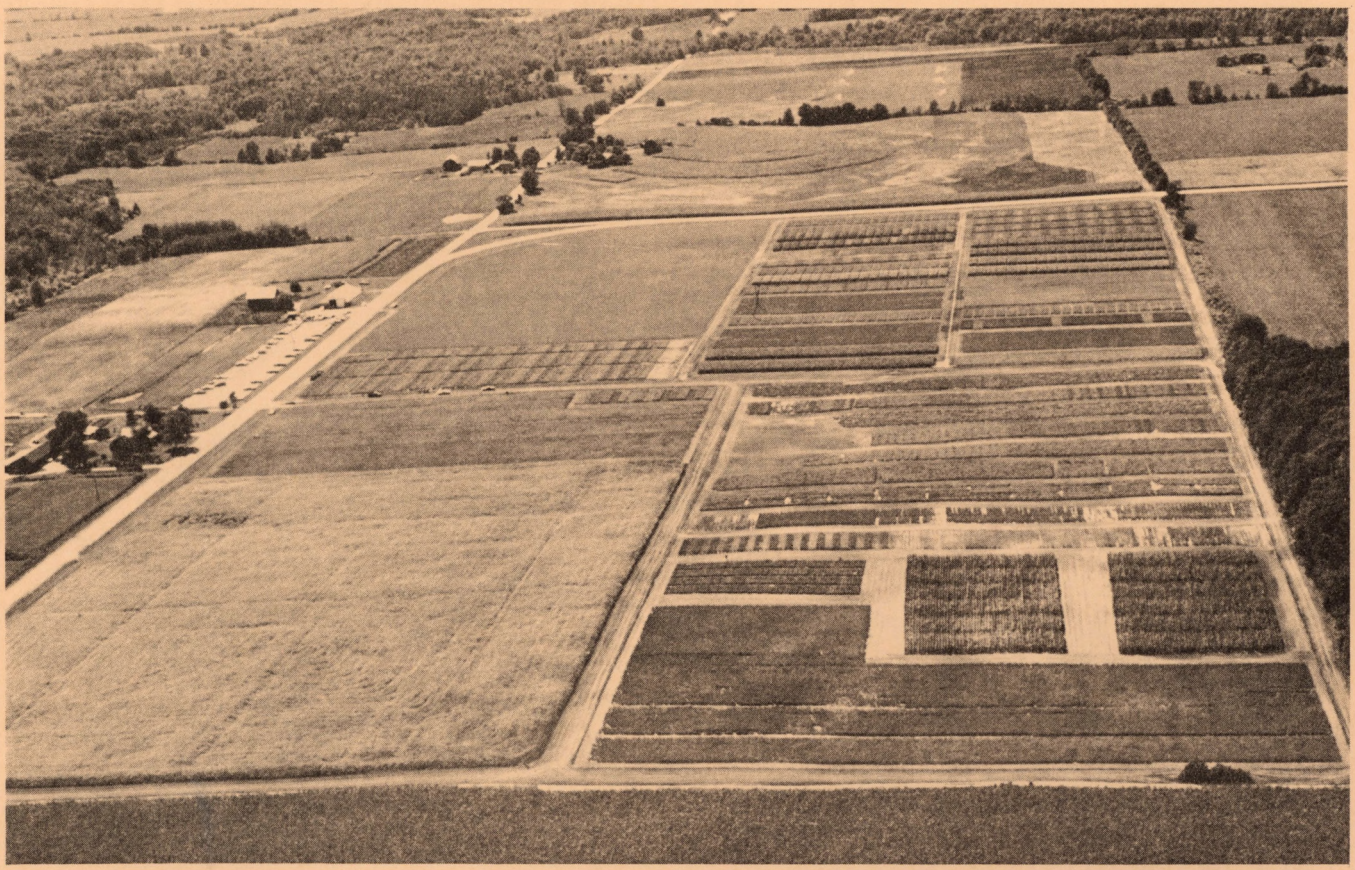
OFFICE FILE

1971 Research Report



MONTCALM EXPERIMENTAL FARM

Michigan State University
Agricultural Experiment Station

ACKNOWLEDGEMENTS

Research personnel working at the Montcalm Experimental Farm have received much assistance in various ways. A special thanks is made to each of these individuals, private companies and government agencies who have made this research possible. Many valuable contributions in the way of fertilizers, chemicals, seeds, equipment, technical assistance and personal services as well as monetary grants were received and are hereby gratefully acknowledged.

Special recognition is given to Mr. Theron Comden for his devoted cooperation and assistance in many of the day-to-day operations and personal services.

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MONTCALM BRANCH EXPERIMENT STATION RESEARCH REPORT

R. W. Chase, Coordinator
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INTRODUCTION

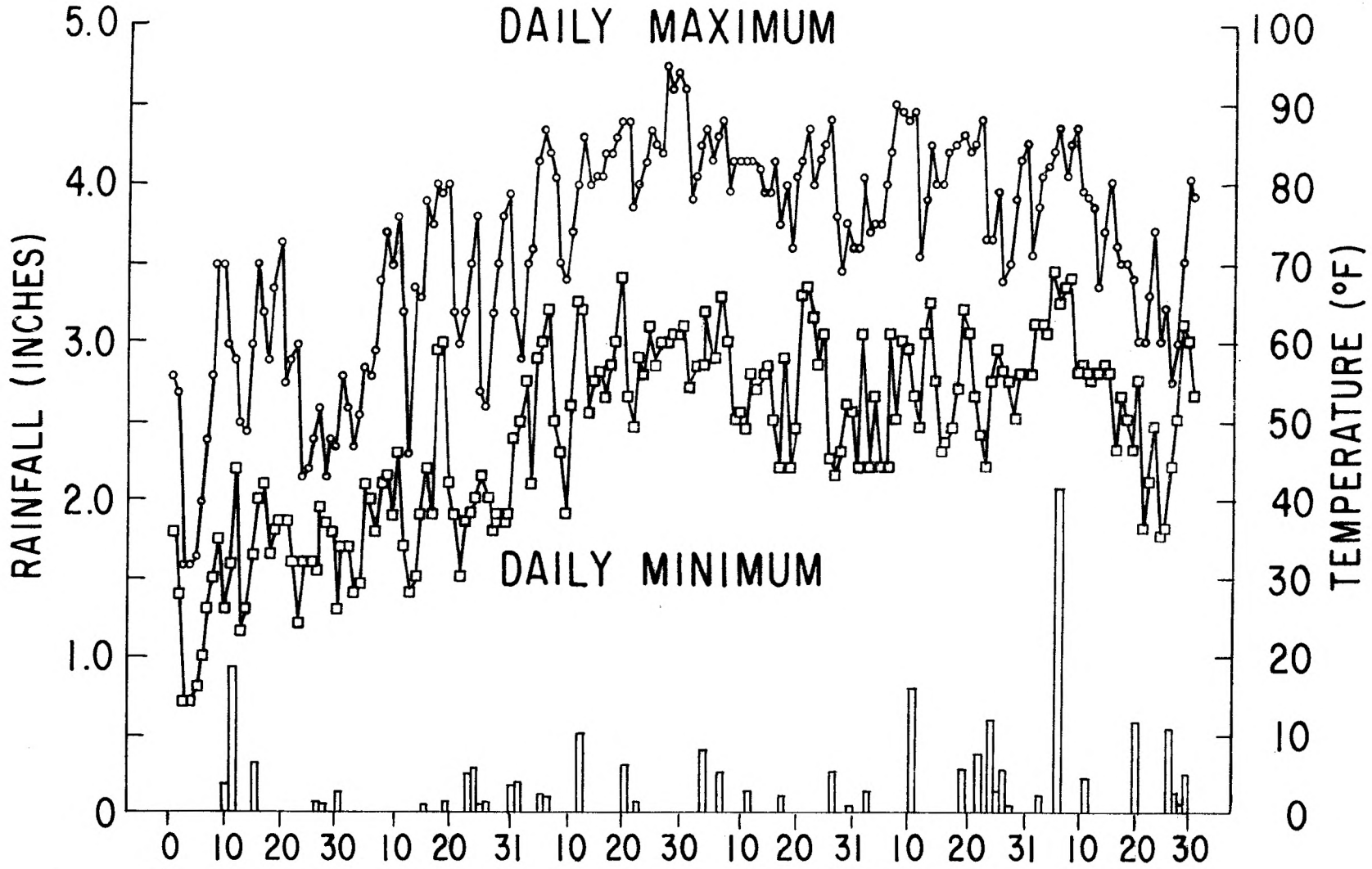
The Montcalm Experiment Station was established in 1966 with the first experiments initiated in 1967. This report marks the completion of five years of studies. The 80 acre facility is leased from Mr. Theron Comden and is located one mile west of Entrican, Michigan. The farm was established primarily for research on potatoes and is located in the heart of a major potato producing area. Crops commonly used in a potato rotation are also being investigated.

This report is designed to coordinate all of the research data obtained at the facility during 1971. Much of the data herein represents ongoing projects so complete 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

Temperature and rainfall recordings are shown in Figure 1. An exceptionally warm and dry spring allowed for early plot plantings without any interruptions. This weather pattern continued through June and the plots required supplemental irrigation early in the growing season. The graph reveals an unseasonable warm period during June with temperatures in the 90's three times during the last week.

Rainfall was unseasonably low throughout the entire growing season. If one considers May through August as the peak growing season, total rainfall during this period was 6.32 inches. This compares with 18.92 inches during the same period in 1970 and 14.25 inches in 1969. As a consequence irrigation was greatly increased. Most of the potato research plots (unless otherwise specified) received supplemental irrigation of 12-13 inches. Irrigation was initiated on June 11 and the final application was on August 17. The supplemental irrigation requirements for the 1971 crop were nearly double that of 1970.



	APRIL	MAY	JUNE	JULY	AUGUST	SEPT.
AVERAGE MONTHLY TEMP.	MAX. 53 MIN. 31	MAX. 65 MIN. 39	MAX. 81 MIN. 56	MAX. 82 MIN. 55	MAX. 80 MIN. 53	MAX. 73 MIN. 54
RAINFALL	1.59 inches	.93 inches	1.50 inches	1.22 inches	2.67 inches	4.00 inches

Fig. 1. CLIMATOLOGY OBSERVATIONS MADE AT THE MONTCALM EXPERIMENTAL FARM IN 1971

Soil Tests

Soil test results for the general plot area are as follows. For specific projects where more detailed analysis are needed, the results are reported with the individual reports.

	Pounds/Acre			
pH	P	K	Ca	Mg
6.6	189	216	743	149

Disease and Insect Control

A systemic insecticide was applied to most of the potato plots at the time of planting. The foliar insecticide program began on June 12. The foliar aphid control program was initiated on June 19 and continued on a seven day schedule throughout the growing season. Aphid control was very satisfactory. The fungicide spray program was initiated on June 26. All spray applications were made with an air blast sprayer. The insecticides used were Disulfoton, Phorate, Endosulfan, Carbaryl, Dimethoate and Meta-Systox-R. The fungicide used was Dithane M-45. Linuron (Lorox) at 1 3/4 lb/A and applied pre-emergence (approximately 15 days after planting) was used as the herbicide.

SOIL FERTILITY RESEARCH WITH POTATOES

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Five soil fertility experiments were conducted on potatoes in 1971. All except the fertilizer materials experiment were established in 1967. Slight modifications of the experiments, however, have been incorporated from year to year. The major crop sequence in the past has been potatoes followed by red kidney beans and then sweet corn. In 1971, potatoes followed either dent corn, sweet corn or red clover. Irrigation was initiated June 16 and continued until August 13. Because of the unusually dry season, approximately 9.4 inches of water was applied in 11 applications. Soil tests and other management practices are given at the bottom of Tables 1, 4, 6, 8 and 10.

The soil on which these experiments were established has been classified as McBride sandy loam. A more detailed examination of specific areas indicates that there are local areas which are not typical of the major soil type. Montcalm sandy loam is present in small scattered areas of the major soil type. The main difference between these two soil types is the presence or absence of a fine textured "B" horizon. The McBride soil contains a thicker, fine textured "B" horizon than the Montcalm series. The management of these two soil types may be quite different with regard to irrigation and nitrogen losses through leaching. Since these small areas cannot be managed separately, either on a small experimental scale or in a large field, no attempt has been made to make any adjustments for this variability in soil type. The variability in soil type does account for some of the variability in yields.

Source, Rate and Time of Nitrogen Application:

The design of this experiment was the same as in 1970. A slow release form of nitrogen (sulfur-coated urea) was incorporated to evaluate its performance as a source of nitrogen.

Total yield of Russet Burbank potatoes in this experiment in 1971 was slightly lower than in 1970, as was also true of the other experiments in 1971 (Table 1). Reasons for the lower yields are not apparent. Total yields of the Sebago variety were very comparable to 1970. Size in 1971 was far superior for both varieties. Approximately 95% of all the tubers were marketable (larger than 1 7/8" diameter). Nearly 30% of the Russet Burbanks were over 10 ounces. Nitrogen beyond the first increment (120 lb total N/A) had no effect on size.

Differences between broadcast and sidedress applications were not as apparent in 1971 as in previous years. Broadcast applications of N in previous years have been inferior because of leaching losses. This past season was very dry and no appreciable leaching occurred. A total of 180 lb N/A, either broadcast or sidedressed, produced maximum yields.

Specific gravity of Russet Burbank tubers was not affected by rates of nitrogen. Sebago tubers from the check plot had lower specific gravity than all N treatments. This has not been observed before. Chip color rating which was only determined on the Russet Burbank variety was not significantly affected by N treatments. Ratings were made on the basis of the 1-10 reference standard prepared by the Potato Chip Institute International. All chips were of acceptable quality.

Potato petiole analysis is shown in Table 2. These samples were taken approximately two weeks earlier than last year. Nitrogen content in general was slightly higher than in 1970. Based on two years data, potato petioles should contain about 2.3 to 2.7% N at 45 to 60 days after plant emergence.

Phosphorus, calcium, iron, zinc, and boron were not significantly affected by N treatments in 1971. In 1970, these elements were significantly affected. Manganese was the only element besides N affected both years. Higher rates of N resulted in higher manganese levels in potato petioles. Increased acidity caused by higher N rates may account for the increased manganese uptake. The potassium content was slightly higher where no N was applied, a trend also observed in 1970.

Soil samples were taken from each plot after harvest and analyzed for nitrate-nitrogen. Because the surface soil was very thoroughly mixed by the action of the potato digger, variation between the plots in any given treatment was very small, resulting in highly significant differences due to treatments and varieties. Soil nitrates were higher where larger rates of N were applied. The soil nitrate levels were also consistently lower where Russet Burbank potatoes were grown. This may indicate that this variety has a higher N requirement. The difference in nitrates in the surface 9" is equivalent to about 12 lb N/A. This represents only a very small amount of the total used on potatoes. This total difference may be more significant than is observed for the top 6 inches. Other evidence to support the idea that the Russet Burbank has a higher N requirement than most other varieties is that the petioles will normally run 0.2 to 0.3% higher than that of the Sebago variety.

Potassium-Magnesium Study:

This experiment was established in 1967 to evaluate various rates of broadcast, banded and fall applied potassium. Four years of data indicate very little difference between methods of application. In 1971, the experiment was changed to evaluate four rates of potassium with and without magnesium.

Russet Burbank yields were better than the N rate experiment; however, there was a difference in the seed spacing. Russet Burbanks were planted in 10 inch seed spacing in this experiment, compared to a 14 inch spacing in the previous experiment. Yields were increased slightly with the first increment of potassium, but the increase was not large enough to be statistically significant.

Specific gravity decreased with increasing rates of potassium, especially where magnesium was applied. The additional salt under dry soil conditions may account for the reduced specific gravity. Size and chip color were not affected by the potassium or magnesium treatments.

Petiole analysis (Table 5) indicated that Ca,Mg, Al and Ba were the only elements significantly affected by the potassium and magnesium treatments. Potassium fertilizers decreased the Ca and Mg content of petioles. No explanation can be offered for the observed Al and Ba differences. In 1970, K, Ca, Mg, and Fe were the only elements significantly affected by the K treatments.

Potassium Carrier Study:

This experiment was begun in 1967. This spring it was discovered that potassium-magnesium sulfate was used in place of potassium sulfate for (1969 and 1970). The data reported for the K sulfate treatment for these two years should be ignored because the rate of potassium supplied was not equal to the other potassium sources.

Total yields in 1971 were increased with potassium, especially for the Sebago variety (Table 6). Differences due to potassium sources were not statistically significant. All sources gave equal yield responses. The same trends were observed for the various size classes and chip color. All sources of potassium decreased specific gravity over the no-potassium treatment.

Petiole analysis (Table 7) indicates that K, Ca, Mg, Zn and Ba were significantly affected by the treatments. Potassium, regardless of source, increased potassium content and decreased the Ca and Mg content of the petioles. The highest Zn content and lowest Ba content was observed with the potassium sulfate treatment.

Nitrogen Carrier Study:

This study was started in 1967 to evaluate five sources of N on yield and quality of potatoes. In 1971, 20 lb N/A as ammonium nitrate was banded on all treatments to eliminate any early difference due to fertilizer placement. All N sources were topdressed just prior to emergence, except anhydrous ammonia which was knifed in at the same time. In 1970, it was felt that the anhydrous ammonia treatment was at a disadvantage early in the season because of fertilizer placement.

Total yield for Russet Burbank was not affected by the five N carriers (Table 8). Urea, however, appeared to be superior to calcium nitrate and anhydrous ammonia treatments for the Sebago variety. Anhydrous ammonia also appeared to lower the specific gravity of the Sebago variety. Again, good size distribution for all sources was observed with approximately 95% and 92% of the Russet Burbank and Sebago potatoes, respectively, being marketable (greater than 1 7/8 inches in diameter).

A four-year and five-year average for these N carriers is shown in Table 9. Urea and anhydrous ammonia appear to be superior for the Sebago variety. Calcium nitrate seems inferior as a N carrier for both varieties. All of the nitrogen in calcium nitrate is in the nitrate form, and is more subject to leaching in wet years than the other sources containing the ammonium form.

