oceania	377	364	364	368b
Onaway	415	364	425	401d
Superior	353	336	353	347b
B 7516-9	375	330	317	341b
Mean	353b	328a	343ab	

[1] 700 lbs 6-24-24 was applied at planting to supply 42 lbs of N. The additional N was topdressed on May 29 at emergence.

[2] Value within a column followed by different letters are significantly different (P=.05) as determined by the Duncans Multiple Range test.

Table 4. Specific gravity of tubers as affected by nitrogen fertilizer from six potato varieties grown in Bay County (Meyers Farm).

Variety	Total Nitrogen (lbs N/A)[1/]			
	100	150	200	Mean
	g/cc			
Belrus	1.065	1.074	1.063	1.067c[2/]
Atlantic	1.076	1.077	1.076	1.076d
Oceania	1.057	1.057	1.057	1.057a
Onaway	1.060	1.058	1.058	1.059ab
Superior	1.065	1.062	1.061	1.063b
B 7516-9	1.059	1.059	1.058	1.059ab
Mean	1.064ab	1.065b	1.062a	

1/ 700 lbs of 6-24-24 was applied at planting to supply 42 lbs of N. The additional N was topdressed on May 29 at emergence.

2/ Values with a column followed by different letters are significantly different (P=.05) as determined by the Duncans Multiple Range test.

PHOSPHORUS STUDY WITH RUSSET BURBANKS

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Introduction

Phosphorus studies at the Montcalm Research Farm in 1979 showed that phosphorus fertilizer gave a very significant increase in yield of potatoes even though Bray P_1 soil tests were in excess of 400 lbs per acre. Corn rarely responds to phosphorus when the soil test exceeds 60 lbs per acre. The objectives of this study were to look at potato response to two phosphorus sources (diammonium phosphate and monoammonium phosphate), three phosphorus rates (0, 50, and 150 lbs P_2O_5 per acre) and two methods of application (band vs. broadcast).

Procedure

The experiment was established on a Montcalm-McBride sandy loam soil at the Montcalm Research Farm. Soil samples were taken from each plot prior to applying any fertilizer. The soil test results are shown in Table 1. The data indicate that the soil was quite uniform and no difference in values existed prior to the application of fertilizer. Soil test phosphorus ranged from 472-509 lb per acre which was similar to the area studied in 1979.

The experimental design was a randomized complete block with eight treatments and four replications. Russet Burbank seed was planted on May 13, 1980, after the broadcast phosphorus treatments were applied and disked in. Urea (46-0-0) and potash (0-0-60) were blended with diammonium phosphate (18-46-0) and monoammoniumphosphate (13-52-0) to balance the N and K in each treatment. All plots received 100 lbs N and K_2O per acre either banded or braodcast applied as was the phosphorus carrier.

Potato petioles were sampled on June 30 and July 21 for analysis of P and other elements. The samples were oven dried, ground and analyzed by a plasma spectrophotometer. Tubers were harvested on October 7th, sized, weighed and sampled for specific gravity determination.

Results

The elemental composition of potato petioles sampled on June 30th are reported in Table 2. Phosphorus and manganese were the only elements significantly affected by the phosphorus treatments at this early sampling. The 150 lbs P_2O_5 banded, resulted in significantly higher concentrations of both P and Mn than 150 lbs P_2O_5 broadcast or 50 lbs P_2O_5 banded. The broadcast treatments resulted in similar concentration of P and Mn as the 0 phosphorus treatments. No differences between phosphorus sources was observed in these petiole samples.

Potato petiole analysis for the July 21 sample date are shown in Table 3. Results for P and Mn were very similar to the first sampling where only the 150 lb rate banded significantly increased the concentration of these elements in the petioles. In addition boron was found to be significantly affected by the treatments, however the differences are small and not consistent enough to be explained. All values except three zinc and one copper value are above the critical level as described in Extension Bulletin E-486. The critical values for Zn and copper are 30 and 7 ppm, respectively. All values for the June 30 samples were well above the critical values and it is unlekely these elements would be classified as deficient.

Tuber yield, size and quality are reported in Table 4. Only total yield was significantly affected by the treatments. Only the last treatment (a 0 P treatment) was found to yield significantly less than all other treatments including treatment one which was also a 0 P treatment. Table 1 does not indicate any significant difference between soil test P in plots of these treatments thus given no clue as to why these plots responded differently. Phosphorus source and placement had no significant effect on yield, size or specific gravity.

Summary

The results in 1980 were not as dramatic as 1979 showing only a small but inconsistent response to phosphorus fertilizer. The plant analysis data indicate that the rate of banded P has a greater influence on P concentration in the plant than source of P. Fifty lbs of P_2O_5 banded at planting on soils similar to this sandy loam should be sufficient for optimum yields

Table 1. Soil tests from the experimental area prior to the application of the phosphorus fertilizer treatments.

Phosphorus			Soil Test				
Source	Placement	Rate	pH	P	K	Ca	Mg
		-lb P_2O_5/A-		- - - - - - lb/A - - - - - - - - -			
None	-	0	7.0	497	350	1045	216
18-46-0	Band	50	7.1	509	343	1087	228
13-52-0	Band	50	7.0	472	347	1087	228
18-46-0	Band	150	7.1	493	341	1088	240
13-52-0	Band	150	7.1	496	320	1088	208
18-46-0	Broadcast	150	6.8	482	393	1109	210
13-52-0	Broadcast	150	6.8	487	341	1045	193
None	-	0	7.0	481	345	1088	224
LSD(.05)			NS	NS	NS	NS	NS

Table 2. Elemental composition of potato petioles sampled June 30, 1980 as affected by rate source and placement of phosphorus fertilizer.

Phosphorus			Elements										
Source	Placement	Rate[3/]	P	K	Ca	Mg	Zn	Mn	Cu	B	Fe	Mo	Al
		-lb P_2O_5/A-	- - - - - -%- - - - - -				- - - - - - - - - - - - - ppm - - - - - - - - - - - - -						
None	-	0	.22	10.6	1.11	.65	44	64	16	25	75	4	162
18-46-0[1/]	Band[4/]	50	.31	9.8	1.10	.62	41	89	8	24	68	4	163
13-52-0[2/]	Band	50	.30	9.6	.97	.60	40	64	19	24	79	4	192
18-46-0	Band	150	.47	9.6	.93	.60	42	102	11	24	69	4	183
13-52-0	Band	150	.48	11.9	1.22	.71	46	119	16	28	78	4	159
18-46-0	Broadcast[5/]	150	.29	10.5	1.13	.61	42	43	8	26	78	4	176
13-52-0	Broadcast	150	.27	10.1	1.03	.60	40	36	13	26	81	4	183
None	-	-	.25	10.1	1.06	.62	40	38	10	27	80	4	164
LSD (.05)			.10	NS	NS	NS	NS	35	NS	NS	NS	NS	NS

1/ Diammonium phosphate

2/ Monoammonium phosphate

3/ Diammonium and monoammonium phosphates were blended with urea and potash to supply 100 lbs of N and K_2O at planting for all plots. In addition 120 lbs of N was sidedress at hilling time.

4/ Banded in two bands 2 inches to the side and 2 inches below the seed piece.

5/ Disked in after plowing and before planting.

Table 3. Elemental composition of potato petioles sampled July 21, 1980 as affected by rate, source and placement of phosphorus fertilizer.

Phosphorus			Elements										
Source	Placement	Rate3/	P	K	Ca	Mg	Zn	Mn	Cu	B	Fe	Mo	Al
		-lb P_2O_5/A-	%				ppm						
None	-	0	.27	8.0	.72	.61	37	89	9	28	55	3	48
18-46-0 1/	Band	50	.27	6.9	.58	.52	34	122	9	27	57	3	83
13-52-0 2/	Band	50	.28	7.0	.63	.54	31	103	7	26	54	3	48
18-46-0	Band	150	.39	7.3	.75	.68	29	125	8	26	53	3	45
13-52-0	Band	150	.39	7.4	.77	.63	32	164	6	27	57	3	50
18-46-0	Broadcast	150	.33	7.8	.71	.58	32	85	7	27	53	3	53
13-52-0	Broadcast	150	.29	8.7	.89	.72	29	90	9	29	56	3	45
None	-	-	.29	8.7	.90	.72	27	53	7	28	56	3	66
LSD (.05)			.11	NS	NS	NS	NS	48	NS	2	NS	NS	NS

1/ Diammonium phosphate

2/ Monoammonium phosphate

3/ Diammonium and monoammonium phosphates were blended with urea and potash to supply 100 lbs of N and K_2O at planting for all plots. In addition 120 lbs of N was sidedressed at hilling time.

4/ Banded in two bands two inches to the side and two inches below the seed piece.

5/ Disked in after plowing and before planting.

Table 4. Effect of phosphorus fertilizer source, placement and rate of application on tuber shape, size, yield and specific gravity of Russet Burbank potatoes.

Phosphorus Source	Phosphorus Placement	Phosphorus Rate[3/]	Off Type	Over 10 oz	A Size	B Size	Total Yield	Specific Gravity
		-lb P_2O_5/A-	cwt/A	cwt/A	cwt/A	cwt/A	cwt/A	g/cc
None	-	0	55	77	189	50	371	1.077
18-46-0[1/]	Band[4/]	50	60	73	200	50	383	1.080
13-52-0[2/]	Band	50	58	83	187	49	376	1.079
18-46-0	Band	150	54	76	194	57	380	1.078
13-52-0	Band	150	67	71	182	53	373	1.079
18-46-0	Broadcast[5/]	150	61	72	193	52	377	1.079
13-52-0	Broadcast	150	64	76	182	48	369	1.080
None	-	0	60	64	162	51	337	1.077
LSD (.05)			NS	NS	NS	NS	25	NS

1/ Diammonium phosphate

2/ Monoammonium phosphate

3/ Diammonium and monoammonium phosphates were blended with urea and potash to supply 100 lbs N and K_2O at planting for all plots. In addition 120 lbs of N was sidedressed at hilling time.

4/ Banded in two bands two inches to the side and two inches below the seed piece.

5/ Disked in after plowing and before planting.

THE INFLUENCE OF SELECTED PRODUCTION MANAGEMENT INPUTS ON THE YIELD, QUALITY, AND STORABILITY OF POTATOES

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Previous experiments investigating the response of potatoes to nitrogen and phosphorus have demonstrated that the use of nematicide is important for optimal use of nutrient inputs when Pratylenchus penetrans is present. The 1980 Integrated experiment dealt with the effect of potassium and pest control inputs on the yield, quality and storability of Superior.

Our objectives were to evaluate the interactions of three potassium levels subjected to three pest control measures and their effect on yield, quality and storability of Superior and to monitor nematodes, fungi and insects to determine their effect on yield response to the inputs.

Methods

Seed pieces were planted on May 12, 1980 (degree day base 10 C [DD_{10} = 139]) in a McBride sandy loam soil at the Montcalm Potato Research Farm in Entrican, Michigan. Each plot consisted of four rows 50 feet long having a 34 inch row width and 8-12 inches between seed pieces. Three levels of potassium 0, 50 and 150 pounds K_2O/A were subjected to three different pest control treatments: Temik 15G 3.0 lbs. a.i./A, Terraclor 8.0 lbs. a.i./A, and a check. Each of the nine treatments were replicated five times. A 3x3x5 split factorial design was used. All plots received the standard rate of nitrogen and phosphorus fertilizers. 50 and 150 lbs. per acre of potassium were broadcast prior to planting. Temik 15G was banded with the starter fertilizer at a rate of 3.0 lbs. a.i./A. T errachlor was broadcast as a granular at 8.0 lbs. a.i./A and disked in. Insects were monitored weekly and sprays were applied when deemed necessary. Soil and root population densities of the root lesion nematode (P. penetrans) were determined by sampling at planting and every two weeks thereafter. Colletotrichum spp., Fusarium spp., Rhizoctonia spp., and Verticillium spp. were monitored three times during the growing season: July 16, 28 and Aug. 12 (DD_{10} = 1049, 1296, 1580, respectively). Nutrient levels were monitored by preplant soil samples plus petiole sampling twice during the growing season. The center two rows of each plot were harvested, graded and weighed.

RESULTS AND CONCLUSIONS

Table 1 is a summary of the yield and specific gravity data. The amount of oversized tubers was significantly (P = 0.05) increased by Temik and again by potassium inputs within the Temik treatment. The temik treated plants were able to utilize higher potassium inputs than the non-Temik plants and marketable tuber yields increased incrementally with increasing potassium. Without nematode control (check and Terraclor) there were no yield increases above 50 lbs K_2O/A. Only the plots treated with 150 lbs K_2O/A plus Temik had significantly higher (P = 0.05) production of A sized tubers. There was no significant (P = 0.05) difference in the yields of B sized tubers. Either the nematode control and/or other properties of Temik allowed optimal use of the potassium inputs not realized in the check or Terraclor treatments. It is probable that the root damage cuased by high nematode densities reduced the root system's efficiency to adsorb and transport potassium resulting in reduced ruber production. There were no significant (P = 0.05) differences relating the inputs and specific gravities, though there was a tendency for reduced specific gravity with the highest potassium input and with Temik.

Soil samples were taken from every plot just prior to applying the broadcast K fertilizer. Good soil test uniformity was observed for all treatments except soil pH as indicated by the non-significant (NS) LSD tests (See Table 2). Soil pH, however, did not vary more than 0.3 for all treatments compared. Exchangeable K varied from 300 to 403 and yet these differences were not measured as signicantly different indicating that considerable variability exists for this element. The range for K in the entire experimental area was 244 to 541. Using the average value for the entire area (333 lb K/A) the maximum recommendation for a yield of 450-550 cwt/A would be 100 lb K_2O/A. A zero K recommendation would be given for any yield level of less than 350 cwt/A.

Potato petiole samples were taken June 30 and three weeks later on July 21. Analysis for the first sampling are showing in Table 3. Only K was significantly affected by the treatments. In general, K concentrations in the potato petiole were directly related to the rate of K fertilizer applied. Temik and Terrachlor had no effect on K concentration in the petioles.

The second sampling data are presented in Table 4. In addition to K, Ca and Mg were also significantly affected by the treatments. In general, increasing the K content of the potato petioles decreased the Ca and Mg levels.

Many of the elements (NO_3, P, K, Zn and Mo) tended to increase with the second sampling while Ca, Mg, Mn, Fe and Al decreased. Copper was found to be highly variable indicating the possibility of problems with analyzing petioles for this element.

Normal or sufficient ranges for potato petioles from recently matured leaves sampled in mid-season have been reported as follows:

P = .18 - .22
K = 6.0 - 9.0
Ca = .36 - .50
Mg = .17 - .22
Mn = 30 - 200
Fe = 30 +
B = 14 - 40
Cu = 7 - 30
Zn = 30 - 100

From these sufficiency ranges, we find K in the petioles at the first sampling was below the 6.0% critical level except where 150 lb K_2O per acre was broadcast. On the second sampling date, all K values were above the critical 6.0% level. I would conclude that some K banded at planting time would probably have increased the early uptake of K and may have resulted in better plant gorwth. Zinc values for the first sampling also appear to be below the suggested critical level of 30 ppm. The second sampling data, however, shows that nearly all Zn levels were above the 30 ppm.

In summary, it appears that some K banded at planting may be beneficial and would have resulted in higher K levels in potato petioles sampled in late June. Since broadcast K did not result in increased yield, we can only speculate what may have happened if K had been banded. A general trend toward a yield increase due to applied K was observed when Temik was included. The largest yield was obtained with 150 lbs K_2O and Temik.

Temik and Terrachlor did not significantly affect the chemical composition of potato petioles. Previous studies have shown that Mn content was decreased with use of Temik.

Yields for this experiment were somewhat lower than anticipated. At this yield level, the MSU recommendation would be zero lbs K_2O. Thus, it would appear that the present K recommendations are adequate.

The experiment was established on May 12, but significant ($P = 0.05$) _P. penetrans_ control did not occur until the July 8 sampling (see Fig. 5). At this time, there were many juveniles in the check and Terraclor roots but none in the Temik roots. There was no significant ($P = 0.05$) influence by potassium levels or Terraclor on _P. penetrans_ populations. The relatively late nematode control by Temik is probably due to a lack of soil moisture early in the growing season, limiting Temik's diffusion through the soil and root uptake.

Due to the heavy spray schedule, Colorado potato beetles were the only insects of any consequence. The first brook of Colorado potato beetle adults were present by May 27 and through July 1. The second brood began emerging slightly before the July 15 sampling and was present at harvest, August 19. No beetle adults were active in the Temik treatments until July 22. Egg masses laid by the first-brood adults were present on the non-Temik plots most of the growing season. The egg masses from the second-brood adults were first noted on August 4 and were present on all treatments. Larvae were present on the non-Temik plants from June 17 through July 22 and then again on August 4. No larvae were detected on the Temik treatment. The spray schedule was adequate to control significant damage to the non-Temik treatments.

Terraclor was used to reduce soil-borne fungi populations. Early dying symptoms were noted by mid-July and the laboratory procedures concurred that Verticillium was a factor. There were no differences in infection levels due to the potassium treatments. The earliness of Verticillium infection is considered by some researchers to be the most important factor for predicting yield loss from Verticillium. The earlier the infection, the greater the yield loss. Our late sampling plus the lack of early-season nematode control may have caused our limited success in detecting treatment effects on Verticillium. Rhizoctonia, Fusarium, and Colletotrichum were also identified from the samples. There was no noticeable difference in their infection levels due to the treatments. By August 12, percent infection of Rhizoctonia, Fusarium and Colletotrichum was 40, 40 and 90, respectively. Based on our sampling, Terraclor did little to limit fungal infection.

SUMMARY

By integrating pest control measures and potassium inputs, we were able to more fully understand the interactions of nutrient inputs and pest influences. When nematodes were controlled with Temik 15G, there was a significant ($P = 0.05$) yield increase of oversized tubers plus a greater significant ($P = 0.05$) yield increase of oversized tubers from the potassium inputs. The production of marketable tubers was significantly ($P = 0.05$) increased with Temik 15G. The potassium inputs had no noticeable effect on the nematode, fungus or insect population densities. The results indicate that with P. penetrans present, Temik 15G was necessary to optimize potassium inputs.

The pest control treatments had no effect on potassium concentration in the plants. It appears that some potassium banded at planting was necessary to obtain proper early season potassium levels for good plant growth.

TABLE 1

Influence of Selected Management Practices on Final

Tuber Yield and Specific Gravity of Superior

1980

	TUBER YIELDS (CWT/A)				
	A	JUMBO	B	(A+JUMBO)	SPECIFIC GRAVITY
1. 0 lbs K_2O/A - check	228.24^{a}[1]	1.06^{a}	17.68^{a}	227.62^{a}	1.0710^{bc}
2. 50 lbs K_2O/A - check	236.84^{a}	1.54^{a}	15.54^{a}	238.38^{a}	1.0700^{abc}
3. 150 lbs K_2O/A - check	234.86^{a}	2.14^{a}	16.60^{a}	237.00^{a}	1.0696^{abc}
4. 0 lbs K_2O/A - Temik[2]	269.74^{bc}	5.54^{b}	18.16^{a}	275.28^{b}	1.0678^{ab}
5. 50 lbs K_2O/A - Temik	273.58^{bc}	8.60^{c}	15.82^{a}	282.20^{b}	1.0674^{ab}
6. 150 lbs K_2O/A - Temik	294.96^{c}	8.92^{c}	16.38^{a}	303.90^{b}	1.0672^{a}
7. 0 lbs K_2O/A - Terraclor[3]	233.30^{a}	0.94^{a}	18.44^{a}	234.24^{a}	1.0692^{abc}
8. 50 lbs K_2O/A - Terraclor	242.40^{ba}	1.52^{a}	15.98^{a}	243.94^{a}	1.0718^{c}
9. 150 lbs K_2O/A - Terraclor	241.92^{ba}	1.38^{a}	16.28^{a}	243.32^{a}	1.0664^{a}

[1]Treatment means within column followed by the same letter are not significantly different at the .05 probability level based on Student-Newman-Keuls multiple range test.

[2](3.0 lbs. a.i./A)

[3](8.0 lbs. a.i./A)

Table 2. Soil tests from the experimental area prior to the application of the potassium fertilizer and chemical treatment.

Potassium	Chemical	Soil Test				
		pH	P	K	Ca	Mg
-lb K_29/A-			- - - - - lbs/A - - - - - - - -			
0	Control	6.9	544	310	1258	237
50	Control	6.8	539	315	1067	205
150	Control	7.0	518	340	1259	254
0	Temik	7.1	505	300	1109	228
50	Temik	7.0	546	403	1280	237
150	Temik	6.8	559	341	1237	241
0	Terrachlor	7.0	511	325	1130	211
50	Terrachlor	7.0	522	330	1237	252
150	Terrachlor	6.9	510	334	1216	241
LSD (.05)		0.2	NS	NS	NS	NS

Table 3. Elemental composition of potato petioles sampled on June 30, 1980 as affected by potassium fertilizer and chemical treatments.

Treatment		Elements											
Potassium[1/]	Chemical	NO_3	P	K	Ca	Mg	Zn	Mn	Cu	B	Fe	Mo	Al
-lb K_2O/A-		ppm	- - - - % - - - -				- - - - - - - - - -ppm- - - - - - - - - - -						
0	Control[2/]	21,921	.23	5.15	1.38	1.14	29	400	67	37	120	9	257
50	Control	19,559	.23	5.68	1.44	1.08	26	461	12	34	112	9	187
150	Control	20,215	.22	6.43	1.51	1.08	27	573	24	39	120	9	214
0	Temik[3/]	21,914	.30	5.07	1.37	1.23	25	354	24	35	94	9	145
50	Temik	21,109	.21	6.48	1.43	1.01	25	455	34	36	114	9	227
150	Temik	20,308	.30	6.32	1.28	1.03	23	424	39	33	102	9	164
0	Terrachlor[4/]	19,988	.21	5.56	1.46	1.21	27	394	29	37	112	9	191
50	Terrachlor	19,013	.23	5.98	1.44	1.24	24	394	44	34	119	9	197
150	Terrachlor	20,180	.23	6.64	1.45	1.05	25	539	37	35	113	9	210
LSD (.05)		NS	NS	0.82	NS	NS	NS	NS	NS	NS	NS	NS	NS

[1/]Broadcast and disked in before planting

[2/]Foliar pesticides to control insects and disease

[3/]Banded with the fertilizer at 3 lb a.i. per acre

[4/]Broadcast spray and disked in before planting.

Table 4. Elemental composition of potato petioles sampled on July 21, 1980 as affected by potassium fertilizer and chemical treatments.

Treatment		Elements											
Potassium[1/]	Chemical	NO_3	P	K	Ca	Mg	Zn	Mn	Cu	B	Fe	Mo	Al
-lb K_2O/A-		ppm	- - -	- - - %	- - -		- - -	- - -	- - -	ppm - - -	- - -	- - -	- - -
0	Control[2/]	29,234	.39	6.28	1.21	.85	28	306	29	28	107	7	299
50	Control	31,318	.36	6.48	1.08	.74	33	261	28	27	110	7	408
150	Control	30,074	.35	6.98	.94	.55	38	247	40	25	97	7	393
0	Temik[3/]	31,274	.38	6.37	1.17	.90	28	267	11	29	111	8	331
50	Temik	28,917	.37	7.93	1.01	.54	37	229	40	30	113	7	375
150	Temik	29,495	.39	8.03	1.19	.82	31	240	47	31	132	8	466
0	Terrachlor[4/]	30,373	.35	7.62	1.16	.79	37	267	12	32	120	8	421
50	Terrachlor	33,729	.38	7.10	1.16	.85	32	218	23	27	98	7	282
150	Terrachlor	28,787	.39	7.88	1.05	.64	39	257	41	32	137	8	467
LSD (.05)		NS	NS	1.20	.16	.18	NS	NS	NS	NS	NS	NS	NS

1/ Broadcast and disked in before planting

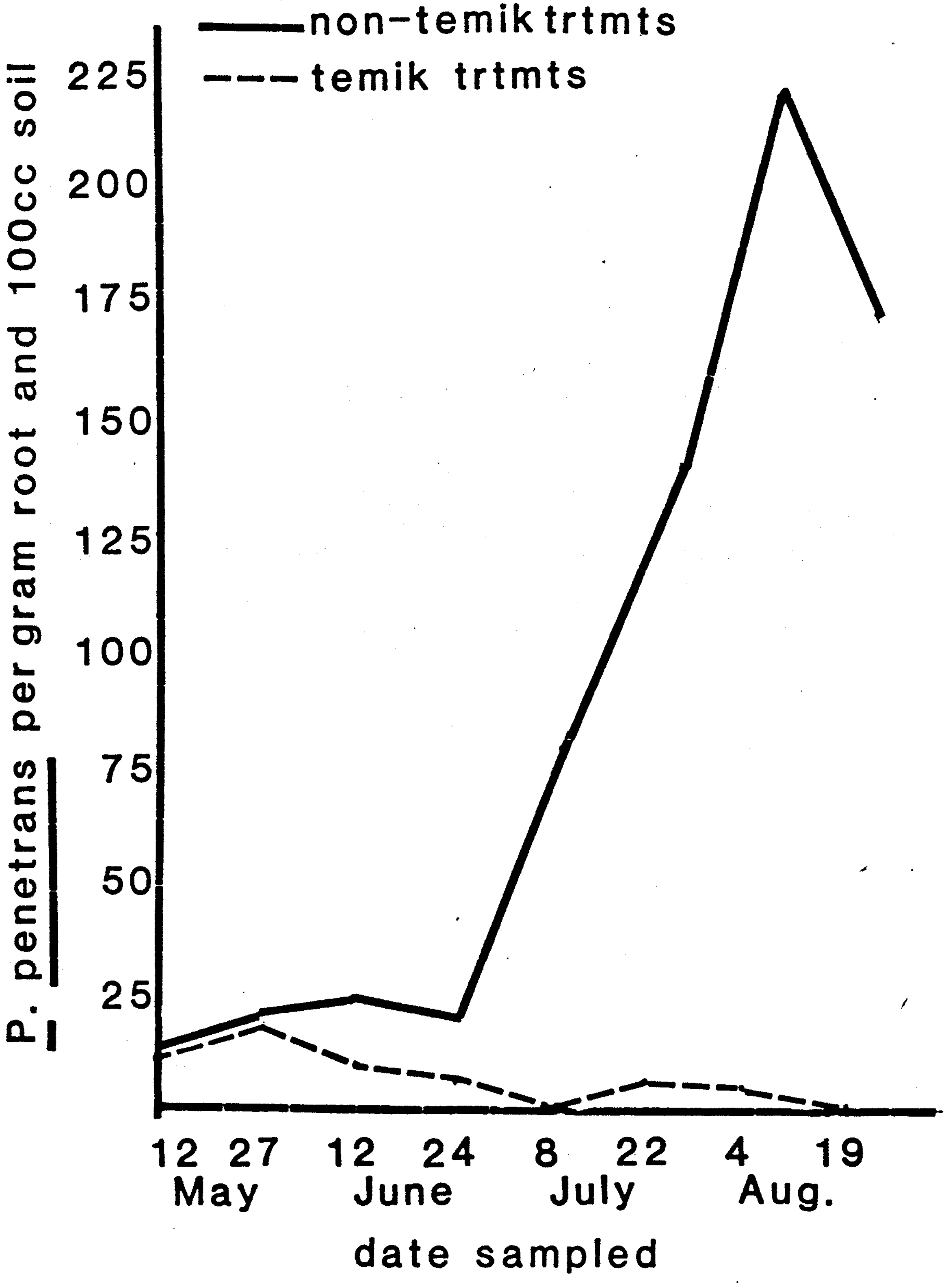
2/ Foliar pesticides to control insects and disease

3/ Banded with the fertilizer at 3 lb a.i. per acre

4/ Broadcast spray and disked in before planting

FIGURE 5

POPULATION DYNAMICS OF P. PENETRANS ON SUPERIOR



THE RELATIONSHIP OF VARIETY AND NITROGEN TO YIELD, SPECIFIC GRAVITY, SUCROSE AND PROCESSING QUALITY

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Introduction

Although physical maturity and tuber size are important because they determine crop yield, one of the major factors affecting the final quality of processed potato products, especially chips, is the sugar content at harvest and the amount of reducing sugars which accumulate during storage. In a storage situation, the carbohydrate, sucrose, can be enzymatically converted to two, 6 carbon reducing sugars (glucose and fructose), which then react with amino acids during frying, to produce dark colored chips. Under these circumstances, it has been shown to be very important for potatoes being stored for chipping to have minimal sucrose levels when harvested and it is this factor which separates good processing potatoes from poor processors.

Since carbohydrate content is so important for finished product quality, it was felt that monitoring the sugar changes during growth of tubers could be useful in predicting harvest maturity, however, these changes may be influenced by a number of factors, including, variety, growing conditions, soil fertility and stress conditions. The present, two year study, has been designed to incorporate some of these factors in order to determine their effects on sucrose content during tuber growth. A second, and equally important objective, has been to obtain sucrose data for potatoes grown in Michigan.

Procedure

Six varieties, Atlantic, Belchip, Denali, Monona, Norchip and Russet Burbank were grown at two levels of nitrogen, 170 and 240 lbs/A. Fertilizer applied was 200 lbs/A 0-0-60 at plowdown, 500 lbs/A of 19-19-19 at planting. Sidedress nitrogen (150 lbs/A 46-0-0) was applied to the high fertility plots as a sidedress when the plants were approximately 10 inches tall. A one year old stand of alfalfa was plowed down.

The varieties and fertility were arranged in a randomized block with 4 replications. Russet Burbank and Norchip were planted at 10 inches and the others at 7 inches. Six plantings of the entire experiment were made on May 6 so variable harvests could be made at approximately 2 week intervals. Actual harvests were July 31, August 14, 27, September 16 and October 1 and yields, size distribution, specific gravity and chip color were determined. Samples were also collected for sucrose and carbohydrate analysis. Samples from the September 16 harvest were placed in 53F and 45F storages for chip processing in January and February respectively. Soil temperatures at the 4 and 10 inch depths were monitored during the total harvest period.

Field Results

The marketable yield and specific gravity response for each variety appears in Figures 1-6. There was very little total yield response to the higher level of nitrogen suggesting that some factor other than nitrogen limits a further increase in yield. This was particularly true for Norchip, Belchip and Atlantic. Monona, Russet Burbank and Denali did show a yield increase at the higher level. Denali, Belchip and Russet Burbank are late maturing varieties and did not reach their optimum yields until late September whereas Norchip Monona and Atlantic had a much lower bulking rate late in the season as evidenced by the leveling off of their yield curves later in the season.