Fertilizer Materials Study:

In 1971, a new experiment compared liquid versus dry fertilizers and polyphosphate versus orthophosphate. Yields for this experiment were not quite as high as some others because the area was somewhat difficult to irrigate.

Analysis of the overall experiment indicated that neither yield nor size were significantly affected by the treatments. The average of the three dry fertilizer treatments out-yielded the liquid fertilizer treatments by 9 cwt/A. Polyphosphate produced higher yields than orthophosphate, however, caution should be used in placing too much emphasis on one year of data. Many other experiments on other crops have indicated no clear-cut advantage to either source of phosphorus.

Table 1. Effects of rate, source and time of nitrogen application on yield, size, chip color and specific gravity of irrigated Russet Burbank and Sebago potatoes.

Nitrogen Application (a)				Russet Burbank							Sebago				
Broadcast	Banded	Sidedressed	Total	Total Yield	Over 10 oz.	10 oz - 1 7/8"	Less Than 1 7/8"	Off Type	Chip Rating	Sp. Gr.	Total Yield	Over 3 1/4"	3 1/4" - 1 7/8"	Less Than 1 7/8"	Sp. Gr.
lb N/A				(cwt/A)	%						(cwt/A)	%			
0	0	0	0	135	8	73	9	10	5	1.075	173	4	83	13	1.068
60 SCU	60 U	0	120	243	19	62	6	13	5	1.076	377	5	89	6	1.073
120 U	60 U	0	180	280	24	57	5	14	4	1.077	433	9	85	5	1.075
180 U	60 U	0	240	275	33	51	3	13	4	1.076	412	12	81	7	1.071
240 U	60 U	0	300	277	29	52	4	15	5	1.076	438	9	86	5	1.074
120 SCU	60 U	0	180	274	29	54	4	13	5	1.076	424	10	86	4	1.072
	60 U	120 U	180	285	28	48	4	20	5	1.078	416	10	85	5	1.076
0	60 U	240 U	300	308	28	51	4	17	5	1.078	419	11	84	5	1.073
0	60 U	360 U	400	285	25	51	6	18	5	1.075	397	12	81	6	1.072
180 SCU	60 U	0	240	303	31	49	6	17	4	1.075	421	11	83	6	1.075
LSD (.05) treatments within varieties				45	6	6	3	3	NS	.004	45	6	6	3	.004
LSD (.05) varieties within treatments				48	--	7	3	--	--	.003	48	--	7	3	.003

(a) Broadcast urea (U) and sulfur coated urea (SCU) was applied and plowed down two days prior to planting. Banded urea was applied at planting time 2 inches to side and 2 inches below the seed piece. Sidedress urea was applied to soil surface on June 10 prior to hilling.

Planted: April 23, 1971. Harvested: September 27, 1971. Harvest Area: 266 sq. ft.
Row Spacing: 32 inches. Seed Spacing: Russet Burbank = 14", Sebago = 10" Previous Crop: Field corn
Basic Fertilizer: 0-150-200 banded at planting time. Irrigation: 9.4 inches

Soil Test: pH = 6.5, P = 275, K = 196

Table 2. Effect of rate, source and time of nitrogen application on the elemental composition of potato petioles.
(Russet Burbank and Sebago varieties sampled 7-13-71)

Treatment[a]	Elements[b]								
No.	N	P	K	Ca	Mg	Fe	Zn	Ba	Mn
	----------%----------					----------ppm----------			
1	1.8	.33	11.96	.66	.33	54	23	90	36
2	2.6	.29	9.64	.68	.58	57	28	54	84
3	3.0	.32	8.69	.62	.63	56	34	46	83
4	2.8	.28	9.22	.68	.69	58	33	60	97
5	2.9	.30	9.29	.70	.63	39	35	57	161
6	2.7	.32	10.30	.62	.58	38	28	46	61
7	2.9	.29	9.72	.66	.63	41	28	53	63
8	3.0	.29	9.91	.70	.77	48	34	55	80
9	3.1	.32	9.12	.68	.70	41	33	49	97
10	2.9	.31	10.31	.66	.60	39	29	54	75
LSD (.05)	.3	NS	.9	NS	.08	NS	NS	14	19

(a) Treatments are the same as in the previous table.

(b) Other elements which were not significantly affected by the treatments in this experiment: Cu, B, Na and Al.

Table 3. Nitrates remaining in the surface 9 inches of a McBride sandy loam soil at harvest time as affected by two potato varieties and ten nitrogen treatments (sampled 9-29-71).[a]

Nitrogen Application				Varieties		
Broad cast	Band ed	Side dressed	Total N	Russet Burbank	Sebago	Treatment Average
---------- lb N/A ----------			-------- ppm NO_3-N			
0	0	0	0	9	9	9
60 SCU	0	0	60	10	14	12
120 U	60 U	0	180	11	15	13
180 U	60 U	0	240	14	25	19
240 U	60 U	0	300	15	22	19
60 SCU	60 U	0	120	12	11	11
0	60 U	120 U	180	10	14	12
0	60 U	240 U	300	15	22	18
0	60 U	360 U	400	12	27	20
120 SCU	60 U	0	180	14	18	16
Variety Average				12	18	--
LSD (.05) Treatments				--	--	4
LSD (.05) Varieties				2		--
LSD (.05) Treatments within Varieties				5	5	--
LSD (.05) Varieties within Treatments				5	5	--

(a) Values for each variety are the average of 4 replications.

(b) Approximate conversion of ppm NO_3-N to lb N/A can be obtained by multiplying ppm NO_3-N by 2.

Table 4. Effect of rate of potassium and magnesium on yield, size, chip color and specific gravity of irrgated Russet Burbank and Sebago potatoes

Potassium-Magnesium (a) Application				Russet Burbank							Sebago				
Broadcast	Banded	Broadcast	Total	Total Yield	Over 10 oz	10 oz-1 7/8"	Less than 1 7/8"	Off Type	Chip	Sp.	Total Yield	Over 3¼"	3¼"-1 7/8"	Less than 1 7/8"	Sp.
--lb K_2O/A--		lb Mg/A	lb K_2O/A	(cwt/A)-		------%			-Rating	Gr.	(cwt/A)		------%		Gr.
0	0	0	0	318	25	65	5	5	6	1.080	381	7	83	10	1.073
0	60	0	60	356	25	65	6	5	5	1.079	416	9	81	10	1.071
60	60	0	120	359	29	60	6	5	5	1.077	423	9	81	10	1.068
120	60	0	180	337	26	64	3	6	6	1.076	381	11	78	11	1.065
180	60	0	240	335	29	59	6	5	6	1.075	409	10	81	9	1.067
420	60	0	480	342	31	58	4	7	4	1.070	409	10	81	9	1.062
0	60	50	60	315	23	65	7	5	5	1.077	402	9	81	9	1.070
60	60	50	120	334	27	65	4	5	6	1.075	406	11	81	8	1.070
120	60	50	180	362	30	59	5	5	5	1.075	419	9	82	9	1.067
180	60	50	240	344	28	59	6	7	5	1.072	396	11	79	9	1.064
LSD (.05) treatments within varieties				NS	NS	NS	NS	NS	NS	.003	NS	NS	NS	NS	.003
LSD (.05) varieties within treatments				45	NS	NS	NS	--	--	.002	45	NS	NS	NS	.002

(a) Potassium and magnesium sources were KCl and $MgSO_4$.

Planted: April 27, 1971 Harvested: Sept. 27, 1971 Harvest ares: 266 sq. ft
Row spacing: 32 inches Seed spacing: Russet Burbank = 10" Sebago = 10"
Basic Fertilizer: 60-150-0, 180 lb N/A sidedressed June 10, 1971
Irrigation: 9.4 inches Soil test: pH = 6.4, P = 209, K range = 146-253
Previous crop: Sweet corn

Table 5. Effect of rate of potassium and magnesium on elemental composition of potato petioles. (Russet Burbank and Sebago varieties sampled 6-30-71)

Treatment No. (a)	Elements (b)						
	N	P	K	Ca	Mg	Al	Ba
		- - - - - - % - - - - - - -					
1	Not determined	.50	6.30	1.04	100	155	47
2		.42	6.23	.74	.63	120	42
3		.43	8.33	.71	.56	125	51
4		.41	7.78	.76	.58	120	55
5		.49	9.16	.79	.60	125	62
6		.39	9.49	.75	.48	132	74
7		.42	6.53	.74	.73	140	33
8		.44	8.02	.74	.65	135	34
9		.42	10.28	.78	.68	140	43
10		.40	9.58	.72	.61	175	42
LSD (.05)		NS	NS	.13	.16	26	18

(a) Treatments are the same as previous table.

(b) Other elements which were not significantly affected by the treatments in this experiment: Na, Cu, Zn, Fe, B, & Mn.

Table 6. Effects of different sources of potassium on yield, size, chip color and specific gravity of irrigated Russet Burbank and Sebago Potatoes.

Source of Potassium (a)	Russet Burbank							Sebago				
	Total Yield (cwt/A)	over 10 oz	10 oz-1 7/8"	Less than 1 7/8"	Off Type	Chip Rating	Sp. Gr.	Total Yield (cwt/A)	over 3 ¼"	3 ¼"-1 7/8"	Less than 1 7/8"	Sp. Gr.
		%							%			
None	295	21	65	4	10	5	1.083	342	5	84	11	1.072
Potassium Chloride	310	31	58	3	8	6	1.077	426	10	80	10	1.066
Potassium Nitrate	327	27	60	3	10	5	1.077	424	11	81	8	1.069
Potassium Sulfate	322	30	59	4	7	5	1.076	434	9	83	8	1.068
Potassium Carbonate	326	26	64	3	7	5	1.079	421	10	82	8	1.069
LSD (.05) treatments within varieties	42	7	8	3	NS	NS	.033	42	7	8	3	.003
LSD (.05) varieties within treatments	35	7	10	3	--	--	.004	35	7	10	3	.004

(a) Applied at a rate of 300 lb K_2O per acre broadcast and plowed down prior to planting.

Planted: April 23, 1971
Row spacing: 32 inches
Basic fertilizer: 120-150-0, 93 lb N/A broadcast and plowed down prior to planting
Soil test: pH - 6.6, P = 316, K range = 153-258
Harvested: Sept. 27, 1971
Seed Spacing: Burbank = 14", Sebago = 10"
Previous crop: Red clover
Harvest areas: 266 sq. ft.
Irrigation: 9.4 inches

Table 7. Effect of potassium carriers on elemental composition of potato petioles (Russet Burbank and Sebago Varieties samples 7-8-71)

Treatment No. (a)	Elements (b)						
	N	P	K	Ca	Mg	Zn	Ba
1	Not determined	.44	5.86	.83	.98	37	42
2		.48	9.04	.66	.66	45	46
3		.45	8.58	.60	.58	35	44
4		.44	8.43	.62	.59	53	22
5		.40	8.27	.69	.64	40	54
LSD (.05)		NS	1.29	.13	.15	8	18

(a) Treatments are same as in previous table.

(b) Other elements which were not significantly affected by the treatments in this experiment: Na, Cu, Fe, Zn, B, Mn and Al.

Table 8. Effect of different sources of nitrogen on yield, specific gravity chip color and size of irrigated Russet Burbank and Sebago potatoes

Source of Nitrogen	Russet Burbank							Sebago				
	Total Yield (cwt/A)	over 10 oz	10 oz-1 7/8"	Less than 1 7/8"	Off Type	Chip Rating	Sp. Gr.	Total Yield (cwt/A)	over 3 ¼"	3 ¼"-1 7/8"	Less than 1 7/8"	Sp. Gr.
		%							%			
Ammonium Sulfate (a)	349	34	54	5	7	4	1.076	413	17	75	8	1.066
Ammonium Nitrate (a)	342	27	58	4	11	6	1.076	420	16	77	7	1.066
Calcium Nitrate (a)	329	33	52	5	10	5	1.077	393	14	78	8	1.068
Urea (a)	335	33	53	5	9	5	1.078	446	14	78	8	1.067
Anhydrous Ammonia (b)	369	32	50	5	13	5	1.077	390	14	78	8	1.064
LSD (.05) treatments within varieties	46	7	7	NS	NS	NS	.003	46	7	7	NS	.003
LSD (.05) varieties within treatments	39	8	9	1	--	--	.003	39	8	9	1	.003

(a) 180 lb N/A was top dressed May 19, 1971 just prior to emergence
(b) 180 lb N/A was knifed in May 18, 1971 just prior to emergence

Planted: April 23, 1971
Row spacing: 32 inches
Basic fertilizer: 20-150-200, banded 2 inches to side and 2 inches below seed piece
Irrigation: 9.4 inches
Soil test: pH = 6.4, P = 348, K = 207
Harvested: Sept. 27, 1971
Seed spacing: Russet Burbank = 14", Sebago = 10"
Previous crop: Sweet corn
Harvest area: 266 sq. ft.

Table 9. Summary of yield results for nitrogen carrier experiment.

Source of Nitrogen	(1968-1971) 4 year average		(1967-1971) 5 year average	
	Russet Burbank	Sebago	Russet Burbank	Sebago
	cwt/A			
Ammonium Sulfate	296	348	277	332
Ammonium Nitrate	290	347	277	327
Calcium Nitrate	264	346	253	321
Urea	291	370	269	345
Anhydrous Ammonia	301	364	---(a)	---(a)

(a) 5 year average is not available.

Table 10. The effect of liquid, dry, poly and ortho-phosphate fertilizers on yield, and size of irrigated Russet Burbank potatoes.

Treatment	Rate N-P_2O_5-K_2O	Total Yield (cwt/A)	Over 10 oz	10 oz-1 7/8"	Less than 1 7/8"	Off type
	-- lb/A --			%		
Liquid N (28%)	50-0-0	255	14	59	9	17
Dry N (32%)	50-0-0	269	17	50	10	24
Liquid poly-P + N	50-100-0	279	15	56	9	20
Dry poly-P + N	50-100-0	270	13	53	9	24
Liquid ortho-P + N	50-100-0	241	11	52	11	26
Dry ortho-P + N	50-100-0	261	13	56	9	22
LSD (.05) Treatments		NS	NS	NS	NS	NS
Liquid average[a]		258	13	56	10	21
Dry average[a]		267	14	53	9	23
Polyphosphate average [b]		274	14	54	9	22
Orthophosphate average[b]		251	12	54	10	24

(a) These are the averages of the three liquid and dry fertilizer treatments.

(b) These are the averages of the two poly and ortho-phosphate treatments.

Planted: May 5, 1971 Harvested: September 28, 1971
Row Spacing: 34 inches Seed Spacing: 14 inches
Broadcast Fertilizer: 70-0-120
Sidedress N: 70 lb N/A just prior to hilling.
Irrigation: 8.0 inches
Soil tests: pH = 6.6, P = 189, K = 216

The Effect of Harvest Date and Storage on the Yield Potential of Onaway and Sebago Seed Potatoes

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Department of Crop and Soil Sciences

Procedure

This is the second year of this study to determine the harvest and storage factors which can influence potential seed quality. Seed of the Onaway and Sebago varieties was harvested at several different harvest dates and placed in storage at East Lansing either directly into a 40F environment or stored for 7-10 days at 60-65F and then placed in the 40F storage. Prior to planting (approximately 2 weeks) the seed was warmed to 50-55F, cut and then hand planted with a uniform spacing and number of seed pieces per plot. Both varieties were planted on May 4, 1971 at a 10" spacing. Fertilizer applied consisted of plowdown 70-0-120 lb/A, 800 lbs per acre of 14-14-14 plus 2% Mg and 70 lb N/A side-dress.

A summary of the 1970 harvest and storage conditions is as follows:

Onaway

	Topkill	Harvest Date	Storage Condition °F	Days Growing	Days to Harvest
1	-----	Aug. 5	40	91	91
2	-----	"	70-40	91	91
3	Aug 5	Sept. 16	40	91	133
4	-----	Aug. 24	40	110	110
5	-----	"	70-40	110	110
6	Aug. 24	Sept. 16	40	110	133
7	-----	Sept. 16	40	133	133

Sebago

1	-----	Aug. 24	40	110	110
2	-----	"	70-40	110	110
3	Aug. 24	Oct. 8	40	110	155
4	-----	Sept. 16	40	133	133
5	-----	Sept. 16	70-40	133	133
6	Sept. 16	Oct. 8	40	133	155
7	-----	Oct. 8	40	155	155

Results and Discussion

Table 1 summarizes the Onaway yield data. The lowest yields did occur with treatments 1, 3 and 7. The reduced yield of treatment 1 is due primarily to the physical condition of the seed at planting time. This was the earliest harvested seed and consequently the most immature. Placing this seed directly into a 40F storage allowed no wound healing and the seed at planting time was badly shrivelled and damaged. Treatment 4 which represents the next stage of harvest did not show the same physical defects at planting time even though it was stored at 40F. Needless to say, the curing period is essential to maintain sound tuber quality particularly if the tubers are immature.

Treatment 3 represents early topkill and leaving the tubers in the ground for an additional 5 weeks. This did result in reduced yields which follows the same pattern as the 1970 results. Apparently some loss in seed vigor results when seed tubers are left in the ground for an extended period after top killing. Similarly there was a reduced yield from treatment 7 seed which was allowed to grow until the 133 day harvest.

Table 2 summarizes the Sebago observations. The lowest yields did occur with treatments 1, 4 and 7. The lowered yield of treatment 1 was because of the poor physical condition of the seed just as was observed with the Onaway. Allowing the seed to heal as was done in 2 did retain the seed in a sound physical condition. Treatment 4 had a reduced yield also and it is suspected that the Sebago which is a late maturing variety was still relatively immature at the 133 day harvest and the 40F environment did not allow for wound healing and conditioning.

Allowing the seed to go to full maturity at 155 days did result in a reduced yield compared to the earlier harvests and properly conditioned seed however to a lesser degree than was noted with Onaway.

Notes made at 30 days after planting showed considerable differences in emergence, uniformity, and plant vigor. With the Onaway the most vigorous and uniform plants were observed with treatments 2, 5 and 6. The poorest vigor was observed with treatments 1, 3 and 7. With the Sebago, treatments 2 and 5 were much more vigorous whereas treatments 4 and 7 were the poorest. This study will be continued one more year at which time it will be summarized and terminated.

Table 1. Effect of Harvest Date on the Yield Potential of Onaway Seed.