Of particular interest is the development of specific gravity during the growing season. In nearly all varieties the higher level of nitrogen resulted in a lower specific gravity. This fact has been demonstrated on other varieties by other researchers. Monona, Norchip and Russet Burbank reached their maximum levels of specific gravity by the end of August followed by a slight decline. The above average rainfall during September may have added to the decline. Atlantic and Belchip reached their maximum level approximately 2 weeks later or by mid-September. Denali declined in mid-September and then increased again by October 1, however to only the same level attained by the end of August.

Chipping tests were conducted at 1 and 4 days after harvest. For all varieties and all harvests, chip color was well within the acceptable color range.

Soil temperatures at the 4 inch level ranged from a high of 74 to a low of 43. (Table 1) At the 10 inch level the range was from 71 to 50. As expected, the extremes at the 4 inch level were much greater than at the 10 inch depth.

Table 1. The soil temperatures recorded at a 4 and 10 inch depth during the harvest period of August 14 - October 1. Montcalm Research Farm, 1980.

Recording	4 inch		10 inch	
Period	High	Low	High	Low
Aug. 14 - 21	72	59	68	62
Aug. 21 - 28	74	62	70	64
Aug. 28 - Sept. 5	74	62	71	64
Sept. 5 - 12	74	55	68	60
Sept. 12 - 19	70	49	65	55
Sept. 19 - 25	66	48	63	55
Sept. 25 - Oct. 1	64	43	59	50

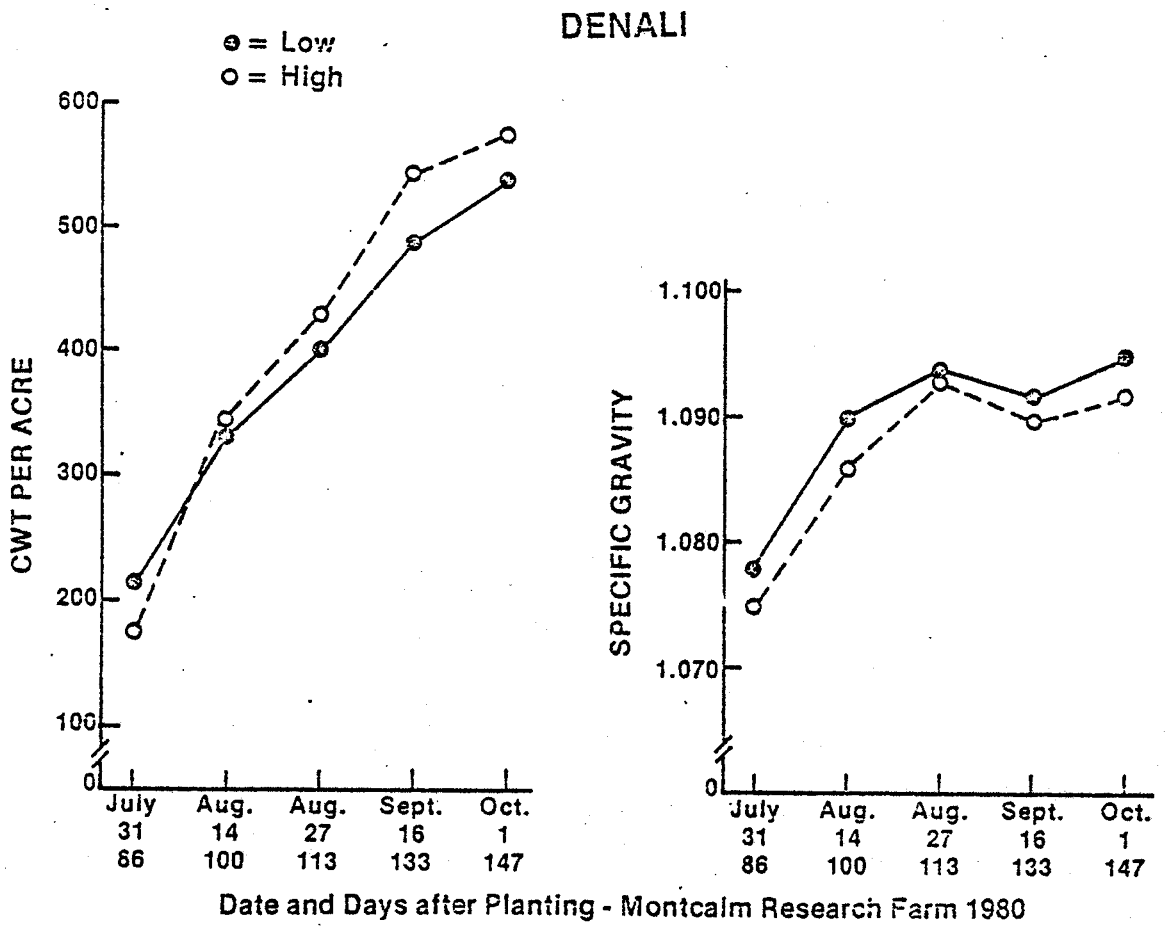

Figure 3. The marketable yield and specific gravity of Denali grown at two nitrogen levels and harvested on different days after planting.

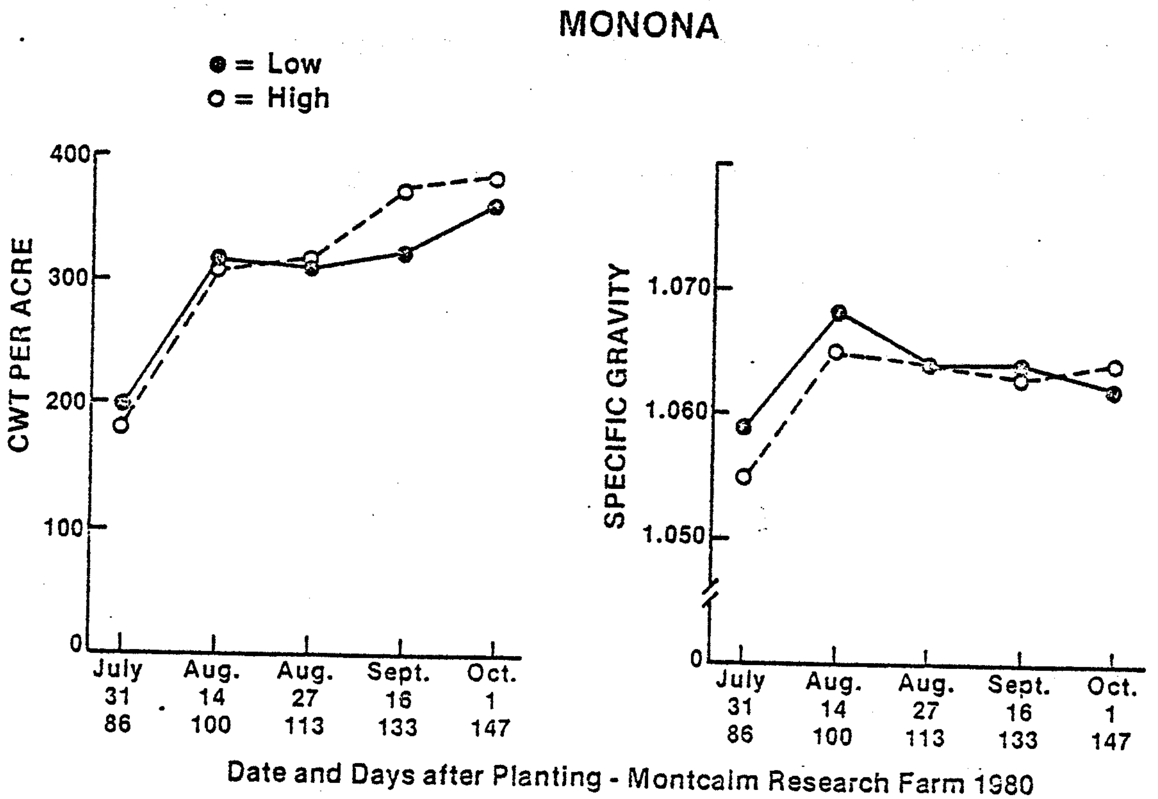

Figure 4. The marketable yield and specific gravity of Monona grown at two nitrogen levels and harvested on different days after planting.

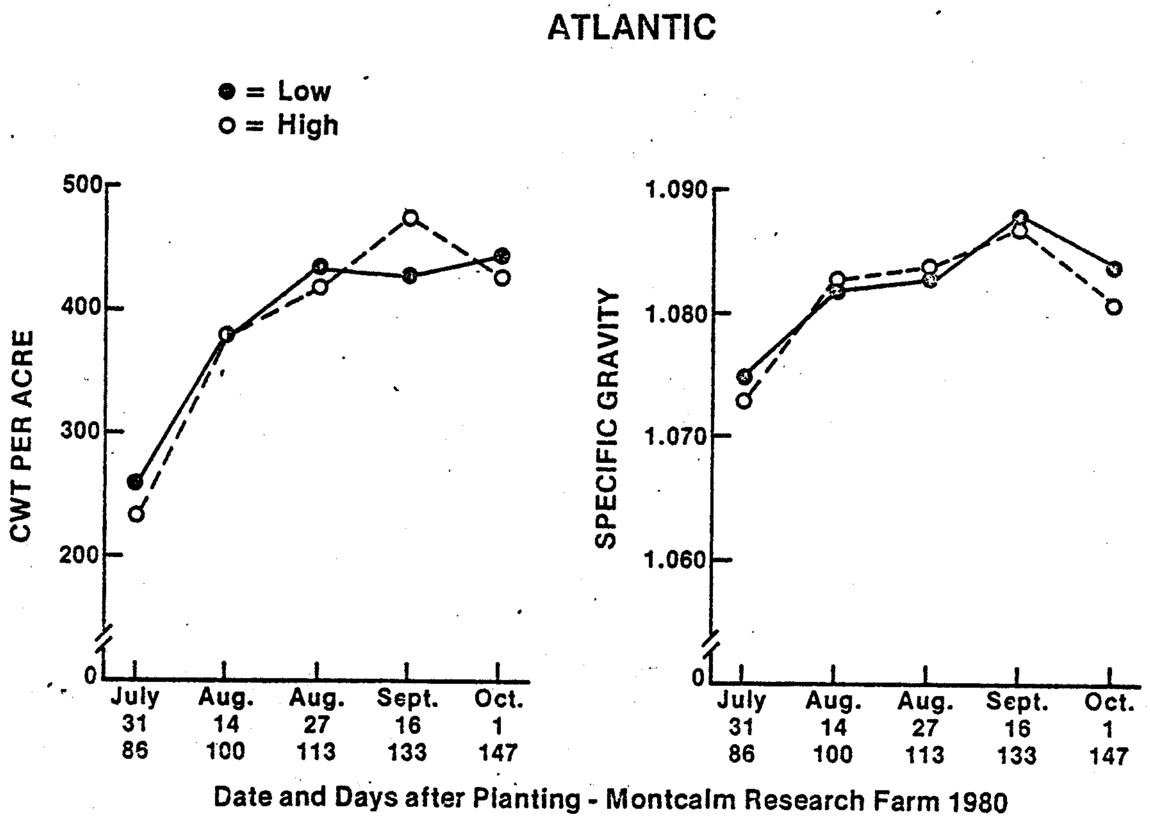

Figure 1. The marketable yield and specific gravity of Atlantic grown at two nitrogen levels and harvested on different days after planting.

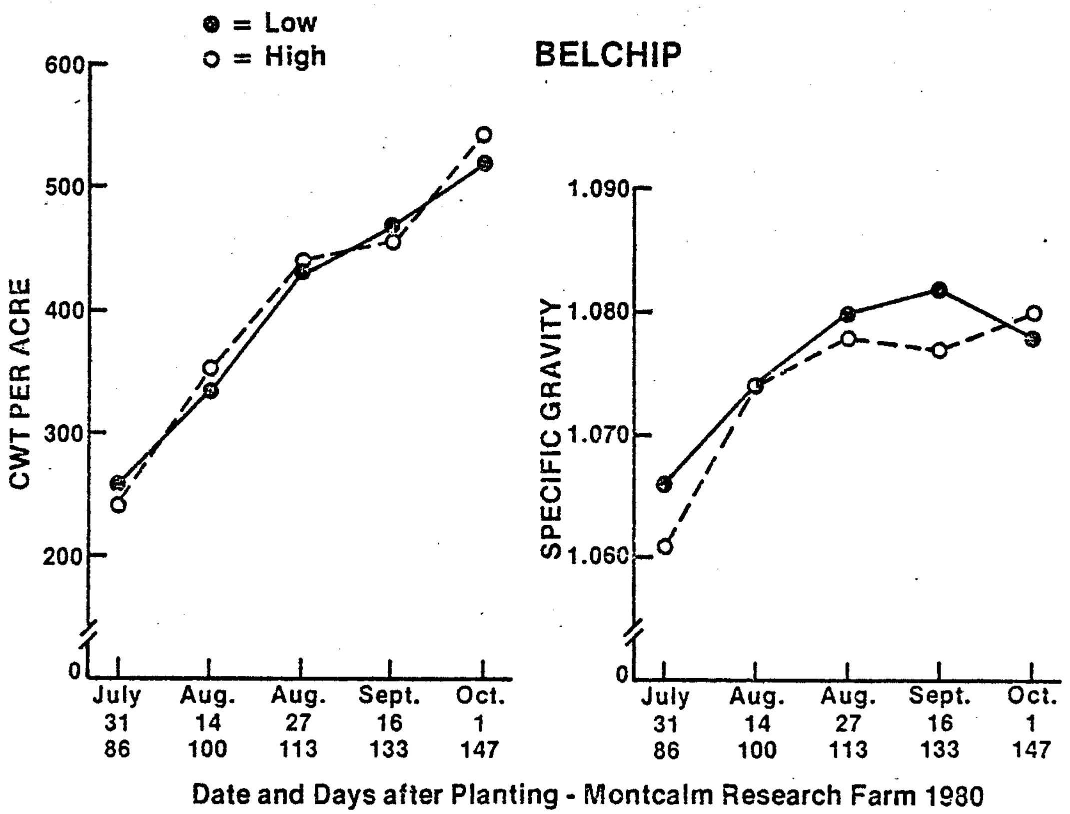

Figure 2. The marketable yield and specific gravity of Belchip grown at two nitrogen levels and harvested at different days after planting.

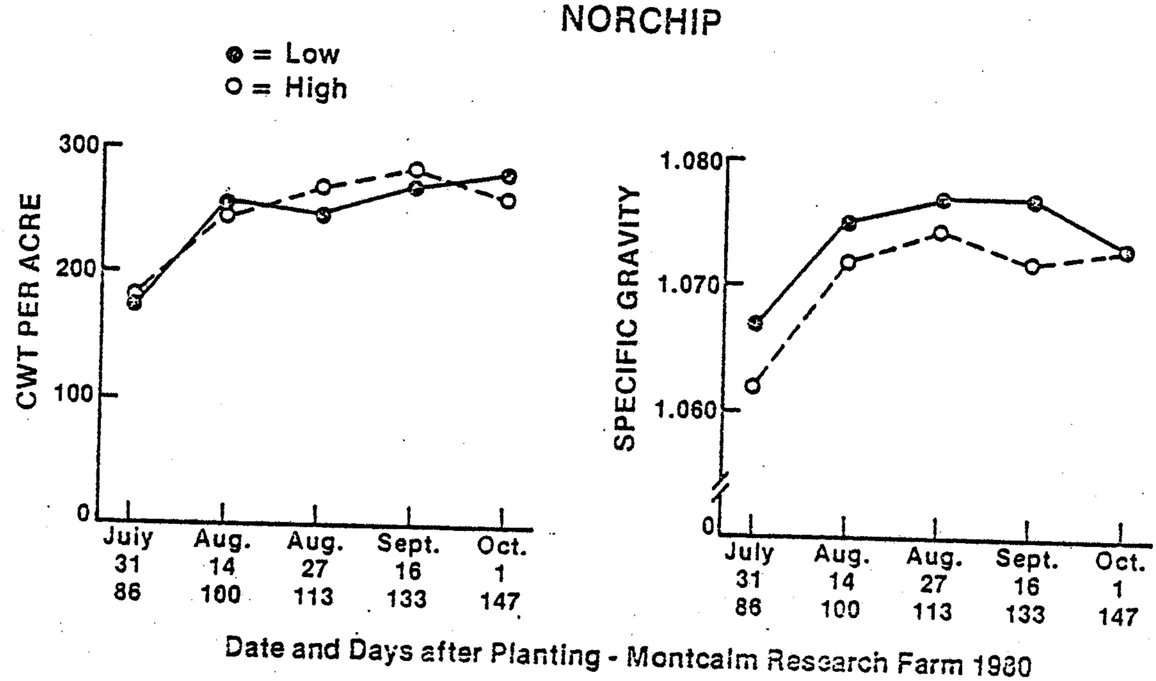

Figure 5. The marketable yield and specific gravity of Norchip grown at two nitrogen levels and harvested on different days after planting.

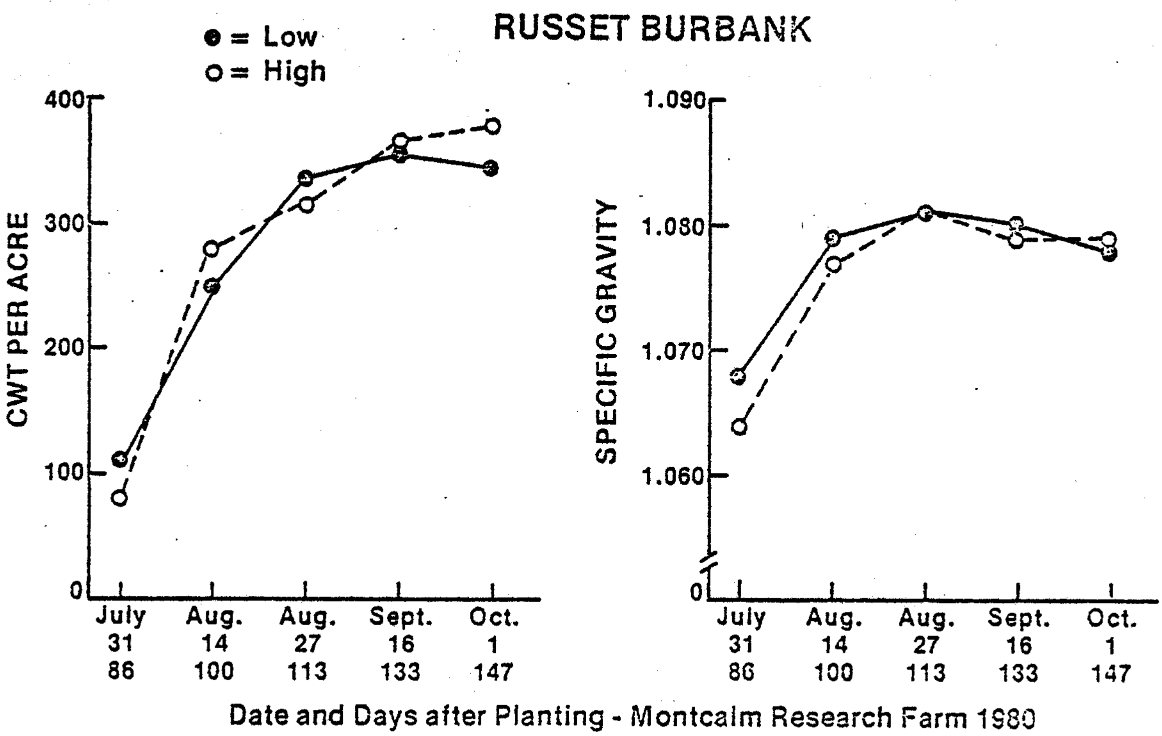

Figure 6. The marketable yield and specific gravity of Russet Burbank grown at two nitrogen levels and harvested on different days after planting.

Carbohydrate Analysis Results

Sugar changes were determined by a standard sucrose rating (SR) technique at each harvest date. Previous work, using the SR analysis for predicting storage stability, has indicated that an SR of 2.8 or less is desirable for good processing potatoes. All the varieties tested were below this level by July 31 (86 days after planting) but tubers were still small and specific gravity was very low at this point (see Figures 7 and 8). The SR values leveled off and did not change significantly after the July 31 harvest. As expected, chip color tended to follow the same trend with all cultivars producing chips that rated between 1 and 2 on the PC/SFA 5 code color scale (1 lightest - 5 darkest) by July 31.

For the present study, use of the SR as an aid in predicting harvest maturity showed that there was a great deal of difference in sucrose contents between samples but all potatoes tested attained low sucrose levels several weeks before tuber size, specific gravity, and chip yield were at their maximum. Fluctuations in the SR occurred with environmental changes but in 1980 these changes were not statistically significant within cultivars or selections. Although the SR may be a valuable tool for planning storage regimes and predicting storage stability, it has not correlated well, under the conditions of the present study, with physical maturity parameters for predicting harvest maturity.

In addition to the 6 cultivars included in the primary study, 27 cultivars and/or selections from the MSU variety trials were monitored for SR changes during the growing season. Results of these analyses are shown in Table 3 of the "1980 Potato Variety Evaluations" report.

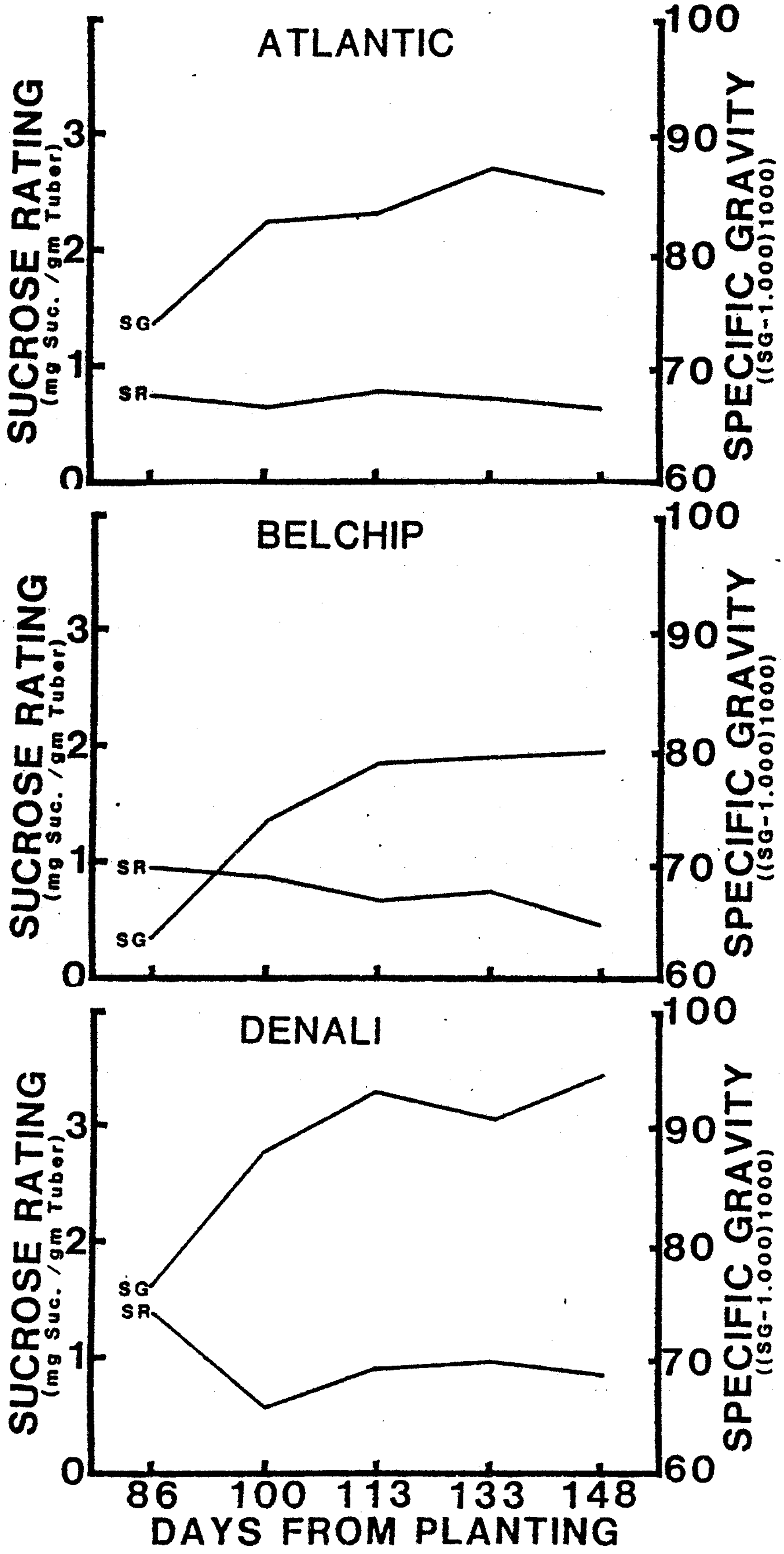

Figure 7 . Sucrose Rating (SR) and Specific Gravity (SG) of Atlantic, Belchip and Denali Potato Cultivars Grown at the Montcalm Farm in 1980.

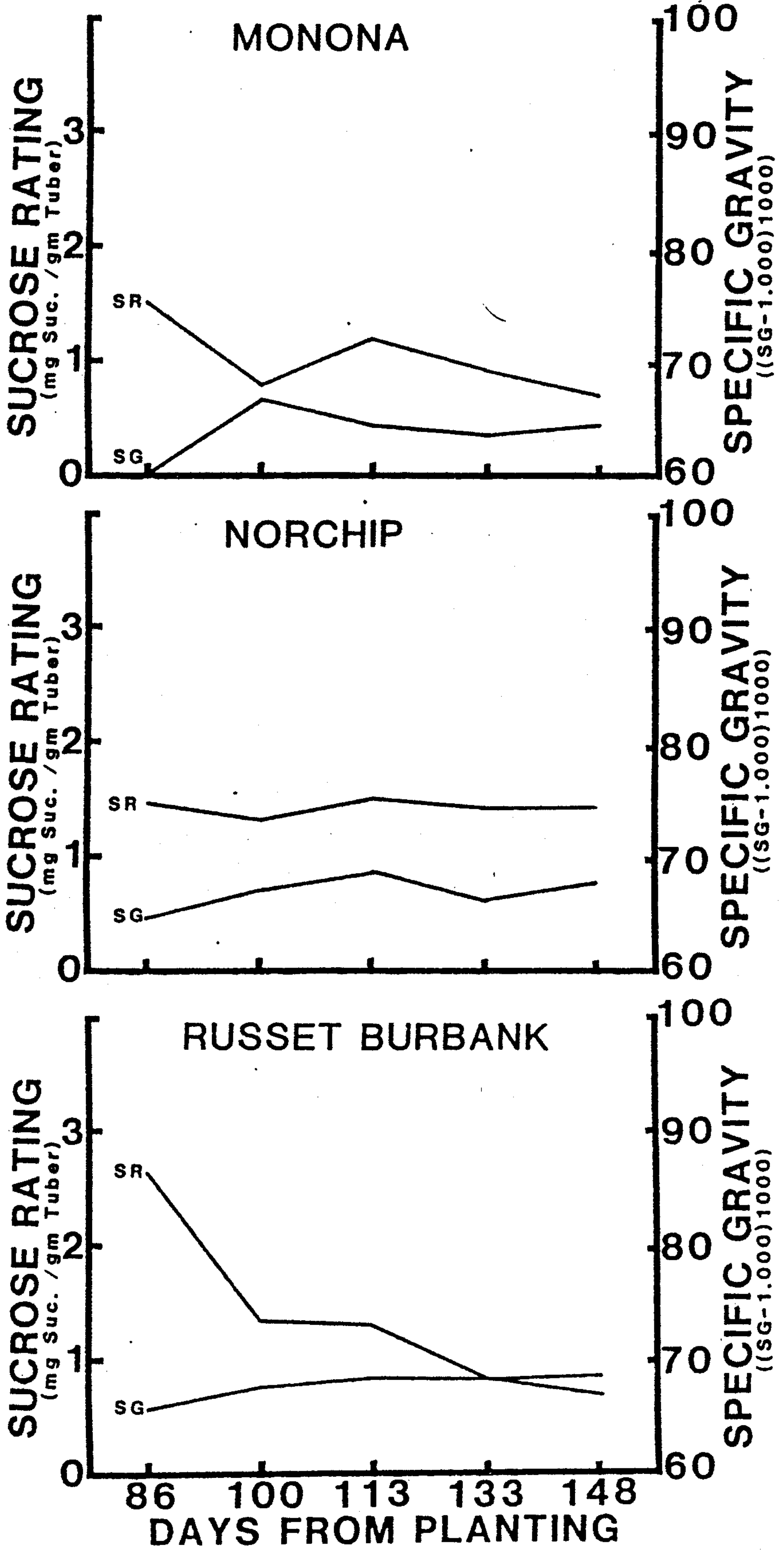

Figure 8 . Sucrose Rating (SR) and Specific Gravity (SG) of Monona, Norchip and Russet Burbank Potato Cultivars Grown at the Montcalm Farm in 1980.

SOIL INSECT CONTROL STUDIES

Arthur L. Wells
Department of Entomology

A plot to evaluate 20 different treatments including combinations of experimental and registered insecticides on soil insects was conducted at the Comden Farm adjacent to the Montcalm Experimental Farm in Montcalm County. The plot was located in a field which had been out of production several years and had become established with weeds and grasses. An early inspection of the area indicated that a low infestation of white grubs were present and could cause potential feeding damage to potato tubers.

The treatments were applied in six replications of paired 25 foot rows in a randomized block design. The outside and every third plot was left untreated so the grub damage in each treated plot could be compared with an adjacent untreated plot. This plot layout was selected to assume adequate evaluation of the data since past research indicated that soil insects, especially white grubs, are seldom evenly distributed over an area. A space equivalent to one blank row was left between each plot. Ten foot alleys were left untreated between the ends of the replicated plots.

The broadcast applications were distributed as granules or in water at the rate of 80 gallons per acre to the soil surface and incorporated immediately with a double disc to a depth of 6-8 inches. The treatments were made on May 15 and they were then planted the following day. The potato seed were planted with a two row planter leaving the seed furrow open for application of the band or in-furrow treatments after which they were covered with a disc and weeder attachment on a tractor. Whole Foundation Grade Sebago seed were used in the study. Recommended fertilizer and herbicide programs were followed early in the season and the plants in the alleys were removed so foliar fungicide and insecticide applications could be made as needed.

A vine killer was applied prior to harvest to facilitate the use of the plot mechanical harvester. The plots were harvested on October 8-10 and placed in bags which were then labeled and taken to the research building at the Montcalm Research Farm. The "B" size tubers were sorted with the plot harvester and kept separate in the labeled bags.