	No. Days Growing	No. Days to Harvest	Storage Temp.	Total Cwt/A	Percent Size Distribution		
					-1 7/8"	1 7/8"-3 1/4"	+ 3 1/4"
1.	91	91	40	296	3.3	73.5	23.2
2.	91	91	70-40	361	2.8	69.8	27.4
3.	91	133	40	309	3.8	73.3	22.9
4.	110	110	40	342	3.4	70.1	26.5
5.	110	110	70-40	364	3.7	74.0	22.3
6.	110	133	40	344	4.7	75.3	20.0
7.	133	133	40	319	4.2	73.0	22.8

Table 2. Effect of Harvest Date on the Yield Potential of Sebago Seed.

1.	110	110	40	310	5.1	70.3	24.6
2.	110	110	70-40	361	4.5	73.5	22.0
3.	110	155	40	342	5.4	69.1	25.5
4.	133	133	40	319	3.7	72.6	23.7
5.	133	133	70-40	337	4.5	73.8	21.7
6.	133	155	40	345	4.6	69.2	26.2
7.	155	155	40	329	4.8	68.3	26.9

Plant Spacing Studies

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Procedure

Three of the most advanced new seedlings from the Michigan breeding program were observed in terms of optimum plant spacing. The seedling identification numbers are 711-3, 503 and 709.

Planted: April 27, 1971

Fertilizer:	plowdown	200 lbs/A	33.5-0-0
		200 lbs/A	0-0-60
	planter	800 lbs/A	14-14-14 + 2% Mg
	sidedress (6/10/71)	200 lbs/A	33.5-0-0

Cut seed of each seedling was hand planted at spacings of 7, 10, 13 and 16 inches within the row. Row width was 34 inches. Each plot was 10 feet long and replicated four times.

Results

Table 1 gives a summary of the yield, size distribution and specific gravity response. Each of the seedlings responded differently in terms of these measurements. For example, 709 produced the greatest total and marketable yield at the 7 inch spacing. The 10 and 13 inch spacings were quite similar in yield and also produced the greater percentage of tubers over 3 1/4 inches. This seedling does have a tendency to develop large tubers so a spacing somewhere in the 7-8 inch range seems desirable depending on the level of total management.

Seedling number 503 was the lowest yielding of the three. Its most favorable response occurred in the 10-13 inch spacing. The seedling sets heavier than 709 and therefore appears to require a wider space in order to adequately size the tubers. Oversize does not appear to be a problem with this seedling.

The 711-3 seedling responded most favorably at the 10 inch spacing with a higher percentage of tubers in the 1 7/8 - 3 1/4" category.

An interesting response was observed in terms of the specific gravity readings. In each of the three seedlings, the lowest readings occurred at the

16" spacing. With 709 and 503 the highest reading occurred at the 7" spacing. The differences in growth were noticeable throughout the growing season. In all cases the closest spacing was the quickest to emerge and the plants seemed to show considerably more vigor than did the wider plantings. This trend occurred through to maturity.

On August 20 observations were made on relative degrees of maturity. Seedling 503 was the most mature and only some green in the stems still remained. The 711-3 was next in maturity with considerable yellowing showing. The 709 vines were down but still had a considerable amount of green foliage. Lower leaves were yellow.

When maturity observations are considered as it relates to the subsequent yields it appears that 709 does set and develop its tubers earlier than does 503 or 711-3.

Table 1. The yield, size distribution, and specific gravity of three seedlings when grown at different plant spacings.

Seedling	In-Row Space (inches)	Total Cwt/A	Total Greater than 1 7/8 Cwt/A	Percent Size Distribution			Spec. Gravi
				-1 7/8	+3 1/4	1 7/8-3 1/4	
709	7	387	375	3	19	78	1.076
	10	360	346	4	35	61	1.074
	13	357	346	3	30	67	1.073
	16	324	314	3	19	78	1.073
503	7	282	223	21	6	73	1.076
	10	273	224	18	5	77	1.071
	13	273	235	14	7	79	1.073
	16	223	185	17	1	82	1.070
711-3	7	290	247	15	0	85	1.089
	10	314	276	12	0	88	1.089
	13	281	244	13	5	82	1.089
	16	264	240	9	8	83	1.085

Potato Vine Killing Results in 1971

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Chemicals were applied on two varieties for killing tops prior to harvest. The varieties, chemicals and dates of application are listed in Table 1 and 2. Treatments were applied in 50 gal of water per acre. Plot size was 3 rows by 50 ft. Samples were taken for storage quality and chipping evaluation.

A number of chemicals provided satisfactory vine kill. Currently the only materials registered are dinoseb (DNBP or General) and paraquat. Crop oil or crop oil concentrates were the most effective additives used with the dinoseb. Heavier and less mature vines require dinoseb at 2 qt/A whereas 1 1/2 qt is sufficient where vines have begun natural maturing.

There were no observable differences in the chipping quality from any of the vine killing treatments.

Table 1. Chemicals for Potato Vine Killing, Montcalm County, 1971

Trt. No.	Chemical	Rate/A	Rating* 1 day	5 day	13 day	Weeds
1	Ametryne	2 lb	2.0	4.3	10.0	10.0
2	Ametryne + Crop Oil	2 + 1 gal	3.0	5.7	10.0	9.3
3	" + "	4	2.7	5.3	10.0	9.7
4	" + "	4 + 1	3.3	6.0	10.0	10.0
5	Des-i-cate	1 gal	3.3	6.7	9.7	4.7
6	Des-i-cate + Crop Oil	1 gal + 1 gal	3.7	6.3	9.3	5.3
7	" + "	2	3.3	6.0	9.7	7.7
8	" + "	2 + 1	4.7	7.0	9.7	7.7
9	Rhodia 2929	3 lb	2.7	5.3	8.7	4.7
10	Rhodia 2929 + Crop Oil	3 + 1 gal	4.0	6.0	9.3	6.7
11	Rhodia 2929	4	2.7	5.0	8.7	7.0
12	Rhodia 2929 + Crop Oil	4 + 1	4.3	6.3	9.7	5.3
13	Paraquat	2 pt	4.7	7.3	10.0	9.7
14	General + Crop Oil	1 1/2 qt + 1 gal	6.3	7.7	10.0	7.7
15	General + Crop Oil	2 + 1	5.7	7.7	9.3	7.7
16	General + fuel oil	1 1/2 + 5 gal	4.7	6.0	9.3	6.0
17	General + fuel oil	2 + 5	5.7	7.7	10.0	7.0
18	General + Tronic	1 1/2 + 1 pt	4.3	6.3	9.3	4.7
19	General + Tronic	2 + 1	5.3	6.7	9.7	8.3
20	General + Agri-Oil Plus	2 + 1 qt	5.7	7.3	9.7	7.3
21	General + U.C. #4	2 + 1 qt	6.0	7.3	9.7	7.3
22	General + U.C. #5	2 + 1 qt	5.7	7.3	9.3	6.7
23	General + R558 MO	2 + 1 qt	6.7	8.0	10.0	8.3
24	No Treatment	------	2.0	3.7	7.0	5.0

* 0 - no kill
10 - complete kill

Variety - Onaway
Treated - August 5, 1971

Table 2. 1971 Vine Kill Treatments, Montcalm Experimental Farm

Trt. No.	Chemical	Rate/A	5 day* Rating
1	Ametryne	2 lb	7.0
2	Ametryne + oil	2 lb + 1 gal	6.3
3	Des-i-cate	1 1/2 gal	7.0
4	Des-i-cate + oil	1 1/2 gal + 1 gal	8.0
5	Rhodia 2929	3 lb	8.3
6	Rhodia + oil	3 lb + 1 gal	8.7
7	Paraquat + X77	2 pt + .1%	7.3
8	General + oil	1 1/2 qt + 1 gal	9.3
9	General + oil	2 qt + 1 gal	8.7
10	General + agri oil plus	1 1/2 qt + 1 qt	8.0
11	General + agri oil plus	2 qt + 1 qt	9.0
12	General + fuel oil	1 1/2 qt + 5 gal	8.3
13	General + R558 MO	1 1/2 qt + 1 qt	8.7
14	General + R558 MO	1 1/2 qt + 2 qt	8.7
15	General + Tronic	1 1/2 qt + 1 qt	7.0
16	General + U.C. #4	1 1/2 qt + 1 qt	8.7
17	General E/emulsifier	3 qt of mixture 1/3 fuel oil	7.7
18	General	1 1/2 qt	9.0
19	General + Kocide 101 + oil	1 1/2 qt + 3/4 lb + 1 gal	8.7
20	General + Kocide 101 + oil	2 qt + 3/4 lb + 1 gal	8.7
21	General + Kocide 101 + Agri oil plus	1 1/2 + 3/4 + 1 qt	7.8
22	" + " + "	2 qt + 3/4 lb + 1 qt	8.7
23	Formulated General		9.3
24	Check - no treatment	-----	4.7
25	Flame - LP gas		7.0

* 0 - no kill
10 - complete kill

Variety - Russet Burbank
Treated - September 2, 1971

Potato Breeding

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Segregating Populations

First year seedlings comprised 4200 individual cultivars from 9 cross pollinations and one self-fertilized family. After a very slow start, growth was rapid and vigorous. The appearance of aphids required that the vines be killed September 6 when 20% of the plants were still in full bloom. This immaturity accounted for the lower than anticipated specific gravity of many cultivars. However, in the first year with only one hill of a cultivar it is essential that the spread of viruses be controlled or many good cultivars will be lost.

Shape, size and general appearance was exceptionally good and a greater than normal number were retained. Quality studies, i.e., total solids, chip color, and storage tests will determine the cultivars to be planted in 1972. If the random sampling of 50 selections (Table 1) from each cross is representative between 2500 and 3000 will be saved.

Table 1. Average performance of 50 randomly selected samples from ten segregating seedling populations.

Cross		Yield lbs/hill			Specific gravity			Chip color		
No.	Parentage	Low	Av.	High	Low	Av.	High	Low	Av	High
001	320-6 x 709	0.18	1.7	4.7	1.062	1.075	1.083	1	3.8	7
002	321-38 x 709	0.26	1.6	3.8	1.067	1.082	1.143	2	3.5	6
003	321-65 x 709	0.17	1.9	5.7	1.074	1.089	1.144	1	3.1	6
004	321-70 x 709	1.4	2.4	4.5	1.061	1.075	1.087	2	4.3	7
005	706-34 x 709	0.85	2.5	6.5	1.054	1.073	1.089	1	3.9	8
006	706-34 x 706-32	0.79	2.6	5.1	1.059	1.070	1.089	1	4.8	7
007	706-34 x 711-8	1.05	2.4	5.2	1.048	1.067	1.082	1	4.0	8
008	706-34 x 735-1	1.32	3.0	6.0	1.054	1.068	1.083	3	5.7	9
009*	709 x	0.89	2.3	4.5	1.060	1.071	1.080	3	5.0	6
010	711-8 x 735-1	1.01	2.4	4.6	1.049	1.071	1.090	1	4.8	9
Av.			2.28						4.29	

*7 samples only

The continued backcrossing of the S. stoloniferum hybrids seems to have eliminated the wild characteristics while retaining the high total solids and chip quality. Shape and yield of the S. tuberosum parent was clearly evident in the progeny. These seedlings will be analyzed for protein and methionine. Methionine is the essential amino acid which most commonly limits the total nutritive value of the potato. Protein and methionine content of the parental clones is presented in Table 2. Several S_2 selections from an inbred population of the variety Merrimack are shown in Table 3. Five thousand new cultivars of similar genetic background have been grown in the greenhouse for planting in 1972.

Table 2

Keildahl Protein and

Methionine of Parental Clones 1971

Cultivar	Protein %N x 6.25/d.m.	Available Methionine % met/N x 6.25
735-1	9.2	1.05
321-38	14.4	1.25
321-70	13.0	1.45
320-6	10.8	1.20
706-34	15.2	1.45
709	9.5	1.25
371-65	7.8	1.1
711-8	12.6	1.35

Table 3

Inbred
Merrimack Population, 1971

Cultivar	Protein %N x 6.25/d.m.	Available Methionine % met/N x 6.25
854-1	11.6	2.5
852-18	10.1	2.3
854-28	14.7	1.8
864-56	12.5	2.25
866-7	11.8	1.8
866-13	10.1	1.61
864-19	11.2	1.19
Merr. 114	12.2	1.40
Merr. 132	11.6	1.54
Merr. 249	15.1	1.55

Merr. 249, yielding 29,200 lbs/acre with a protein content of 3.5% on a fresh weight basis yielded 1022 lbs protein per acre.

Advanced Clones

For varietal potential 35 cultivars were evaluated. Ten hills of each were dug early for seed increase. The balance were killed September 6 and harvested for yield quality and storage studies, Table 4.

Chipping tests in January after reconditioning from 45°F storage, dormancy, baking, boiling and french frying will determine which of the cultivars will be screened for diseases in the greenhouse prior to increase on the Coleman Farms, Marquette.

Table 4. Advanced Seedling Clones.

Clone No.	Yield, cwt/A US #1	B's	Total	Specific Gravity	Chip Color
735-1	866	00	866	1.076	5
706-34	736	28	764	1.063	8
613-18	616	51	667	1.064	5
859-144	585	30	615	1.079	5
*321-101	513	102	615	1.083	2
706-1	533	60	593	1.074	2
711-8	543	29	572	1.068	4
645-1	508	41	549	1.075	2
613-20	462	77	539	1.074	2
645-2	508	30	538	1.074	2
*321-30	462	61	523	1.090	3
1111-2	451	11.0	462	1.070	3
623	393	25	418	1.070	1
613-27	354	57	411	1.059	3
Merr 114	391	12	403	1.078	3
613-7	369	31	400	1.067	6
*321-55	354	45	389	1.106	2
613-9	339	48	387	1.067	4

*Derived from S. stoloniferum hybrids.

Several of the cultivars have been in overstate yield trials or seedling trials for three or more years and will be increased for commercial testing as soon as possible.

MS 735-1 - A slightly elongated smooth white skinned seedling with shallow eyes and a very high yield potential. Primarily a table potato.

MS 706-34 - A round white table potato with a consistently high yield potential; tends to be slightly rough especially the large tubers.

MS 711-8 - A smooth oval shaped tuber that retains its shape; stores well for tablestock market.

MS 706-1 - A round white with chip processing characteristics. Medium total solids but color is uniform and good; stores well.

1971 Overstate Potato Variety Trials

R. W. Chase and N. R. Thompson

The 1971 overstate potato variety trials were conducted at 4 locations: Shoemaker Bros. in Allegan County; Don Meyers in Bay County; Delekta Bros. in Presque Isle County; and the Montcalm Experimental Farm. Growing conditions in each location were quite variable and undoubtedly reflects the differences in variety performance between locations.

Table 1 summarizes the overall response when all of the data from the 4 locations are averaged. Table 2 provides the variety data at each of the locations. Table 1 does not include the specific gravity readings from the Presque Isle location. A look at the data from this location in Table 2 reveals specific gravity readings which appear to be abnormal. This location did receive considerable rainfall throughout the growing season which may have resulted in the lower-than-expected readings.

Two of the locations were irrigated - the Montcalm Experimental Farm and the Bay locations. The Allegan trial was on an organic soil. Planting and harvest dates for each location are as follows: Bay County, April 28 and August 30; Allegan County, May 14 and October 1; Presque Isle, May 29 and October 11; and Montcalm Experimental Farm, April 27 and September 7. Plant spacings at all locations were 12 inches.

Table 1. The average yield, size distribution and specific gravity of several potato varieties grown at four locations.

Variety	Total Cwt/A	Size Distribution Percent -1 7/8	+3 1/4	1 7/8-3 1/4	Specific Gravity
Abnaki	447	5.3	27.3	67.4	1.076
Sioux	430	6.1	23.2	70.7	1.081
MS-709	396	5.5	33.5	61.0	1.074
Jewel	396	10.3	10.2	79.5	1.086
Onaway	388	5.6	27.2	67.2	1.071
Norchip	379	6.6	21.4	72.0	1.079
Shurchip	366	9.8	15.9	74.3	1.071
Cascade	364	5.3	13.5	81.2	1.073
Alamo	353	10.3	9.0	80.7	1.065
Wauseon	346	7.1	20.5	72.4	1.073
Iopride	335	10.0	12.7	77.3	1.069
MS 711-3	331	9.6	12.0	78.4	1.086
MS-58	329	8.3	15.5	76.2	1.081
MS-1111-2	297	7.0	24.9	68.1	1.064
Katahdin	294	9.0	18.5	72.5	1.073
York	288	5.4	22.1	72.5	1.071
MS-503	286	15.7	5.6	78.7	1.073
Average	354.4				

Table 2. The yield, size distribution and specific gravity of several potato varieties grown at 4 locations.

ALLEGAN CO.

Variety	Total Cwt/A	Percent -1 7/8	Percent +3 1/4	Percent 1 7/8-3 1/4	Sp. Gr.
Abnaki	488	4.4	38.0	57.6	1.077
Jewel	454	13.7	2.0	84.3	1.084
Shurchip	395	9.4	16.3	74.3	1.071
Cascade	373	6.3	19.9	73.8	1.073
Norchip	371	6.3	23.2	70.5	1.078
Onaway	367	8.5	31.4	60.1	1.069
Sioux	351	6.7	21.1	72.2	1.076
Iopride	334	8.2	15.8	76.0	1.068
Wauseon	326	8.3	22.2	69.5	1.073
Alamo	303	14.2	4.5	81.3	1.066
MS-709	314	8.1	33.5	58.4	1.072
York	306	6.4	26.1	67.5	1.071
MS 1111-2	293	5.4	33.3	61.3	1.065
MS 711-3	275	7.8	2.1	90.1	1.086
Katahdin	264	6.0	20.7	73.3	1.074
MS-503	243	12.0	2.4	85.6	1.078

BAY CO.