The tubers were sorted by size and examined for wireworm and white grub damage to determine the effects of the soil treatments on the yield and quality of the tubers. The damaged and undamaged tubers in each size class were counted and weighed for complete evaluation of the data. Samples of tubers from three replications of the treated plots were saved to determine their specific gravity. The plot data are presented in Table 1.

Table 1. Yields and insect tuber damage data from soil insect research plot, Montcalm County, 1980

Material	Place-ment	Lb ai/A	Yield Cwt/A	Percent Tubers by Size B's	A's	Over	Spec. Grav.	Total Tubers	Percent Good	Damag	B's % of Tubers	B's % Damag	A's % of Tubers	A's % Damag	Oversize % of Tubers	Oversize % Damag
BASF 263 10G	Brdcst	4 lb	398	9	78	13	1.066	2591	98.1	1.9	23.2	1.0	72.0	1.7	4.6	10.0
Untreated	--	--	384	8	82	10	--	2551	98.9	1.1	20.8	0.2	75.4	1.3	3.7	0.0
BASF 263 10G	Brdcst	4 lb														
+ Temik 15G	Band	3 lb	391	9	74	17	1.068	2395	99.4	0.6	23.1	0.5	70.4	0.4	6.5	3.2
Untreated	--	--	333	11	82	7	--	2423	99.2	0.8	25.2	0.2	72.5	1.0	2.3	0.0
Lorsban 4E	Brdcst	4 lb	350	11	80	9	1.063	2428	99.5	0.5	25.7	0.2	71.2	0.6	3.1	1.3
Untreated	--	--	350	9	81	10	--	2370	99.3	0.7	20.9	0.2	75.4	0.8	3.7	2.3
Lorsban 4E	Brdcst	4 lb														
+ Temik 15G	Band	3 lb	393	6	77	17	1.068	2239	99.2	0.8	18.4	0.0	74.8	1.0	6.8	1.3
Untreated	--	--	342	9	84	7	--	2349	99.0	1.0	20.6	0.6	77.0	1.0	2.4	3.6
Mocap 6 EC	Brdcst	4 lb	341	11	81	8	1.065	2420	98.9	1.1	25.6	0.3	71.7	1.4	2.7	1.5
Untreated	--	--	350	10	84	6	--	2492	98.7	1.3	23.6	0.3	74.4	1.6	2.1	2.0
Mocap 6 EC	Brdcst	4 lb														
+ Temik 15G	Band	3 lb	386	8	70	22	1.067	2345	99.2	0.8	22.8	0.0	68.7	0.8	8.4	2.5
Untreated	--	--	362	10	80	10	--	2535	99.3	0.7	23.4	0.3	73.2	0.6	3.4	4.7
Mocap 6 EC	Brdcst	4 lb														
+ Furadan 10G	Band	3 lb	382	10	78	12	1.065	2403	99.6	0.4	25.8	0.3	69.3	0.4	5.0	0.8
Untreated	--	--	329	10	84	6	--	2415	98.7	1.3	23.1	0.4	74.7	1.5	2.2	3.8
SN-72129 5G	Brdcst	4 lb	333	10	80	10	1.067	2315	98.8	1.2	24.2	0.4	72.7	1.5	3.2	1.3
Untreated	--	--	317	12	80	8	--	2191	98.3	1.7	26.8	0.5	70.6	2.1	2.6	3.5
SN-72129 5G	Brdcst	8 lb	357	10	79	11	1.063	2444	99.0	1.0	24.4	1.0	71.9	1.0	3.7	1.1
Untreated	--	--	352	9	80	11	--	2397	99.1	0.9	22.6	0.2	73.6	1.0	3.8	2.2
SN-72129 5G	Brdcst	4 lb														
+ Temik 15G	Band	3 lb	386	9	74	17	1.066	2442	98.2	1.8	22.7	0.2	70.8	2.5	6.4	0.6
Untreated	--	--	326	12	82	6	--	2515	99.0	1.0	26.0	0.5	72.4	1.3	1.6	0.0
Dyfonate 4E	Brdcst	4 lb	356	11	82	7	1.067	2460	98.1	1.9	26.5	0.9	71.2	2.3	2.4	0.0
Untreated	--	--	356	11	79	10	--	2484	98.2	1.8	25.3	0.6	71.4	2.1	3.3	4.8
Dyfonate 4E	Brdcst	4 lb														
+ Temik 15G	Band	3 lb	378	8	74	18	1.067	2301	99.0	1.0	23.0	0.2	70.2	1.3	6.7	0.6
Untreated	--	--	316	13	81	6	--	2458	98.7	1.3	27.4	0.7	70.8	1.4	1.8	4.6

Material	Place-ment	Lb ai/A	Yield Cwt/A	Percent Tubers by Size[1] B's	A's	Over	Spec. Grav.	Total Tubers	Percent Good	Damag	B's % of Tubers	B's % Damag	A's % of Tubers	A's % Damag	Oversize % of Tubers	Oversize % Damag
Dyfonate 4E	Brdcst	4 lb														
+ Furadan 10G	Band	3 lb	383	8	79	13	1.067	2415	99.5	0.5	20.6	0.4	74.6	0.6	4.8	0.0
Untreated	--	--	334	11	81	8	--	2392	99.3	0.7	24.6	0.2	72.7	1.0	2.8	0.0
Diazinon 4E	Brdcst	4 lb	340	12	81	7	1.065	2548	99.3	0.7	26.8	0.1	70.6	0.8	2.5	4.7
Untreated	--	--	328	12	80	8	--	2381	98.7	1.3	27.3	0.3	70.0	1.6	2.7	1.6
Diazinon 4E	Brdcst	4 lb														
+ Temik 15G	Band	3 lb	378	10	76	14	1.064	2451	99.4	0.6	24.2	0.0	70.8	0.8	5.0	1.6
Untreated	--	--	345	10	81	9	--	2402	98.8	1.2	23.0	0.4	73.9	1.5	3.1	1.3
Diazinon 4E	Brdcst	4 lb														
+ Furadan 10G	Band	3 lb	396	8	81	11	1.065	2551	99.1	0.9	20.5	0.4	75.4	1.0	4.2	0.9
Untreated	--	--	335	9	83	8	--	2336	99.1	0.9	21.5	0.8	75.9	1.0	2.7	0.0
Temik 15G	Band	3 lb	387	9	75	16	1.067	2685	98.7	1.3	22.5	0.7	66.2	1.5	11.4	1.3
Untreated	--	--	337	13	79	8	--	2466	99.3	0.7	27.9	0.4	69.5	0.9	2.6	0.0
Furadan 10G	Band	3 lb	393	10	77	13	1.063	2712	98.3	1.7	25.0	0.6	70.4	1.9	4.6	4.8
Untreated	--	--	339	12	81	7	--	2456	98.9	1.1	26.6	0.3	71.2	1.4	2.2	1.8
Untreated	--	--	323	10	82	8	1.066	2261	97.5	2.5	24.6	1.3	72.9	2.9	2.5	3.6
Untreated	--	--	337	12	81	7	--	2478	98.3	1.7	27.0	0.6	70.9	2.2	2.1	0.0
Untreated	--	--	335	10	79	11	1.063	2303	99.3	0.7	24.5	0.2	71.9	0.9	3.7	0.0
Untreated	--	--	321	12	82	6	--	2378	98.6	1.4	27.7	0.6	70.3	1.7	2.1	2.0

[1]Grade sizes: B - to 1 7/8 in.; A - 1 7/8 to 3 1/4 in.; Oversize - over 3 1/4 in.

Results

Although the primary objective of the study was to obtain control data for white grub infestations the populations were apparently too low to show differences between the feeding damage in the treated plots and that in the adjacent untreated plots. There were very few tubers showing wireworm damage therefore no damage ratings were made. The treatments which included band applications of Temik or Furadan resulted in a larger tuber size and approximately 50 cwt per acre increase in yield. There were no differences in the number or specific gravity of the tubers between the treatments. The data will be further analyzed by computer.

BIOLOGY AND CONTROL STRATEGIES FOR INSECT PESTS OF POTATOES

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Department of Entomology

Insect pests of commercially grown potatoes in Michigan cause frequent concern to growers, but are generally kept well under control with the use of chemical insecticides, applied either as a preventive measure ("insurance sprays") or applied when the problem becomes apparent. Although these strategies are effective, the cost is high (approximately $50-75/A or $2-3 million per year in Michigan) and occasional unexpected pest outbreaks cause serious damage, either as the result of foliar damage or tuber damage.

Our current research is focusing on two areas:
1) How to effectively detect and accurately assess insect populations in potatoes (Sampling),
and 2) What levels of pest populations can be present under various cultural and environmental conditions before significant damage is caused (Economic Thresholds).

The combination of these kinds of information with scouting programs (potentially available at a cost of approximately $10/A per year) will result in savings to the grower through:
1) Decreased need for preventive (insurance) treatments,
and 2) Increased probability of detecting unexpected pest outbreaks (such as variegated cutworm in 1977, cabbage looper in 1978) in time to prevent serious damage.

In addition, the reduction in insecticide usage would have considerable long term benefits in slowing the build-up of resistance to insecticides by pest species. Resistance to insecticides has already become a severe problem for control of Colorado potato beetle in the eastern U.S. and isolated cases of green peach aphid resistance to particular insecticides occur regularly in Michigan. The rate of resistance build-up must be slowed, at least to the point where it does not exceed the rate that new insecticides or groups of insecticides become available. One sure way of doing this is the reduction of insecticide use on a regional basis (what your neighbor does in this respect has an impact on you).

Studies in 1980 continued to look at the impact of Colorado potato beetle on the potato plant under various conditions. Research was also continued on the detection, sampling, and impact of cutworms on potato production.

Methods and Results

Colorado potato beetle/root lesion nematode/fertilizer studies

Field plots (4 rows x 50 ft) were established at the Montcalm Potato Research Farm. Each plot was treated to provide one of three levels of CPB infestation, one of two levels of nematode infestation, and one of three levels of fertilization. There were a total of 18 different treatment combinations (Table 1).

CPB populations were manipulated using insecticide applications timed to reduce populations, as needed. Numbers of adults, larvae, and egg masses were counted on four to six plants per plot in each of the three replications approximately weekly during the season. Mean number of CPB adults plus larvae per plant from June 17 to August 19 was 3.0 in the low CPB level plots (Fig. 1) and nearly all were very small larvae (1st or 2nd instars) that did virtually no damage to the plants. In the moderate CPB level plots, mean number of adults plus larvae per plant was 7.8 and there was a proportionately higher number of large larvae and adults. Mean number of adults plus larvae in the high CPB level plots was 10.6 larvae and/or adults per plant with a maximum value of 37.7 insects per plant on July 8, midway through the first generation of larvae.

Nematode levels were established using a pre-plant soil fumigation or leaving natural soil populations intact. The predominant plant parasitic nematode was the root lesion nematode, _Pratylenchus penetrans_. Mean numbers of _P. penetrans_ per 100 cm^3 of soil at planting were 31.7 in the non-fumigated soil (range 8-104) and 6.2 in the fumigated plots (range 0-26). Numbers of _P. penetrans_ per gram of root tissue on July 17 averaged 124.1 in the non-fumigated plots (range 30-328) and 38.6 in the fumigated plots (range 4-155).

Fertilizer levels were established as indicated in Table 1. These levels of fertilization were chosen to determine how the effect of an additional stress (low soil nutrients) would affect the plant's response to CPB and nematode damage.

Plant samples were taken three times during the growing season to estimate leaf weight, root weight, and tuber development in the respective treatments. However, this data has not been analysed at this time.

Plots were harvested on September 10 and 11 and data was collected on total yield from the center two rows of each plot (100 row ft), yield of size A tubers, yield and number of size B tubers, and yield and number of oversized tubers. A random sample of 60-100 tubers from each plot was taken to estimate number of A's and mean weight per A tuber (Table 2). Analysis showed significant effects of CPB level, nematode level, and fertilization level on total yield, yield of A's, yield of oversized, weight per A tuber, and number of A's. Total weight of B's was significantly affected only by fertilization level.

Maximum total yield and maximum yield of size A tubers were equivalent to approximately 317 cwt/A and 291 cwt/A respectively and occurred in the low CPB/low nematode/medium fertilization treatment.

A portion of the yield results given in Table 2 are shown in figures 2 - 7. Mean number of A tubers and mean weight per A are shown in each figure, since these two components make up yield of A's (yield = number of tubers times weight per tuber). Since tuber number is thought to be determined relatively early in the plant's growth and tuber weight occurs later in the season (bulking), separating out the two yield components seems logical when we are trying to explain yield responses of the potato plant.

As shown in figure 2a, total yield under normal fertilization conditions decreased with higher CPB or nematode populations, as expected. However, fumigation had little effect on yield when CPB levels were high. Number of A's decreased with CPB level but did not decrease significantly with increased nematode pressure, as expected (fig. 2b). Mean weight per tuber generally decreased with higher CPB and nematode populations but not at the highest CPB level. In this case, the number of tubers was apparently reduced to such an extent (fig. 2b) that tuber bulking was slightly higher on a per tuber basis.

The average of plots at all fertilization levels showed a somewhat different picture. Yield was reduced by higher CPB and nematode levels, more or less as before (fig. 3a). However, mean number of tubers was much more drastically reduced (fig. 3b) and mean weight per tuber stayed relatively constant regardless of treatment. Here again, we see the interaction between tuber number and tuber weight. Under fertilization stress, the plant is apparently affected (especially by nematode damage) much earlier in its growth, resulting in the drastic reduction in tuber numbers.

The effect of fertilization levels on the plants' responses to CPB levels are shown in figures 4 and 5. Total yield decreased with higher CPB populations at generally the same rate, regardless of the fertilization level (figs. 4a and 5a). The predominant effect of CPB level was expressed in fewer size A tubers (figs. 4b and 5b) rather than reduced weight per tuber (figs. 4c and 5c). It is interesting to note that the extra side-dressed urea ("normal" fertilization compared with "medium" fertilization) did not result in significant increases in yield or significant increases in either of the yield components at any level of CPB infestation (figs. 4 and 5; compare = normal with = medium fertilization). Nitrogen at these levels is apparently not limiting to plant growth.

The lack of response to the side-dressed N is also evident when we examine the effect of fumigation on the plants' responses to fertilization (figs 6 and 7). Total yield at all fertilization levels was increased by fumigation (figs. 6a and 7a). At low to medium levels of fertilization, number of tubers was strongly affected by nematode (fumigation) level (figs 6b and 7b), while at normal fertilization level, more of the yield increase occurred through increased weight per tuber, particularly at the low CPB level (fig. 6c). This may again have been the result of a low number of tubers set (see fig. 6b).

Although the data presented here requires further analysis for positive conclusions to be reached, it suggests that impacts of stresses such as CPB defoliation or nematode damage are most often nearly additive in their effect on potato production. That is, a CPB population that would normally be expected to cause a 10% yield loss, for example, will cause a similar 10% loss even in the presence of other stresses such as nematodes or nutrient deficiences. If this proves to be the case, prediction of economic losses due to pest population observed in the field will be greatly simplified.

Cutworm studies

In 1980 variegated cutworm (VCW) populations were very low. They were not an economic problem in most potato fields. However, the spotted cutworm (SCW), a slightly smaller green worm, that is sometimes confused with the cabbage looper, was a problem in many Montcalm County fields. At the Montcalm Experimental Farm, we were not able to get natural infestations of either species. Our approach in the past has been to artificially infest plots from a laboratory reared colony, but unfortunately we lost our VCW colony to disease and thus were not able to artificially infest our plots set up to look at the influence of VCW's on potato growth and yield.

We are attempting to develop better tools to detect VCW population, since attacks are sporadic. Sex attractant and black light traps are being evaluated for use in a regional adult activity monitoring program. Adult activity information, when coupled with egg and larval development information should allow us to better predict when larvae will be in potato fields. This will allow optimal use of sampling resources. After we have tested this trapping program at different population levels, it should allow us to assess the relative population pressure and hence the immediacy of the need to check field for larvae. Much more knowledge will be needed before individual trap catches can be used as threshold values for treatment decisions, however, a regional approach appears to have some merit.

Work was conducted in several growers fields to assess cutworm population levels and their impact on potato production. Characteristics of the various cutworm populations are given in Table 3 and yield and damage results for the respective fields and treatments are shown in Table 4. In one field of Russet Burbank's there was a fairly uniform population of 6.3 1.2 SCW per plant (mostly 4-5th instars) on 7/23 (Table 3). The SCW's made up 96% of the cutworm population with VCW and black cutworms (BCW) splitting the remainder. Tubers were all less than a half inch in diameter. The grower decided that he needed to control them at this point and used a single application of Monitor. In order to check what would have happened if he had let them go, we placed 6 clear plastic tarps that covered 5 rows by 20 feet at random in one corner of the field just prior to spraying. We tried to remove them before plant damage occurred, but were not successful. All the new growth on most of the plants was burned. This significantly reduced yield 26% from 287 cwt/acre down to 212 cwt/acre (Table 4). To sort out the SCW effect, we went back into the field and treated half of the area that had been under the plastic. SCW feeding did not significantly reduce the yield, although the yield was 11% lower in the area that remained untreated (179 ctw/acre vs. 212 cwt/acre). There was virtually no tuber feeding. In a second grower's Onaway's, we found 3.6 ± .8 SCW per plant (mostly 5th instars). The SCW population made up only 80% of the total cutworms found. VCW's accounted for 16% and BCW's 4%. The plants were further along (tuber 1/2-1 inch diameters) and the cutworms were larger so the grower decided to use a single application of Monitor. An odd corner was left untreated to check and see how much damage this population would do if it were let go. Yields in the untreated area were not significantly lower than the treated despite a 12% yield reduction (335 vs. 380 cwt/acre). However, the treatment significantly reduced tuber feeding over 85% from 1.2% of the tubers fed upon, to .15%. In another grower's Onaway's, an application of Sevin left a residual population of 6 ± 1 SCW per plant. SCW's made up 96% of the total cutworm population. The Sevin apparently killed mostly younger instars since 98% of the SCW's were 4-6th instars. The grower was concerned with the black cutworm population level (20% of the plants sampled had at least 1 BCW/plant), so he used an additional application of Monitor. No control plot was left so it was not possible to compare treated and untreated areas. No significant yield differences or differences in tuber feeding were noted from groups of plants exhibiting cutworm feeding and those that apparently were not fed upon. Overall, 1.1% of the tubers sampled were fed upon.

Occasional pests are difficult to work with in the field, because you never really know if there will be a population with which to work. We will continue in our endeavors to better understand the cutworm-potato plant interactions. More stringent measures have been taken to protect our laboratory colony from disease to insure the possibility of artificially infesting plots to get better information on the effects of cutworms on potato production. Particular emphasis will be placed on developing a regional sampling program to alert growers of the need to check their fields, before it is too late and the damage already done. All this information will then be put in value terms to facilitate making better insect pest management decisions under a variety of conditions.

Table 1

Treatment Combinations

Colorado Potato Beetle Levels	Nematode Levels	Fertilizer Levels
Low (insecticides applied as needed to prevent visible foliar damage).	Non-fumigated (no pre-plant soil fumigation)	Low (no fertilizer applied at planting)
Moderate (insecticide applied when damage began to be obvious)		Medium (500 lb NPK 20-10-10 applied at planting)
High (insecticides applied only late in season to prevent population build-up and spread to other plots)	Fumigated (pre-plant soil fumigation)	Normal (500 lb NPK 20-10-10 applied at planting plus 145 lb 45% urea as side dress at hilling time)

3 X 2 X 3

= 18 TREATMENT COMBINATIONS

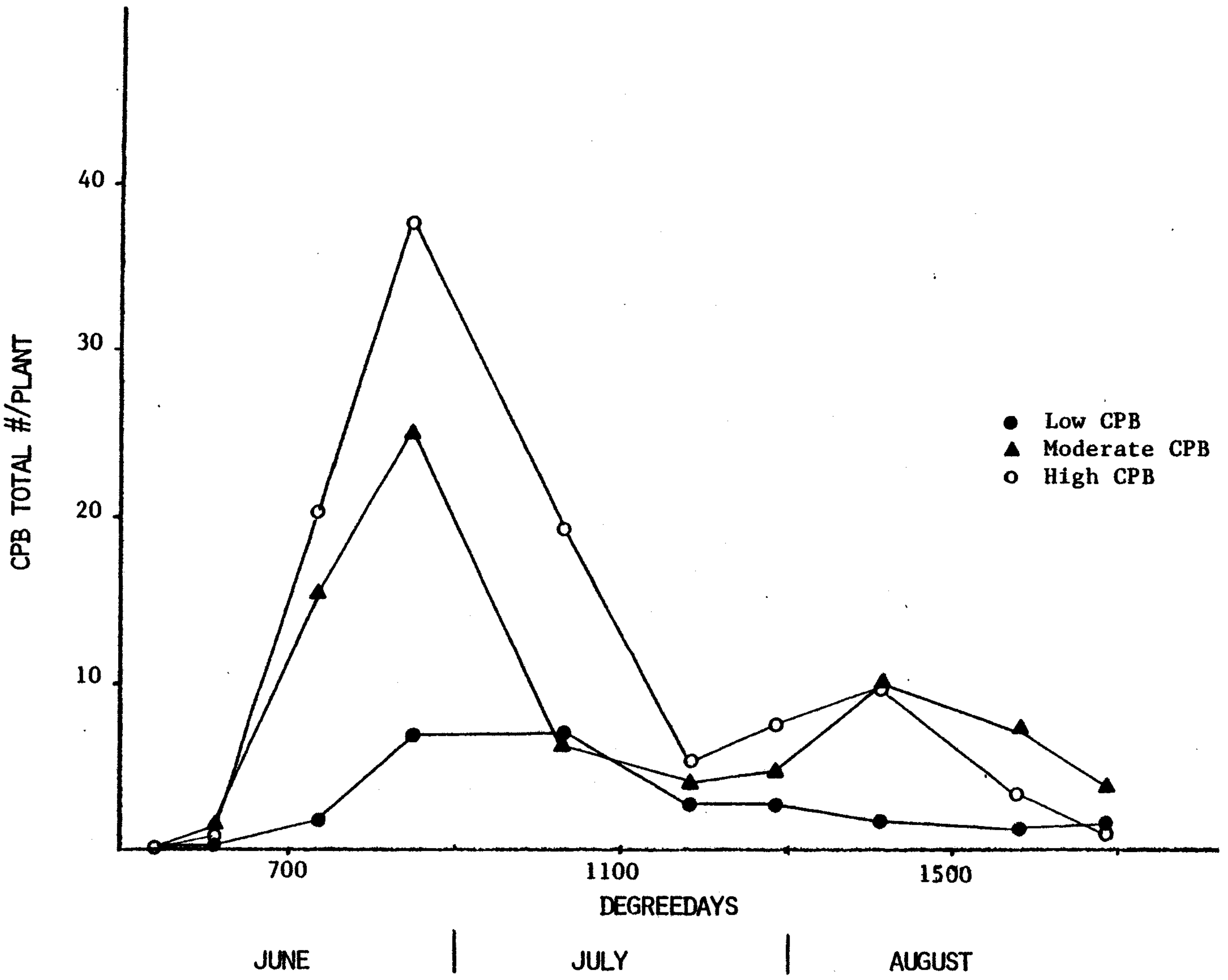

Figure 1. Mean numbers of Colorado potato beetle adults plus larvae per plant in low, moderate, and high treatment levels during June - August 1980.

Table 2

Potato Harvest Data - Sept. 1980

Colorado Potato Beetle/Nematode/Fertilizer Studies

CPB Level	Nematode Level	N Fertilizer Level	Mean Yield (lb/100 ft) Total	A's	B's	Over's	Mean Wt. per A (lb)	Mean Number A's/100 ft
Low	Non-fumigated	None Added	90.1	77.0	13.1	0.0	0.20	381
		At Planting	154.3	141.7	9.3	3.3	0.28	500
		At Planting + Side Dressed	154.5	142.3	10.8	1.3	0.28	508
	Fumigated	None Added	147.8	130.0	17.2	0.7	0.23	557
		At Planting	218.3	200.8	9.0	8.5	0.30	681
		At Planting + Side Dressed	203.8	182.3	8.8	12.7	0.33	547
Moderate	Non-fumigated	None Added	71.5	53.2	18.3	0.0	0.23	229
		At Planting	134.2	123.5	10.3	0.3	0.25	494
		At Planting + Side Dressed	124.3	115.0	9.3	0.0	0.25	465
	Fumigated	None Added	106.8	90.0	16.8	0.0	0.21	425
		At Planting	153.8	140.5	10.8	2.5	0.28	500
		At Planting + Side Dressed	131.3	119.0	11.5	0.8	0.27	436
High	Non-fumigated	None Added	41.3	25.2	16.1	0.0	0.17	142
		At Planting	83.8	70.8	12.0	1.0	0.22	322
		At Planting + Side Dressed	100.8	89.7	10.0	1.2	0.26	344
	Fumigated	None Added	79.3	60.1	19.1	0.0	0.19	317
		At Planting	104.8	95.5	9.0	0.3	0.30	318
		At Planting + Side Dressed	103.7	91.5	11.0	1.2	0.24	372

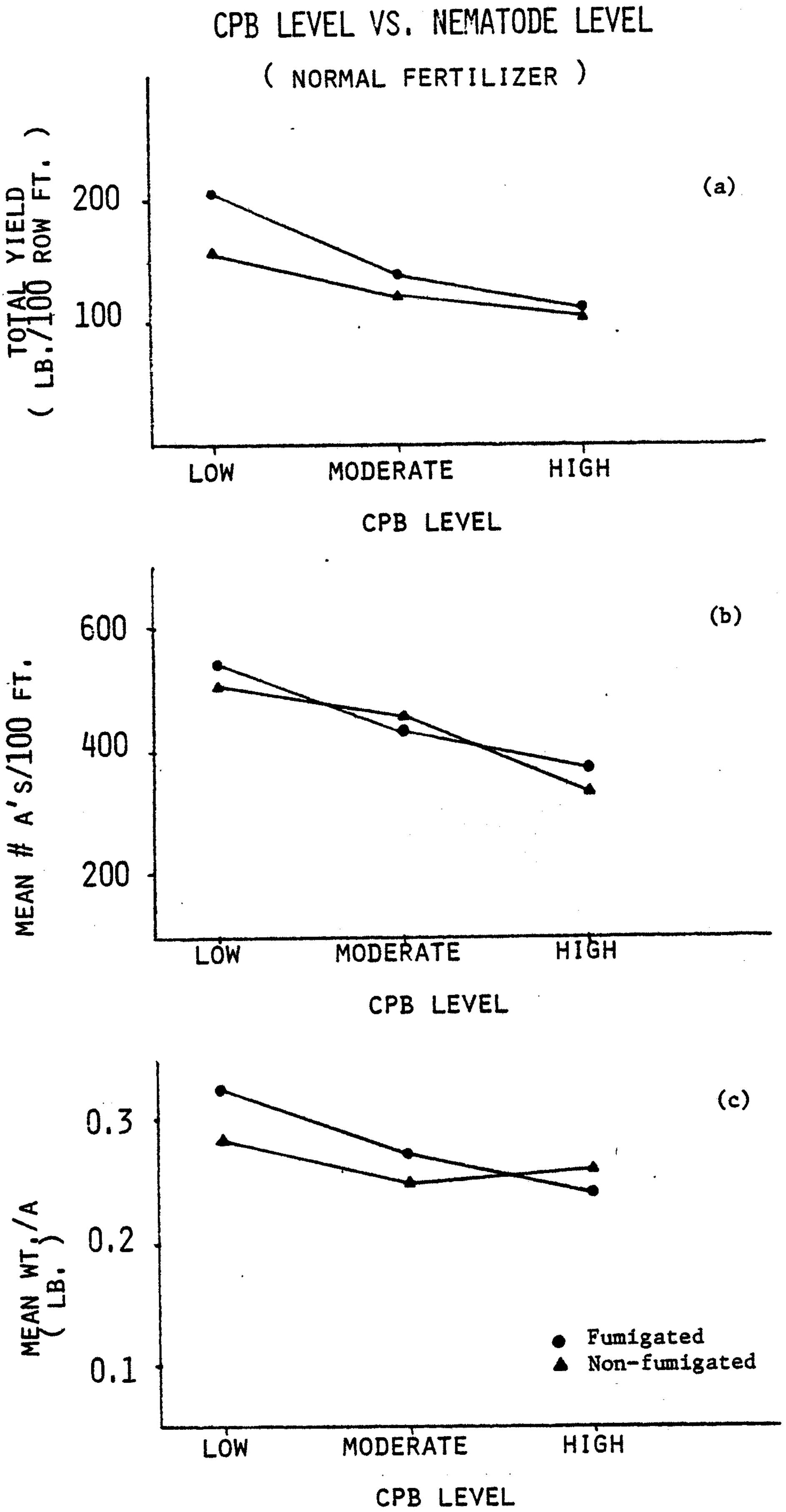

Figure 2. Yield responses to various Colorado potato beetle and nematode levels under normal fertilization. a) Total yield /100 ft of row. b) Number of size A tubers per 100 row ft. c) Mean weight per size A tuber.

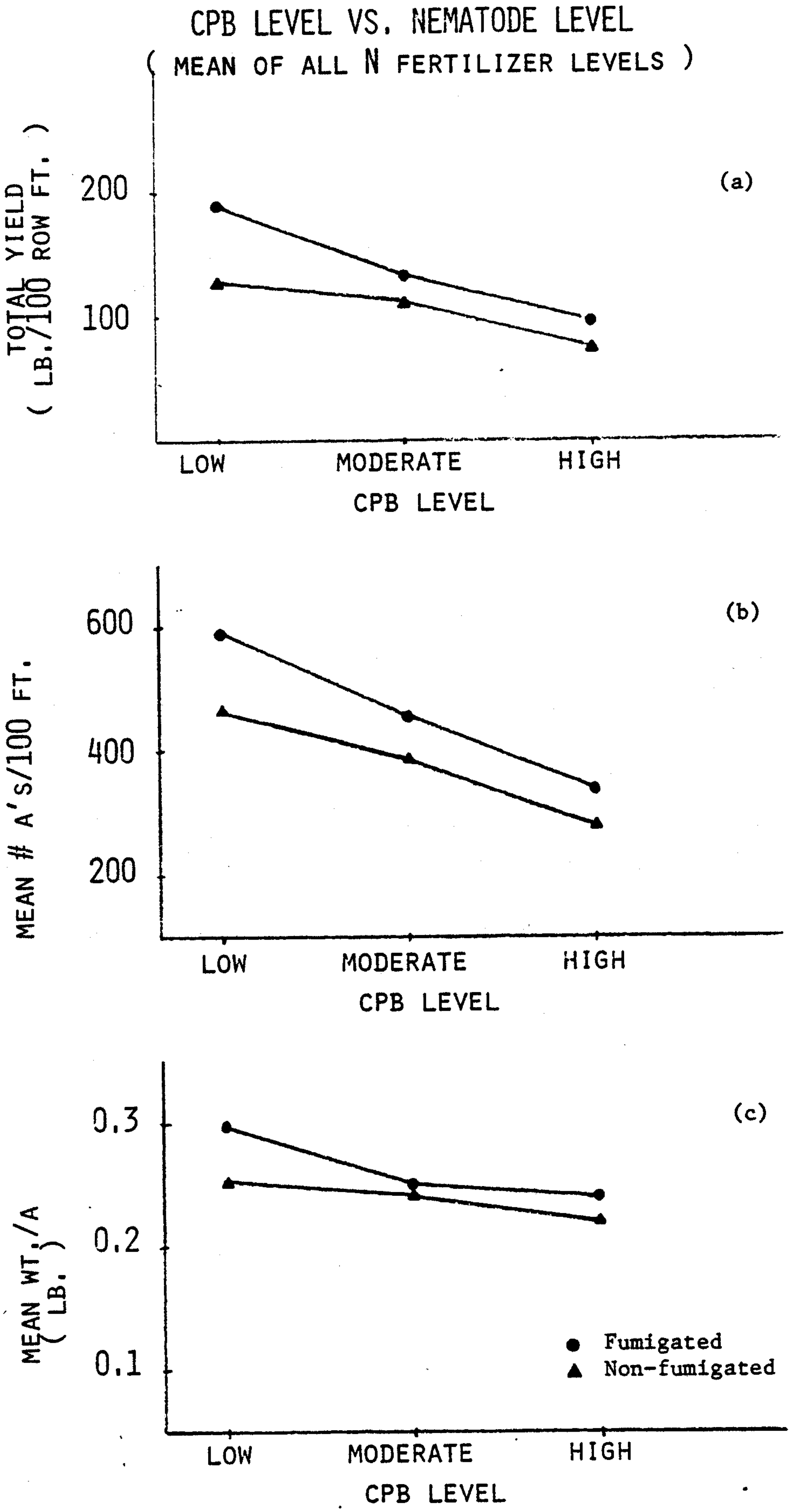

Figure 3. Yield responses to various Colorado potato beetle and nematode levels averaged over all fertilization levels. a) Total yield/ 100 row ft. b) Number of size A tubers per 100 row ft. c) Weight per size A tuber.

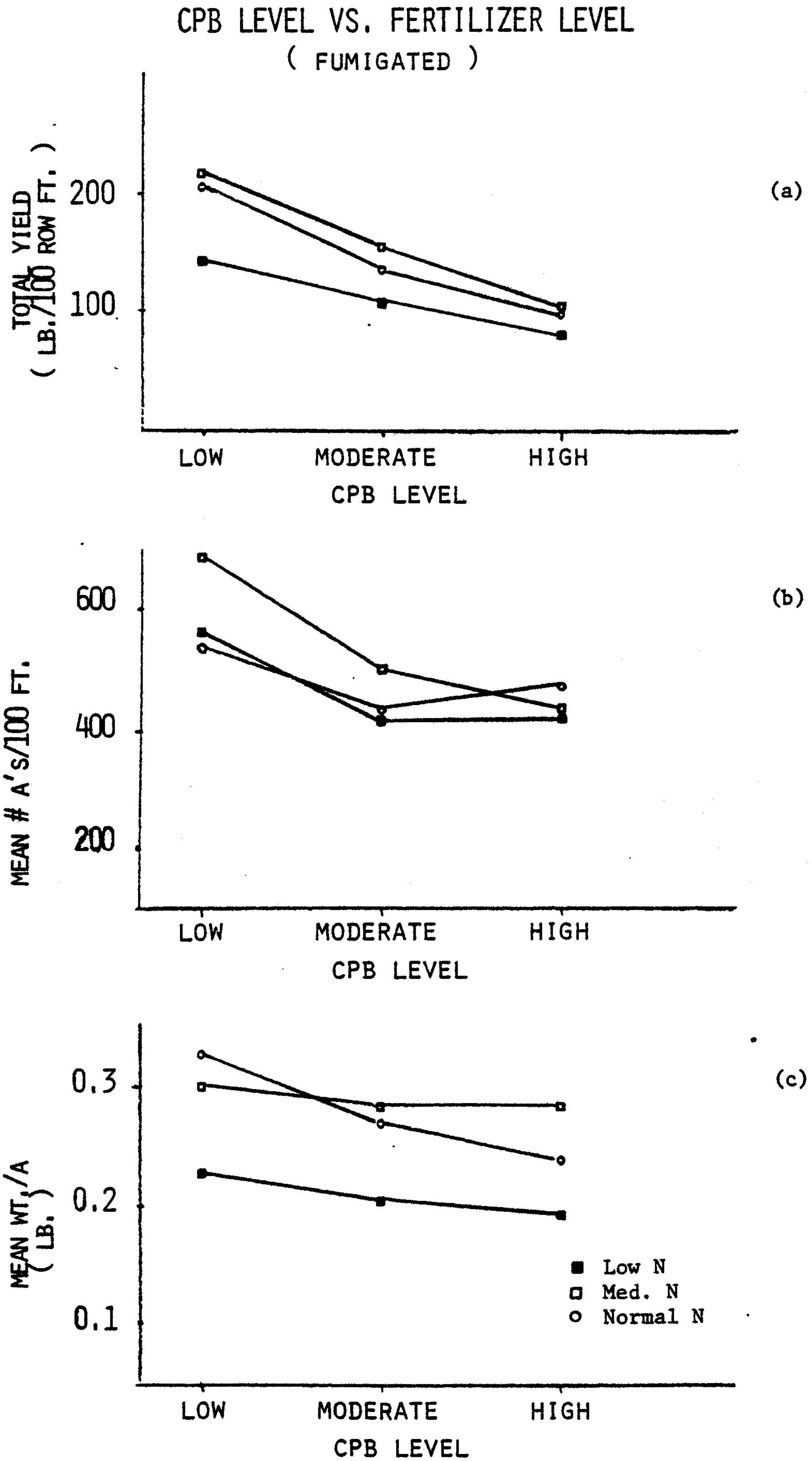

Figure 4. Yield responses to various levels of Colorado potato beetle and fertilization. a) Total yield /100 row ft. b) Number of size A tubers per 100 row ft. c) Mean weight per size A tuber.

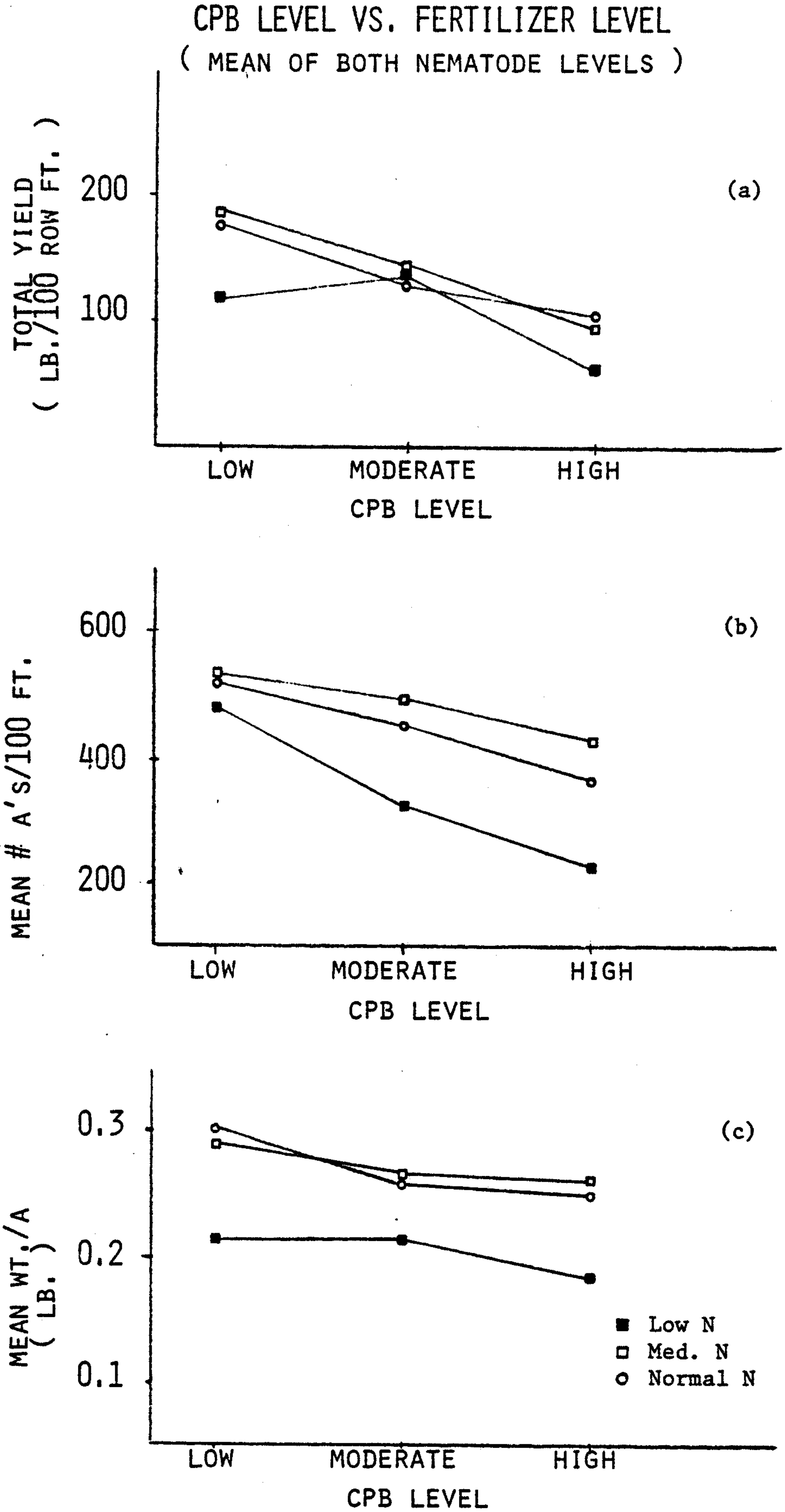

Figure 5. Yield responses to various levels of Colorado potato beetle and fertilization averaged over fumigated and non-fumigated plots. a) Total yield per 100 row ft. b) Number of size A tubers per 100 row ft. c) Weight per size A tuber.

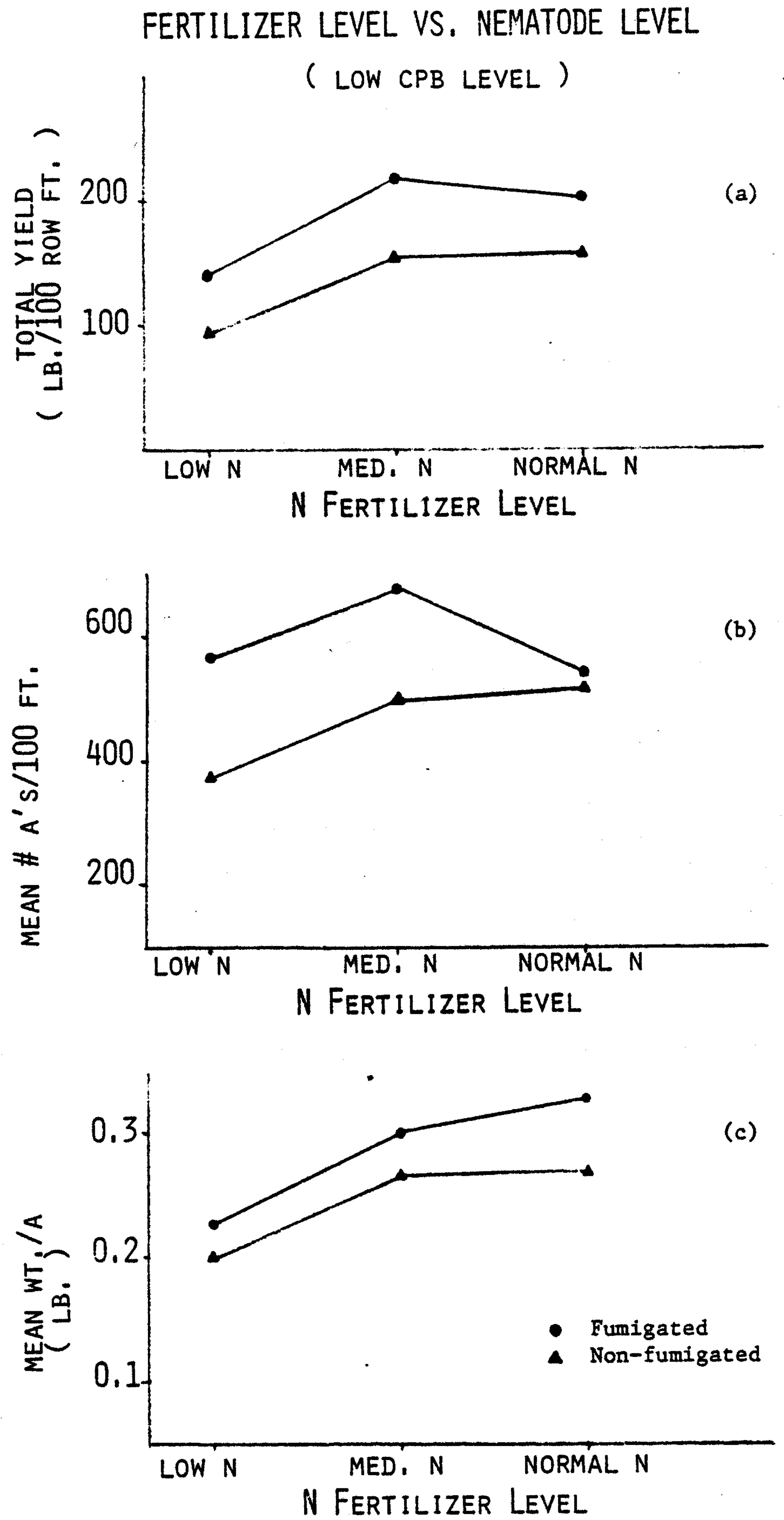

Figure 6. Yield responses to various levels of fertilization and nematodes at low Colorado potato beetle populations. a) Total yield per 100 row ft. b) Number of size A tubers per 100 row ft. c) Weight per size A tuber.

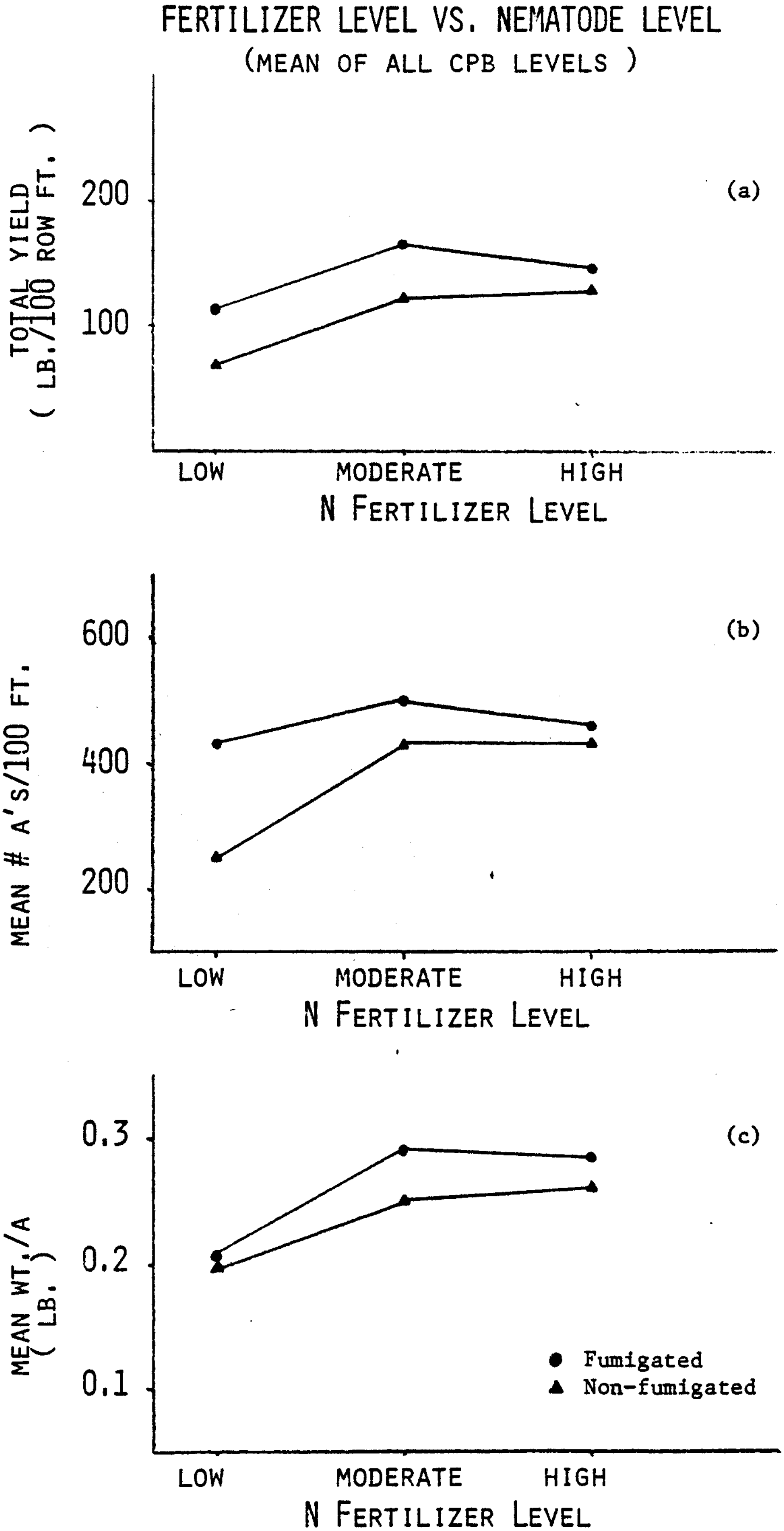

Figure 7. Yield responses to various levels of fertilization and nematodes averaged over all Colorado potato beetle levels. a) Total yield per 100 row ft. b) Number of size A tubers per 100 row ft. c) Weight per size A tuber.

Table 3. Densities and age distribution of selected cutworm species in selected Montcalm county fields.

Potato variety	Sampling date	Cutworms			Spotted cutworms						
					Age distribution[2]						Density avg.
		Species[1]	Number	%	6	5	4	3	2	Avg.	number±S.E./plant
Russet Burbank	7/23/80	SCW	780	96	8.3	40.5	40.9	99.9	.4	4.5	6.32 ± 1.22
		BCW	17	2.1	-	-	-	-	-	-	.14 ± .03
		VCW	15	1.9	-	-	-	-	-	4.8	.12 ± .10
Onaway Field 1	7/17	SCW	141	79.7	11.3	36.9	28.4	19.1	4.3	4.3	3.56 ± .80
		VCW	28	15.8	-	-	-	-	-	5.1	.78 ± .39
		BCW	8	4.5	-	-	-	-	-	-	.25 ± .25
Onaway Field 2	7/24	SCW	168	96	42.3	42.9	12.5	2.4	-	5.2	5.67 ± .98
		BCW	4	2.3	-	-	-	-	-	-	.23 ± .09
		VCW	3	1.7	-	-	-	-	-	6.0	.1 ± .07

[1]SCW - Spotted cutworm
BCW - Black cutworm
VCW - Variegated cutworm

[2]% in each instar with 6 being the final instar.

Table 4. Average yield and % tuber damage following selected insecticide treatments for cutworm populations.[1]

Potato variety	Treatment	Avg. yield[2] cwt ± S.E./acre[3,4]	Avg. % tuber feeding[4]
Russet Burbank	Monitor 4F .75 # A.I.	287 ± 20a	0
	Lannate 2L 1 # A.I. under plastic	212 ± 25b	0
	Untreated under plastic	189 ± 13b	0
Onaway Field 1	Monitor 4F .75 # A.I.	380 ± 36	.15
	Untreated	335 ± 24	1.18*
Onaway Field 2	Monitor 4F .75 # A.I.	202 ± 18	1.11

[1]Cutworm species composition, age distribution and densities are described in Table 3.

[2]Weight of A + jumbo or oversize tubers. Samples varied in size from 5-9 row feet and replications varied from 4-10 per treatment.

[3]Treatment means in comparable groups followed by the same letter are not distinguishable from one another at the .05 level by the S-N-K multiple range test.

[4]An * denotes treatment mean values significantly different at .05 level by a t-test.

FOLIAR INSECT CONTROL

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Twenty insecticide treatments including foliar and soil systemic materials or combination of both were evaluated against the foliar insect complex on potatoes in 1980. The plots consisted of paired 48 foot rows randomized in three replications using Russet Burbank variety of seed. The rows were left open during the planting operation on May 8 so the band applications of the systemics could be made prior to covering. A second application of granules was sidedressed to the Disyston plot at the time of hilling. Recommended fertilizer, herbicide and fungicide programs were followed during the study.

A CO_2 sprayer delivering 50 gallons per acre was used to apply the foliar insecticides. Applications were started on July 1 and repeated on July 18, 24, August 7 and 14. The foliar insects were sampled with an insect net on July 1, 11, 18, 30, August 11 and 28 prior to the insecticide application on the corresponding days. The data are presented in Tables 1-5. A vine killer was applied in early September and the plots were harvested on October 6. The potato yields, size distribution, and specific gravity from the plots are presented in Table 6.

Results

The foliar insect samples as presented in the Tables indicate an infestation of potato leafhoppers, tarnished plant bugs and Colorado potato beetles (CPB) were already in the plots at the time the first foliar treatments were applied. Since these samples had not been influenced by the treatments the counts from only the subsequent samples were included in the totals in the tables. The leafhopper and CPB counts in the BAS 263, Temik and Furadan plots were much lower than in the untreated plots at the first sampling indicating the effectiveness of these materials.

The foliar treatments were applied again on July 18 and 24 at which time Pirimor 50W at 0.25 lb. ai/A was added to the Ambush treatment, Tiovel 3E at 0.75 lb. ai/A was applied to the Disyston plot and Monitor 4E at 0.75 lb. ai/A was applied to the first untreated plot. These were added to the respective plots to supplement the control against added insect pressure of green peach aphid and second generation CPB at this time. The effects of these treatments were noted in subsequent samples. The foliars were applied again on August 7 and 14 at which time the foliage was dying down in certain plots.

The specificity of certain treatments against the chewing and sucking insects were most evident in Tables 2 and 3 (Colorado potato beetle and green peach aphid, respectively). Bay SIR 8514 plus Monitor, SN-72129, the synthetic pyrethroids (Pydrin, FMC 45806 and Ambush), Vydate and endosulfan (Tiovel) were effective in controling the potato beetles at the rates and intervals tested. The weakness of Bay SIR 8514 alone, SN-72129, Larvin, BAS 263 and Furadan against green peach aphids were apparent as shown in the

Table 1. Control of Potato Leafhopper in Foliar Evaluation Study

Treatment	Lb/A	Total Insects/30 Sweeps July 1	July 11	July 18	July 30	August 11	August 28	Total Insects
Am. Cy. 222,705	0.025	3	3	7	5	0	0	15
Am. Cy. 222,705	0.05	2	2	13	1	0	2	18
Bay SIR 8514	0.5	14	16	15	9	4	3	47
Bay SIR 8514 + Monitor	0.1 + 0.5	4	4	7	1	0	5	17
Bay SIR 8514 + Monitor	0.5 + 0.5	10	4	24	4	1	4	37
Monitor	0.75	12	5	17	1	2	3	28
SN-72129	0.25	1	17	27	30	7	7	88
SN-72129	0.5	7	20	50	52	13	4	139
Pydrin	0.05	19	5	18	4	0	4	31
FMC 45806	0.10	7	4	7	3	0	3	17
Ambush + Pirimor	0.10 + 0.25	3	6	7	0	2	1	16
Larvin	0.45	17	5	1	0	0	0	6
Larvin	0.90	3	2	3	1	0	2	8
Vydate	0.50	22	9	20	4	2	3	38
BAS 263	3.0	0	2	4	1	0	2	9
Temik	3.0	0	1	1	7	1	4	14
Furadan	3.0	0	0	5	2	1	0	8
Disyston	3.0 + 3.0	6	1	2	4	2	7	16
Untreated	--	8	1	20	2	0	2	25
Untreated	--	5	7	28	16	0	4	55

Table 2. Control of Colorado Potato Beetle Adults and Larvae

	Insects per 30 Sweeps													
	July								August					
	1		11		18		30		11		28		Totals	
Treatment	Ad	La	Ad	La	Ad	La	Ad	La	Ad	La	Ad	La	Ad	La
Am. Cy. 222,705 0.025	18	360	5	79	7	40	125	23	44	54	28	10	209	206
Am. Cy. 222,705 0.05	4	327	2	42	8	16	81	5	79	51	78	13	248	127
Bay SIR 8514 0.5	3	246	1	51	35	10	63	0	34	7	9	0	142	68
Bay SIR + Monitor 0.1 + 0.5	4	310	1	20	20	4	50	0	17	1	8	0	96	25
Bay SIR + Mon. 0.5 + 0.5	4	429	0	10	14	0	7	1	2	0	1	0	24	11
Monitor 0.75	3	424	2	75	2	21	60	4	16	8	2	1	82	109
SN-72129 0.25	5	330	1	4	3	3	14	1	11	2	5	0	34	10
SN-72129 0.50	3	300	1	1	3	0	4	0	1	3	5	0	14	4
Pydrin 0.05	2	300	0	27	12	15	37	7	12	48	17	8	78	105
FMC 45806 0.10	2	362	0	5	4	5	10	0	10	5	18	2	42	17
Ambush + Pirimor	4	328	1	63	16	59	33	14	17	21	24	4	91	161
Larvin 0.45	11	324	0	121	37	91	116	5	42	89	24	2	219	308
Larvin 0.90	3	344	0	75	19	45	59	13	17	73	24	10	119	216
Vydate 0.50	3	397	0	36	16	28	28	2	4	1	10	2	58	69
BAS 263 3.0	2	0	0	7	1	6	21	0	13	33	8	3	43	49
Temik 3.0	3	0	1	4	0	23	14	40	1	2	6	0	22	69
Furadan 3.0	5	10	1	21	0	1	6	0	8	21	1	0	16	43
Disyston 3.0 + 3.0	5	153	0	263	15	6	66	2	12	83	4	1	97	355
Untreated	5	382	0	485	39	49	101	1	4	5	12	0	156	540
Untreated	6	280	1	498	27	235	134	0	7	31	3	0	172	764
% of Total/Sample	2	98	1	99	30	70	92	8	40	60	84	16	19	81

Table 3. Control of Green Peach Aphid in Foliar Evaluation Study

Treatment	Lb/A	Total Insects/30 Sweeps: July 1	July 11	July 18	July 30	August 11	August 28	Total Insects
Am. Cy. 222,705	0.025	2	0	9	3	0	0	12
Am. Cy. 222,705	0.05	0	1	1	0	0	0	2
Bay SIR 8514	0.5	0	20	55	40	23	8	146
Bay SIR 8514 + Monitor	0.1 + 0.5	0	1	22	1	0	5	29
Bay SIR 8514 + Monitor	0.5 + 0.5	0	5	9	7	0	2	23
Monitor	0.75	0	3	8	0	2	8	21
SN-72129	0.25	0	26	108	129	11	6	280
SN-72129	0.5	0	34	90	90	0	4	218
Pydrin	0.05	0	1	8	3	3	5	20
FMC 45806	0.10	0	2	16	1	0	54	73
Ambush + Pirimor	0.1 + 0.25	0	4	30	2	0	0	36
Larvin	0.45	2	0	101	54	0	2	157
Larvin	0.90	1	16	163	21	1	0	201
Vydate	0.5	0	29	37	25	2	1	94
BAS 263	3.0	0	26	100	148	5	4	283
Temik	3.0	0	1	2	5	5	6	19
Furadan	3.0	1	13	52	85	11	4	165
Disyston	3.0 + 3.0	0	0	5	0	1	2	8
Untreated	--	0	2	53	1	1	4	61
Untreated	--	0	5	56	49	0	3	113

Table 4. Control of Tarnished Plant Bugs in Foliar Evaluation Study

		Total Insects/30 Sweeps						
		July				August		Total
Treatment	Lb/A	1	11	18	30	11	28	Insects
Am. Cy. 222,705	0.025	25	31	26	12	16	7	92
Am. Cy. 222,705	0.05	23	24	33	6	6	7	76
Bay Sir 8514	0.5	22	27	32	23	17	0	99
Bay SIR 8514 + Monitor	0.1 + 0.5	14	28	22	5	4	5	64
Bay SIR 8514 + Monitor	0.5 + 0.5	26	32	29	6	6	3	76
Monitor	0.75	26	23	33	10	13	6	85
SN-72129	0.25	30	35	31	18	11	19	114
SN-72129	0.50	5	42	19	16	27	7	111
Pydrin	0.05	26	37	32	14	18	8	109
FMC 45806	0.10	32	12	23	2	2	1	40
Ambus + Pirimor	0.10 + 0.25	33	41	34	3	3	10	91
Larvin	0.45	17	15	20	1	2	2	40
Larvin	0.90	18	19	17	8	0	1	45
Vydate	0.50	27	33	29	4	7	6	79
BAS 263	3.0	18	22	18	16	28	9	93
Temik	3.0	5	13	10	3	5	3	34
Furadan	3.0	15	16	26	13	16	1	72
Disyston	3.0 + 3.0	26	27	21	4	10	4	66
Untreated	--	13	20	21	5	2	11	59
Untreated	--	10	23	26	10	9	5	73

Table 5. Predator and Parasite Populations in Foliar Evaluation Study (Lady bird beetles, wasps, spiders, etc.)