Variety	Total Cwt/A	Percent -1/78	Percent +3 1/4	Percent 1 7/8-3 1/4	Sp. Gr.
Abnaki	488	5.8	36.7	57.5	1.078
Jewel	473	14.1	8.3	77.6	1.091
Shurchip	387	17.3	8.1	74.6	1.073
Cascade	433	5.4	10.8	83.8	1.077
Norchip	435	10.0	15.4	74.6	1.081
Onaway	394	4.0	30.8	65.2	1.075
Sioux	493	5.7	34.2	60.1	1.084
Iopride	363	10.7	16.3	73.0	1.069
Haig	496	7.8	10.4	81.8	1.075
MS-709	466	7.7	29.4	62.9	1.073
Katahdin	376	9.5	18.7	71.8	1.071
MS 711-3	332	16.4	6.1	77.5	1.081
MS 1111-2	329	14.2	6.2	79.6	1.063
MS-503	301	31.1	0	68.9	1.070

Table 2. (Continued)

Montcalm Experimental Farm

Variety	Total Cwt/A	Percent -1 7/8	Percent +3 1/4	Percent 1 7/8-3 1/4	Sp. Gr.
Onaway	437	2.7	13.8	83.5	1.070
Sioux	423	5.5	17.4	77.1	1.081
MS-709	407	4.3	31.1	64.6	1.075
Abnaki	379	5.1	11.9	83.0	1.073
Iopride	373	5.7	8.4	85.9	1.070
Jewel	351	6.7	7.2	86.1	1.083
Cascade	345	4.0	9.6	86.4	1.070
MS-711-3	328	9.5	1.8	88.7	1.089
Norchip	328	7.2	8.3	84.5	1.078
MS-58	324	10.2	0	89.8	1.081
Shurchip	306	8.9	9.6	81.5	1.067
Katahdin	285	10.3	20.5	69.2	1.075
MS 1111-2	275	5.7	17.0	77.3	1.065
MS-503	248	15.0	7.8	77.2	1.072

Presque Isle County

Variety	Total Cwt/A	Percent -1 7/8	Percent +3 1/4	Percent 1 7/8-3 1/4	Sp. Gr.
Sioux	454	6.4	20.2	73.4	1.066
Alamo	402	6.3	13.6	80.1	1.056
MS-709	395	2.0	40.1	57.9	1.064
MS 711-3	387	4.5	38.2	57.3	1.068
Norchip	381	3.0	38.5	58.5	1.070
Shurchip	374	3.6	29.7	66.7	1.062
Wauseon	365	5.9	18.7	75.4	1.065
Abnaki	363	5.9	22.6	71.5	1.066
Onaway	353	7.2	32.6	60.2	1.060
MS-503	351	5.0	12.2	82.8	1.065
MS-58	334	6.4	31.0	62.6	1.058
Cascade	304	5.7	13.5	80.8	1.063
Jewel	303	6.5	23.2	70.3	1.067
MS 1111-2	289	2.7	43.2	54.1	1.062
York	270	4.4	18.1	77.5	1.069
Iopride	270	15.3	10.1	74.6	1.063
Katahdin	250	10.1	14.1	75.8	1.067

Following are the general observations of each of the varieties:

Abnaki - released in 1970 by the U. S. D. A., New York and Main. In all locations the yields and size distribution and general appearance were exceptionally good. Tubers over 3 1/4 inch were common, however, they were not rough nor off-type. A closer spacing would help correct this factor. Specific gravity is medium; maturity is late; the tubers are round and somewhat flattened; and the skin was noted to be slightly netted at some locations. Abnaki is reported to be resistant to Verticillium wilt, mild mosaic and leaf roll. No hollow heart was observed.

Sioux - released in 1969 by Nebraska. This was the only red skin variety in the trials. The tubers have a slightly scaly russeted skin; are round and slightly flattened; and a fairly shallow eye. The yields, size distribution and general appearance were very good. Dry matter content was high. Maturity is similar to Kennebec. Sioux is reported to be resistant to scab, but is susceptible to Fusarium and Verticillium wilt and late blight.

MS-709 - a Michigan seedling which will be released in 1972. Maturity is early (similar to Onaway) and medium dry matter. It has a smooth white skin, shallow eyes, and very acceptable appearance. At the 12 inch spacing used in these trials, the percent over 3 1/4" was considerable, however, a closer spacing would correct this concern. These oversize tubers did not go off-type and hollow heart was not observed to be a concern. It does produce an acceptable chip out-of-the-field, however, it is not suggested for chipping out-of-storage.

Jewel - released by private breeders in New York in 1968. This variety has a very high dry matter content. Jewel is reported to have no disease resistance. Despite this it has continued to perform well in our trials. The tubers are white skinned; round and flattened; and shallow eyed. Maturity is similar to Kennebec.

Onaway - used as a standard early maturing variety. Tubers were more off-type and irregular than in other years.

Norchip - tuber shape and appearance this year were not as uniform and attractive as in other years. Some irregular shapes and off-types. Yields were favorable and dry matter content was medium-high.

Shurchip - released in 1969 by Nebraska. This variety does have a high yield potential. The tubers do have a scaly russet on the skin. The tubers are elongated and somewhat flattened in appearance. Specific gravity was medium to medium low. Shurchip is reported to be resistant to scab and tolerant to Fusarium and Verticillium wilts. The foliage is susceptible and the tubers are highly susceptible to late blight.

Cascade - released in 1969 by the U. S. D. A. and Washington. This variety yielded about average with a medium specific gravity. It is a round white variety with a slightly netted skin and a favorable general appearance. The variety is reported to have moderate resistance to Verticillium wilt and the leaf roll virus. Maturity was about medium.

Alamo - released in 1967 by the U. S. D. A. and Texas. The tubers are somewhat elongated, have a smooth white skin and a medium eye depth. It appeared in this years trials to set heavy and this is reflected in the size distribution. Its maturity is medium early and has resistance to late blight, common scab, net necrosis and mild mosaic.

Wauseon - released in 1967 by the U. S. D. A. and New York. The tubers have a smooth white skin with a very slight netting on some soils. It has a round and somewhat flattened shape. It is a late maturing variety and has resistance to golden nematode and moderate resistance to common scab, latent and mild mosaics and net necrosis from current season leaf roll infections.

Iopride - was released in 1970 by Iowa. Maturity is medium early and the tubers were slightly netted in most locations. This variety performed about average in these trials and was medium to low in specific gravity.

MS-711-3 - an unreleased Michigan seedling. The tubers are rounded with a very slight net showing at some locations. Tubers lacked uniformity in type and shape. Maturity is similar to Kennebec and it was one of the highest in specific gravity readings. It has a high dry matter and is a good processor.

MS-58 - an unreleased inbred Merrimack from the Michigan program. It is a late maturing seedling which does have a high dry matter content. It has a good balance of protein for human nutrition as it is high in methionine - one of the amino acids commonly deficient in potatoes.

MS-1111-2 - an unreleased Michigan seedling which has an early maturity.

Katahdin - included as a standard late maturing variety. In all locations this variety yielded well below average which is not typical of its usual performance. It is suspected that there must have been some loss in seed quality although its physical appearance did not indicate any concerns.

York - released in 1969 by Canada. The tubers had considerable netting at most locations, were round and slightly flattened and had a rather shallow eye depth. This variety was included at only the Allegan and Presque Isle locations and performed well below average at both locations. In the release description it is classed as early maturing and high total solids. Gravity readings at these two locations would rank it as medium to low. In Canadian trials it has performed best on the organic soils.

MS-503 - an unreleased Michigan seedling.

Water Management of Potatoes

R. J. Kunze and Ana Garay
Department of Crop and Soil Sciences

This is a joint project between several departments with Dick Chase of this department and Ernie Kidder from Agricultural Engineering actively involved both in the planning and development stages. Ana Garay is a doctorate student from Argentina. To carry out her assigned duties it was necessary that she spend full time on this project and we are greatly indebted to the Theron Comden's for providing living facilities which enabled her to give complete attention to her summer duties. All concerned with the project appreciate their cooperation and helpfulness.

The project is a two-year study and has four objectives:

1. To measure the yield difference resulting from either day or night irrigation.

2. To measure the effects of two levels of irrigation cooling.

3. To determine if timing of the initial irrigation affects tuber initiation, quality and yield. The initiation of irrigation in 1971 commenced 50, 60, and 70 days after planting.

4. To devise an accurate, inexpensive scheme for determining irrigation frequency.

Procedure

Russet Burbank and Kennebec potatoes were planted on April 30, 1971. The fertilization program consisted of the following amounts in pounds/acre: 70N-120K at plow-down, 110^{N}-110^{P}-110^{K}-16Mg banded at planting, and 70N as sidedressing before hilling. Disyston at 3 lb/acre was also applied at planting. Potatoes were harvested on September 21.

The early part of the growing season was very dry so that all objectives had great potential of showing real differences. A small weather station for recording rainfall, pan evaporation, temperature, relative humidity, wind velocity and solar radiation was set up adjacent to the plot area. Electrical power was needed for operating several instruments and a small electrically driven irrigation pump.

Irrigation of small plot areas was accomplished with the use of garden sprinkler hoses. These were fastened onto elevated irrigation pipe and the pipe was rotated to compensate for wind velocity and direction.

The irrigation water was stored in a 4' x 15' diameter swimming pool. This pool was filled intermittently from a well-pump as needed. All plot areas were irrigated on a time basis. Four irrigation volume meters were purchased to provide equal application of water but these did not arrive in time to be of any benefit in 1971.

Because of inadequate seals and much leakage from normal irrigation pipe, the entire system was converted to a 2 inch plastic pipe system on July 26, 1971. This system was completely water tight and performed flawlessly for the remainder of the season. The entire cost of this system was less than the fittings alone for the aluminum pipe system.

Results

Table 1 shows a very definite trend between yield and the timing of the first irrigation of Russet Burbank potatoes. The potatoes in treatment 1 were first irrigated 50 days after planting, treatment 2 - 60 days after planting and treatment 3 - 70 days after planting. Treatment 1 received 10 one-inch irrigations; treatment 2 received 8; and treatment 3 received 6. Yields decreased with delayed irrigation. However, water added at a late stage was increasingly more beneficial in terms of yield per inch of water applied. The same general trends exhibited in the yield data is also demonstrated in the specific gravity data. The percentage of off type or knobby potatoes was closely correlated with the amount of water added to the Russet Burbank. There appears to be no trend in day versus night irrigation in terms of yield, however percentage of knobs seems to be slightly higher with night irrigation.

The same general trend between yield and treatment exhibited by the Russet Burbank potatoes is also true for Kennebec as shown in Table 2. The yield differences are larger for day irrigation but smaller for night irrigation. Specific gravity values are lower than those for the Russet Burbank but follow the same general trend.

A very simple way of determining the proper time to irrigate is shown in Figure 1. The slope of the upper diagonal line represents the average loss of water per day by evapotranspiration as determined by pan data. The width span between the two diagonal lines represents the amount of plant-available water that can be stored in a McBride sandy loam soil. The vertical dashed lines represent inches of irrigation applied and the solid vertical lines the

Table 1. Average yields and specific gravity of Russet Burbank potatoes under day and night irrigation (1971).

	Day			Night		
	Yield cwt/A	Sp. Gr.	% Knobs	Yield cwt/A	Sp. Gr.	% Knobs
Check 1	197.6	1.0695	41.4	160.2	1.0677	45.3
Treatment 1	326.7	1.075	12.4	341.7	1.0762	14.5
Treatment 2	299.6	1.0737	14.3	304.4	1.074	15.5
Treatment 3	295.4	1.0725	19.9	290.4	1.0697	23.2

Table 2. Average yields and specific gravity of Kennebec potatoes under day and night irrigation (1971).

	Day		Night	
	Yield cwt/A	Specific Gravity	Yield cwt/A	Specific Gravity
Check	184.8	1.063	147.5	1.0627
Treatment 1	353.8	1.067	304.1	1.0672
Treatment 2	288.0	1.0617	324.5	1.065
Treatment 3	280.5	1.059	291.1	1.0625

Table 3. Effect of irrigation cooling on yields and specific gravity of Russet Burbank and Kennebec potatoes (1971).

	Russet Bubank		Kennebec	
	Yield cwt/A	Specific Gravity	Yield cwt/A	Specific Gravity
Check	265.8	1.0727	265.0	1.0607
Treatment 1*	315.9	1.0763	315.0	1.0637
Treatment 2**	374.7	1.0752	324.8	1.065

* When ambient temperature higher 75° F

**When ambient temperature higher 80° F

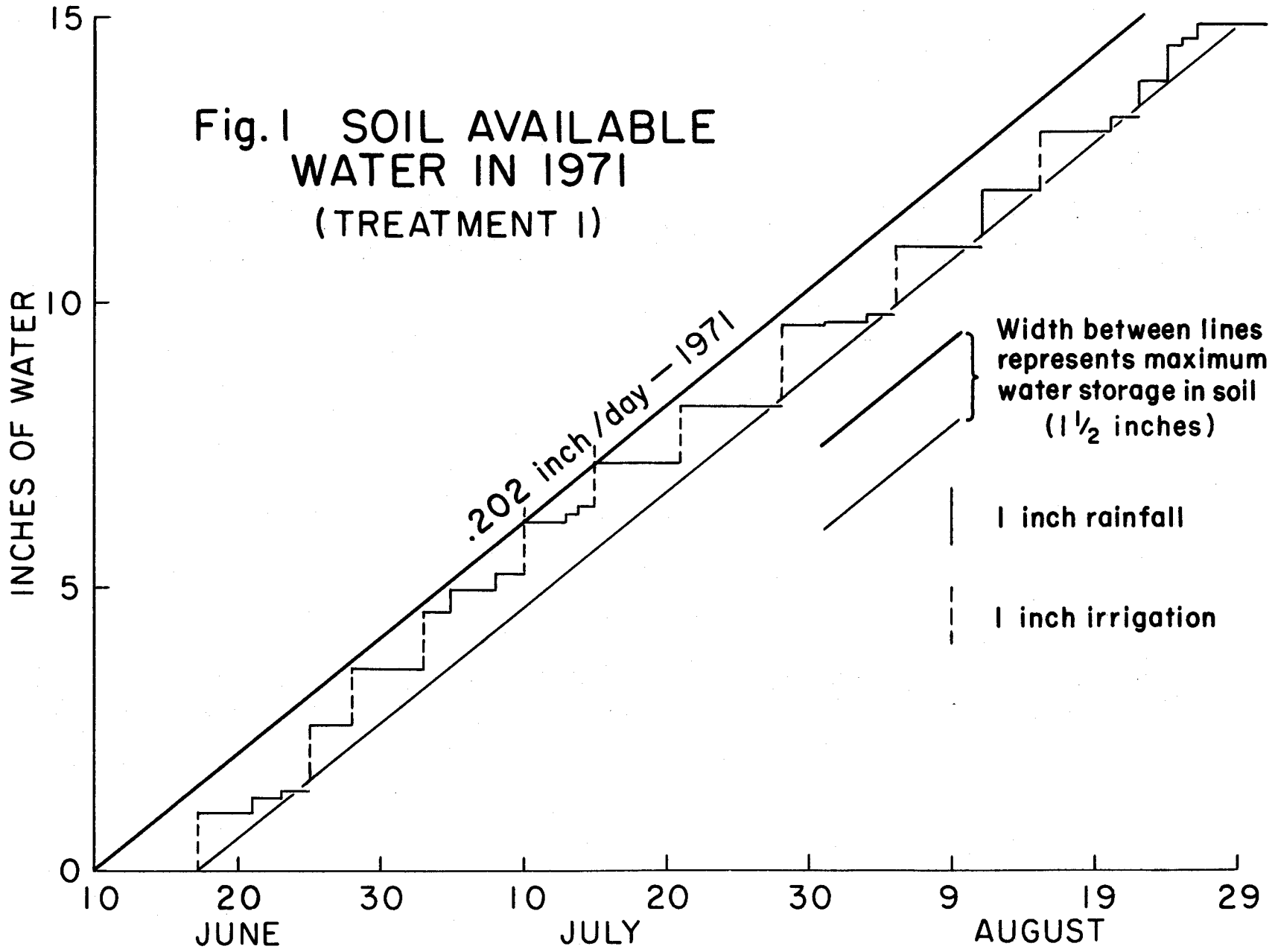
Fig. 1 SOIL AVAILABLE WATER IN 1971
(TREATMENT 1)
INCHES OF WATER
15
10
5
0
.202 inch/day – 1971
Width between lines represents maximum water storage in soil (1½ inches)
1 inch rainfall
1 inch irrigation
10
20
30
10
20
30
9
19
29
JUNE
JULY
AUGUST

frequency and amount of precipitation. For each day without irrigation or rainfall a line of 1 unit length is drawn horizontally. When the horizontal line approaches the lower diagonal line, the soil has a deficit of plant-available water, and lacking rainfall, additional water must be added by irrigation. The same is true when a quantity of water is added that would cause a vertical line to go beyond the upper diagonal line. This is excess water and it will be lost by flow through the soil profile to a depth beyond the range of plant roots.

The irrigation plan shown here was developed on the basis of daily evaporative losses from a class A weather pan. The daily evaporative losses varied from almost zero to .5 inch per day. When averaged over the entire summer about .2 inch was lost per day. Yet when this irrigation management plan is tested as shown in Figure 1 it does a very good job of predicting when a potato farmer should irrigate.

Significant differences appear to exist in yield for both potato varieties when they were irrigated cooled; however, large variations were found in the check data (see Table 3). Although these potato plots were irrigated 15 times via the farm irrigation system, and in general received about 12 inches of water, there is some question as to how well the water was distributed. The irrigation cooling system was running only 5 minutes out of 30 and in 34 days of irrigation cooling on treatment 1 only 2.3 inches of water were applied. In treatment 2 there were 14 irrigation cooling days resulting in 1 inch of water applied. No explanation can be given why yields from treatment 1 were lower than those of treatment 2. Again variable distribution from the farm irrigation system is suspected. In 1972 these plots will be irrigated with the small sprinkler system which will permit better control and distribution of water applied.

The Influence of Water, Systemic Insecticides and Sidedress Nitrogen on the Incidence of Speckle Leaf

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The speckle leaf disorder was of considerable economic concern in certain varieties and areas of the state in 1968 and 1969. As a consequence studies were performed in 1970 and 1971 to measure those factors which may contribute to the problem. Experiments on the Lennard Farm in Monroe County in 1970 revealed that excessive water and inadequate nitrogen at the early stages of growth on the Haig and Norchip varieties increased the occurrence of the speckle leaf lesions and reduced yields when compared to plots which received less water and did not show nitrogen deficiencies.