		Total Insects/30 Sweeps						
		July				August		Total
Treatment	Lb/A	1	11	18	30	11	28	Insects
Am. Cy. 222,705	0.025	1	0	0	6	3	11	22
Am. Cy. 222,705	0.05	1	0	2	3	2	2	9
Bay SIR 8514	0.50	4	0	9	10	3	7	29
Bay SIR 8514 + Monitor	0.10 + 0.50	0	0	1	3	0	10	14
Bay SIR 8514 + Monitor	0.50 + 0.50	9	5	0	2	0	3	10
Monitor	0.75	6	5	4	2	3	2	16
SN-72129	0.25	2	1	5	8	7	13	34
SN-72129	0.50	0	1	2	19	6	22	50
Pydrin	0.05	0	1	4	3	6	10	24
FMC 45806	0.10	1	0	1	3	2	11	17
Ambush + Pirimor	0.10 + 0.25	0	2	4	2	4	3	15
Larvin	0.45	4	1	13	6	2	8	30
Larvin	0.90	1	3	9	2	2	10	26
Vydate	0.50	2	1	12	10	8	11	42
BAS 263	3.0	2	0	9	12	4	17	42
Temik	3.0	1	0	1	1	3	2	7
Furadan	3.0	0	1	2	12	5	7	27
Disyston	3.0 + 3.0	3	1	1	3	1	6	12
Untreated	--	0	2	7	4	1	6	20
Untreated	--	5	0	17	0	2	4	23

Table 6. Yield Data and Specific Gravity of Tubers from Foliar Evaluation Study

Material and Formulation	Rate(ai) per A	Yield/A	Percent by Grade Size: B's	A's	10 oz	Off-Type	Spec. Grav.
Foliar Applications							
Am. Cy. 222-705 2.5 E	0.025 lb	319 cwt	18%	69%	5%	8%	1.072
Am. Cy. 222-705 2.5 E	0.05	324	17	68	6	9	1.076
Bay SIR 8514 25 WP	0.5	351	14	74	8	4	1.075
Bay SIR 8514 25 WP + Monitor 4 EC	0.1 0.5	338	15	71	7	7	1.072
Bay SIR 8514 25 WP + Monitor 4 EC	0.5 0.5	337	15	69	6	10	1.073
Monitor 4 EC	0.75	358	14	68	7	11	1.074
SN-72129 50 WP	0.25	375	15	73	6	6	1.071
SN-72129 50 WP	0.5	319	19	72	5	4	1.071
Pydrin 2.4 EC	0.05	300	19	66	6	9	1.076
FMC 45806 2.5 EC	0.10	384	14	70	8	8	1.074
Ambush 2 E + Pirimor 50 W	0.1 0.25	297	19	68	7	6	1.071
Larvin 500	0.45	273	17	69	6	7	1.074
Larvin 500	0.90	341	18	71	5	6	1.076
Vydate 2 L	0.5	301	18	68	5	9	1.073
Soil Systemics							
BAS 263 10 G	3.0	341	17	70	4	9	1.072
Temik 15 G	3.0	434	10	67	10	13	1.076
Furadan 10 G	3.0	411	14	69	8	9	1.073
Disyston 15 G	3.0 + 3.0	301	17	69	4	10	1.077
Untreated	--	265	22	67	6	5	1.072
Untreated	--	189	34	62	1	3	1.069

sample counts. The insect damage in most of the plots had caused the foliage to die down by the time the vine killers were applied in early September.

The tuber yields in the plots as shown in Table 6 indicate the influence of heavy beetle populations during the season. The highest yields came from the Temik and Furadan plots with 434 and 411 cwt/A, respectively. Most of the other treatments gave good yields except the untreated plot which was later treated with Monitor. It is apparent that with heavy beetle pressure it is important to protect the plants early in the season so they will not be under stress during early tuber formation.

EFFECTS OF NEMATICIDES ON *PRATYLENCHUS PENETRANS* AND POTATO YIELDS

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Dept. of Entomology

Temik 15G (3.0 lbs. a.i./A) and Mocap 10G (3.0, 6.0, and 12.0 lbs. a.i. /A) were evaluated throught the season for nematode control and yield response of *Solanum tuberosum* 'Superior'. A complete randomized block design was used with each treatment replicted five times. Seed pieces were planted on May 14, 1980 at the Montcalm Potato Research Farm in Entrican, Michigan. Each plot consisted of four rows 50 feet long and 34 inches apart with seed piece spacing 8 to 12 inches. Temik 15G was banded with the fertilizer 2 inches to the side and down from the seed pieces at planting. Mocap 10G was broadcast immediately before planting. Soil samples were analyzed for nematodes using the centrifugation-flotation technique and the roots were processed using the shaker extraction technique. Insects were controlled by sprays of Sevin, Thiodan, and Monitor. Irrigation was applied when necessary. The center two rows of each plot were harvested, graded and weighed.

There was a significant (P=0.05) yield difference between treated plots and the check. Temik 15G had the greatest production of oversized tubers. There was a 66%, 71%, and 74% yield increase over the check with 3.0, 6.0, and 12.0 lbs. Mocap 10G respectively. Temik 15G provided an 84% yield increase.

Nematode densities for all treatments were significantly (P=0.05) lower than the check throughout the season. There was no significant difference in nematode control between the nematicide treatments.

Figure 1

Effects of Nematicides on *Pratylenchus penetrans* and Potato Yields

Treatment (a.i./A)	Population of *P. penetrans*[1] May 14	July 1	July 28	Aug. 18	Tuber Yields[3] U.S. No. 1	Over-sized	Total[4] Marketable
Temik 15G (3.0 lbs.)	45.2[a][2]	8.4[a]	1.8[a]	2.0[a]	214.2[a]	2.3[a]	216.5[a]
Mocap 10G (3.0 lbs.)	18.0[a]	0.8[a]	2.6[a]	0.4[a]	194.0[a]	0.9[a]	194.9[a]
Mocap 10G (6.0 lbs.)	18.2[a]	4.6[a]	1.6[a]	2.5[a]	200.4[a]	0.3[a]	200.7[a]
Mocap 10G (12.0 lbs.)	22.8[a]	3.0[a]	2.0[a]	0.8[a]	204.0[a]	0.3[a]	204.3[a]
Check	28.6[a]	48.6[b]	172.4[b]	180.1[b]	117.4[b]	0.0[a]	117.4[b]

[1]*P. penetrans*/gram of root plus *P. penetrans*/100cc soil [2]Column means followed by the same letter are not significantly different (P=0.05) according to the Student-Newman-Keuls Multiple Range Test [3]CWT/A [4]U.S. No. 1 plus oversized grade.

EFFECT OF PRE-PLANT SOIL TREATMENTS ON THE CONTROL OF POTATO SCAB, 1979, 1980

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Department of Botany and Plant Pathology

Nitrate inhibitors Dwell and Enserve were compared with the fungicide Terraclor and with combinations of Terraclor and Dwell for control of scab (*Streptomyces scabies*) on potatoes (var. Sebago). Tests were conducted on the Michigan State University Experimental Soils Farm, East Lansing, Michigan. Treatments were broadcast along with 150 lbs. of N as urea on the soil surface and pre-plant incorporated. The soil in the test plots was fine sandy loam with a pH of 7.2. It was known to be heavily infested with the scab pathogen *S. scabies*. Irrigation was used sparingly and only to maintain normal growth. Plots were mechanically weeded and sprayed weekly for disease and insect control. Temik was not used because of the possibility that it might interfere with the scab treatments. Certified Sebago seed was cut and planted on May 26, 1979 and May 30, 1980 in single row plots 50 feet long. The row width was 32 inches with seed pieces spaced 9 inches apart. A single guard row separated each plot. Treatments were arranged in a single block planting, randomized and replicated 5 times.

The results of both tests indicate that the nitrate inhibitors Enserve and Dwell with urea will suppess scab symptoms as will Terraclor with urea. But by far the best control of scab and the highest marketable yield resulted from the combination of Dwell and Terraclor with urea. In the 1979 test it was apparent that Dwell used in this combination at the 1/2 lb rate was more effective than at the 1/4 lb rate. Harvested yield results in both tests suggest that Dwell and Enserve may be inhibiting potato growth.

TEST 1 (1979)

TREATMENT	RATE/A	Average Yield CWT/A[1] Harvested U.S. #1	Harvested B Grade	Marketable U.S. #1	Marketable B Grade	Ave. % Marketable[1,2] Tubers
Dwell (Terrazole)	.25 lb ai	290.8ab	57.4 cd	90.7 c	17.9 c	31.2 c
Dwell	.5 lb ai	270.9 c	54.2 d	99.1 c	19.8 c	36.6 c
Enserve	.5 lb ai	250.8 d	66.5a	89.3 c	23.7 bc	35.6 c
Dwell + Terraclor 2E	.25 lb ai + 12.5 gal	320.5a	58.9 c	174.7 b	32.1ab	54.5 b
Dwell + Terraclor 2E	.5 lb ai + 12.5 gal	310.6ab	63.0 b	205.6a	41.7a	66.2a
Terraclor 2E	12.5 gal	312.0ab	57.2 cd	150.1 b	27.5 bc	48.1 b
No Treatment	--	279.1 b	50.4 e	58.9 d	11.5 d	21.1 d
LSD .05		34.9	2.6	28.8	12.1	8.2

[1] Small letters indicate treatments that do not differ significantly at the 5% level according to the LSD test.

[2] Potato tubers with no more than 2% scab.

NOTE: All treatments 150 lbs of N in the form of urea.

TEST 2 (1980)

TREATMENT[2]	RATE/A	Ave. Yield CWT/A[1] Harvested U.S. #1	Harvested B Grade	Marketable U.S. #1	Marketable B Grade	Ave. % Marketable Tubers[1,3]
Dwell (Pre-mix with urea)	.5 lb ai	178.3ab	15.5a	150.4 b	13.2ab	85.3 b
Dwell 2EC	.5 lb ai	172.8a	18.0ab	152.0 b	15.7abc	86.5 b
Enserve 2EC	.5 lb ai (1 qt)	178.0a	20.8 b	147.1 b	17.2 bc	82.7 b
Terraclor 2EC	12.5 gal	186.7abc	20.7 b	162.1 b	18.0 c	86.9 bc
Dwell (Pre-mix with urea) + Terraclor 2EC	.5 lb ai + 12.5 gal	201.0 cd	16.2ab	183.4 c	15.1abc	93.1 cd
Dwell 2EC + Terraclor 2EC	.5 lb ai (1 qt) 12.5 gal	206.2 d	20.1ab	195.1 c	19.0 c	94.7 d
Check	----	192.5 bcd	18.1ab	127.0a	12.1a	65.8a
LSD .05		14.4	5.0	17.4	4.5	6.4

[1] Small letters indicate treatments that do not differ significantly at the 5% level according to the LSD test.

[2] Nitrate inhibitors Dwell (Terrazol-Olin), Enserve (Dow).

[3] Potato tubers with not more than 2% scab.

NOTE: 150 lbs of N in form of urea applied on all plots.

EFFECT OF DELAYED PLANTING OF CUT POTATO SEED AND CHEMICAL SEED PIECE TREATMENT ON STAND AND YIELD - 1980

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Potato cut seed tests were conducted at the Montcalm Experimental Farm to evaluate the effect of delayed planting after cutting and chemical seed piece treatment on stand and yield. Certified Sebago seed was cut and treated 2 weeks before planting (April 27, 1980), 2 days before planting (May 9, 1980) and 0 days before planting (May 11, 1980). Chemicals were applied by dusting in a plastic bag or by dipping for 2 minutes and allowing seed to dry. Planting was done by hand in 34 inch rows with seed pieces spaced 9 inches apart. Treatments were randomized and replicated three times in a single block planting. Plots consisted of a single 50 foot row. Temik was applied at planting for early insect control and supplemented with foliar applications of Thiodan as needed. Fungicide sprays were applied at regular intervals. Irrigation was used when necessary to maintain a vigorous growth.

The stand count was taken 4 weeks after planting and plots were harvested on October 9, 1980. The best stand resulted from the Terraclor-captan dust treatment applied at planting and the poorest stand from the sodium hypochlorite dip applied 2 weeks before planting. In most instances stand was significantly increased as the time between cutting and planting was reduced. Chemical treatments generally had a beneficial effect on stand and tended to offset somewhat the detrimental effect of delayed planting. Yield increases in some but not all cases appeared to be correlated with increased stand. Some chemical treatment significantly increased yields of US #1 potatoes others did not. The more effective treatments were the captan dust, the captan + streptomycin dust, and the stretomycin dip. The least effective treatments were the sodium hypochlorite dip and chlorine dioxide dip and the Dithane M-45 dust. The water treatment was particularly detrimental. It significantly reduced both the stands and the yields as compared with the check.

1980 RESULTS: POTATO SEED TREATMENT TRIALS

TREATMENT AND RATE		METHOD OF APPLICATION	TIME APPLIED BEFORE PLANTING - DAYS 14	2	0	% STAND	US #1	B GRADE
SODIUM HYPOCHLORITE (CLOROX)	500 PPM	DIP	X			56.9	195.3	11.4
" "	"	"		X		77.6	255.9	8.3
" "	"	"			X	91.0	396.9	15.4
CHLORINE DIOXIDE (PENETRAAT ClO_2)								
	100 PPM	"	X			62.87	285.1	9.5
" "	"	"		X		81.3	316.1	8.6
" "	"	"			X	88.5	336.1	10.8
STREPTOMYCIN SULFATE (AGRI-STREP)								
	100 PPM	"	X			63.5	327.5	7.1
" "	"	"		X		80.1	380.4	10.5
" "	"	"			X	84.2	389.6	10.2
STREPTOMYCIN SULFATE + CAPTAN								
10D + 10D	1 LB/CWT OF SEED	DUST	X			83.9	347.5	8.3
" "	"	"		X		89.7	379.2	8.3
" "	"	"			X	92.6	385.9	12.3
CAPTAN 10D	1 LB	"	X			83.0	355.8	5.2
"	"	"		X		85.5	378.2	7.1
"	"	"			X	91.0	397.3	10.2
DITHANE M-45 10D	1 LB	"	X			73.8	308.4	9.2
"	"	"		X		87.2	327.5	8.6
"	"	"			X	90.4	346.0	14.8
CAPTAN + TBZ 10D + .5D	.75 LB	"			X	91.3	361.3	12.3
KL491 25W	15.25 GRS/2 GALS OF WATER	DIP			X	87.2	304.4	13.8
TERRACLOR 10D	1 LB/CWT OF SEED	DUST			X	92.0	360.4	11.7
TERRACLOR + CAPTAN 10D + 10D								
	1 LB/CWT OF SEED	"			X	96.1	354.3	13.8
WATER	---		X			60.3	266.0	9.8
"	---			X		64.0	241.4	6.8
"	---				X	71.8	315.8	7.1
NO TREATMENT	---		X			72.4	303.8	9.0
"	---			X		67.5	344.4	9.2
"	---				X	83.3	352.7	11.7
LSD .05						3.4	14.9	1.7
.01						4.6	19.8	2.3

1980 TRIALS WITH SYSTEMIC SURFACE PROTECTANT FUNGICIDES FOR CONTROL OF EARLY AND LATE BLIGHT OF POTATOES

Investigator: H. Spencer Potter, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824

Location: MSU Muck Crops Research Farm, Bath, MI

Variety: Russet Burbank (Certified Seed)

Soil Type: Muck (Reed-Sedge Type) irrigated

Row Spacing: 34 inches, Plant Spacing: 12 inches

Planting Date: June 2, 1980

Harvest Date: October 12, 1980

Experimental Design: Randomized block with 3 replications. Plots were 2 rows wide and 50 feet long separated by 2 unsprayed guard rows.

Method of Application: Granular soil treatments applied with funnel applicator. Foliar application with a CO_2 backpack sprayer using a single row boom with 3 hollow cone nozzles (one overhead and 2 on drops). The operating pressure was 40 psi and the volume sprayed 25 gals/A.

Spray Schedule:
A. In furrow treatments - June 2, 1980
B. Hilling treatments - July 12, 1980
C. Foliar treatments - July 18 thru September 23, 1980
At 7 to 14 day intervals. Some treatments required only a single application at flowering (August 3-10) other treatments applied only after late blight appeared (August 19).

Pesticides Applied:
Herbicides: Lorox 50 W 1.5 lb/A
Insecticides: Thiodan 3EC 1 qt/A, August 19 and Sept. 2.
Fungicides: see table

Summary: The systemic compounds Ridomil, RE 26745, RE 26940 and RE 31155 applied to the foliage gave control of late blight that was equal to or better than that obtained with Dithane M-45 at the recommended rate. None of these systemics alone controlled early blight. Ridomil with CGA 64250 and RE 26745 with JX-13 were very effective against both early and late blight. A single application of Difolatan at the 4 qt rate either alone or in combination with RE 26745, RE 26940 and RE 31155 was less effective for control of early blight than Dithane M-45, and JX-13. The yield increase for all treatments was highly significant as compared to the check. There were significant differences in yield between some treatments but these did not in all cases reflect significant differences in disease control.

Results:

Treatment and Rate/A		Application Schedule	No. Of Applications	Disease Index[1] Late Blight	Disease Index[1] Early Blight	Yield CWT/A US # 1	Yield CWT/A B Grade	% Tuber Rot
Dithane M-45 80W	1 lb	Spray 7 day	11	3.2	3.8	268.2	102.4	4.9
Dithane M-45 80W	2 lb	Spray 7 day	11	2.3	3.2	282.1	84.3	3.2
Dithane M-45 3.8F	.8 qt	Spray 7 day	11	3.4	3.7	262.4	92.0	4.8
Dithane M-45 3.8F	1.7 qt	Spray 7 day	11	2.2	2.0	306.6	84.1	3.4
Dithane M-45 80W	2 lb	Spray 14 day	6	2.4	2.8	272.2	119.6	5.6
Dithane M-45 3.8F	1.7 qt	Spray 14 day	6	2.3	2.6	283.3	91.0	4.2
Difolatan 4F	4 qt	Spray at flowering	1	4.9	5.0	249.4	86.2	2.8
RE 26940 50W	2 lb	Spray at flowering	1	2.4	6.1	294.0	91.7	1.8
RE 26745 50W	2 lb	Spray at flowering	1	2.6	5.9	271.1	89.9	2.2
RE 31155 50W	2 lb	Spray at flowering	1	2.3	6.2	298.3	68.4	1.9
JX-13 50W	2 lb	Spray at flowering	1	5.8	3.7	220.1	76.6	8.6
RE26940 50W + Difolatan 4F	2 lb 4 qt	Spray at flowering	1	1.8	4.5	327.2	91.7	1.8
RE 26745 50W + Difolatan 4F	2 lb 4 qt	Spray at flowering	1	2.2	4.3	324.6	102.0	2.4
RE 31155 50W + Difolatan 4F	2 lb 4 qt	Spray at flowering	1	2.1	4.8	322.3	105.3	2.2
RE 26745 50W + JX-13 50W	2 lb 2 lb	Spray at flowering	1	2.5	3.8	315.5	101.4	1.6
Ridomil 15G	15 lb	In furrow at planting	1	3.0	6.2	280.5	98.2	2.7
Ridomil 15G	15 lb	At hilling	1	3.2	5.9	267.2	111.8	1.9
Ridomil 2E	1.5 pt 1 pt	Spray 7 daywhen late Bl. appears + Spray 14 days thereafter	2 2	1.3	6.0	295.2	72.5	0.6
Ridomil 2E + CGA 64250 3.6E	.75 pt 9 oz	Spray 7 day when late Bl. appears + Spray 14 days thereafter	2 2	1.7	1.8	336.1	82.1	0.4
Check	--	--	--	7.1	6.1	203.0	102.4	7.7
LSD .05				.3	.3	29.9	17.1	1.2
.01				.4	.4	40.1	22.8	1.5

[1] Disease Index = 0=no disease - 10=100% defoliation

1980 FUNGIGATION TRIALS FOR CONTROL OF LATE BLIGHT ON POTATOES

Investigator: H. Spencer Potter, Department of Botany and Plant Pathology, Michigan State University, East Lansing, Michigan 48824

Location: Michigan State University Muck Research Farm, Bath, Michigan

Variety: Russet Burbank

Pathogen: Phytophthora infestans

Soil Type: Muck (reed-sedge) - irrigated

Planting Date: June 2, 1980

Harvest Date: October 4, 1980

Experimental Design: Treatment randomized in 2 parallel blocks with 4 replications. Plots were semi-circular with a radium of 26 ft (.025 acres) and separated by an unsprayed area of the same size.

Method of Application: Solid set irrigation with sprinkler heads on 3' risers spaced 50 ft apart and adjusted to operate in a 180° arc. Pressure at the sprinkler heads was 70 psi. Spray suspensions (20X concentrations) were injected into the irrigation systems at 120 psi using a fertilizer proportioner and a power sprayer. A colored dye was mixed with the spray suspensions to indicate the beginning and end of treatments. Plots were treated with a single sprinkler at a volume of 600 gals/A. Treatments were started on July 25, 1980 and continued on a 7 day schedule (Ridomil + CGA 64250 on a 14 day schedule) thru September 24, 1980 (Ridomil + CGA 64250 5 applications, other treatments 10 applications).

Pesticides Applied:

Herbicides: Lorox 50W 1.5 lb/A 1 application by ground sprayer

Insecticides: Thiodan 3EC 1 qt/A 2 applications thru the irrigation system.

Fungicides: See table below.

Results:

Treatment and Rate/A	Foliar Disease Index[1] Late Blight	Yield cwt/A[2] US #1	B GRADE	% Tuber Infection
Ridomil 2E 16 oz + CGA 64250 3.6E 9 oz	.4	271.3	55.8	.9
Bravo 500 2 pts	1.1	253.4	63.9	1.9
Quintar 5 F 6.4 oz + Plyac 4 oz	1.8	242.6	70.4	2.8
Manex 4 F 1.6 qts	1.7	255.5	68.3	2.9
Check	4.5	194.1	56.0	8.5
LSD .05	0.2	17.2	N.S	2.8
.01	0.3	23.8		3.8

[1]Disease Index 0=no disease - 10=100% defoliation

[2]*Average yield based on weight of tubers from 2 20 ft of row samplings.*

Summary: All treatments were effective in controlling late blight. Ridomil + CGA 64250 was the most effective treatment and resulted in the highest yield of US #1 potatoes.

1980 FOLIAR SPRAY TRIALS FOR DISEASE CONTROL ON POTATOES

Investigator: H. Spencer Potter, Department of Botany and Plant Fathology, Michigan State University, East Lansing, MI 48824.

Location: MSU Botany Farm, East Lansing, MI 48824

Crop Variety: Sebago

Soil Type: Sandy Loam - irrigated

Row Width: 34 inches, Plant Spacing: 12 inches

Planting Date: May 27, 1980

Harvest Date: October 6, 1980

Experimental Design: Randomized block and 4 replications with single row plots 50 feet long separated by unsprayed guard rows.

Spray Schedule: Weekly, starting July 6 and Ending September 21 (11 applications)

Method of Application: Co_2 backpack sprayer with a single row boom and 3 flat fan S.S. 8003 low pressure nozzles (1 overhead and 2 on drops). Operating pressure was 20 psi and volume of spray applied 25 gals/A.

Pesticide used: Herbicides: Eptan 7E, 3.5 pts/A preplant incorporated, Sencore 50 WP .5 lb/A 2 post emergence applications.

Insecticides: Thiodan 3EC 1 qt/A 3 applications with Fungicides

Fungicides: See table below.

Results:

Treatment	Disease Index[1] Early Blight	Yield cwt/A US #1	Yield cwt/A B Grade
Quintar 5F 9 oz/A	3.2	171.7	22.9
Quintar 5F 12.8 oz/A	2.9	184.5	24.0
Quintar 5F 25 oz/A	2.5	188.9	28.7
Qunitar 5F 12.8 oz/A + Dithane M-22 80 W .5 lb/A	2.0	204.5	22.3
Dithane M-22 80 W 1.5 lb/A	1.8	205.7	21.5
BFN 8099 40EC 4.1 oz/A	1.3	216.9	16.5
BFN 8099 40EC 12.6 oz/A	1.1	215.4	15.2
Bravo 500 2.25 pts/A	1.4	224.1	15.0
Check	6.0	164.2	36.9
LSD .05	.2	16.1	6.8
.01	.3	22.0	9.3

[1] Disease Index = 0=no disease - 10=100% defoliation

Summary: All fungicide treatments had significantly less early blight than the check. The experimental compound BFN 8099 and Bravo 500 resulted in significantly better disease control than any of the other treatments. Quintar's effectiveness increased as the rate of application increased. However, it was more effective at the 12.8 oz rate in combination with the .5 lb rate of Dithane M-22 than it was alone at 25 oz per acre. Treatments providing the best disease control also had the highest yields.

INFLUENCE OF SELECTED PRODUCTION MANAGEMENT INPUTS ON WEIGHT LOSS AND MARKET QUALITY OF STORED POTATOES DUE TO STORAGE ENVIRONMENTS

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INTRODUCTION (The 1979 MSU Integrated Project)

The MSU Integrated Project is a multi-disciplinary phase involving all aspects of potato production and handling from planting the potatoes in 1979 through a 1980 study of seed viability after storage of the 1979 crop.

Superior potatoes for this Integrated Phase were planted May 9, 1979 in Range 5 at the MSU Montcalm Potato Research Farm under the supervision of Dr. Richard Chase of the MSU Department of Crop and Soil Sciences. These Superior potatoes were produced using three (3) levels of phosphorus, two (2) nematicides and a check. There were nine (9) treatments replicated five (5) times in Range 5.

The production management objective of this study was to examine the varying phosphorus levels and their interaction with selected control programs. Researchers in the Departments of Crop and Soil Sciences; Entomology; and Botany and Plant Pathology were responsible for the production phase.

Superior potatoes were planted in four (4) row plots (rows each 50 feet or 15.24m long and 34 inches or 0.86m apart). Seed pieces were spaced 8 to 12 inches (20.5 - 30.5cm) in the row.

A four (4) row plot was used for a treatment. Superior seed pieces were of phosphorus (50, 150 lb/acre) and two nematicides (Temik 15G 3.0 a.i./acre, Vorlex 10 gal/acre). Temik 15G was applied in the seed piece furrow at planting and Vorlex was injected to a 6-8 in. (15-20cm) soil depth on May 1, 1979. Those plots to receive phosphorus were applied with either 50 lbs/acre or 150 lbs/acre P_2O_5 at planting. All plots also received a uniform application of 500 lbs/acre NPK (20-0-0) at planting. The plots were hilled and sidedressed at an application rate of 145 lbs/acre Urea (45%) on June 20, 1979.

At harvest, only the two center rows of each plot were harvested, graded, and weighed. During the season, plots were maintained under normal commercial irrigation and insect and disease control practices.

PROCEDURE (The storability phase of the MSU Integrated Project)

a. Seed viability: representative samples of potatoes were obtained during the 1979 harvest from the nine treatments and five applications--45 sample bags containing approximately 25 pounds each after harvesting.

*Other Researchers on this storage project: Dr. H.S. Potter, Dept. of Botany and Plant Pathology, Dr. J.N. Cash, Dept. of Food Science and Human Nutrition, Dr. Richard Chase, Dept. of Crop and Soil Sciences

August 24, 1979 these sample bags of potatoes were weighed and placed in the MSU storage cubicles for 3 weeks at 60°F and 95% RH for suberization. After suberization the storage temperature was lowered 5°F per week until the desired storage temperature of 40°F was obtained.

These potatoes were planted by Dr. Chase on May 9, 1980 to determine seed viability. The seed potatoes from the 1979 production were evaluated in 1980 for plant stand count, total yield in cwt/A; % grade #1, and specific gravity.

b. Tuber quality: sample bags (approximately 25 pounds each) were obtained and stored for tuber quality evaluation; 45 bags (9 treatments and 5 replications) were stored at 40°F after suberization and another 45 bags were stored at 50°F. These potatoes were weighed and evaluated for marketable quality at four storage intervals from December 24, 1979 to April 15, 1980.

c. Weight loss: two lots of 45 sample bags, each approximately 25 pounds per bag, were stored at 40° and 50°F after suberization. These potatoes were weighed six different times after harvest (67 to 281 days storage).

DISCUSSION AND RESULTS

The influence of selected management inputs on Superior yield, grade, and specific gravity are shown in Table 1.

The weight loss information is shown in Tables 2 - 5. Various samples of Superior potatoes from the MSU Potato Farm were stored in the MSU cubicles. The weight loss data in Table 2 is from potato samples for tuber quality evaluation, however, all samples stored were weighed. Table 2 shows that there is a steady increase in weight loss over the storage period. The reason that there is a decreasing number of sample bags over the duration of the storage is that some sample bags are removed for tuber evaluation (after tuber evaluation, these potatoes are removed from the test).

One purpose of continually researching weight loss is to establish a "weight loss factor" (weight loss per day in storage) for various storage conditions. The weight loss factors for the Superior potatoes in Table 2 are:

Storage period, days	Weight loss factor wt loss/day, %	
	50°F	40°F
118	.044	.039
167	.042	.036
195	.050	.040
233	.059	.041
281	.071	.047

There is no apparent effect of the nine production treatments as shown in Table 2 on weight loss.

Weight loss data for a sample of Superior potatoes designated for a weight loss study are shown in Table 3. This table shows there is a steady increase in weight loss over the storage period for Superior potatoes stored at 40F and 95% RH. The weight loss factor is:

Storage period, days	Weight loss factor wt loss/day, % 40^oF
118	.038
174	.034
195	.033
237	.032
256	.034

Table 1

Influence of selected management inputs on the yield, grade and specific gravity of 1979 Superior potatoes grown at the Montcalm Potato Research Farm Farm, Entrican, Michigan

	PRODUCTION TREATMENTS			YIELD (CTW/ACRE) A Grade	B Grade	Jumbo Grade	Total	SPECIFIC GRAVITY
1	0P[2]	Check		215.0a[1]	10.9a	10.5a	236.7a	1.066ab
2	0P	Temik 15G	3 lb a.i./acre	247.5ab	13.2a	20.0ab	280.7ab	1.066ab
3	0P	Vorlex	10 gal/acre	277.5bc	14.9a	22.6abc	314.9bc	1.067ab
4	50P	Check		247.7ab	10.5a	15.0ab	273.3ab	1.066ab
5	50P	Temik 15G	3 lb a.i./acre	276.8bc	11.2a	28.7bcd	316.7bc	1.065a
6	50P	Vorlex	10 gal/acre	298.1c	12.7a	38.1d	348.9c	1.068b
7	150P	Check		282.7bc	11.6a	19.4ab	313.7bc	1.068b
8	150P	Temik 15G	3 lb a.i./acre	315.7c	11.9a	36.4cd	364.1c	1.066ab
9	150P	Vorlex	10 gal/acre	324.6c	12.3a	29.9bcd	366.7c	1.068b

[1] Column followed by the same letter are not significantly different ($P = 0.05$) according to the Student-Newmans-Keuls Multiple Range Test.

[2] 0P = 0 lb. phosphorous per acre

Superior potatoes seed pieces were planted May 16-17, 1979 and harvested August 24, 1979.

Table 2

Influence of storage duration on weight loss from 1979 Superior potatoes using nine different production treatments and stored at 40° and 50°F and 95% relative humidity.

Production Treatments* and Storage Temperature		Storage Period, Days 67[1]	118[1]	167[2]	195[3]	233[4]	281[5]
		Weight Loss, %					
50°F	1	3.7	4.9	6.3	8.9	13.5	18.8
	2	3.9	5.1	7.1	9.0	14.1	20.7
	3	4.2	5.2	7.7	10.0	14.2	22.2
	4	4.3	5.1	6.9	9.3	12.5	20.0
	5	4.1	6.0	7.2	9.8	14.0	19.7
	6	4.1	5.5	7.6	10.9	15.0	--
	7	3.9	4.8	6.8	9.8	12.8	17.9
	8	4.1	5.2	7.5	9.7	13.5	19.0
	9	4.1	5.2	7.1	9.8	13.4	21.2
	Av.	4.0	5.2	7.1	9.7	13.7	19.9
40°F	1	**	4.2	5.8	7.6	9.2	13.8
	2		4.7	6.2	7.4	9.2	13.7
	3		4.7	6.1	7.9	9.5	12.6
	4		4.2	5.7	7.5	9.4	12.2
	5		4.3	6.1	7.8	9.5	13.0
	6		4.7	6.9	8.4	10.6	14.6
	7		3.9	5.8	7.0	9.2	13.2
	8		5.0	6.2	7.7	8.6	12.1
	9		4.4	6.4	8.0	10.3	14.6
	Av.		4.6	6.1	7.7	9.5	13.3

[1]Average weight loss from 5 sample bags--sample bags approximately 25 lbs each
[2]Average weight loss from 4 sample bags
[3]Average weight loss from 3 sample bags
[4]Average weight loss from 2 sample bags
[5]Average weight loss from 1 sample bag

* No.	Phosphorus Rate	Pesticide
1.	0 lb P_2O_5/A	Check
2.	0 lb P_2O_5/A	Temik
3.	0 lb P_2O_5/A	Vorlex
4.	50 lb P_2O_5/A	Check
5.	50 lb P_2O_5/A	Temik
6.	50 lb P_2O_5/A	Vorlex
7.	150 lb P_2O_5/A	Check
8.	150 lb P_2O_5/A	Temik
9.	150 lb P_2O_5/A	Vorlex

**No data taken for this storage period

Table 3

Influence of storage duration on weight loss from 1979 Superior potatoes* using nine different production treatments and stored at 40° and 95% relative humidity.

Production Treatments**	Storage Period, days					
	34	118	174	195	237	256
	Weight Loss, %***					
1	3.6	4.0	5.6	6.3	7.5	8.9
2	3.5	4.2	5.4	5.9	7.2	8.2
3	4.1	4.9	6.5	7.1	8.2	9.6
4.	4.0	5.1	6.1	6.8	7.7	8.7
5.	3.3	3.8	5.3	5.7	6.7	7.9
6.	3.2	4.2	5.3	5.9	7.0	8.2
7.	3.7	4.4	5.7	6.3	7.3	8.5
8.	4.1	4.7	6.4	6.9	8.0	9.1
9.	4.5	5.2	6.5	7.2	8.3	9.4
Av.	3.8	4.5	5.9	6.5	7.5	8.7

*Sample bags of Superior potatoes from the MSU Integrated Potato plots were specifically stored for weight loss determination

**Refer to Table 2 footnotes for description of production treatments

***All data is the average of five sample bags--each sample bag is approximately 25 lbs

Again Table 3 shows that there is no apparent effect of the nine production treatments on weight loss.

One lot of Superior potatoes was specifically stored (40°F and 95% RH) for seed viability. These samples were placed in the cubicles on August 24, 1979 and not moved or weighed until they were removed for planting for the seed viability study on May 8, 1980 (256 days in storage.) Table 4 illustrates a justified researcher concern in the weight loss studies; periodically moving sample bags of potatoes for weighing may influence the weight loss data. The weight loss factor for this 40°F lot is .021 for 256 days at 40°F; compared to .034 (Table 3) and .059 (Table 2).

Table 4

Weight loss from 1979 Superior potatoes stored (for seed viability*) in MSU cubicles at 40°F and 95% relative humidity.

Production Treatment**	Initial Weight Aug. 24 '79	Final Weight May 8 '80	Weight Loss lbs.	%
1	28.1	26.8	1.3	4.6
2	30.1	28.7	1.4	4.7
3	30.2	28.4	1.8	6.0
4	28.9	27.8	1.1	3.8
5	31.8	30.4	1.4	4.4
6	32.1	30.2	1.9	5.9
7	30.2	28.4	1.8	6.0
8	3.26	30.5	2.1	6.4
9	31.0	29.3	1.7	5.5
Av.				5.3

*Superior potatoes from the MSU Integrated Potato Project were stored at 40°F and 95% RH. These potatoes were planted May 9, 1980 to determine seed performance. See Superior seed performance Table 8 for results.

**Refer to Table 2 footnotes for description of production treatments

Table 5 is a comparison of two nematicides on weight loss. In the 1979 report comparing Temik and Vorlex there appeared to be a higher weight loss in Superior plots with Vorlex than Temik. It again appears in Table 5 that Vorlex may be associated with a higher weight loss. In 12 of the comparisons shown in Table 5, ten of twelve lots show Vorlex associated with a greater weight loss than Temik.

On the other hand, there appears to be no association between levels of P_2O_5 and weight loss; the average weight loss of the four storage lots in Table 5 are: 9.3%, 9.8% and 9.4% for the 0, 50, and 150 lbs P_2O_5 respectfully.

In summary for Superior potatoes, the 1979 data indicates the following weight loss factors:

	Weight Loss Factor, % 4 mos.	6 mos.	8 mos.
40°	4.6	6.5	11.0
50°	5.3	8.3	14.6

Table 5

Comparison of extended storage weight loss from Superior potatoes grown in Temik and Vorlex plots at three levels of phosphorus.

Production Treatments			Storage Lot Numbers*				
			1	2	3	4	Av.
0	P_2O_5	Temik	9.2	13.7	4.7	8.2	9.0
		Vorlex	9.5	12.6	6.0	9.6	9.4
		Check	9.2	13.8	4.6	8.9	
50	P_2O_5	Temik	9.5	13.0	4.4	7.9	8.7
		Vorlex	10.6	14.6	5.9	8.2	9.8
		Check	9.4	12.2	3.8	8.7	
150	P_2O_5	Temik	8.6	12.1	6.4	9.1	9.0
		Vorlex	10.3	14.6	5.5	9.4	10.0
		Check	9.2	13.2	6.0	8.5	

*Storage Lot Numbers

1 Superior Tuber Quality Lots, Stored 233 days at 40°F and 95% RH

2 Superior Tuber Quality Lots, Stored 281 days at 40°F and 95% RH

3 Superior Seed Viability Lot stored 256 days at 40°F and 95% RH

4 Superior weight loss lot stored 256 days at 40°F and 95% RH

Superior potatoes grown on the MSU Research Farm for the MSU Integrated Project were stored at 40° and 50°F and 95% RH and evaluated for marketable quality after various periods of storage, Tables 6 and 7.

Table 6 contains the quality data from the Superior lots specifically stored for market quality evaluation. Five sample bags from each treatment were stored at the specified environment. One sample bag (approximately 25 lbs) was evaluated from each treatment at various periods during storage. Dr. H.S. Potter (Botany & Plant Pathology) evaluated each individual tuber for quality after the various periods of storage.

Market quality is a subjective determination. Each sample lot was divided into ten catagories:

1. Marketable
2. 0 to 5.0% dry rot
3. 5.1 to 10.0% dry rot
4. 10.1 to 25.0% dry rot
5. Over 25.0% dry rot
6. 0 to 5.0 soft rot
7. 5.1 to 10.0 soft rot
8. 10.1 to 25.0 soft rot
9. Over 25% soft rot
10. Other reasons (but not due to storage such as insect, excess scab, etc.).

This above evaluation destroyed a sample lot, therefore, only one lot was evaluated on a specific date except one date. On April 15, 1980 two sample bags were evaluated from each treatment to observe the potential variability between sample bags stored at random in the same MSU cubicle. Lot IV averaged 95.8% good where as Lot V averaged 98.6% good. Therefore, it may be concluded that a ± 1.4% variation may be applied to the data for the 40° and ± 2.5% to the data for 50°F.

In Table 6, there appears to be no apparent difference in market quality at a specific storage attributable to the production treatments.

Two lots of Superior potatoes were stored for other than market quality evaluation purposes: Lot SWL for weight loss and Lot SS for seed viability. However, at the conclusion of the storage season and just prior to the 1980 planting, these lots were evaluated for market quality, Table 7. A comparison of the data for comparable potatoes in Tables 6 and 7 shows the average marketable quality at 97.2% (Table 6) and 95.7 (SWL) and 95.6 (SS) Table 7 for potatoes stored 8 months at 40°F. This average of 96.2% for the three lots is higher than one might expect. These Superior potatoes were: special production management at the MSU Potato Research Farm; harvested with the MSU Plot harvester under ideal weather and temperature conditions; immediately stored at 60°F for suberization, and stored at 40°F and 95%.

Again as in Table 6, the data in Table 7 shows no apparent difference in marketable quality attributable to the nine production treatments.

Table 6

Marketable Superior potatoes grown on the MSU Potato Research Farm under nine production treatments and stored at two conditions, 40° and 50°F and 95% RH.

Integrated Project Treatment Number*	Quality Evaluation Date I Dec. 27 1979	II Feb. 8 1980	III Mar. 17 1980	IV Apr. 15 1980	V Apr. 15 1980
	Marketable Potatoes[1], % good stored at 40° 95% RH				
1	100.0	94.5	83.8	95.9	100.0
2	97.3	93.4	82.3	94.3	96.7
3	94.6	92.8	89.9	98.5	98.9
4	95.6	98.7	80.8	95.7	98.9
5	94.9	91.4	86.3	96.3	100.0
6	94.4	91.0	88.5	94.3	100.0
7	90.1	90.4	93.8	94.7	94.6
8	100.0	94.4	90.2	98.8	98.6
9	89.1	93.3	87.0	93.8	100.0
Av.	95.1	93.3	87.0	95.8	98.6
	Marketable Potatoes[1], % good stored at 50° 95% RH				
1	91.9	93.7	80.7	95.9	98.9
2	90.1	95.1	84.3	89.2	99.0
3	100.0	93.3	82.6	90.3	98.8
4	97.3	91.8	85.1	91.1	94.7
5	88.9	98.3	81.8	93.5	96.0
6	88.3	84.1	84.4	94.9	95.1
7	84.1	93.4	85.5	90.9	96.3
8	88.8	95.8	86.2	88.0	94.8
9	98.5	95.5	77.5	93.6	98.8
Av.	92.0	93.4	83.1	91.9	96.9

*Refer to Table 2 footnotes for description of production treatments.

[1]Average market quality from 1 sample bag (approximately 25 lbs.) from each treatment

Table 7

Market quality of 1979 Superior potatoes stored in MSU cubicles at 40°F and 95% relative humidity for 256 days.

Sample Designation* and Production Treatment**		Replication I	II	III	IV	V	Average
		Market Quality, %good					
SWL	1	97.4	100.0	93.2	100.0	96.5	97.4
	2	96.4	98.6	93.3	95.5	95.5	95.9
	3	97.4	93.0	100.0	97.3	90.9	95.7
	4	97.0	93.2	94.0	97.5	100.0	96.3
	5	96.4	98.5	98.4	95.1	96.4	97.0
	6	89.1	95.5	93.4	94.6	96.6	93.8
	7	97.4	95.7	94.6	94.8	100.0	96.5
	8	94.4	98.6	93.3	97.4	95.1	95.8
	9	94.6	93.2	98.3	85.7	94.0	93.2
Av.							95.7
SS	1	93.8	94.1	94.1	100.0	100.0	96.4
	2	100.0	88.2	88.2	100.0	100.0	95.3
	3	93.8	89.5	100.0	94.4	93.3	94.2
	4	93.8	88.9	88.9	88.9	94.1	90.9
	5	100.0	100.0	88.9	100.0	93.3	96.4
	6	100.0	88.2	100.0	100.0	87.5	95.1
	7	100.0	100.0	100.0	93.3	93.8	97.4
	8	93.3	100.0	100.0	100.0	100.0	98.7
	9	92.9	100.0	100.0	100.0	88.2	96.2
Av.							95.6

*Sample bags of Superior potatoes from the 1979 MSU Integrated Potato Project were stored at 40° and 95% RH. SWL potatoes were stored specifically for weight loss determination and SS potatoes were stored for a seed viability determination

**Refer to Table 2 footnotes for description of production treatments

Table 8

Yield performance of 1979 Superior seed potatoes* produced with different levels of phosphorus and nematicides, stored at 40°F and 95% RH, and planted May 9, 1980.

1979 Production Treatments**			Stand	Yield			
No.	P_2O_5 lbs.	Nematicide	%	Total cwt/A	No 1 cwt/A	No 1 %	Specific Gravity
1	0	None	97	317	291	91.8	1.069
2	0	Temik	97	309	287	92.9	1.068
3	0	Vorlex	95	305	287	94.1	1.068
4	50	None	97	320	290	90.6	1.068
5	50	Temik	95	332	314	94.6	1.069
6	50	Vorlex	94	331	317	95.8	1.066
7	150	None	95	326	305	93.6	1.068
8	150	Temik	98	305	287	94.1	1.068
9	150	Vorlex	98	303	280	92.4	1.067

*The 1979 MSU Integrated Potato Project produced Superior potatoes using various levels of phosphorus and nematicides, representative samples were secured from these plots, stored, and planted in 1980 to study the influence of production treatments on seed vigor

**Refer to Table 2 footnotes for description of production treatments

Another measure of potato quality is seed viability or yield performance. One sample bag of potatoes was taken at random from each of the five replications of each of the nine treatments (45 sample bags, approximately 25 lbs each). These potatoes were stored in the MSU cubicles at 40° after suberization. On May 8, 1980 these potatoes were evaluated and 12 tubers each of the 5 replications of the 9 treatments were provided to Dr. Richard Chase for planting. Table 8 presents the yield performance data. There is a range in total yield 303 to 332 cwt/A and yield of No. 1 potatoes ranges 280 to 317 cwt/A but it is not apparent that this difference is attributable to the nine production treatments. The specific gravities were all low and ranged from 1.066 to 1.069.

QUALITY OF STORED POTATOES DUE TO HANDLING, PRESTORAGE TREATMENTS, AND STORAGE ENVIRONMENTS

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INTRODUCTION:

Monona potatoes grown commercially and under one of the recommended MSU Integrated project treatments (repeating a 1978 treatment) will be used for this phase of the storage project. These potatoes will be used for evaluation of various prestorage handling and chemical treatments and storage environments in controlled environment cubicles and in the center of a bulk pile of commercially stored potatoes.

OBJECTIVE:

(1) To determine the influence of prestorage treatments (bacte/fungicides and sprout inhibitors) on bruised potatoes after extended storage under various storage environmental conditions.
(2) To monitor equivalent potatoes stored in the center of a bulk pile of commercially stored potatoes.

Note:
It is surmised that more air than necessary is recommended in bulk-stored potatoes but data is not available to enable reduced volume recommendations. This research is designed to eventually enable the development of a storage operational system which will be activated by the requirements of the "potato" and not by man. This ultimately will reduce fan time and storage operational costs for electricity.

PROCEDURE:

This phase involved three aspects: 1) mechanical harvesting and handling, 2) post harvest treatment and 3) storage location of Monona potatoes. The purpose was to determine the effects of handling and prestorage chemical treatments on weight loss and marketable quality of potatoes out of storage.

Two lots of Monona potatoes were used. One lot of Monona potatoes was grown on the MSU Potato Research Farm; the second lot was grown on a commercial potato farm in Montcalm County (near Edmore).

The MSU potatoes were harvested with the MSU plot harvester. One half of this lot was rerun over a windrower twice to simulate additional mechanical handling. The windrower was operated at a PTO speed of 800 rpm. The Monona potatoes on this commercial farm were dug with a two row windrower and six rows were harvested at one time with a John Bean Air Harvester. Three lots of potatoes were treated, stored and evaluated: a) hand selected potatoes out of the windrow, b) sample bags were filled directly from the end of the bin piler and c) one half of the hand selected potatoes from the windrower were twice rerun over the windrower (3x bruise). Thus the handling variables were:

*Other Researchers contributing to the Project: Dr. H.S. Potter, Dept. of Botany and Plant Pathology, Dr. J.N. Cash, Dept. of Food Science and Human Nutrition, Dr. Richard Chase, Dept. of Crop and Soil Sciences

MSU Grown Monona Potatoes

1) Minimum bruise - MSU plot harvester (1x bruise).
2) Bruised (3x) rerun over the windrower (2 times).

Commercially grown and harvested Monona

1) Minimum bruise - hand selected from the windrow (1x bruise).
2) Sample obtained directly from the end of the bin piler
3) Hand selected potatoes from windrow were rerun (2 times) over the windrower (3x bruise).

These two lots of Monona potatoes were prestorage treated with a calibrated system mounted on a conveyor (to simulate prestorage application of chemicals prior to storage.

Bruised and non-bruised potatoes from each lot were prestorage treated as follows:

Check - no chemical
Chlorine
TBZ - Mertec applied at approved rate per ton
TBZ & chlorine - both chemicals were applied in the same solution

1. Potatoes - (a) MSU Research farm potatoes of the Monona variety will be grown using one of the recommended production treatments from the 1978 MSU Integrated potato project. These potatoes will be subjected to a 3 x bruise by re-running tubers over a commercial potato windrower. (b) Monona potatoes from a commercial grower will be collected and pre storage treated similar to the MSU potatoes.

2. Storage - The MSU as well as the commercially grown Monona potatoes will be stored in the MSU controlled environment cubicles and in the center of the bulk pile of commercially grown and stored Monona potatoes.

3. Storage Environment - (a) MSU potatoes will be stored in cubicles at 40° and 50°F and 95% R.H. (after suberization) and in the center of the bulk pile of commercially stored potatoes.
(b) The commercially grown Monona potatoes will be bagged, tagged, treated, and weighed. Potatoes will be placed in the MSU cubicles at 40° and 50° F and in the center of the bulk pile of commercially stored potatoes (along with the MSU potatoes). This arrangement is being made to observe the potential storability quality difference between the cubicle and bulk storage environment.

4. Bulk Storage Environment - Temperature and relative humidity monitoring instrumentation will be placed in the pre-storage treated MSU and commercially grown potatoes in the bulk storage pile. The instrumentation will enable continuous monitoring of temperature and R.H. throughout the entire depth in the bulk storage.

5. Weight Loss - Weight loss data will be taken at harvest, after suberization, and monthly thereafter until June, 1980 for the cubicle-stored potatoes. Similar weight loss data will be taken at harvest and upon removal of potatoes from the commercial bulk storage.

6. Tuber Quality - A bruise-free evaluation will be made at harvest by Ore-Ida (before and after bruising). Tuber quality evaluations will be made every other month until June, 1980 on cubicle-stored potatoes and upon emptying the bulk storage.

7. Chipping Quality - Chip quality will be checked just prior to storage and every other month until June, 1980 on cubicle-stored potatoes and upon removal of test potatoes from the bulk storage.

DISUCSSION AND RESULTS:

Weight loss data for Monona potatoes is shown in Tables 1 to 4 and Figs. 1 and 2. Monona potatoes were harvested on the MSU Potato Research Farm and on a commercial potato farm. These potatoes were mechanically and chemically treated and stored in the MSU cubicles at 40° and 50°F and in the center of a pile in a commercial storage. Tables 1 and 2 show the weight loss data for these two lots of Monona (bruised and non-bruised; treated and checks) stored at 40° and 50°F; the weight loss factor for these is as follows:

Storage Period Days	Weight Loss Factor wt loss/day, % 50°F		40°F	
	Bruised	Non-Bruised	Bruised	Non-Bruised
77	.047	.038	.052	.042
126	.040	.032	.043	.036
145	.042	.036	.042	.034
187	.049	.045	.042	.034
231	.061	.059	.042	.035

Additional weight loss data for the two lots of bruised and non-bruised Monona potatoes is shown in Tables 3 and 4. Table 3 is data for a storage of 145 days at 50°F in MSU cubicles and Table 4 is for 150 days at approximately 48°F in the center of the pile in a commercial storage. As was demonstrated for the second year, there is less weight loss in the center of the pile than from the sample bags stored in the MSU cubicles at 95% RH. An analysis of the data for 1979 potatoes shown in Tables 3 and 4 follows:

Weight Loss Factor wt. loss/day, %

Treat-ments	Non-Bruised Lot 1	Lot 2	Aver.	Bruised Lot 3	Lot 4	Lot 5	Aver.
	145 days at 50°F in MSU cubicles						
Check	.036	.033	.034	.047	.040	.045	.044
Treated	.034	.040	.037	.036	.038	.048	.041
	150 days at 48°F in commercial storage						
Check	.023	.023	.023	.025	.027	.027	.026
Treated	.027	.025	.026	.030	.025	.029	.028

Table 1

Influence of pre-storage mechanical and chemical treatments and storage duration on weight loss from two plots of 1979 Monona potatoes stored in MSU cubicles at 40°F and 95% relative humidity.

Sample* Number & Pre-storage Treatments		Storage Period, days					
		26[1]	77[1]	126[2]	145[3]	187[4]	231[5]
		% Weight Loss					
MMO 40°F	NS	1.9	2.9	4.5	4.7	6.7	8.0
	NC	2.0	2.9	4.2	5.2	7.3	8.9
	NT	2.0	3.3	4.2	4.9	6.5	8.5
	NA	1.9	2.8	3.9	4.3	5.3	6.7
Av.		2.0	3.0	4.2	4.8	6.5	8.0
MMO 40°F	BS	2.9	3.8	5.2	5.3	6.5	8.2
	BC	2.8	3.7	5.4	5.6	-	-
	BT	2.8	4.0	5.3	5.7	7.0	8.5
	BA	2.8	3.7	4.7	5.5	6.3	8.1
Av.		2.8	3.8	5.2	5.5	6.6	8.3
CMO 40°F	WS	2.3	3.3	4.8	5.6	6.9	8.5
	WC	2.6	3.4	4.8	5.1	6.1	7.7
	WT	2.4	3.4	4.7	4.9	6.3	8.4
	WA	2.1	3.3	4.3	5.0	5.9	7.9
Av.		2.4	3.4	4.7	5.2	6.3	8.1
CMO 40°F	PS	3.0	4.0	5.5	6.0	7.7	9.6
	PC	3.2	4.4	5.6	6.6	9.6	11.6
	PT	3.2	4.3	6.1	7.0	8.3	9.8
	PA	2.4	3.6	5.0	5.7	7.4	9.0
Av.		3.0	4.1	5.6	6.3	8.3	10.0
CMO 40°F	BS	2.9	4.0	-	5.9	7.8	9.9
	BC	2.7	3.9	5.5	6.8	9.2	10.8
	BT	3.0	4.0	5.3	6.6	9.0	10.7
	BA	2.8	3.9	5.6	7.0	8.6	10.3
Av.		2.9	4.0	5.5	6.6	8.7	10.4
Av. Non-Bruised		2.2	3.2	4.6	5.0	6.4	8.1
Av. Bruised		2.9	4.0	5.4	6.1	7.9	9.6

Table 1 con't.

*Lettercodes for samples
Two potato lots -- harvested October 4, 1979

Lot MMO - Monona potatoes grown on the MSU Montcalm Potato Research Farm at Entrican, Michigan.

Lot CMO - Monona potatoes grown on a commercial Montcalm County potato farm at Edmore, Michigan.

Mechanical Treatments

- N Non-bruised - MSU potatoes harvested with MSU plot harvester.
- B Bruised 3x - plot harvested potatoes intentionally mechanically bruised by rerunning potatoes twice over a windrower operated at a PTO speed of 800 rpm, MMO-B.
- W Hand-selected potato samples from commercially windrowed potatoes.
- P Potato samples from same field but obtained off the end of the piler.
- B CMO-B are W potato samples bruised by rerunning twice over windrower like MMO-B above.

Chemical Treatments

- S Check lot no chemical treatment
- C Chlorine only
- T Mertec (TBZ) only
- A Both TBZ and chlorine

[1]Average weight loss from 5 sample bags--sample bags approximately 25 lbs. each.
[2]Average weight loss from 4 bags.
[3]Average weight loss from 3 bags.
[4]Average weight loss from 2 bags.
[5]Average weight loss from 1 bag.

Table 2

Influence of pre-storage mechanical and chemical treatments and storage duration on weight loss from two plots of 1979 Monona potatoes stored in MSU cubicles at 50°F and 95% relative humidity.

Sample* Number & Pre-storage Treatments		Storage Period, days					
		26[1]	77[1]	126[2]	145[3]	187[4]	231[5]
		% Weight Loss					
MMO	NS	1.5	2.8	4.1	5.2	8.3	12.7
50°F	NC	1.5	2.6	3.5	4.0	7.2	12.8
	NT	1.3	2.0	2.8	4.1	8.3	13.4
	NA	1.2	3.4	4.8	6.8	9.7	15.0
Av.		1.4	2.7	3.8	5.0	8.4	13.5
MMO	BS	2.0	3.4	5.9	6.9	11.4	16.5
50°F	BC	1.9	3.3	4.0	5.4	8.3	13.8
	BT	2.5	3.8	4.8	6.6	8.8	13.7
	BA	1.2	2.7	4.5	4.5	8.6	12.8
Av.		1.9	3.3	4.8	5.9	9.3	14.2
CMO	WS	1.1	2.5	3.9	4.8	8.9	16.9
50°F	WC	2.2	3.2	4.9	6.1	9.0	13.5
	WT	2.2	3.4	4.3	5.5	7.7	12.2
	WA	1.9	3.3	4.3	5.7	8.4	13.4
Av.		1.9	3.1	4.4	5.5	8.5	13.8
CMO	PS	1.9	3.5	5.1	6.7	9.8	15.1
50°F	PC	1.5	3.0	3.9	4.9	10.2	15.3
	PT	2.1	3.6	4.7	4.9	7.1	12.5
	PA	1.9	3.7	4.9	5.7	8.3	12.3
Av.		1.9	3.5	4.7	5.6	8.9	13.8
CMO	BS	2.7	3.9	5.4	6.5	9.6	14.8
50°F	BL	2.4	4.3	5.6	7.3	10.7	16.0
	BT	2.3	3.7	5.3	5.7	8.9	15.1
	BA	1.9	3.9	5.8	7.8	8.1	12.2
Av.		2.3	4.0	5.5	6.8	9.3	14.5
Av. Non-Bruised		1.6	2.9	4.1	5.2	8.4	13.6
Av. Bruised		2.0	3.6	5.0	6.1	9.2	14.2

Table 2 con't.

*Lettercodes for samples
Two potato lots -- harvested October 4, 1979

Lot MMO - Monona potatoes grown on the MSU Montcalm Potato Research Farm at Entrican, Michigan.

Lot CMO - Monona potatoes grown on a commercial Montcalm County potato farm at Edmore, Michigan.

Mechanical Treatments

- N Non-bruised - MSU potatoes harvested with MSU plot harvester.
- B Bruised 3x - plot harvested potatoes intentionally mechanically bruised by rerunning potatoes twice over a windrower operated at a PTO speed of 800 rpm, MMO-B.
- W Hand-selected potato samples from commercially windrowed potatoes.
- P Potato samples from same field but obtained off the end of the piler.
- B CMO-B are W potato samples bruised by rerunning twice over windrower like MMO-B above.

Chemical Treatments

- S Check lot no chemical treatment
- C Chlorine only
- T Mertec (TBZ) and chlorine
- A Both TBZ and chlorine

[1]Average weight loss from 5 sample bags--sample bags approximately 25 lbs. each.
[2]Average weight loss from 4 bags.
[3]Average weight loss from 3 bags.
[4]Average weight loss from 2 bags.
[5]Average weight loss from 1 bag.