To pursue this further a similar study was conducted in 1971 at the Montcalm Experimental Farm which in addition to water management and sidedress nitrogen levels also evaluated in interaction of systemic insecticides.

Procedure

Plots of the Haig variety were planted on April 29, 1971 at spacings of 34" between rows and 9 inches within the row. Plots were established using: no systemic insecticide; 3 lb/A phorate (Thimet) and 3 lb/A Disulfoton (Disyston). Four sidedress nitrogen levels were compared on the sub plots: none; 75 lb/A; 150 lb/A; and three applications of 50 lb/A each. Plowdown fertilizer was 70-0-120. The planter fertilizer was 1250 lb/A 6-12-12.

Duplicate plots were established so that one-half of the experiment could be given additional water early in the growing season. To these plots an additional 3 inches of water was added between June 10 and 14. This was done in an attempt to simulate conditions which occurred in 1968 and 1969 just prior to the reports of fields with high incidence of speckle leaf.

The plots were harvested on September 2, 1971. Total yield, size distribution, specific gravity, incidence of speckle leaf lesions and chip acceptability were all determined.

Results

Table 1 summarizes the yield response observed under the different levels of water management. The increased yields due to the additional water suggests that under these conditions leaching of nitrogen was not a problem and a nitrogen deficiency did not exist. The additional water applied at this time was beneficial.

In terms of sidedress nitrogen, maximum yield response was obtained at the 150 lb level where the additional water was applied. Other studies have shown that the Haig does have a high nitrogen requirement in early plant development. On the normal irrigation treatment response to sidedress N was not apparent. The greatest response under these conditions occurred when the nitrogen application was divided into three applications of 50 lb each.

It was further observed that a reduced yield occurred in the plots treated with phorate when compared with the untreated or the disulfoton plots. This occurred only where the additional water was applied. Statistical analysis of the data did not show this to be a significant difference. The trend however did occur at all nitrogen levels.

Table 2 summarizes the specific gravity data. As was noted with yields, higher specific gravities occurred on plots receiving the additional water. There was a slight reduction in specific gravity of potatoes harvested from the plots treated with a systemic insecticide when compared to the untreated plots. Nitrogen had no appreciable effect on specific gravity.

The incidence of speckle leaf symptoms was not serious in 1971. Evidence of the lesions was present, however, it could not be consistently related to any of the treatments.

Table 1. The cwt/A of Haig potatoes grown at different levels of water management, sidedress nitrogen and systemic insecticides.

	Additional Irrigation				Normal Irrigation			
Sidedress Nitrogen	No Banded Insecticide	Disulfoton	Phorate	Average	No Banded Insecticide	Disulfoton	Phorate	Average
0	429	458	386	424	375	366	363	368
75	470	454	415	446	358	398	359	372
150	487	490	457	478	367	382	387	379
50-50-50	479	468	449	465	384	403	392	393
Ave.	466	467	427	453	371	387	375	378

Table 2. The specific gravity of Haig potatoes grown at different levels of water management, sidedress nitrogen and systemic insecticides.

	Additional Irrigation				Normal Irrigation			
Sidedress Nitrogen	No Banded Insecticide	Disulfoton	Phorate	Average	No Banded Insecticide	Disulfoton	Phorate	Average
0	1.076	1.073	1.074	1.074	1.073	1.071	1.070	1.072
75	1.074	1.073	1.074	1.074	1.073	1.071	1.071	1.072
150	1.076	1.075	1.074	1.075	1.073	1.072	1.072	1.072
50-50-50	1.075	1.074	1.072	1.074	1.073	1.072	1.070	1.072
Average	1.075	1.074	1.074	1.074	1.073	1.072	1.071	1.072

Herbicides for Weed Control in Potatoes

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Department of Crop and Soil Sciences

Russet Burbank potatoes were planted May 12 on a McBride sandy loam (2.0% organic matter) and treated preemergence on May 22 and postemergence on June 14. The design of the experiment was a randomized block with three replications. Rainfall was .67 inches within 10 days after application.

The major weeds present were pigweed (Amaranthus retroflexus) and barnyardgrass (Echinochloa crusgalli). The plot was visually rated June 30.

The preemergence herbicide treatments on the sandy loam soil all gave 80% or more control of the broadleaf weeds. The best overall preemergence treatments were linuron, 2 lb/A, oryzalin + linuron, 1 1/2 + 1 1/2 lb/A, chlorobromuron, 2 lb/A, alachlor + dinoseb, 2 + 4 1/2 lb/A and Bay 94337, 1/2 and 1 lb/A, all of which controlled 96-100% of both the broadleaf and grass species. Bay 94337 as a split preemergence and postemergence treatment on the sandy loam soil at 3/4, 1/2 lb/A preemergence and 1/4, 1/2 lb/A postemergence also controlled 100% of the total weed population.

Preemergence and Postemergence Weed Control Evaluations in Potatoes.
Montcalm Co., 1971

Planted: May 12, 1971
Rated: June 30, 1971

Treated: Pre - May 22, 1971
Post- June 14, 1971

Weeds Present: pigweed, purslane, barnyardgrass, crabgrass

Soil Type and Organic Matter: McBride sandy loam, 2.0%

	Preemergence		Postemergence			Weed Control Rating	
Trmt. No.	Trmt.	Rate lb/A	Trmt.	Rate lb/A	Injury	Bd. Lv.	Grass
1	Lorox	2			0.0	10.0	10.0
2	Patoran	2			0.0	10.0	6.6
3	GA-2-270	2			0.0	10.0	8.6
4	GA-2-271	2			0.0	10.0	6.6
5	Ryzelan+DNBP	1 1/2+4 1/2			0.0	8.0	9.3
6	Ryzelan+Lorox	1 1/2+1 1/2			0.0	10.0	10.0
7	Maloran	2			0.0	10.0	9.6
8	RP-17623	1 1/2			3.3	9.6	9.0
9	Lasso+DNBP	2 + 4 1/2			0.0	10.0	10.0
10	Sencor	1/4			0.0	10.0	8.6
11	Sencor	1/2			0.0	10.0	9.6
12	Sencor	1			0.0	10.0	10.0
13	Sencor	3/4	Sencor	1/4	0.3	10.0	10.0
14	Sencor	1/2	Sencor	1/2	0.0	10.0	10.0
15	-------	---	Sencor	1	1.3	10.0	10.0
16	No treatment	---	No trmt.	--	---	----	----

0 - no injury and no control; 10 - complete control or kill

INSECTICIDE EVALUATION

A. L. Wells,
Department of Entomology

The research on potato insects and nematodes at the Montcalm Experimental Farm was composed of three separate studies: (a) an evaluation of soil systemic insecticides alone or in combination with foliar applications; (b) a continuation of the study on the role of nematode control in cash crop rotations; and (c) a study to determine the varietal response of potatoes to in-row band applications of soil systemic insecticides on speckle leaf, maturity, yield and tuber quality. A corollary study on the evaluation of foliar insecticides for the control of foliar feeding insects; d) was conducted at the Muck Experimental Farm.

A. Evaluation of Soil Systemic and Foliar Insecticides

Procedure

Seventeen treatments including eight soil systemic insecticides alone or in combination with additional sidedress or foliar applications were evaluated for foliar insect control and yield. Russet Burbank and Norchip seed planted in 12 inch spacings were used in the study. A normal fertilizer program of 200 lb. ammonium nitrate and 200 lb. 0-0-60 were plowed down and 800 lb. of 14-14-14 plus 2% Mg was banded at planting with 70 lb. of additional nitrogen sidedressed at hilling on June 23. The soil insecticides were either broadcast and disced in prior to planting, placed in a 4 inch band in the seed furrow prior to covering, sidedressed on each side of the row prior to hilling, or applied as foliar sprays. The plots consisted of three applications of four 50 foot rows (two rows of each variety). The broadcast and band applications were made and the plots planted on May 5 and Lorox was applied preemergence. The foliar applications were made on June 22, July 15 and 29.

Potato flea beetle control was determined by counting the number of feeding holes in 10 leaves of each variety in each plot on June 22. Foliar insect populations were evaluated on July 7, 15, 29, August 9, 19 and 31 by taking ten sweeps with an insect net on each plot. The total insects collected from each treatment for the six samplings are presented in Table 1.

The inside row of each variety was harvested on September 23 and yield and size distribution of the tubers determined. These data are presented in Table 2.

Results

All of the treatments applied at planting provided early season control of the flea beetles as shown by the feeding hole counts. High populations of the flea beetles as well as potato leafhoppers, and green peach aphids developed during the season on certain plots. Included in the high flea beetle counts were the emergence of new adults in late August. This may represent the start of a third generation on late varieties. The relatively low aphid populations in the untreated plots was the result of early maturing vines caused by heavy early flea beetle and leafhopper populations. The overall effectiveness of

Table 1. The effects of soil systemic and foliar insecticides on insect populations.

Material & Formulation	Placement	Lb Tox/A	Flea Beetle Holes/Leaf (June 22)		Total Insects Collected					
			Norchip	Burbank	Potato Flea Beetle	Potato Leafhopper	Aster Leafhopper	Tarnished Plant Bugs	Green Peach Aphids	Parasites and Predators
Thimet 15% Gran	Band	3 lb	0.3	0.1	24	14	15	36	716	22
Diazinon 4 EC + Sevin 50% WP + Cygon 10% Gran	Foliar Sidedress	1/2 lb + 1 lb 3 lb	3.1	5.5	365	28	8	44	897	14
Am Cyan 92100 15% Gran	Band	3 lb	0.1	0	7	6	10	23	801	16
Am Cyan 64,475 10% Gran	Band	3 lb	0.5	1.1	234	32	26	56	1511	20
Disyston 15% Gran	Band	3 lb	1.4	0.7	216	40	24	92	724	28
Disyston 15% Gran + MSR 2 SC + Guthion 2 SC	Band Foliar	3 lb 1/2 lb + 1/2 lb	0.2	0	31	16	15	41	286	18
MSR 2 SC + Guthion 2 SC + Disyston 15% Gran	Foliar Sidedress	1/2 lb + 1/2 lb 3 lb	2.9	4.5	280	27	21	73	530	18
Disyston 15% Gran + Disyston 15% Gran	Band Sidedress	3 lb 3 lb	1.0	0.7	52	14	10	58	143	11
Disyston 6 SC	Broadcast	4 lb	1.7	2.3	203	24	14	104	677	8
Disyston 6 SC + Disyston 15% Gran	Broadcast Sidedress	4 lb 2 lb	0.7	1.5	60	23	16	40	199	15
DS-15647 10% Gran	Band	3 lb	0.2	0.4	53	8	2	21	358	17
Furadan 10% Gran	Band	3 lb	0.1	0.4	71	16	6	52	531	22
Furadan 10% Gran + Furadan 10% Gran	Band Sidedress	2 lb 2 lb	0.2	0.3	23	11	9	47	723	18
Furadan 10% Gran	Band	6 lb	0.1	0	48	4	5	34	690	23
Temik 10% Gran	Band	3 lb	0	0.1	148	9	5	12	105	11
Untreated	--	--	3.9	2.7	443	415	24	124	395	20
Untreated	--	--	4.4	4.1	615	432	25	133	257	28

* Broadcast--Liquids applied in water at 75 gal/A and disc incorporated; Band--Rates based on 34" rows (15,390 row-ft/A); Sidedress-Band on both sides of row June 22 prior to hilling; Foliar--Applied in water at 90 gal/A using drop nozzles with CO_2 sprayer on June 22, July 15 and 29.

Table 2. The effect of soil systemic and foliar insecticides on potato yield and size distribution.

Material & Formulation	Placement	Russet Burbank					Norchip			
		Yield (cwt/A)	% Size Distribution				Yield (cwt/A)	% Size Distribution		
			Less than 1 7/8"	1 7/8" to 10 oz.	10 oz. and over	Off Type		Less than 1 7/8"	1 7/8" to 3 1/4"	3 1/4" and over
Thimet 15% Gran	Band	362	3%	64%	19%	14%	303	9%	83%	8%
Diazinon 4 EC + Sevin 50% WP	Foliar									
+ Cygon 10% Gran	Sidedress	334	4	57	21	18	289	8	87	5
Am Cyan 92100 15% Gran	Band	346	3	54	20	23	374	5	86	9
Am Cyan 64,475 10% Gran	Band	272	4	54	14	28	266	6	86	8
Disyston 15% Gran	Band	394	3	61	16	20	313	6	85	9
Disyston 15% Gran	Band									
+ MSR 2 SC + Guthion 2 SC	Foliar	366	3	58	22	17	335	7	85	8
MSR 2 SC + Guthion 2 SC	Foliar									
+ Disyston 15% Gran	Sidedress	371	4	57	20	19	319	8	87	5
Disyston 15% Gran	Band									
+ Disyston 15% Gran	sidedress	422	2	54	27	17	363	6	84	10
Disyston 6 SC	Broadcast	395	4	60	18	18	383	8	83	9
Disyston 6 SC	Broadcast									
+ Disyston 15% Gran	Sidedress	375	4	57	19	20	350	7	88	5
DS-15647 10% Gran	Band	400	4	57	23	16	371	6	86	8
Furadan 10% Gran	Band	343	4	59	18	19	348	7	87	6
Furadan 10% Gran	Band									
+ Furadan 10% Gran	Sidedress	380	3	59	21	17	350	7	85	8
Furadan 10% Gran	Band	340	4	57	19	20	313	10	81	9
Temik 10% Gran	Band	362	4	59	19	18	347	6	86	8
Untreated	--	249	5	67	12	16	227	13	84	3
Untreated	--	262	5	71	12	12	246	10	89	1

the Amer. Cyan. 92100, DS-15647, Furadan and Temik as well as split applications of Disyston may lead to their commercial use in the future. The degree of insect control is reflected directly in the yield and size distribution.

B. The Role of Nematode Control in Cash Crop Rotations

Purpose of Study

To determine the effects of nematode control with soil fumigants and granular nematocides on five different three year rotations of cash crops. The study was initiated in April of 1968 and carried through a complete rotation and a follow-up evaluation in 1971. Although a high population of root leison nematode, Pratylenchus penetrans, was present during the first two years of the study, sampling in the spring of 1970 indicated the population had dropped to a very low level. The populations have not recovered as indicated by subsequent samplings in 1971.

Procedure

The soil treatments used in the study consisted of Annual Fumigation (FA)--Fumigated with Vorlex at 10 gallons per acre on October 25, 1969; Fumigation as needed (FN)--Fumigated with Telone at 20 gallons per acre on April 24, 1968; Granular nematocide (Bay)--Bay 68138 (Nemacur) granules incorporated on May 7, 1970 prior to planting at rate of 6 lbs. active per acre; and Untreated (Unt.)--no soil treatments applied. An adjacent area of alfalfa seeding was plowed in 1969 and fumigated with Vorlex (Vor) at 30 gallons per acre on October 25, 1969. These treated areas were crossed with four replications of five different rotations as given in Table 3.

Normal agronomic practices were followed in all of the plots, including herbicides and systemic insecticides. Supplementary foliar insecticides and fungicides were applied on a 7-10 day schedule. The planting date, variety and harvest data are presented in Table 3.

Results

There were no apparent differences in vine growth in the different treatments early in the season however by late August the untreated plots had matured while the granular treated plot (Bay) as well as the Vorlex (Vor) and FA plots remained green. This difference in late growth is reflected in the yields and increased tuber size of these plots. The preceding crop had little apparent affect on these findings. The lower yields in the untreated plot may be from the lack of earlier treatments since the nematode populations present in 1971 could not account for these differences.

NOTE: A complete summary of this study is being made and will be available later.

C. Varietal Response to Soil Systemic Insecticides

A study to compare the response of 12 varieties of potatoes to soil applications of systemic insecticides was continued after a preliminary study in 1970. The principal factor to be studied was the speckling condition to the lower leaves which had been observed in prior studies.

Table 3. Agronomic and Yield Data from the Nematode Rotation Study.

Variety: Russet Burbank "B" seed in 12 in. spacing.
Fertilizer: 200 lb. Ammonium Nitrate plus 200 lb. 0-0-60 plowdown; 800 lb. of 14-14-14 + 2% Mg banded at planting; 70 lb Nitrogen sidedressed on June 15.
Systemic Insecticide: Disyston 15% Gran. (3 lb. act/A) banded at planting
Date Planted: May 11
Herbicide: Lorox applied pre-emergence May 26
Foliar Insecticide: Thiodan, Meta-Systox-R or Diazinon + Sevin applied with fungicide on 7-10 day schedule.
Date Vines Killed: September 30
Date Harvested: October 12
Date Specific Gravity Determined: October 21

Soil	Yield/A		% Size Distribution				Specific
Treatment	Cwt	Bu	to 1-7/8"	1-7/8"-10 oz	10 oz +	Off-type	Gravity
Plot 1 (Potatoes 1968, 1969, 1970)							
FA	377	628	5%	65%	21%	9%	1.080
FN	337	561	5	63	17	15	1.078
Unt	313	522	7	63	13	17	1.077
Bay	363	603	4	60	17	19	1.075
Vor	410	683	4	60	27	9	1.076
Plot 2 (Potatoes 1968, 1968, Beans 1970)							
FA	346	576	5%	61%	22%	12%	1.080
FN	363	605	5	62	19	14	1.078
Unt	297	495	6	61	16	17	1.076
Bay	334	557	6	58	24	12	1.078
Vor	347	578	4	64	22	10	1.078
Plot 3 (Beans 1968, Cucumbers 1969, Potatoes 1970)							
FA	367	611	4%	61%	28%	7%	1.079
FN	340	566	5	64	19	12	1.078
Unt	326	543	6	55	18	21	1.077
Bay	384	640	4	54	24	18	1.078
Vor	348	580	4	53	32	11	1.077
Plot 4 (Cucumbers 1968, Sweet Corn 1969, Potatoes 1970)							
FA	384	640	5%	69%	21%	5%	1.081
FN	354	589	5	60	15	20	1.078
Unt	296	493	7	62	13	18	1.078
Bay	369	615	3	51	27	19	1.077
Vor	397	661	5	66	23	6	1.078
Plot 5 (Sweet Corn 1968, Potatoes 1969, Beans 1970)							
FA	375	626	4%	63%	23%	10%	1.080
FN	327	546	5	66	14	15	1.078
Unt	310	517	5	61	13	21	1.077
Bay	366	610	3	54	25	18	1.075
Vor	345	575	4	58	26	12	1.078

Procedure

Sixteen seed pieces of each variety were planted in three replications of 16 row-feet each for each treatment. The insecticide granules were placed in a 4 inch band in the seed furrow prior to covering with soil on May 6. Normal agronomic practices of fertilization, herbicide usage, irrigation and foliar applications of insecticides and fungicides were followed on all of the plots. Speckle leaf ratings were made at the time of hilling and sidedressing. Maturity ratings of the vines based on amount of green foliage present were made on August 20. Yields and size distributions of the tubers were made at harvest on September 28. The data are presented in Table 4.

Results

The differences in the speckle leaf incidence between certain treatments was apparent at the time of sidedressing and hilling. This condition could possibly have been the result of a slight retardation of early growth by the in-row applications. The three pound rate of application was on the upper limit of use for all materials on this type of soil. It also verifies the suggestion that these materials be placed with the fertilizer band to avoid any affects on the young plants. The affects of the Thimet treatment on the plants evidentally carried through to maturity and resulted in reduced yields of most varieties.

D. Evaluation of Foliar Insecticides on Foliar Insects

Procedure

Twenty foliar treatments including recommended and candidate insecticides were evaluated for the control of foliar feeding insects at the Muck Experimental Farm (Clinton Co.). The treatments were randomized in three replications of paired 18 foot rows using Sebago. The plots were planted on May 18 using whole seed and the insecticides were applied with a hydraulic sprayer with drop nozzles delivering 125 gallons per acre. Applications were made on July 1, 14, 23, August 14, 23, August 5, 9, 16, 27 and September 2. Ten sweeps were taken on each of the plots and the totals collected on all replications for the duration of the study are presented in Table 5. Yields and size distribution of the tubers were determined at harvest on October 4. The data are presented in Table 6.

Results

Heavy populations of leafhoppers, flea beetles and Colorado potato beetles developed early on the untreated plots and aphids started building up by early August. The selectivity of the treatments became apparent as soon as the populations developed. The fluctuations of these differences resulting from residual effects of the materials are not shown in the summary however the counts are the result of the populations as they developed.

Most of the treatments were effective on the potato leafhopper but were not effective on the extremely high populations present at the time of sampling. This is a result of the residual effectiveness of the materials on the highly active beetles when evaluated in small plots. The relatively low populations of aphids and flea beetles in the untreated plots were probably caused by the poor condition of the plants after the potato beetle and leafhopper damage occurred.

Table 4. Varietal response to soil systemic insecticides

Variety	Speckle Rating*	Maturity Rating**	Yield Data Cwt/A	% Size Distribution -1 7/8"	1 7/8"-3 1/4"	+3 1/4"	Off-type
Thimet 15% Gran. at 21 lb. (3 lb. tox.)/Acre							
Haig	1.7	3.3	225	9%	68%	23%	--
Norland	1.7	5.0	258	9	81	11	
MSU-709	3.0	2.3	347	4	56	40	--
FL-96	3.0	3.0	297	6	75	19	--
Sebago	2.3	1.0	366	7	70	23	--
R. Burbank	1.7	1.7	363	3	48	17***	32%
Norgold	2.0	4.0	244	9	74	17	--
Norchip	1.7	2.7	379	6	65	29	--
Onaway	3.0	4.3	292	7	65	28	--
Katahdin	2.7	2.3	285	7	62	31	--
Kennebec	2.7	3.0	302	5	74	21	--
Superior	2.7	4.7	232	6	81	13	--
Disyston 15% Gran. at 21 lb. (3 lb. tox.)/Acre							
Haig	2.0	3.3	281	5%	63%	32%	--
Norland	1.0	4.7	337	6	78	16	--
MSU-709	2.0	2.7	363	4	52	44	--
FL-96	1.3	2.7	326	12	78	10	--
Sebago	2.3	1.0	339	6	71	23	--
R. Burbank	1.7	1.3	356	4	42	24	30%
Norgold	1.3	4.0	240	10	80	10	--
Norchip	1.3	2.7	416	4	53	43	--
Onaway	1.3	3.0	351	4	51	45	--
Katahdin	1.3	2.3	327	7	56	37	--
Kennebec	1.7	3.0	385	4	62	34	--
Superior	2.0	3.7	331	5	66	29	--
Furadan 10% Gran. at 30 lb. (3 lb. tox.)/Acre							
Haig	1.0	3.0	317	5%	59%	36%	--
Norland	1.0	5.0	356	6	85	9	--
MSU-709	1.0	2.7	337	3	55	42	--
FL-96	1.0	2.7	303	14	78	8	--
Sebago	1.0	1.0	384	5	76	19	--
R. Burbank	1.0	1.7	365	4	54	22	20%
Norgold	1.0	4.0	229	10	77	13	--
Norchip	1.0	2.7	411	5	58	37	--
Onaway	1.0	3.7	394	4	56	40	--
Katahdin	1.0	2.3	332	5	65	30	--
Kennebec	1.0	2.7	363	6	65	29	--
Superior	1.3	3.7	307	7	71	22	--
Untreated							
Haig	1.0	3.3	303	5%	56%	39%	--
Norland	1.0	4.7	382	5	78	17	--
MSU-709	1.0	2.3	355	2	47	51	--
FL-96	1.0	2.7	318	11	78	11	--
Sebago	1.0	1.0	390	7	69	24	--
R. Burbank	1.3	1.7	392	3	53	28	16%
Norgold	1.0	4.3	227	9	81	10	--
Norchip	1.0	3.0	402	3	66	31	--
Onaway	1.0	4.0	360	5	58	37	--
Katahdin	1.0	2.7	286	8	66	26	--
Kennebec	1.0	2.7	360	6	60	34	--
Superior	1.0	3.7	315	5	73	22	--

* Speckle Leaf Rating: 1--None apparent to 4--Injury very apparent.

** Maturity Rating: (Aug. 20) 1--Vines green to 5--Mature (vines dead).

*** Indicating Burbank 10 oz. and over.

Table 5. SUMMARY OF FOLIAR INSECT CONTROL ON POTATOES
Mich. State Univ. Muck Exptl. Farm
(Total insects collected from plots July 2-September 2)

Material and Formulation	Lbs Tox/A.	Potato Leaf-hopper	Aster Leaf-hopper	Miridae (Plant Bugs)	Aphids	Flea Beetles	Colorado Potato Beetles	Parasites and Predators
Cygon 267	1/2 lb	159	18	70	166	1,109	187	18
Cygon 267	1 lb	177	10	64	309	862	180	30
Am Cy 72, 841 2 EC	1 lb	211	15	76	375	1,080	159	34
Am Cy 84,484 2 EC	1 lb							
--Azodrin 3.2 EC	1/2 lb*	231	32	98	356	933	144	24
Meto-Systox R 2 EC	1/2 lb	142	10	87	201	1,274	174	30
Disyston 6 EC	1/2 lb	147	20	95	210	897	203	32
Orthene 75% WP	1 lb	98	14	72	37	1,056	172	16
Monitor 6 S	1 lb	166	11	83	85	1,103	51	23
Lannate 90% WDL	1/2 lb	216	10	105	232	1,115	132	25
Fundal 4 EC	1/2 lb	225	7	104	519	906	96	25
Fisons NC-6897 80% WP	1 lb	224	14	98	2,974	794	9	25
Diazinon 4 EC	1/2 lb	331	16	106	668	1,059	28	18
Diazinon 4 EC	1/2 lb							
+ Sevin 50% WP	+ 1 lb	273	16	111	644	977	25	20
Zolone 3 EC	1 lb	275	18	122	177	932	34	20
Mobil MC-4044 2 EC	1 lb	296	24	109	238	882	47	25
Sandoz 52139 2 EC	1/2 lb	335	18	114	163	1,024	13	29
Geigy GS-15171 4 EC	1 lb	513	32	101	133	910	20	30
Thiodan 2 EC	3/4 lb	344	20	101	133	829	1	16
Untreated	--	547	23	201	206	740	205	29
Untreated	--	599	20	203	141	862	231	22

*Am. Cy. 84,484 applied July 1, 14 & 23; Azodrin applied Aug. 8, 17 and 31.

Table 6. FOLIAR INSECTICIDE EVALUATION ON POTATOES YIELDS

Material and Formulation	Lb Tox/A	Yield/A Bu	Yield/A Cwt	Percent Size Distribution: Less than 1-7/8"	1-7/8"-3-1/4"	Greater than 3-1/4"
Cygon 267	1/2 lb	773	464	3%	67%	30%
Cygon 267	1 lb	845	507	3	65	32
Am Cy 72,841 2 EC	1 lb	867	520	3	68	29
Am Cy 84,484 2 EC --Azodrin 3.2 EC	1 lb 1/2 lb*	855	513	3	67	30
Meta-Systox R 2 EC	1/2 lb	855	513	3	59	38
Disyston 6 EC	1/2 lb	800	480	4	67	29
Orthene 75% WP	1 lb	957	574	3	65	32
Monitor 6 S	1 lb	965	579	3	61	36
Lannate 90% WDP	1/2 lb	770	462	4	63	33
Fundal 4 EC	1/2 lb	875	525	4	67	29
Fisons NC-6897 80% WP	1 lb	717	430	4	75	21
Diazinon 4 EC	1/2 lb	835	501	2	66	32
Diazinon 4 EC + Sevin 50% WP	1/2 lb + 1 lb	868	521	3	68	29
Zolone 3 EC	1 lb	895	537	3	61	36
Mobil MC-4044 2 EC	1 lb	852	511	3	67	30
Sandoz 52139 2 EC	1/2 lb	845	507	3	64	33
Geigy GS-15171 4 EC	1 lb	715	429	2	75	23
Thiodan 2 EC	3/4 lb	872	523	3	55	42
Untreated	--	763	458	3	69	28
Untreated	--	678	407	3	68	29

*Am. Cy. 84,484 applied July 1, 14 & 23; Azodrin applied Aug. 8, 17 and 31.

All but two of the treatments resulted in higher yields than the average of the two untreated plots. The yields and size distribution resulting from the NC-6897 and GS-15171 treatments could be the lack of control of aphids and potato leafhoppers, respectively. The unusually high yields in the untreated plots reflect the inherent plant growth and maturity despite heavy insect damage to the foliage.

Green Manure Study

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Potatoes are usually grown in rotation with other crops. On farms where potatoes are the principal cash crop, rotational crops are selected to improve the soil, reduce disease and insect problems, and when possible, to provide some additional cash return.

Procedure

In 1970 a trial was initiated to evaluate a sudangrass hybrid, ryegrass, and lupines as green manure crops preceding potatoes. Planting dates and seeding rates are given in Table 1. Nitrogen at 150 lb/A was applied May 18 to the ryegrass and sorghum-sudan plots. Plots were replicated 4 times. Grain and/or forage yields were obtained and calculated at 12% moisture. All crop residues were returned to the respective plots. In September of 1970 all plots were cut with a rotary mower.

In April of 1971 the area was plowed and planted to Russet Burbank potatoes. The fertility program was 70 lb N and 120 lb K/A plowdown, 800 lb/A 14-14-14 + 2% Mg banded and 70 lbs N/A sidedress.

Results

Table 1 gives the yield data obtained from the green manure crop practices. The sudangrass yields were greater than normally expected. Two cuttings of sudangrass and ryegrass were made. The ryegrass continued to make considerable growth even after the frost had killed off the sudangrass and lupine regrowth. The ryegrass developed a very extensive and fibrous root system which was very apparent when the potato plots were established in 1971. The plow-plant tillage was used and the root system of the ryegrass was so extensive that the soil was quite soddy and did not allow for good planting conditions. This condition, although to a lesser degree, was still noticeable at harvest time. A crop such as this could be useful to improve soil textural conditions particularly where clods are a problem.

Table 2 summarizes the potato yields. There is a slight trend to a greater yield on the plots which followed the lupines. There was no appreciable difference in terms of the size distribution. A second year of the trial is currently underway

Table 1. Planting dates, seeding rates and yields of four green manure crops preceding potatoes.

	Seeding Rate Lb/A	Seeding Date	Grain Bu/A	Forage Tons/A	Total Tonnage/A
1. sudangrass	30	May 30	----	5.96	5.96
2. ryegrass	20	May 9	----	2.95*	2.95
3. lupines	75	May 9	32.95	0.99	2.42
4. lupines	131	May 9	44.74	1.34	2.80

*considerable growth after September 10 not harvested

Table 2. The yields and quality of Russet Burbank potatoes following four green manure crops.

		Percent Size Distribution			Off
	Cwt/A	-1 7/8	+10 oz.	1 7/8-10 oz.	Type
1. sudangrass	319	6.6	17.7	60.0	15.7
2. ryegrass	320	4.6	19.8	56.9	18.7
3. lupines-75 lb/A	348	6.0	20.1	56.0	17.9
4. lupines-131 lb/A	336	7.1	20.0	57.9	15.0

Corn Hybrids, Plant Population and Irrigation

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Agronomic data for 56 commercial and experimental corn hybrids, irrigated and not irrigated in 1971, are presented in Table 2. Irrigated corn averaged 162.5 bushels per acre compared to 28.2 not irrigated, a difference of 134.3 bushels for irrigation.

Rainfall was unusually low in 1971. Total amounts were: May = .93", June = 1.5", July = 1.22", August = 2.67", September = 4.0". Effective rainfall (.40" or more) during this period occurred on: June 13 = .51", July 5 = .40", August 11 = .80", August 23 = .38", August 25 = .60", September 6 = 2.08", September 20 = .58", and September 26 = .54". During June-August there were only five effective rains with a total of 2.69".

Buoyoucous soil moisture blocks were placed at 6, 12, 18, and 24-inch depths in both unirrigated and irrigated plot areas. Soil moisture readings are presented in Table 1. Without irrigation, soil moisture at 12-24" depths remained below 50% water holding capacity from July 5 to August 30 when readings were discontinued.

The range (highest and lowest) in yields for the 56 hybrids was: irrigated 210.5 to 91.0, not irrigated = 41.9 to 10.6. The highest yielding hybrid, Michigan Exp. 67-3124 (2x) produced 172.5 bushels (210.5 vs. 38.0) more when irrigated than when not irrigated. The lowest yielding hybrid, Renk NR1 (2x)--a very early maturing hybrid, yielded 80.4 bushels (91.0 vs. 10.6) more when irrigated.

Hybrids significantly better than average in yield when irrigated in 1971 were (in order of early to late maturity): Acco UC2301 (2x), Michigan 396-3X (3x), Pioneer 3784 (2x), Mich. Exp. 67-2023 (2x), Pride R290 (2x), Blaney B-AA (2x), Michigan 572-3X (3x), Super Crost S25 (2x), Michigan 500-2X (2x), Mich. Exp. 69-3097 (3x), Super Crost S27 (2x), Michigan 511-3X (3x),Blaney BX-AA (2x), P.A.G. SX69 (2x), Jacques JX162A (2x),Michigan 555-3X (3x), Funk Bros. G4444 (2x), Mich. Exp. 67-3124A, and Mich. Exp. 67-3124.

Hybrids significantly better than average in yield when not irrigated in 1971 were (in order of early to late maturity): Funk Bros. G4180 (2x), Cowbell SX102 (2x), Funk Bros. G4263 (3x), Mich. Exp. 67-4006 (2x), Cowbell SX002 (2x), Michigan 380-3X (3x), Mich. Exp. 67-3106 (3x), Acco UC1900 (2x), Acco UC1901 (2x), DeKalb XL24 (2x), Blaney B-AA (2x), Mich. Exp. 69-3097 (3x), Jacques JX162A (2x), Michigan 555-3X (3x), Funk Bros. G4444 (2x), Mich. Exp. 67-3124A (2x), and Mich. Exp. 67-3124 (2x).

Only seven of the 19 hybrids significantly better than average in yield irrigated were also significantly better than average without irrigation. The agreement of high yield selection from irrigated vs. not irrigated trials was less with the extreme drouth of 1971 than in three previous years, 1968-1970, when correlations were much higher and highly significant--.860 in 1968, .839 in 1969, and .927 in 1970 compared to a non-significant correlation of .182 in 1971.

Four-Year Averages 1968-1971

Table 3 presents a four-year summary of yields and stalk lodging.

Yields. Irrigated corn averaged 68.9 bushels more than unirrigated, 147.1 vs. 78.2, for the four-year period. The highest yielding hybrids averaged 92.5

Table 1. Per cent water holding capacity at 6, 12, 18, and 24-inch soil depths in unirrigated and irrigated plots, dates and amount of irrigation water applied 1971.

Date of soil moisture reading	Not irrigated				Irrigated				Date of irrigation	Inches of water applied
	6"	12"	18"	24"	6"	12"	18"	24"		
June 22	100	80	100	100	82	86	90	80	June 23	.75
June 29	45	74	100	100	100	100	100	100	June 27	1.00
July 5	18	20	48	50	100	98	85	85	July 3	1.00
July 14	18	18	18	18	100	100	90	72	July 7	.75
July 20	18	18	18	18	98	96	90	64	July 12	1.00
July 27	18	18	18	18	94	92	90	84	July 16	1.00
August 2	18	18	18	18	99	98	96	92	July 20	1.00
August 10	72	18	18	18	98	98	98	98	July 23	1.00
August 17	22	18	18	18	100	100	99	99	July 27	1.00
August 24	68	24	18	18	100	100	99	95	August 2	1.00
August 30	62	20	18	18	100	100	100	100	August 6	1.00
									August 13	1.00
									August 17	1.00
									Total	12.50

Table 2.