Table 3

Summary of weight loss data* for bruised and non-bruised potatoes from two lots of Monona potatoes stored in MSU cubicles at 50°F and 95% RH for 145 days.
*See Table 2

Post Harvest Chemical Treatment	Non-bruised lots**		Bruised lots**		
	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Check	5.2	4.8	6.7	6.9	6.5
Chlorine	4.0	6.1	4.9	5.4	7.3
TBZ	4.1	5.5	4.9	6.6	5.7
TBZ & Chlorine	6.8	5.7	5.7	4.5	7.8

**Lot 1 MSU grown Monona harvested with MSU plot harvester
Lot 2 Monona potatoes commercially grown in Montcalm County and windrowed--potatoes hand selected out of the windrow
Lot 3 Commercially grown and harvested with the John Bean harvester--potatoes were bagged off the end of the bin piler
Lot 4 Lot 1 potatoes rerun two times by a windrower operating with PTO at 800 rpm
Lot 5 Lot 2 potatoes rerun as was Lot 4

Table 4

Summary* of weight loss data for bruised and non-bruised potatoes from two lots of Monona potatoes stored in the center of a commercial pile of potatoes at 48°F for 150 days.
*See Table 2

Post Harvest Chemical Treatment	Non-bruised lots**		Bruised lots**		
	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Check	3.5	3.5	3.8	4.1	4.1
Chlorine	4.3	3.7	4.1	3.7	4.7
TBZ	3.9	3.6	4.3	3.6	3.9
TBZ & Chlorine	3.9	4.1	5.0	3.8	4.3

**Lot 1 MSU grown Monona harvested with MSU plot harvester
Lot 2 Monona potatoes commercially grown in Montcalm County and windrowed--potatoes hand selected out of the windrow
Lot 3 Commercially grown and harvested with the John Bean harvester--potatoes were bagged off the end of the bin piler
Lot 4 Lot 1 potatoes rerun two times by a windrower operating with PTO at 800 rpm
Lot 5 Lot 2 potatoes rerun as was Lot 4

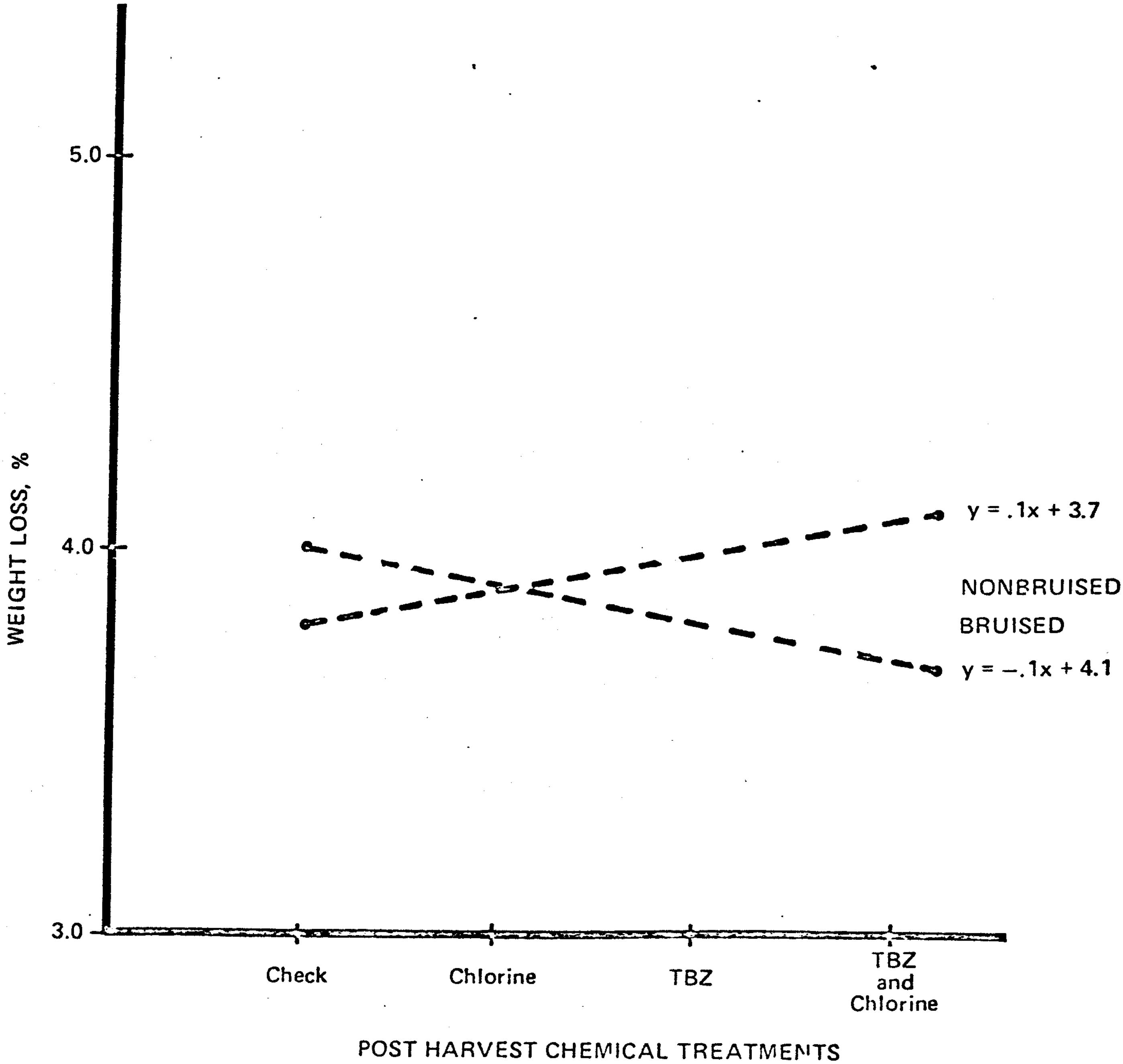

Fig. 1. "Best Fit" line representing weight loss due to handling and post harvest chemical treatments on 1979 Monona potatoes grown on the MSU Potato Research Farm and stored in the center of a commercial potato bin at 48° for 150 days.

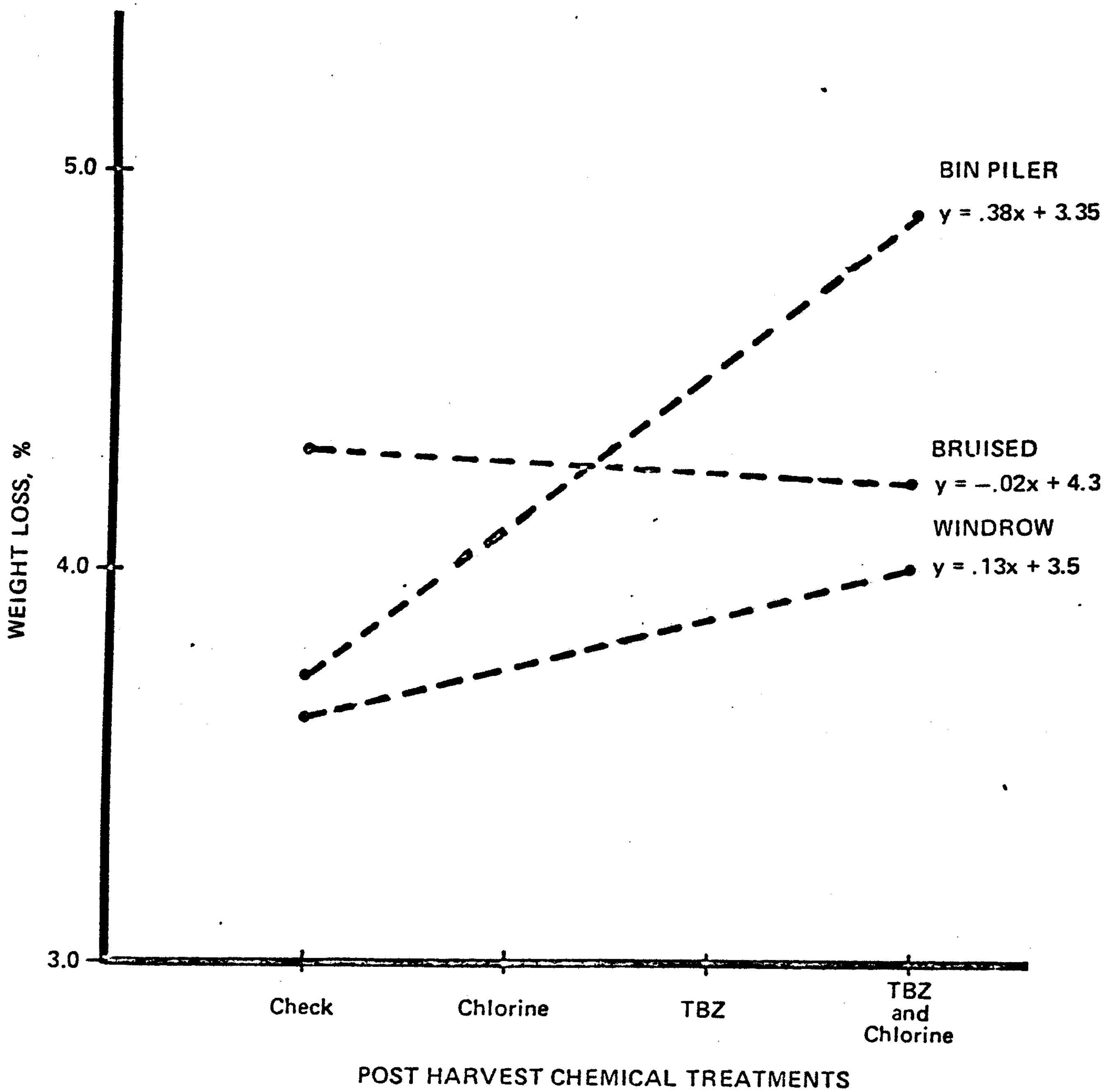

Fig. 2. "Best Fit" line representing weight loss due to mechanical handling and post harvest chemical treatments on 1979 Monona potatoes grown in Montcalm County Michigan and stored in the center of a commercial potato bin at 48°F for 150 days.

Weight loss in relationship to handling and post-storage chemical treatments needs additional research.

Post harvest treatment chemicals appear to have a negative effect upon weight loss in relationship to the non-treated check in spite of the fact the check received the same handling (without chemical applications). Figures 1 and 2 are best fit lines representing the data in Tables 3 and 4 . In Figures 1 and 2 bruised, treated potatoes show slightly less weight loss than non-bruised and windrowed potatoes. Research in progress for 1980 may help clarify this point.

The two lots of Monona potatoes were evaluated for the effects of mechanical handling and post harvest chemical treatments on out-of-storage market quality. Non-bruised, mechanically harvested, and intentionally bruised Monona potatoes were treated with combinations of Mertec and chlorine and stored in MSU cubicles and in the center of the pile of a commercial storage. Data representing market quality are shown in Tables 5 and 6 and Figures 3 to 6.

Tables 5 and 6 show bruised and non-bruised stored at 40^{o} and 50^{o}F in the MSU cubicles.

These tables show that pre-storage chemical treatments are more effective on up-grading the market quality of bruised versus non-bruised potatoes. In general non-bruised, non-treated potatoes are at about the same grade as bruised and treated potatoes stored under equivalent conditions.

Figures 3 and 4 are a graphic presentation of the effect mechanical damage has upon market quality; these figures also dramatically show the beneficial effects of Mertec and chlorine on improving market quality. Figure 3 graphically presents the picture for MSU plot harvested potatoes and intentionally rebruised and Figure 4 presents the picture for commercially harvested Monona potatoes (harvested under ideal conditions); the bruised line in Figure 4 is data for windrowed potatoes that were intentionally rebruised like Figure 3.

Figures 5 and 6 graphically present the picture of market quality degradation due to:

1. Storage duration
2. Storage temperature
3. Mechanical handling

Figure 5 represents the effect storage duration and temperature and bruising have on market quality of MSU Monona potatoes stored in the MSU cubicles.

Figure 6 represents the effect of storage duration on commercially grown and harvested Monona potatoes.

Table 5

Influence of pre-storage mechanical and chemical treatments and storage duration on marketable quality of 1979 Monona potatoes stored in MSU cubicles at 40°F and 95% relative humidity.

Sample* Number & Pre-storage Treatments		Storage Period, days			
		84	127	154	286
		Marketable Quality, % Good**			
MMO	NS	87.7	93.5	62.9	100.0
	NC	91.8	84.2	93.7	94.2
	NT	90.3	100.0	97.0	91.0
	NA	90.4	92.7	88.4	93.3
Av.		90.1	92.6	85.5	94.6
CMO	WS	82.8	93.3	65.0	100.0
	WC	80.1	91.1	75.0	100.0
	WT	90.0	98.3	97.1	93.2
	WA	92.3	97.0	92.2	93.8
Av.		86.4	94.9	82.3	96.8
CMO	PS	83.5	89.4	60.5	85.6
	PL	89.0	81.7	80.8	88.2
	PT	89.1	94.8	88.4	97.0
	PA	89.5	95.9	93.2	--
Av.		87.8	90.5	80.7	90.0
CMO	BS	66.2	62.9	31.0	69.8
	BC	62.7	65.5	65.5	80.3
	BT	78.7	85.1	100.0	87.5
	BA	72.2	88.1	80.8	73.2
Av.		70.0	75.4	69.3	77.7
MMO	BS	72.0	83.3	--	69.4
	BC	66.2	80.5	76.8	61.6
	BT	84.6	93.9	82.3	68.0
	BA	56.6	90.1	80.8	85.0
Av.		70.2	87.0	78.0	71.0
Av. Non-Bruised		88.2	93.8	83.9	95.7
Av. Bruised		76.0	77.6	76.0	78.0

Table 5 con't.

*Lettercodes for samples
Two potato lots -- harvested October 4, 1979

Lot MMO - Monona potatoes grown on the MSU Montcalm Research Farm at Entrican, Michigan

Lot CMO - Monona potatoes grown on a commercial Montcalm County potato farm at Edmore, Michigan.

Mechanical Treatments

- N Non-bruised - MSU potatoes harvested with MSU plot harvester
- B Bruised 3x - plot harvested potatoes intentionally mechanically bruised by rerunning potatoes twice over a windrower operated at a PTO speed of 800 rpm, MMO-B.
- W Hand-selected potato samples from commercially windrowed potatoes.
- P Potato samples from same field but obtained off the end of the piler.
- B CMO-B are W potato samples bruised by rerunning twice over windrower like MMO-B above.

Chemical Treatments

- S Check lot no chemical treatment
- C Chlorine only
- T Mertec (TBZ) only
- A Both TBZ and chlorine

**Average marketable quality from 5 sample bags -- sample bags approximately 25 lbs. each.

Table 6

Influence of pre-storage mechanical and chemical treatments and storage duration on marketable quality of 1979 Monona potatoes stored in MSU cubicles at 50°F and 95% relative humidity.

Sample* Number & Pre-storage Treatments		Storage Period, days			
		84	127	154	286
		Marketable Quality, % Good**			
MMO	NS	91.8	89.9	57.6	88.1
	NC	89.4	92.2	87.9	81.8
	NT	89.0	93.2	91.6	88.5
	NA	79.7	88.2	90.2	95.5
Av.		87.5	90.9	81.5	88.5
CMO	WS	91.5	95.0	74.0	81.6
	WC	84.2	92.3	89.1	59.1
	WT	87.1	93.9	92.8	77.6
	WA	80.4	90.7	95.4	90.7
Av.		85.8	93.0	87.8	77.3
CMO	PS	88.0	93.7	67.3	81.9
	PC	80.7	79.3	77.3	82.7
	PT	77.8	96.0	91.6	69.1
	PA	85.5	94.9	85.7	75.3
Av.		83.0	91.0	80.4	77.3
CMO	BS	65.1	58.8	54.8	63.9
	BC	63.9	--	60.3	36.5
	BT	89.2	78.3	70.3	50.0
	BA	63.0	85.2	79.3	46.2
Av.		70.3	74.1	66.2	49.2
MMO	BS	61.0	73.3	59.0	58.4
	BC	72.5	76.1	65.0	40.0
	BT	70.5	89.9	77.1	66.7
	BA	70.0	93.1	81.2	54.0
Av.		68.5	83.1	70.6	54.8
Av.	Non-Bruised	86.6	91.9	84.6	82.9
Av.	Bruised	73.9	82.7	80.3	60.4

Table 6 con't.

*Lettercodes for samples
Two potato lots -- harvested October 4, 1979

Lot MMO - Monona potatoes grown on the MSU Montcalm Research Farm at Entrican, Michigan.

LOT CMO - Monona potatoes grown on a commercial Montcalm County potato farm at Edmore, Michigan.

Mechanical Treatments
- N Non-bruised - MSU potatoes harvested with MSU plot harvester
- B Bruised 3x - plot harvested potatoes intentionally mechanically bruised by rerunning potatoes twice over a windrower operated at a PTO speed of 800 rpm, MMO-B.
- W Hand-selected potato samples from commercially windrowed potatoes.
- P Potato samples from same field but obtained off the end of the piler.
- B CMO-B are W potato samples bruised by rerunning twice over windrower like MMO-B above.

Chemical Treatments
- S Check lot no chemical treatment
- C Chlorine only
- T Mertec (TBZ) only
- A Both TBZ and chlorine

**Average marketable quality from 5 sample bags -- sample bags approximately 25 lbs. each.

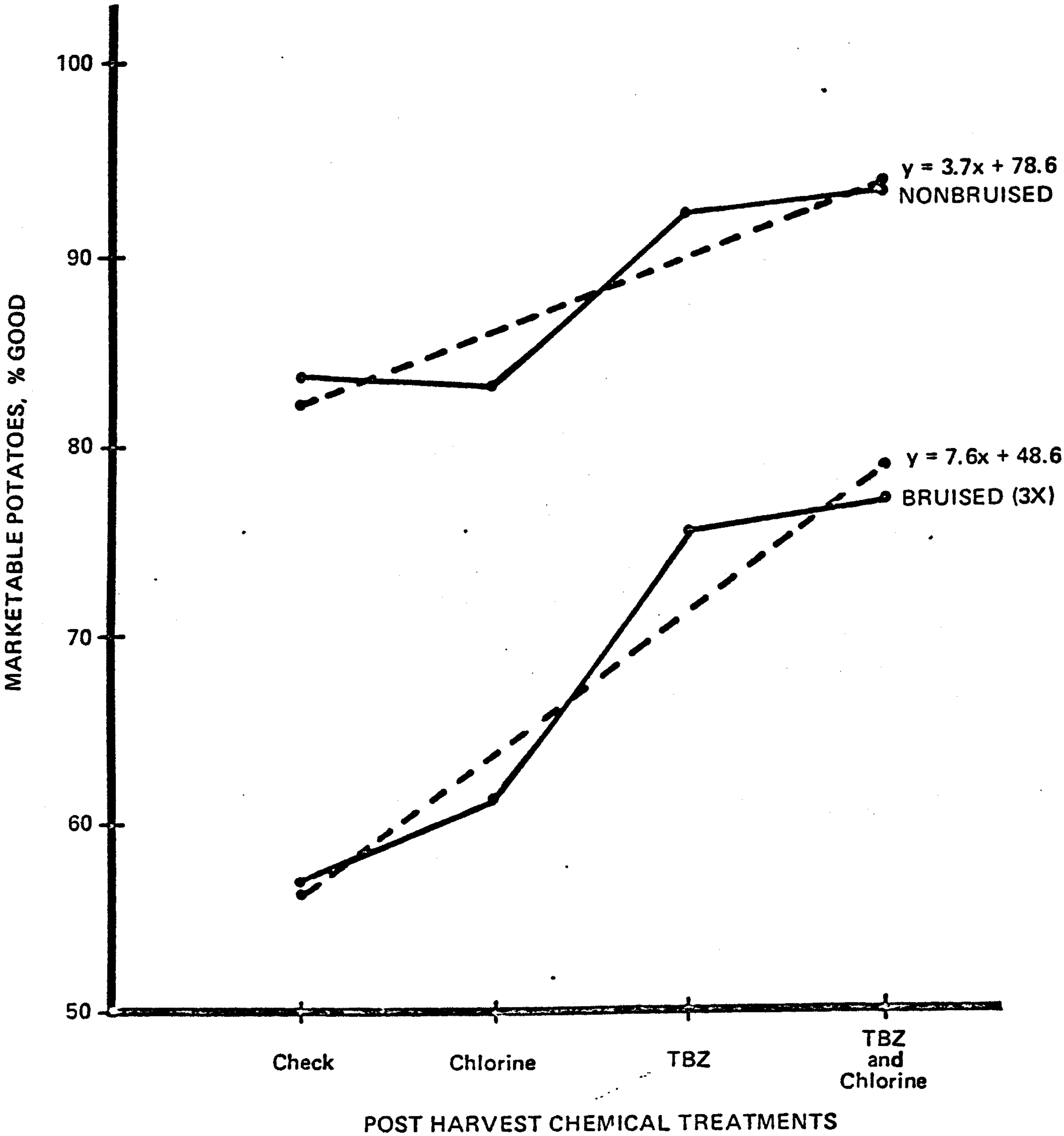

Fig. 3. "Best Fit" line representing market quality loss as influenced by handling of 1979 MSU grown Monona potatoes stored in the center of a commercial potato storage at 48^{o}F and evaluated March 10, 1980.

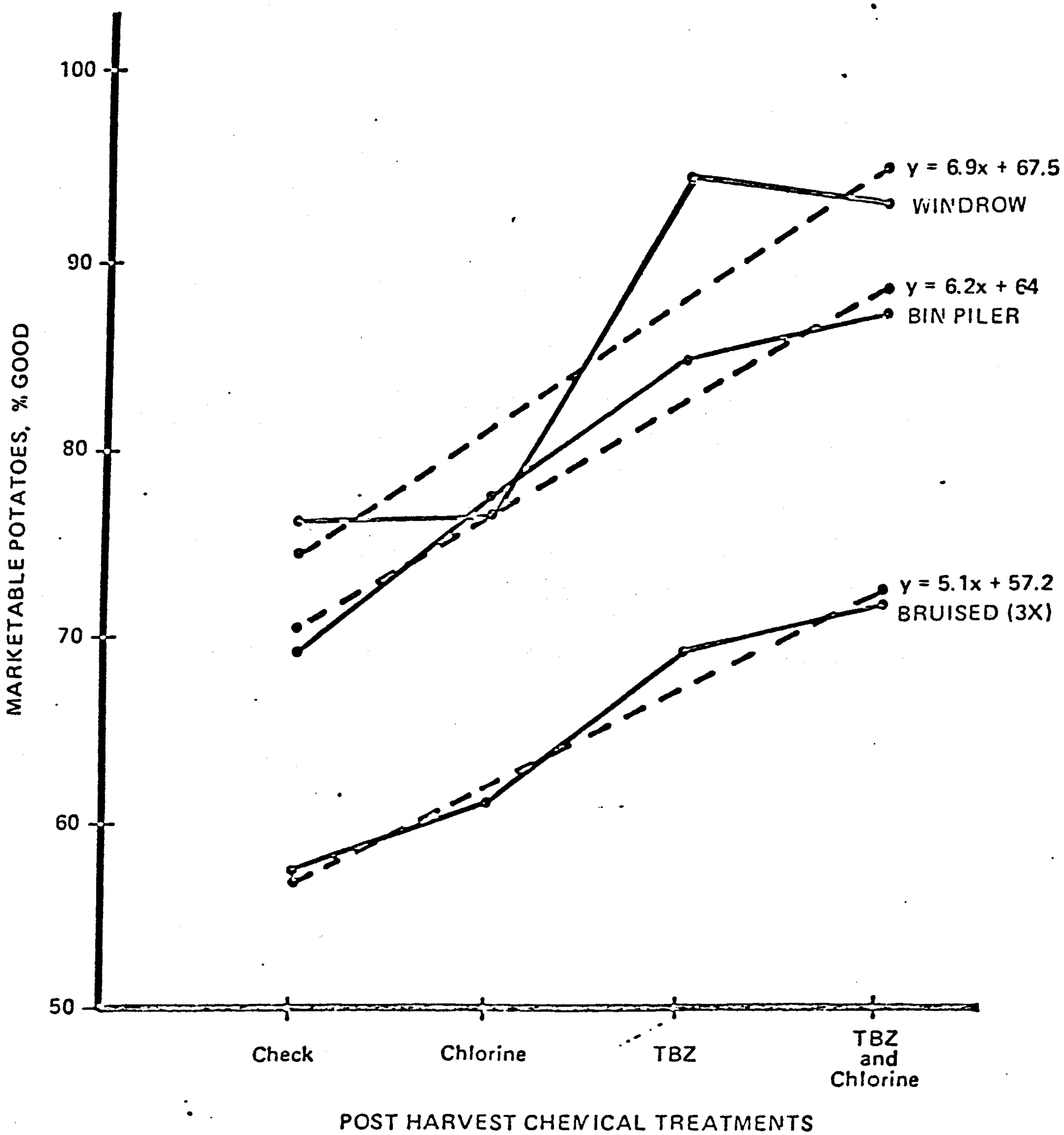

Fig. 4. "Best Fit" line representing market quality loss as influenced by a commercial grower handling of 1979 commercially grown Monona potatoes stored in the center of a commercial potato storage at 48°F and evaluated March 10, 1980.

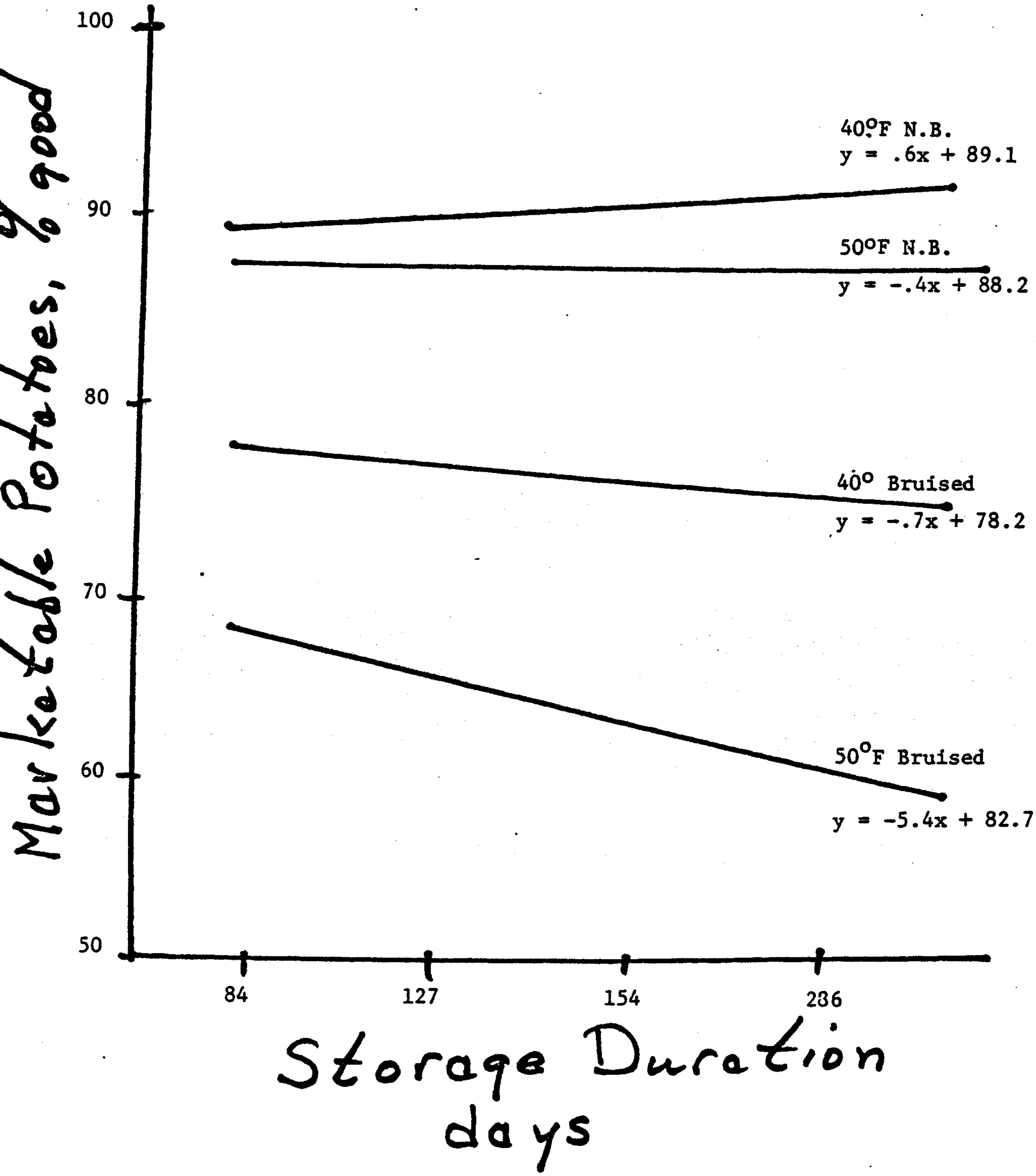

Fig. 5. "Best Fit" line representing market quality loss as influenced by handling and storage duration of 1979 MSU grown Monona potatoes stored in MSU cubicles at 40° and 50°F and 95% RH and evaluated at various times during the storage season.

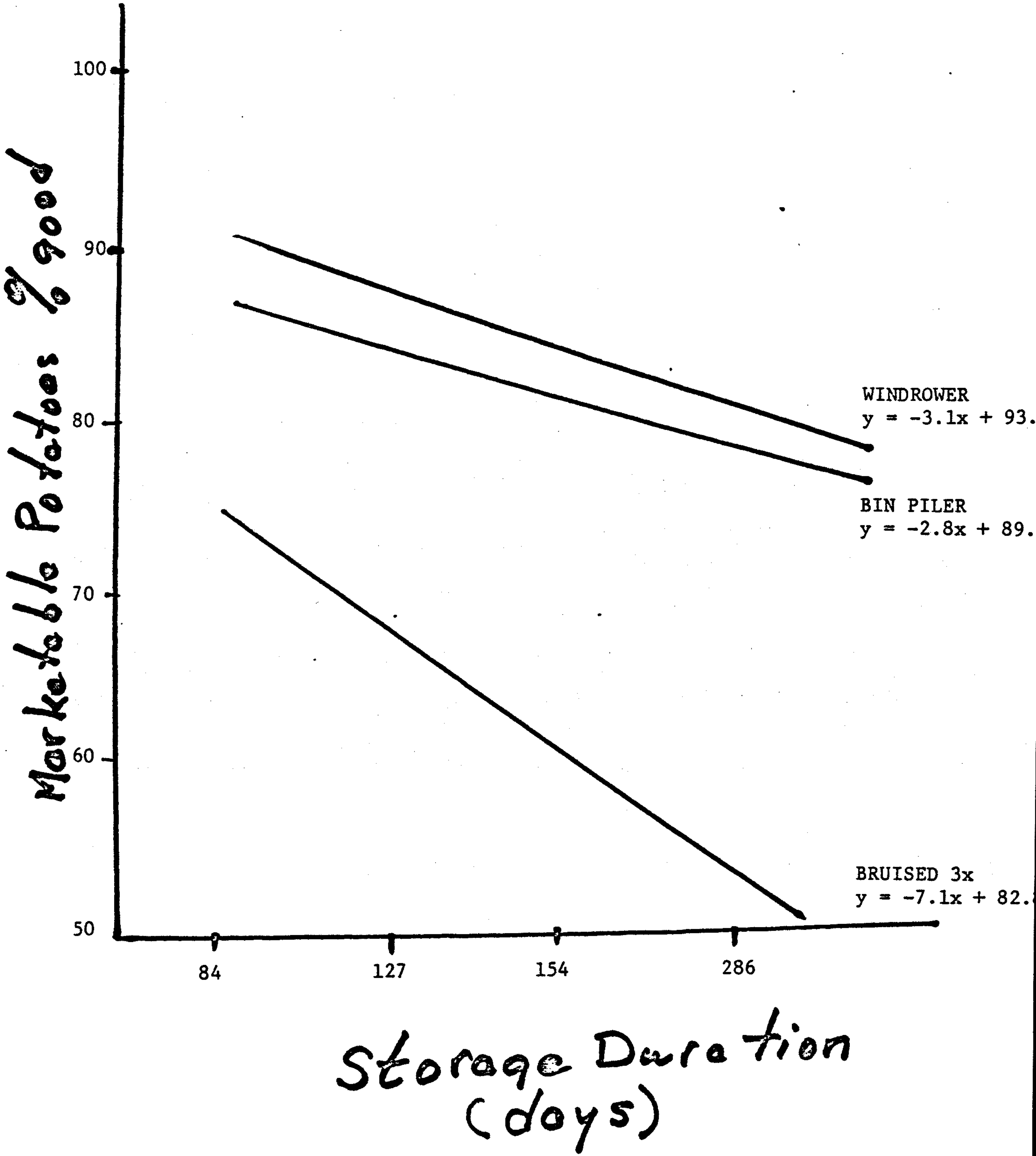

Fig. 6. "Best Fit" line representing market quality loss as influenced by commercial handling and storage duration of 1979 commercially grown Monona potatoes stored in MSU cubicles at 50°F and 95% RH and evaluated at various times during the storage season.

Supplemental Discussion (information on air flow distribution in a commercial potato storage).

One aspect of the 1979 Potato Storage Research not specified in the 1979 objectives was uniformity of air flow distribution through the entire potato pile in the commercial storage. The reason for this concern was that in 1978 the research potatoes for the 1978 project were placed in the commercial bin in a layer one sample bag deep at a pile depth of 6 feet. Sample bags were placed at three locations across the storage at the 6 foot depth (over the main, in the center, and at the side opposite the main).

In 1978 this commercial storage was filled with quality Monona potatoes plus the research potatoes. It was reported later, however, that losses were always observed along the main, in the area of the fan house, and at the unloading end. By April 1979 it was obvious the grower would lose this entire bin of Monona potatoes for chips plus the research potatoes in the center of the pile.

After the storage was emptied and cleaned, an intensive air flow distribution analysis was made of this commercial storage bin. The air distribution was found to be very uneven with extreme shortages of air in one-fourth to one-third of the bin along the side over the main; drastic air shortages occurred from the first three lateral ducts (this is the area around the fan house and the unloading door). The areas where air shortages occurred were the areas where losses normally were excessive.

Extensive air velocity and static pressure measurements were made throughout the entire air distribution system. Air velocities out of the air slots of ducts #1, 2, and 3 (at the fan end) were less than the 200 fpm (feet per minute) to which the instrumentation would respond. However, air velocities out of the slots in the laterals in the opposite end were 2500 fpm in the center and along the side opposite the main. The instrumentation would not respond to slot air flow along the entire main for a distance of 7' to 8' from the side wall of the bin.

The storage air flow system was balanced so that all slots had an air velocity of 1000 fpm $\pm$ 100 fpm. The bin was filled in 1979 with commercially grown Monona potatoes and the 1979 research potatoes were placed in the center of the pile as reported earlier (over the main, in the center and on the side opposite the main--all at a depth of 6 feet).

The storage was maintained by the grower and unloaded the week of March 9, 1980. The research potatoes (MSU grown Monona and the commercially grown and harvested Monona poatotes) were evaluated for weight loss and market quality as reported earlier in this report. The grower sold <u>all</u> the potatoes from this bin for chips.

The potato bag samples in the <u>three</u> locations <u>across</u> the bin were evaluated and compared as to the effect of location. There was <u>no</u> weight loss or quality difference of equivalent potatoes located over the main, in the center, or from the side opposite the main.

Uniform air distribution through the pile throughout the entire storage is essential for the quality storage of potatoes for the chip market.

CORN HYBRIDS, PLANT POPULATION AND IRRIGATION

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Performance data for 71 commercial corn hybrids evaluated in 1980 with and without irrigation are presented in Table 1 along with two and three year averages for those tested in 1979 and 1978. Bouyoucous soil moisture blocks were placed at 6, 12, 18 and 24 inch depths in both irrigated and unirrigated plot areas. Irrigation was applied when soil moisture reached 50% or less of water holding capacity at 6" level. Only three inches of supplemental water was applied during July and August since rainfall was much more favorable than normal during this period in 1980.

Irrigated yields averaged 11.6 bushels more than nonirrigated -- 125.8 vs 114.2, an increase of 10%. Hybrids ranged from 73.7 to 167.8 bushels per acre with irrigation and 65.1 to 158.5 without irrigation. Hybrids significantly better than average yield (arranged in order of increasing grain moisture content at harvest) are listed below. Nineteen of the 24 hybrids were in the highest yielding group for both irrigated and unirrigated plots.

Irrigated	Not Irrigated
Pioneer 3901 (2X)	Amcorn Exp. 4 (2X)
Voris X401 (2X)	Pioneer 3901 (2X)
Michigan 3102 (2X)	Voris X401 (2X)
Hyland HL-2448 (2X)	Michigan 3102 (2X)
Great Lakes GL-455 (2X)	Hyland HL-2448 (2X)
Asgrow RX511 (2X)	Dairyland DX1096 (2X)
Jacques JX97 (2X)	Great Lakes GL-455 (2X)
Amcorn ZX5500 (2X)	Asgrow RX511 (2X)
Wolverine W166 (2X)	DeKalb XL14aa (2X)
Golden Harvest XS715 (2X)	Jacques JX97 (2X)
Michigan 407-2X (2X)	Wolverine W166 (2X)
Jacques JX147	Michigan 407-2X (2X)
Great Lakes GL-477 (2X)	Great Lakes GL-477 (2X)
Super Crost 2350 (2X)	Super Crost 2350 (2X)
Pioneer 3780 (2X)	Pioneer 3780 (2X)
Blaney B507 (2X)	Blaney B507 (2X)
Migro HP23R (2X)	Migro HP23R (2X)
Pride 4488 (2X)	Pride 4488 (2X)
Blaney B606 (2X)	Blaney B606 (2X)
Michigan 5922 (2X)	Michigan 5922 (2X)
ADI 323 (2X)	ADI 323 (2X)
ADI 197 (2X)	ADI 197 (2X)
Migro M-2018X (2X)	Migro M-2018X (2X)
Golden Harvest H-2500 (2X)	Golden Harvest H-2500 (2X)

The correlation of irrigated with unirrigated yields was highly significant, .812, indicating that the hybrids tended to respond alike in both situations. During the 13-year period, 1968-1980, 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 13-year period, 1968-1980, are given in Table 2. The average yielding hybrids have yielded 46 more bushels when irrigated. The highest yielding hybrids have responded with 59 bushels added yield while the lowest yielding hybrids have given only 27 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 no consistent difference in stalk lodging between irrigated and unirrigated plots in 1980, 15.3% vs. 14.9% (Table 1). In most (but not all) of the previous years, there was less lodging on the irrigated plots. Generally, stressed weaker plants on unirrigated plots have been more susceptibale to lodging. In 1980, the highest lodging was 35% stalk breakage when irrigated and compared to 39% when unirrigated. The lowest lodging was only 0.7% irrigated and 1.5% unirrigated.

PLANT POPULATION X IRRIGATION

Five adapted hybrids at four plant populations irrigated and not irrigated have been grown in each of 13 years, 1968-1980, Table 3. Over the 13-year period, a population of 23,300 has given the highest average yield (167 bushels per acre) when irrigated while 19,200 has given the highest yield (110 bushels) without irrigation. The 23,300 population irrigated has given the highest yield in 11 out of 13 years (1973 and 1979 being the exceptions). The 13-year average increase due to irrigation has been 67 bushels per acre at the 23,300 population.

Moisture content of grain at harvest has averaged .5 - 1.0% higher for the higher populations. Stalk lodging has increased with increased plant populations.

Table 1

NORTH CENTRAL MICHIGAN

Zone 3

Montcalm County Trial - Irrigated vs. Not Irrigated
One, Two, Three Year Averages - 1980, 1979, 1978

Hybrid (Brand-Variety)	% Moisture 1980	% Moisture 2 yrs.	% Moisture 3 yrs.	Bushels per acre 1980 Irrig	Bushels per acre 1980 Not Irrig	Bushels per acre 2 years Irrig	Bushels per acre 2 years Not Irrig	Bushels per acre 3 years Irrig	Bushels per acre 3 years Not Irrig	% Stalk lodging 1980 Irrig	% Stalk lodging 1980 Not Irrig	% Stalk lodging 2 years Irrig	% Stalk lodging 2 years Not Irrig	% Stalk lodging 3 years Irrig	% Stalk lodging 3 years Not Irrig
Blaney B100E (2X)	21.1	--	--	73.7	66.8	---	---	---	---	18.6	16.0	--	--	--	--
Golden Harvest XS-824 (2X)	21.3	--	--	86.6	81.3	---	---	---	---	21.2	31.4	--	--	--	--
Great Lakes GL-352 (Sp.)	21.5	--	--	74.5	65.1	---	---	---	---	22.3	21.1	--	--	--	--
Blaney B101 (2X)	21.7	--	--	76.0	69.3	---	---	---	---	25.5	18.2	--	--	--	--
Jacques JX44 (2X)	22.1	--	--	82.4	75.9	---	---	---	---	21.8	28.6	--	--	--	--
Michigan 333-3X (3X)	22.2	23	22	106.6	98.1	104	81	114	83	16.1	19.4	13	15	10	11
Michigan 280 (4X)	22.4	23	21	93.3	91.7	92	72	92	71	20.5	20.0	19	17	16	15
Dairyland DX1095 (2X)	22.4	23	--	91.4	80.4	92	66	---	---	25.5	18.8	20	13	--	--
Migro M-0101 (2X)	22.8	23	22	114.8	104.5	108	84	118	83	12.0	12.2	11	11	9	7
Pioneer 3950 (MSX)	22.8	23	--	112.5	103.7	112	82	---	---	7.8	9.9	11	8	--	--
Warwick W901 (2X)	22.8	--	--	107.0	91.5	---	---	---	---	16.7	23.4	--	--	--	--
Migro HP16 (2X)	23.1	24	--	99.5	89.8	102	75	---	---	13.3	20.1	15	16	--	--
+Amcorn Exp. 4 (2X)	23.1	--	--	132.7	129.7	---	---	---	---	12.0	8.9	--	--	--	--
*+Pioneer 3901 (2X)	23.4	24	23	152.2	138.4	144	117	151	111	8.3	8.4	8	7	5	5
*+Voris X401 (2X)	23.4	--	--	147.7	130.3	---	---	---	---	19.9	19.0	--	--	--	--
*+Michigan 3102 (2X)	23.4	24	23	144.4	138.0	128	104	146	104	14.5	16.3	12	12	9	9
*+Hyland HL-2448 (2X)	23.4	--	--	151.1	132.1	---	---	---	---	4.3	5.0	--	--	--	--
Super Crost 1950 (MSX)	23.4	24	23	112.4	107.1	111	82	130	87	21.6	18.4	18	17	15	13
Super Crost 1700 (MSX)	23.4	--	--	83.6	77.6	---	---	---	---	9.8	9.2	--	--	--	--
Great Lakes GL-422 (2X)	23.4	--	--	129.9	116.9	---	---	---	---	10.1	15.3	--	--	--	--
Pioneer 3958 (2X)	23.5	24	23	101.3	97.6	105	85	112	87	5.1	14.9	7	11	6	8
+Dairyland DX1096 (2X)	23.5	--	--	137.5	133.1	---	---	---	---	11.1	11.1	--	--	--	--
Wolverine W126 (2X)	23.5	--	--	117.5	100.4	---	---	---	---	8.5	8.5	--	--	--	--
Custom CFSE2004 (2X)	23.7	--	--	136.9	117.8	---	---	---	---	7.1	10.3	--	--	--	--
Custom CFS1000 (2X)	23.7	26	24	98.4	88.3	113	84	119	82	28.8	25.2	17	14	14	11
Wolverine W132 (2X)	23.7	--	--	79.8	76.7	---	---	---	---	32.6	33.6	--	--	--	--
Garno S-90 (2X)	23.8	24	23	124.1	119.7	124	106	130	101	17.3	14.9	16	12	10	8
*+Great Lakes GL-455 (2X)	23.9	--	--	152.5	133.5	---	---	---	---	19.4	23.2	--	--	--	--
*+Asgrow RX511 (2X)	24.2	--	--	146.7	128.1	---	---	---	---	32.6	33.4	--	--	--	--
Garno S-94 (2X)	24.2	--	--	128.6	119.1	---	---	---	---	10.6	12.2	--	--	--	--
+DeKalb XL14aa (2X)	24.3	--	--	130.4	130.7	---	---	---	---	11.9	6.0	--	--	--	--
Funk G-4256 (3X)	24.3	--	--	104.2	94.7	---	---	---	---	23.3	20.6	--	--	--	--
*+Jacques JX97 (2X)	24.3	--	--	140.2	134.3	---	---	---	---	10.4	8.9	--	--	--	--
ADI 232 (2X)	24.3	25	24	117.5	107.7	126	92	138	94	11.7	13.9	14	12	12	10
*Amcorn ZX5500 (2X)	24.4	--	--	140.1	123.4	---	---	---	---	12.3	11.9	--	--	--	--
*+Wolverine W166 (2X)	24.6	--	--	141.2	133.6	---	---	---	---	5.8	10.8	--	--	--	--
Funk G-4224 (MSX)	24.6	25	24	109.9	102.6	110	81	120	81	20.4	22.1	13	16	12	12
*Golden Harvest XS715 (2X)	24.7	--	--	141.3	124.0	---	---	---	---	10.7	6.8	--	--	--	--
*+Michigan 407-2X (2X)	24.7	25	24	139.2	139.1	136	112	144	109	14.2	14.8	13	12	10	8
Great Lakes GL-511 (2X)	24.8	--	--	137.7	123.3	---	---	---	---	16.2	15.9	--	--	--	--
Amcorn PSX7300 (2X)	24.9	27	26	127.6	109.4	125	92	125	88	32.4	27.0	21	17	17	13
Dairyland DX1004 (2X)	24.9	--	--	132.4	121.9	---	---	---	---	21.4	19.3	--	--	--	--
*Jacques JX147	25.0	--	--	142.9	124.9	---	---	---	---	8.7	12.2	--	--	--	--
*+Great Lakes GL-477 (2X)	25.0	--	--	154.9	144.9	---	---	---	---	7.7	10.5	--	--	--	--
Migro HP20 (2X)	25.0	27	--	105.7	94.6	110	81	---	---	6.7	9.1	14	12	--	--
Pride 2206 (2X)	25.0	25	--	102.6	89.3	108	76	---	---	20.3	33.3	18	22	--	--
DeKalb XL15 (2X)	25.1	25	24	129.3	112.7	120	93	120	87	11.3	11.9	9	7	8	6
*+Super Crost 2350 (2X)	25.3	25	24	142.3	136.7	134	105	151	106	5.5	4.8	8	6	7	4
DeKalb XL31 (2X)	25.4	--	--	131.0	120.2	---	---	---	---	30.9	34.5	--	--	--	--
Hyland HL-2458 (2X)	25.4	--	--	122.5	109.8	---	---	---	---	7.3	10.6	--	--	--	--

(continued)

Table 1 (continued)

Hybrid (Brand-Variety)	% Moisture 1980	% Moisture 2 yrs.	% Moisture 3 yrs.	Bushels per acre 1980 Irrig	Bushels per acre 1980 Not Irrig	Bushels per acre 2 years Irrig	Bushels per acre 2 years Not Irrig	Bushels per acre 3 years Irrig	Bushels per acre 3 years Not Irrig	% Stalk lodging 1980 Irrig	% Stalk lodging 1980 Not Irrig	% Stalk lodging 2 years Irrig	% Stalk lodging 2 years Not Irrig	% Stalk lodging 3 years Irrig	% Stalk lodging 3 years Not Irrig
Asgrow RX2345 (2X)	25.6	26	—	131.0	109.8	129	94	—	—	35.2	38.8	27	23	—	—
Dairyland DX1003 (2X)	25.7	—	—	126.4	120.7	—	—	—	—	7.6	9.7	—	—	—	—
Dairyland DX1099 (2X)	25.9	26	—	106.2	91.9	105	79	—	—	16.4	17.0	21	16	—	—
Voris V2441 (2X)	26.2	—	—	127.4	108.3	—	—	—	—	12.4	9.7	—	—	—	—
*+Pioneer 3780 (2X)	26.3	26	25	141.2	132.2	131	111	148	109	7.5	7.2	13	8	12	6
*+Blaney B507 (2X)	26.5	26	—	143.9	130.1	135	105	—	—	12.0	14.1	12	12	—	—
P-A-G SX181 (2X)	26.8	—	—	131.5	120.3	—	—	—	—	23.1	25.1	—	—	—	—
*+Migro HP23R (2X)	26.8	27	—	148.6	129.9	132	97	—	—	14.4	11.2	13	9	—	—
*+Pride 4488 (2X)	26.9	28	26	147.5	138.0	140	106	147	103	5.8	1.5	4	1	3	2
*+Blaney B606 (2X)	27.4	28	26	164.9	150.2	153	118	152	110	9.0	9.3	6	5	5	4
Voris V2411 (2X)	27.7	—	—	132.9	122.5	—	—	—	—	7.0	6.7	—	—	—	—
Super Crost 2396 (2X)	27.7	—	—	132.9	114.1	—	—	—	—	12.1	14.6	—	—	—	—
*+Michigan 5922 (2X)	27.8	30	—	167.8	156.5	144	119	—	—	0.7	2.9	1	2	—	—
*+ADI 323 (2X)	28.6	—	—	138.6	127.8	—	—	—	—	8.1	5.6	—	—	—	—
*+ADI 197 (2X)	28.6	29	29	138.8	127.8	124	92	142	94	18.3	10.1	14	8	10	5
DeKalb XL23 (2X)	28.8	28	—	135.5	122.0	128	98	—	—	14.5	12.9	9	9	—	—
Super Crost 79028 (2X)	28.8	—	—	134.8	119.7	—	—	—	—	12.4	8.8	—	—	—	—
ADI 306 (2X)	28.8	—	—	124.0	117.3	—	—	—	—	29.1	28.1	—	—	—	—
*+Migro M-2018X (2X)	29.0	29	27	155.8	140.8	143	113	156	110	5.3	8.6	5	5	4	4
Migro M-2022X (2X)	29.4	28	27	120.6	113.6	117	93	134	96	12.4	7.1	9	9	8	6
*+Golden Harvest H-2500 (2X)	30.8	—	—	164.0	147.8	—	—	—	—	4.1	7.9	—	—	—	—
Average	24.9	26	24	125.8	114.2	121	93	133	95	15.3	14.9	13	11	9	8
Range	21.1 to 30.8	23 to 30	21 to 29	73.7 to 167.8	65.1 to 156.5	92 to 153	66 to 119	92 to 156	71 to 111	0.7 to 35.2	1.5 to 38.8	1 to 27	1 to 23	3 to 17	2 to 15
Least significant difference	1.5	1.0	0.7	13.2	12.6	9	7	6	5	-	-	-	-	-	-

*Significantly better than average yield, irrigated, in 1980.

+Significantly better than average yield, not irrigated, in 1980.

	1980	1979	1978
Planted	*May 12*	*May 19*	*May 3*
Harvested	*November 11*	*November 19*	*November 9*
Soil type	*Montcalm-McBride sandy loams*	*Montcalm-McBride sandy loams*	*Montcalm-McBride sandy loams*
Previous crop	*Alfalfa*	*Alfalfa*	*Corn*
Population	*20,700*	*20,800*	*20,700*
Rows	*30"*	*30"*	*30"*
Fertilizer	*315-155-155*	*213-80-80*	*197-60-60*
Irrigation	*3 inches*	*6 inches*	*8 inches*
Soil test: pH	*6.9*	*5.4*	*6.7*
P	*528 (very high)*	*493 (very high)*	*362 (very high)*
K	*290 (high)*	*336 (very high)*	*188 (medium)*

Farm Cooperator: Theron Comden, Montcalm Experimental Farm, Lakeview

County Extension Director: James Crosby, Stanton

Table 2. Average, highest and lowest yields for corn hybrids irrigated and not irrigated for 13 years, 1968-1980.

Year	No. of Hybrids Tested	AVERAGE		HIGHEST		LOWEST	
		Irrigated	Not Irrigated	Irrigated	Not Irrigated	Irrigated	Not Irrigated
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		138	92	176	117	90	59

Table 3. Average yield at four plant populations irrigated and not irrigated for 13 years. 1968-1980.

Year	15,200 Irrigated	15,200 Not Irrigated	19,200 Irrigated	19,200 Not Irrigated	23,300 Irrigated	23,300 Not Irrigated	27,400 Irrigated	27,400 Not Irrigated
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	139	96	159	110	167	100	151	92

U.S.D.A., DRY BEAN FOOD VALUE, PROCESSING QUALITY AND YIELD POTENTIAL IMPROVEMENT PROGRAM

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Experimental Objectives

TO 1: Develop new and improved genetic populations, breeding lines, and cultivars of vegetables that combine improved yield potentials with favored food quality factors, pest resistance, tolerance to environmental stresses, and adapted for mechanized culture, harvesting, and handling.

TO 2: Develop new and improved cultural and management practices that increase vegetable yields, minimize production losses, improve seed and food-quality attributes, and conserve and use scarce resources efficiently.

Experiments regarding TO 1

Tests 0700-M, 0900-M, and N-Fix-Screen were planted on June 13, 1980 in 4 row plots spaced 50.8cm apart. Row length was 4.9m. Stand count were taken on each plot prior to flowering and from 4m sections of the two center rows. Physiological maturity data were recorded for each plot.

Test 0700-M was designed to evaluate the effect of stress on seed fill, nutritional components, and processing quality of dry bean germplasm. Another goal of this study was to evaluate the relationship between C-assimilate partitioning in common bean yield and yield stability. Six strains of beans were tested (Table 1) under a stress imposed by removing source (leaves) at a physiological period for each strain corresponding to late seed fill. Late seed fill was chosen in hopes that pod set would not be influenced by source manipulations. Stressed plants were compared with non-stressed plants in each plot for seed yield, components of yield, percentage protein and ash, and processing characteristics. An identical experiment was conducted at the Saginaw Valley Bean and Sugarbeet Research Farm. Data from the 2 locations will be compared.

Test N-Fix-Screen is a continuing experiment with a major goal to investigate the relationship of nitrogen fixation rate and phytohemagglutinin type to nutrient availability and nutritional quality of dry and cooked beans.

Test 0900-M was planted to: (1) evaluate the interrelationships among seed coat color, tannin content, and the hard-to-cook phenomenon in food legumes and (2) initiate a genetic program to study the inheritance of these quality factors. This experiment consisted of 20 strains of dry beans differing in seed-coat color, seed characteristics and agronomic traits. These materials were evaluated for tannin and protein content, soaking characteristics, and percentage of hard seed.

Results and Discussion

Data for tests 0700-M and N-Fix-Screen are incomplete at this writing and, hence, are unavailable for publication in this report.

The results of test 0700-M showed large differences among lines for the rate of water uptake (Table 2). In addition, interstrain differences were noted for the percentage of hard seed after 48 hours soaking time (Table 2). Bean strains fell into one of two soaking categories (data not shown). Strains with few hardshell beans after 48 hours soaking reached a water uptake plateau for soaking after 12 hours, but strains with a significant amount of hard beans after 48 hours soaking never reached their water uptake plateau. The percentage of hard seed among genotypes ranged from 0 to 56% with red and brown seeded strains apparently most affected. Protein content among strains ranged from 22.1% to 28.4% and soaked bean texture ranged from 408 Kg/100g to 1,034 Kg/100g. Simple correlation coefficients (Table 3) show no associations between percentage protein and texture and percentage hard seed and texture. The results of this work suggests that the hard seed defect may be associated with seed-coat pigments and tannin levels. Texture, however, appears to be independent of seed-coat color and tannin level.

Experiments regarding TO 2

None.

Table 1. Test 0700-M an evaluation of the effect of leaf removal stress on seed fill, nutritional components and cooking quality in six strains of dry beans.

Strain No.	Pedigree	Seed coat color	Seed source†
1	Nep-2	White	Michigan State University
2	San Fernando	Black	Michigan State University
3	61618	White	Michigan State University
4	15-R-148	Red	University of Wisconsin
5	Sanilac	White	Commercial
6	P766	Brown	CIAT

† CIAT = International Center for Tropical Agriculture, Cali, Colombia, South America.

Table 2. Percent water uptake at 20C and eight time intervals, percent hard seed, protein content, and soaked bean texture for 20 strains of dry beans.

Strain	Seed Coat Color	Soaking Interval Hrs. 2	4	8	12	20	28	48	After 48 Hrs.	Protein	Texture
		Water Uptake g							%	%	Kg/100g
v_1	Brown	22.9	39.5	55.8	65.2	75.4	88.5	104.4	16.4	26.5	870
v_2	Beige	3.0	9.7	34.4	71.9	100.3	110.8	115.3	3.6	22.1	510
v_3	Red	2.3	4.7	10.3	20.0	35.2	54.3	96.3	24.2	28.4	972
v_4	Red	3.4	4.2	8.5	11.9	29.1	70.0	110.6	5.9	26.2	993
v_5	Brown	23.6	30.2	53.8	72.3	93.8	103.4	111.6	13.0	27.0	510
v_6	Dark Brown	40.8	55.3	86.3	101.7	110.8	111.2	111.2	0.0	26.4	680
v_7	Red	1.4	3.3	3.3	5.0	15.7	45.7	94.6	24.6	27.8	870
v_8	Brown Beige Mottle	22.9	30.8	48.0	60.6	81.5	86.3	97.2	22.5	26.1	986
v_9	Glossy Beige	4.4	9.8	17.2	20.6	36.0	41.5	50.8	56.4	22.3	1,034
v_{10}	Yellow	27.1	46.1	57.3	67.0	88.9	93.2	112.0	7.8	25.2	483
v_{11}	Red	64.1	104.1	132.0	134.3	135.3	139.2	141.5	1.1	25.5	537

Table 2 Continued

v_{12}	Brown	24.1	64.2	98.4	112.5	118.9	122.6	123.0	0.0	25.8	462
v_{13}	Beige	0.8	5.0	25.2	65.3	100.7	111.1	115.0	0.0	23.0	510
v_{14}	Dark Brown	2.3	3.1	3.8	12.7	49.8	79.2	105.0	3.8	25.8	619
v_{15}	Red	2.4	3.9	6.8	11.6	33.4	68.8	112.5	10.3	28.3	456
v_{16}	Yellow	10.5	15.5	34.0	48.7	78.8	88.7	102.2	12.3	24.5	408
v_{17}	Dark Brown	1.6	4.1	13.0	34.6	96.1	103.3	105.7	0.0	23.7	564
v_{18}	Black	4.6	27.9	65.7	86.8	106.8	112.3	116.0	0.0	25.0	605
v_{19}	White	73.2	105.9	114.0	114.0	114.0	114.0	114.0	0.0	27.9	665
v_{20}	Beige	13.8	25.5	40.1	49.2	83.4	98.0	106.6	7.7	25.0	537

Table 3. Simple correlations among protein content, texture, and percentage hard seed in 20 strains of dry beans.

Correlation	Correlation coefficient (r)
Protein vs Texture	0.196
Hard Seed vs Protein	0.050
Hard Seed vs Texture	0.293

DRY BEAN VARIETAL TESTING - COLORED BEANS

M.W. Adams & J.L. Taylor

Introduction

Three sets of material were grown in 1980. One set consisted of Kidneys, cranberries, and large whites (14 entries), a second set consisted of 16 selections of light red kidney beans obtained from A. Andersen, and a third set consisted of 18 entries of cranberry selections tracing to A. Andersen (12) and M. Stilwell (6). Only the first test was grown in 4-row, 4 replicate plots. The spacing throughout was 18 inches between rows, plots were irrigated whenever necessary, and neither insects nor diseases were a problem at this site. Average yields reflect the excellence of the growing conditions.

Table 1. Yield (lbs/A at 16% Moisture) of Red Kidney, Cranberry, and Selected Large White-Seeded Strains at Comden Farm, Montcalm Co., 1980.

Entry	Type	Date of Physiological Maturity	Yield (lbs/A)
Charlevoix	DRK	9/12	3297.4
Montcalm	DRK	9/15	2867.1
Manitou	LRK	9/20	3090.2
Mecosta	LRK	9/20	2456.0
70684	LRK	9/5	2833.2
70700	LRK	9/5	3203.8
70688	LRK	9/5	3443.9
Redkloud	LRK	9/5	3233.8
Sacremento	LRK	9/3	3592.7
Alubia	White	9/30	2372.5
5408	White	9/12	3340.8
61144	White	9/8	3717.9
Michicran	Cranberry	9/18	3219.4
Cran 028	Cranberry	9/16	3558.7

$LSD_{.05}$ = 204 lbs/A

Table 2. Yield (lbs/A at 16% Moisture) Selected Light Red Kidney Strains Received from A. Andersen (grown only in two replications), Comden Farm, Montcalm Co., 1980. Test 0217a.

Entry	Date of Physiological Maturity	Yield (lbs/A)
9470	9/5	3098.1
9473	9/5	3064.1
9475	9/5	3061.5
9476	9/5	3293.8
9480	9/5	3609.6
9478	9/5	3171.2
9484	9/5	3609.6
9485	9/5	3202.5
9449	9/5	2805.8
9482	9/20	2962.4
9460	9/5	3098.1

Table 2, continued

9451	9/5	3045.9
9453	9/5	3056.3
9466	9/5	3244.2
9465	9/8	3351.2
9461	9/5	2899.7

$LSD_{.05}$ = 204 lbs/A

Discussion

Test 0217: It appeared from the performance of the limited number of late varieties included in this test that lateness was associated with somewhat lower yields. We have no explanation of this. Sacremento, which is the earliest entry in the test, was the second highest yielding strain tested. Alubia, the large seeded white bean from Argentina, did not mature under the conditions of this test and consequently yielded poorly. Two other large whites, which we have been testing, #5408 and #61144, yielded particularly well. They have also performed well in previous trials.

The early maturing light red kidney strain, 70688, also performed well, and is being proposed for release as a new halo-blight tolerant variety for Michigan.

Cran 028, a bush type, performed well in comparison with Michicran. Bean Shippers tell us, however, that the seed size of Cran 028 is slightly smaller than Italian type with which it must compete in marketing, thus no further steps are to be taken to release Cran 028. We have instead begun a crossing program to increase its seed size.

Test 0217a: This test was grown adjacent to Test 0217 and we think the yields should be comparable. It consisted exclusively of entries submitted by Dr. A. Andersen, who stated that these entries derived from single plant selections which he had made within the variety Redkloud. Most of them resemble Redkloud indistinguishably in plant appearance, maturity, and yield. Two entries, 9480 and 9484, with yields of 36 cwt each, significantly out-performed Redkloud. We cannot be sure until further testing whether this margin of superior yield will be maintained. One entry, 9482, was much later than all the rest, as late as Manitou and Mecosta, with a yield similar to Manitou. It is surprising that such a late line would have originated in an early variety like Redkloud, and one must suspect that it is the result of a mixture or outcross to a later type.

Other materials: In addition to the kidney tests noted above, we grew 18 entries of cranberry type beans, 12 of which came from Andersen and 6 from Mr. Martin Stillwell of the Heinz Company in England. Only short non-replicated rows of each were grown. All entries were bush type, with date of maturity ranging from 9/5 to 9/19. We have found nothing of immediate value as a variety, but possibly one of the Heinz selections may have merit in contributing larger seed size to a cross with Cran 028.

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