NORTH CENTRAL MICHIGAN
Montcalm County Trial - Irrigated vs Not Irrigated

Zone 3

One, Two, and Three Year Averages - 1971, 1970, 1969

Hybrid	% Moisture			Bushels per acre						% Stalk lodging					
				1971		2 Years		3 Years		1971		2 Years		3 Years	
	1971	2 yrs	3 yrs	Irrig.	Not irrig.	Irrig.	Not irrig.	Irrig.	Not irrig.	Irrig.	Not irrig.	Irrig.	Not irrig.	Irrig.	Not irrig.
Michigan 200 (4x)	21.4	20	20	104.4	33.3	114	62	115	65	13.3	0.8	9	3	6	8
Renk NR1 (2x)	21.9	--	--	91.0	10.6	--	--	--	--	23.4	0.0	--	--	--	--
Pride R200A (2x)	22.6	23	23	123.6	30.0	135	65	--	--	15.2	0.0	11	4	--	--
Pride R221 (3x)	22.9	--	--	136.5	17.6	--	--	--	--	2.2	0.8	--	--	--	--
Michigan 275-2X (2x)	23.2	23	23	147.5	29.7	144	64	146	74	5.7	0.8	5	4	5	12
[2]Funk Bros. G4180 (2x)	23.2	--	--	139.5	34.5	--	--	--	--	10.3	2.2	--	--	--	--
Michigan 250 (4x)	23.3	23	23	136.8	23.1	138	66	134	72	12.9	3.0	11	6	9	10
Michigan 300 (4x)	23.5	23	23	152.5	24.7	144	62	--	--	4.9	2.2	5	5	--	--
Michigan 280 (4x)	23.9	23	23	153.0	26.4	149	61	149	71	7.1	2.3	7	6	5	10
[2]Cowbell SX102 (2x)	24.2	24	--	147.1	36.8	147	72	--	--	6.7	0.0	5	3	--	--
[2]Funk Bros. G4263 (3x)	24.4	--	--	155.0	34.8	--	--	--	--	4.6	0.7	--	--	--	--
[2]Mich.Exp. 67-4006 (2x)	24.4	25	--	147.0	36.1	140	67	--	--	3.8	0.0	3	1	--	--
[2]Cowbell SX002 (2x)	24.8	--	--	140.0	34.1	--	--	--	--	1.6	0.8	--	--	--	--
[2]Michigan 380-3X (3x)	24.8	24	--	142.4	35.6	141	69	--	--	11.7	2.3	10	4	--	--
[2]Mich.Exp. 67-3106 (3x)	25.0	--	--	167.1	41.4	--	--	--	--	1.5	0.0	--	--	--	--
[2]Acco UC1900 (2x)	25.0	--	--	160.6	35.8	--	--	--	--	4.5	0.0	--	--	--	--
Northrup King PX20 (2x)	25.0	24	--	157.9	21.1	152	68	--	--	2.2	0.8	4	1	--	--
Michigan 400 (4x)	25.2	25	25	142.8	25.9	140	64	147	75	10.8	0.0	6	2	5	4
Acco UC2300 (2x)	25.4	--	--	156.4	25.5	--	--	--	--	12.8	1.5	--	--	--	--
Pioneer 3911 (2x)	25.4	25	25	129.1	22.6	131	62	137	72	6.0	0.0	3	2	5	9
Mich.Exp. 67-4007 (2x)	25.4	26	--	162.0	14.0	169	63	--	--	6.5	2.3	3	1	--	--
[1]Acco UC2301 (2x)	25.5	--	--	178.6	19.1	--	--	--	--	7.9	0.8	--	--	--	--
Funk Bros. Exp. 23553 (2x)	25.6	--	--	156.1	28.0	--	--	--	--	6.8	0.0	--	--	--	--
[1]DeKalb XL15A (2x)	25.6	--	--	171.9	28.4	--	--	--	--	6.9	0.0	--	--	--	--
Michigan 396-3X (3x)	25.6	25	--	180.5	19.3	173	70	--	--	6.5	0.8	4	1	--	--

[1]Pioneer 3784 (2x)	25.8	--	--	184.0	12.2	--	--	--	--	3.6	1.6	--	--	--	--
Super Crost S19 (2x)	25.9	25	25	171.7	29.8	170	74	165	80	6.0	3.1	5	2	3	5
Blaney B-55A (3x)	26.0	--	--	158.1	19.2	--	--	--	--	9.2	1.6	--	--	--	--
DeKalb XL306 (3x)	26.0	25	26	121.5	29.6	128	60	136	65	20.6	3.1	15	6	10	12
Michigan 402-2X (2x)	26.0	25	25	177.4	26.1	160	63	161	75	12.2	1.6	7	2	7	10
Mich.Exp. 66-2025 (2x)	26.2	26	26	144.7	16.5	155	63	161	75	13.4	0.8	8	3	6	8
[2]Acco UC1901 (2x)	26.3	--	--	152.8	34.9	--	--	--	--	7.6	0.0	--	--	--	--
[2]DeKalb XL24 (2x)	26.4	26	27	152.5	36.2	154	73	152	78	5.0	0.7	4	3	3	6
Pioneer 3909 (2x)	26.4	25	--	148.9	32.5	154	67	--	--	4.7	0.8	4	3	--	--
[1]Mich.Exp. 67-2023 (2x)	26.5	27	--	199.4	30.4	197	79	--	--	10.1	0.0	5	0	--	--
[1]Mich.Exp. 67-3110 (3x)	26.6	26	26	159.4	23.6	170	74	173	84	10.2	0.8	6	2	4	9
[1]Pride R290 (2x)	26.7	26	--	185.3	20.7	182	70	--	--	9.4	0.7	6	1	--	--
P.A.G. SX76 (2x)	26.7	--	--	134.2	25.4	--	--	--	--	6.5	0.0	--	--	--	--
[1,2]Blaney B-AA (2x)	26.8	25	--	184.8	34.1	155	67	--	--	2.9	2.3	3	3	--	--
[1]Michigan 572-3X (3x)	26.9	--	--	182.6	26.2	--	--	--	--	4.4	0.8	--	--	--	--
[1]Super Crost S25 (2x)	27.2	--	--	188.9	16.6	--	--	--	--	5.0	0.8	--	--	--	--
[1]Michigan 500-2X (2x)	27.7	27	27	184.0	27.9	176	77	175	83	6.6	0.0	4	1	3	5
[1]Mich.Exp. 67-1932 (2x)	27.8	--	--	186.7	32.0	--	--	--	--	4.4	3.1	--	--	--	--
[1,2]Mich.Exp. 69-3097 (3x)	27.9	--	--	188.5	37.0	--	--	--	--	6.9	0.0	--	--	--	--
Pioneer 3773 (2x)	28.3	28	28	154.3	21.4	161	66	169	78	6.5	0.8	5	2	3	6
[1]Super Crost S27 (2x)	28.4	--	--	188.0	27.7	--	--	--	--	3.0	0.8	--	--	--	--
[1]Michigan 511-3X (3x)	28.5	--	--	208.6	28.4	--	--	--	--	2.2	0.0	--	--	--	--
[1]Blaney BX-AA (2x)	28.5	--	--	184.9	31.5	--	--	--	--	4.2	0.0	--	--	--	--
Michigan 568-3X (3x)	28.7	28	28	177.6	24.1	164	67	162	79	8.0	0.8	6	1	5	7
[1]P.A.G. SX69 (2x)	28.8	--	--	187.6	31.2	--	--	--	--	5.0	0.0	--	--	--	--
[1,2]Jacques JX162A (2x)	28.8	--	--	185.4	34.5	--	--	--	--	15.6	0.8	--	--	--	--
[1,2]Michigan 555-3X (3x)	29.0	28	28	181.3	41.9	171	81	172	88	8.1	1.5	6	2	4	6
[1,2]Funk Bros. G4444 (2x)	29.3	--	--	195.3	35.2	--	--	--	--	5.9	0.8	--	--	--	--
[1,2]Mich.Exp. 67-3124A(2x)	29.4	--	--	191.7	36.2	--	--	--	--	5.7	2.3	--	--	--	--
[1,2]Mich.Exp. 67-3124(2x)	29.6	--	--	210.5	38.0	--	--	--	--	6.0	0.0	--	--	--	--

DeKalb XL45A (2X)	29.9	--	--	167.6	30.0	--	--	--	--	9.7	0.0	--	--	--	--
Average	26.1	25	25	162.5	28.2	154	68	153	76	7.4	0.9	6	3	5	8
Range	21.4 to 29.9	20 to 28	20 to 28	91.0 to 210.5	10.6 to 41.9	114 to 197	60 to 81	114 to 175	65 to 88	1.5 to 23.4	0.0 to 3.1	2 to 15	0 to 6	3 to 10	4 to 12
Least significant difference	0.8	0.6	0.5	15.2	5.8	7	6	5	4						

1 Significantly better than average yield, irrigated, 1971
2 Significantly better than average yield, not irrigated, 1971

	1971	1970	1969
Planted	May 6	May 8	May 3
Harvested	Oct. 29	Oct. 16	Oct. 31
Soil type	Montcalm sandy loam	Montcalm sandy loam	Montcalm sandy loam
Previous crop	sorghum-sudan seeded to rye in fall	sorghum-sudan seeded to rye in fall	sorghum-sudan seeded to rye in fall
Population	20,300	19,900	19,500
Rows	30"	30"	30"
Fertilizer	160-140-140	213-160-160	205-160-160
Soil test: pH	6.0	6.3	6.2
P	340 (very high)	246 (very high)	242 (very high)
K	246 (high)	255 (high)	237 (high)
Irrigation:	12.5"	5.5"	6.0"

Farm Cooperator: Theron Comden, Lakeview
County Extension Director: James Crosby, Stanton

Table 3. Average, highest, and lowest yields and per cent stalk lodging for corn hybrids irrigated and not irrigated for four years, 1968-1971.

Year	No. of hybrids tested	Average		Highest		Lowest	
		Irrigated	Not irrigated	Irrigated	Not irrigated	Irrigated	Not irrigated
1971	56	162.5	28.2	210.5	41.9	91.0	10.6
1970	64	143.6	102.9	193.8	127.7	94.9	69.6
1969	63	146.0	85.5	184.9	108.6	96.7	56.3
1968	56	136.1	96.0	182.2	123.2	92.2	65.4
4 Year Average		147.1	78.2	192.9	100.4	93.7	50.5
		% Stalk Lodging					
1971	56	7.4	0.9	23.4	3.1	1.5	0.0
1970	64	5.8	7.1	18.3	24.4	0.0	0.0
1969	63	2.9	17.5	10.9	57.8	0.0	5.6
1968	56	1.1	4.3	5.0	13.9	0.0	0.0
4 Year Average		4.3	7.5	14.9	24.8	0.4	1.4

Irrigation:

1971 = 12.5"
June 23 = .75"
June 27 = 1.0"
July 3 = 1.0"
July 7 = .75"
July 12 = 1.0"
July 16 = 1.0"
July 23 = 1.0"
July 27 = 1.0"
Aug. 2 = 1.0"
Aug. 6 = 1.0"
Aug. 13== 1.0"
Aug. 17 = 1.0"

1970 = 5.5"
July 20 - 1"
July 27 = 1"
July 30 = .5"
Aug. 4 = 1"
Aug. 11 = 1"
Aug. 13 = 1"

1969 = 6"
July 26 = 1.5"
Aug. 8 = 1.5"
Aug. 14 = 1.5"
Aug. 27 = 1.5"

1968 = 7.5"
July 16 = 1.5"
Aug. 2 = 1.5"
Aug. 12 = 1.5"
Aug. 20 = 1.5"
Sept. 7 = 1.5"

bushels more when irrigated (192.9 vs. 100.4) and the lowest yielding hybrids averaged 43.2 bushels more (93.7 vs. 50.5). Irrigation response of the highest yielding hybrids was more than twice as great as the response of the lowest yielding hybrids, 92.5 vs. 43.2 bushels increases from irrigation.

Stalk lodging. The extreme drouth of 1971 had a reverse effect on stalk lodging compared to the previous three years. There was more stalk lodging with irrigation in 1971, 7.4% irrigated and 0.9% unirrigated. Lodging was greater on unirrigated plots in each of the three previous years.

Plant Population x Irrigation

Five hybrids at four plant populations irrigated and not irrigated were grown in each of four years 1968-1971. Yields and stalk lodging are summarized in Table 4.

Yields. Populations of 15M and 19M were about equal in yield without irrigation in 1971--36.6 and 35.3 bushels per acre. Yields at 23M and 27M decreased to 20.2 and 10.5 bushels, respectively. In the three previous years without irrigation, the 19M population produced the highest yield when moisture stress was less.

With irrigation in 1971, populations of 19M and 23M produced the highest yields (189.1 and 190.9) with lower average yields at 15M and 27M (172.9 and 180.6). In the three previous years, highest yields were attained at the 23M population with irrigation.

In the four-year averages, highest yields were reached with a population of 19M without irrigation (16.4) and with a 23M population with irrigation (178.9).

Stalk lodging. There was less stalk lodging without irrigation at all four populations than with irrigation in 1971. In the three previous years, the reverse had been true--more lodging without irrigation. Extreme drouth in 1971 drastically reduced plant size and there was a high percentage of barren plants without irrigation.

Moisture content of grain at harvest. The effect of either irrigation or plant population on grain moisture was small during the four years. Irrigated corn averaged 0.8% higher moisture. Populations of 23M and 27M averaged about .7% higher moisture than populations of 15M and 19M.

ble 4. Average yields and per cent stalk lodging at four plant populations irrigated and not irrigated for four years, 1968-1971.

ar	15,100		19,200		23,100		27,200	
	Irrigated	Not irrigated	Irrigated	Not irrigated	Irrigated	Not irrigated	Irrigated	Not irrigated
	Yields							
71	172.9	36.6	189.1	35.3	190.9	20.2	180.6	10.5
70	122.2	91.0	144.1	111.7	158.2	93.4	151.2	85.1
69	125.5	90.7	157.5	108.5	173.2	95.7	147.8	86.3
68	143.5	113.9	169.3	130.2	193.1	107.0	178.4	89.4
erage	141.0	82.8	165.0	96.4	178.9	79.1	164.5	67.8
	% Stalk Lodging							
71	6.4	1.0	7.8	0.6	10.7	0.9	10.1	1.5
70	2.9	8.0	5.8	9.1	8.4	10.6	9.4	11.5
69	2.4	18.5	2.7	23.4	3.4	28.0	5.2	34.4
68	0.6	3.3	0.4	5.1	2.7	12.1	3.4	20.4
erage	3.1	7.7	4.2	9.6	6.3	12.9	7.0	17.0

Yield Data and Summary Statement from the Miscellaneous Colored Bean Test

M. W. Adams, A. W. Saettler and Jerry Taylor
Departments of Crop and Soil Sciences and Plant Pathology

This test included 16 entries, planted June 8-10 in 2-row plots per entry, with 4 replications, and in both 28" and 21" rows. Fertilizer of analysis 5-20-20 with 2% zinc and 2% manganese was applied in the row at planting time. Eptam was applied prior to planting, and irrigation water by sprinkler as needed after flowering.

Due to planter difficulties (we aren't sure whether it was the planter shoe, or the problem of packing) only partial stands were obtained in the 21" rows. We have, therefore, data only for an insignificant number of entries at this row spacing. The yield data are given in the accompanying table. There was no blight of consequence this year.

	Strain Name or No.	Yields in Pounds/A in 28" Rows
(1)	LRK 01 (halo resistant)	1297.39
	02 (" ")	1465.57
	03 (" ")	1448.86
	DRK 021 (" ")	852.92 (1181.61)*
	023 (" ")	1264.49
	Manitou Light Red	1195.55
	Redkote Light Red	1102.05 (1324.50)
	Charlevoix Dark Red	1230.02
	Calif. Dark Red	1011.70 (1567.15)
(2)	Cranberry #026	1478.11
	" #027	1532.95
	" #028	1291.65 (1660.25)
	Michigan Improved Cranberry	1482.29 (1829.74)
(3)	Commercial Yellow Eye	1320.90
	Merithew Medium White	1301.05 (1379.60)
	Swedish Brown Bean	1320.90 (1150.35)

*Figures in parentheses are yields in 21" rows.

Discussion

1) The first objective was to compare the yield performance of the halo-blight resistant kidneys with the standards. In a year when blight was of trivial significance the yield data suggest that the experimental lines are equal to or perhaps slightly superior to the check varieties, excepting here DRK 021, which because of smaller seed size seems less promising than DRK 023.

2) The cranberry selections 026, 027, 028, are bush types with mosaic resistance, whereas Mich. Imp. is vine and susceptible to mosaic. There was no mosaic this year. The experimentals appear to be about equal in yield to the check, but they have the advantage that they do not lodge, whereas Mich. Imp. lodges badly every year. For this reason we are inclined to propose one of the bush lines for seed increase and distribution as a replacement variety of cranberry bean.

3) Among the three miscellaneous colored beans the Swedish Brown continues to perform very well. If market development is favorable for this bean in Sweden, there is no reason why we could not produce this variety profitably and safely in Michigan.

4) The few data from 21" rows suggest in the kidneys and cranberries particularly that closer row spacing, where water is available, or at least not limiting, would lead to higher yields.

LUPINE RESEARCH

H. L. Kohls
Department of Crop and Soil Sciences

Considerable progress has been made in lupine research this year in spite of two very unusual occurrences.

1. Most of the blue lupine, L. angustifolius, varieties produced very few flowers. One very early variety flowered normally and produced an excellent crop of seed, 35.37 bushels per acre. An adjacent variety produced no flowers. Other varieties produced a few flowers and little seed.

Blue lupines require vernalization to initiate flower development. Temperature records show that late April, May and early June were much cooler than the corresponding dates a year ago when flowering was excellent. Therefore high temperature was not the reason for poor flowering. The season was very dry and this may have had an influence on flower development. But we do not know the reason, at present, for the poor flowering.

2. White lupines, L. albus, grew normally and produced one cluster of flowers which produced mature seed. The plants then dried up and died without producing additional flowers. Observations showed a bad case of potato leaf hoppers, Empoasca fabae. The hoppers were controlled by spraying with carbaryl (Sevin) but too late to avoid severe loss of yield.

The season was cool and dry and thin stands resulted in most areas.

All planting was between April 20 and May 5. Preemergence chemical weed control was not as effective this year as in previous seasons and it appeared to be associated with the very dry soil.

The data from the white lupine variety trial are shown in Table 1. There are 24 varieties and only four showed any alkaloids. About 2% of the seed in these four were bitter. The bitter seed can be eliminated this winter.

Table 1. White lupine variety trial results - 1971.

Variety	Maturity	Bu Per Acre
MSU-2	Medium	16.53
51-2	Medium	17.39
51-5	Medium	17.99
46-4	Medium	17.53
46-7	Late	14.47
46-10	Late	16.05
46-12	Early	17.70
Gela X 243335 Selected for earliness	Medium	15.50*
MSU-4	Early	17.27
47-1	Medium	19.48
47-4	Medium	16.63
47-5	Early	22.12
47-8	Early	13.91
Blanca from Georgia	Late	15.44
Blanca Selected for earliness	Medium	15.75
Blanca	Medium	17.23*
44-5	Medium	17.44
49-1	Early	20.62
49-7	Early	21.11
49-9	Medium	20.76
Gela	Early	15.24*
45-7	Medium	18.44*
45-12	Medium	14.78
USSR-305	Early	16.21
L. S. D. at 5% level		3.06
C. V. =		15.70

*2-3% bitter seed.

Also, we have two varieties not shown in Table 1 that are alkaloid free. This will be a total of 26 alkaloid free varieties available for use in various combinations to increase production of very high quality grain and forage varieties. Two group combinations appear much superior to MSU-2, now released to the Michigan Seed Foundation for seed increase.

Table 2. A comparison of yields and stand between 14 and 7 inch rows.

	Average Per Acre			
Width of row	Total tons	Roughage	Bu of Grain	No. of Plants
14"	.94	.67	8.92	81,185
7"	1.21	.87	11.25	161,576
Percent increase over 14" rows	28.72	29.85	26.12	99.02

Seeding rates of 75 and 150 lb per acre were used in the 14" and 7" rows, Table 2. The yields are low but increases of 26 to nearly 30 percent was made by doubling the seeding rate from 75 to 150 lb per acre. These data are very similar to the data of a year ago when the yields were much higher.

In another trial seeding rates of 75, 100, 125, 150, and 175 lb per acre were sown in 6 replications, Table 3.

Table 3. A comparison of stand and yield from various rates of seeding.

Rate of seeding lb per acre	Bu per acre	Plants per plot
75	23.08	180,048
100	24.01	230,868
125	22.32	233,772
150	30.05	296,208
175	23.95	310,728

It appears from the data that 150 lbs per acre may be the optimum rate of seeding even though higher rates give greater population.

The non-flowering of blue lupines this year was unexpected. Nothing like this has been reported in literature, to our knowledge, from early sown seed.

One variety, Unicrop, developed in Australia by Dr. Gladstones, flowered very early and produced an excellent crop of seed of 35.37 bushels per acre. This yield was on a small single plot for seed increase and points out the very high grain yield potential of this variety. It is very low in protein, about 25 percent where the range for the species is about 25-35 percent.

Other early varieties produce fair to low seed yields but the remainder of the varieties produce very little or no seed. Dry soil seemed to be associated with non-flowering and earliness seemed to favor flower production.

The breeding of blue lupines for the production of early maturing, high yielding, low alkaloid, and non-shattering pods, has progressed satisfactorily. The crosses are now in the F_2 and F_3 generations. A few F_3 strains seem to be just what we are looking for but considerable work remains to be done before any new variety is ready for release.

SOIL FERTILITY RESEARCH ON DENT CORN, SWEET CORN, SOYBEANS, AND RED KIDNEY BEANS

M. L. Vitosh
Department of Crop and Soil Sciences

In addition to the five soil fertility experiments on potatoes, seven additional were conducted in 1971. All but one of these experiments were in the potato rotation and all plots were irrigated. Soybeans were grown in place of red kidney beans in the N carrier and N rate and time experiments. This was the first attempt to grow soybeans in this area with irrigation.

Source, Rate, and Time of Nitrogen Application on Field Corn:

This experiment involved comparisons of broadcast versus sidedress N applications and urea versus sulfur-coated urea (SCU), a slow release N material. Two hybrids (Michigan 500-2x and Michigan 396-3x) were used.

The soil at planting time was quite dry and less than 1.4 inches of rain fell during the next four weeks. The largest rain was .29 inches. Certain treatments suffered from fertilizer salt injury. Stand counts were made on three rows of all plots and varieties. The averages of plant population for three rows are shown in Table 1. Injury on one row was more noticeable than the other two. Fertilizer placement for this row was found to be closer than the recommended 1 1/2 inches to the side and 1 inch below the seed. One row was selected for harvest and thinned to 18,464 plants per acre. Although the average for the three rows for certain treatments was below 18,464 plants per acre, the row which was thinned, in all cases had plant populations of 18,464 plants per acre or greater.

Plant population decreased quite drastically with increasing rates of broadcast nitrogen. The additional banded N on these treatments created a very critical situation during this dry weather period. In order to maintain the plant population and reduce salt injury, irrigation was started immediately after stand counts were made.

Even though it was a very dry season, excellent yields were obtained with 5.7 inches of irrigation water. The best yield was 180 bu/A obtained with Michigan 500-2x and 240 lb N/A. Sidedress N again appears to be slightly better than broadcast N.

Sulfur-coated urea did not increase the efficiency of nitrogen use above that of comparable treatments. Yields were similar where equal rates of N were applied.

Leaf samples were taken from the leaf opposite the ear at initial silking. Samples were obtained from Michigan 396-3x but not Michigan 500-2x. Nitrogen content increased with the first few increments of N fertilizer. Although the values were not significantly different, samples from the two SCU plots were slightly lower. All values, including the 2.9% N value for the no N treatments are considered to be in the sufficiency range.

Potassium-Magnesium Study with Field Corn:

This experiment involved various rates of K fertilizer with and without Mg at two plant populations. Stand counts were made three weeks after emergence. It was obvious that increasing rates of broadcast potassium resulted in decreased plant population (Table 2). One row was more severely affected than the other two rows because of improper fertilizer placement. One good row, however, was selected from the low and high plant population levels and thinned to 15,290 or 18,646 plants per acre, respectively. Irrigation water was immediately applied following the stand counts to reduce salt injury.

Although the amounts of fertilizer applied in the band were not excessive, considerable injury was observed. Proper placement appears to be especially important on sandy soils in dry years. Likewise, large broadcast applications of N and K plowed down prior to planting may also cause considerable salt injury if soil moisture is in short supply.

Yields were increased with the first 50 pounds of banded K_2O/A (Table 3). Increases beyond this level were not significant at low plant population. However, two treatments with more than 50 lb K_2O/A produced significantly better yields at the high plant population level. Yields beyond the 100 lb K_2O/A level were not significant.

Leaf analysis shown in Table 3 indicates that zinc was the only element significantly affected by the K-Mg treatments. Several trends, however, are present. As the K content of leaf tissue increases, Ca and Mg content decreases. Similar observations have been observed with potatoes. Zinc appears to have been increased by the highest rate of K (Treatment No. 6).

Potassium-Magnesium Study With Sweet Corn:

The K-Mg treatments had no affect on yields in 1971 (Table 4). The two-year average (1970-1971) indicates a slight yield response to 20 lbs K_2O/A. Twenty pounds of K_2O/A with Mg appears to be slightly better than the same rate of K without Mg. However, the average overall Mg treatments represents only a 2 cwt/A increase over the average of comparable treatments.

Nitrogen Carrier Study With Sweet Corn and Soybeans:

No significant yield increases were obtained for these experiments in 1971 (Tables 5 and 6). A four-year average for sweet corn tends to favor urea and anhydrous ammonia. Calcium nitrate continues to result in the lowest yields. These same trends have been observed with potatoes.

Residual Nitrogen Study With Soybeans:

The plots in this experiment received no N in 1971. The objective was to evaluate any residual or carry-over N from the treatments on potatoes in 1970.

Results of this experiment (Table 7) indicate no residual effect from the N treatment applied in 1970. Soybeans in the N carrier study out-yielded this experiment by 6-8 bushels. Similar results have been observed in 1968, 1969, and 1970, with red kidney beans. Nitrogen response with beans has not been uncommon in this part of Michigan. Nitrogen fixing bacteria cannot supply all the N needed by the beans.

Zinc-Phosphorus Study With Red Kidney Beans:

In 1969, a significant reduction in yields of red kidney beans was observed with 5 pounds Zn per acre banded annually for three years. A positive response at this location has not been observed on potatoes, sweet corn, or red kidney beans since 1967. The question of zinc toxicity became apparent in 1970. These experiments have been continued with the intent of further evaluating zinc toxicity. In 1970, a different treatment (50 lbs of broadcast Zn applied in 1967) caused a significant yield reduction of pea beans.

The results of this experiment are shown in Table 8. Although the yields were not significantly different, the no zinc treatment gave highest yields. The lowest yields were obtained at the low P level where zinc was broadcast in 1968. The four-year average (1968-1971) indicates a 2-3 bushel decrease with zinc treatments.

Zinc content of whole plant samples show the increase in zinc content with the various zinc materials. Three annual applications of 5 pounds of Zn/A as zinc sulfate gave the highest concentration of zinc in plant tissues. Phosphorus levels had little effect on the concentration of zinc in plants. The application of zinc on acid sandy soils without regard to a zinc soil test is not recommended.

Table 1. Effect of rate, source and time of nitrogen application on yield, percent N in leaf tissue and plant population of two irrigated corn hybrids.

Nitrogen Application (a)				Mich. 500-2x		Mich. 396-3x			Average Effects	
Broadcast	Banded	Sidedressed	Total N	Yield (Bu/A)	Plant Population (b) (Plants/A)	Yield (Bu/A)	Plant Population (b) (Plants/Acre)	Leaf Analysis (% N)	Yield (Bu/A)	Plant Population (b) (Plants/A)
	lb N/A									
0	0	0	0	111	22,686	77	23,058	2.9	94	22,862
60 SCU	0	0	60	142	22,717	124	22,779	3.4	133	22,748
60 U	60 U	0	120	160	19,640	151	21,038	3.8	155	20,339
120 U	60 U	0	180	167	18,242	167	19,485	3.5	167	18,863
180 U	60 U	0	240	164	16,999	173	19,764	3.7	169	18,381
60 SCU	60 U	0	120	160	18,801	161	21,380	3.7	161	20,090
0	60 U	60 U	120	165	18,895	158	20,386	3.7	161	19,640
0	60 U	120 U	180	168	18,273	158	19,454	3.7	163	18,863
0	60 U	180 U	240	180	18,957	165	20,138	3.7	173	19,457
120 SCU	60 U	0	180	159	18,460	173	19,578	3.2	166	19,019
LSD (.05)	treatments		---	---	---	---	---	---	10	1,300
LSD (.05)	treatments within varieties			13	1,444	13	1,569	NS	---	---
LSD (.05)	varieties within treatments			11	---	11	---	---	---	---

(a)Broadcast urea (U) and sulfur-coated urea (SCU) was applied and plowed down one day before planting. Banded urea was applied at planting time 1½ inch to side and 1 inch below the seed. Sidedressed urea was topdressed June 21, 1971.

(b)Plant population 3 weeks after emergence before thinning to 18,646 plants per acre.

Planted: May 4, 1971. Harvested: October 26, 1971
Plant Population: 18,646. Row Spacing: 28 inches
Basic Fertilizer: 0-50-100 banded at planting time.
Irrigation: 5.7 inches. Harvest Area: 116 sq. ft.
Soil Tests: pH = 6.7, P = 186, K = 274

Previous crop: Red kidney beans

Table 2. Effect of potassium and magnesium on yield and plant population of 500-2X corn hybrid under irrigation.

Potassium-Magnesium Applications (a)				15,290		18,646		Average Effects	
Broad-cast	Band-ed	Broad-cast	Total K20	Yield (Bu/A)	Plant population before thinning(b)	Yield (Bu/A)	Plant population before thinning(b)	Yield (Bu/A)	Plant population before thinning(b)
lb K_2O/A		lb Mg/A							
0	0	0	0	124	17,496	131	20,884	128	19,190
0	50	0	50	148	14,824	158	20,448	153	17,636
50	50	0	100	146	15,227	158	21,039	152	18,133
100	50	0	150	143	14,016	172	20,759	158	17,388
150	50	0	200	147	14,233	165	20,107	156	17,170
250	50	0	300	158	13,922	159	19,734	159	16,828
0	50	50	50	136	14,917	156	20,821	146	17,869
50	50	50	100	147	14,886	165	19,516	156	17,201
150	50	50	200	160	13,886	169	20,542	164	17,214
250	50	50	300	154	14,171	173	20,169	164	17,160
LSD (.05) treatments				---	---	---	---	11	1,000
LSD (.05) treatments within plant population				15	1,025	15	1,589	--	---
LSD (.05) plant population within treatment				14	---	14	---	--	---

(a) Broadcast potassium and magnesium were applied and plowed down 5 days prior to planting. Banded potassium was applied 1½ inches to side and 1 inch below seed at planting time. Potassium and magnesium sources were KCl and $MgSo_4$.

(b) Plant population 3 weeks after emergence before thinning to 15,280 and 18,646 plants per acre.

Planting: May 4, 1971 Harvest: October 29, 1971
Row Spacing: 28 inches Harvest area: 116 sq. ft.
Basic Fertilizer: 50-50-0 banded, 180 N sidedressed June 21, 1971
Irrigation: 5.7 inches Soil test: pH = 6.9, P = 205, K range = 104-220, Mg = 200
Previous crop: Potatoes

Table 3. Effect of rate of potassium and magnesium on elemental composition of corn leaves for Michigan 500-2X (18,646 Plants/A)

Trt. #(a)	Elements							
	N	P	K	Ca	Mg	Zn	Mn	Cu
		%				ppm		
1	Not Determined	.27	1.26	.94	.65	36	80	20
2		.27	1.46	.84	.49	34	76	21
3		.27	1.14	.84	.60	32	62	21
4		.27	1.40	.76	.42	31	70	20
5		.26	1.58	.68	.31	37	81	20
6		.28	1.62	.73	.36	51	81	21
7		.28	1.45	.79	.50	37	94	20
8		.27	1.57	.74	.40	39	88	20
9		.25	1.53	.72	.38	43	102	19
10		.27	1.51	.71	.41	34	63	20
LSD (.05)		NS	NS	NS	NS	11	NS	NS

(a) Treatments are the same as the previous table.

(b) Other elements which were not significantly affected by the treatments in this experiment: Fe, B and Al.

Table 4. Effect of potassium and magnesium on yield of irrigated sweet corn.

Potassium-Magnesium Applications(a)				Sweet Corn Yield (cwt/A)		
Broad-cast	Band-ed	Broad-cast	Total K_2O	1971	1970-71	Average
lb K_2O/A		lb Mg/A				
0	0	0	0	80	116	
0	20	0	20	89	122	
0	40	0	40	92	128	
0	60	0	60	94	124	
0	80	0	80	86	119	
120	40	0	160	94	122	
0	20	50	20	101	132	
0	40	50	40	99	126	
0	60	50	60	90	121	
0	80	50	80	83	118	
LSD (.05)				NS	---	

(a) Banded potassium was placed 1½ inches to side and 1 inch below seed at planting. Broadcast potassium and magnesium were applied and plowed down prior to planting. Potassium and magnesium sources were KCl and Mg SO_4.

Planted: May 27, 1971
Row Spacing: 28 inches
Basic Fertilizer: 60-50-0 banded, 120 lb N/A sidedressed June 21, 1971
Harvest Area: 233 sq. ft.
Soil Tests: pH = 6.6, P = 155, K = 220
Harvested: August 10, 1971
Plant Population: 18,000
Irrigation: 4.5 inches
Previous Crop: Corn

Table 5. Effect of source of nitrogen on yield of irrigated sweet corn.

Source of Nitrogen	Sweet Corn Yield (cwt/A)	
	1971	1968-71 Average
Ammonium Sulfate (a)	105	116
Ammonium Nitrate (a)	111	115
Calcium Nitrate (a)	102	110
Urea (a)	111	121
Anhydrous Ammonia (b)	114	124
LSD (.05)	NS	--

(a) 140 lb N/A topdressed May 18, 1971
(b) 140 lb N/A sidedressed May 18, 1971

Planted: May 27, 1971
Row Spacing: 28 inches
Harvest Area: 233 sq. ft.
Basic Fertilizer: 10-50-100 banded at planting time
Soil Tests: pH = 6.5, P = 201, K = 265
Harvested: August 10, 1971
Plant Population: 18,000
Irrigation: 4.5 inches
Previous Crop: Red kidney beans

Table 6. Effect of source of nitrogen on yield of irrigated soybeans.

Source of Nitrogen (a)	Yield (Bu/A)
Ammonium Sulfate	26
Ammonium Nitrate	26
Calcium Nitrate	27
Urea	27
Anhydrous Ammonia	29
LSD (.05)	NS

(a) 60 lbs N/A applied 10 days prior to plowing and planting

Planted: May 27, 1971
Row Spacing: 28 inches
Harvest Area: 349 sq. ft.
Basic Fertilizer: 0-50-50 banded at planting time
Harvested: October 20, 1971
Seeding rate: 60 lb/A
Irrigation: 3.9 inches
Previous crop: Potatoes

Table 7. Effects of residual nitrogen on yield of irrigated soybeans.

lb N/A (a)	Yield (Bu/A)
0	20
120	21
180	21
240	23
300	20
LSD (.05) Treatments	NS

(a) Applied as urea in 1970

Planted: May 27, 1971
Row Spacing: 28 inches
Harvest Area: 349 sq. ft.
Basic Fertilizer: 0-50-50 banded at planting time
Soil Tests: pH=7.0, P=216, K=162
Harvested: October 20, 1971
Seeding Rate: 60 lb/A
Irrigation: 3.9 inches
Previous crop: potatoes

Table 8. Effect of zinc on yield and Zn content of plant tissue of irrigated kidney beans at two phosphorus levels.

Treatment (lb Zn/A)	Low P(a)		High P(b)		Average Effects	
	(cwt/A)	(PPM Zn)	(cwt/A)	(PPM Zn)	(cwt/A)	(PPM Zn)
None	43	31	44	29	43	30
25 lb ($ZnSO_4$)(c)	36	37	44	36	40	36
50 lb (AZCo C100)(c)	36	39	44	49	40	40
5 lb (AZCo 12)(d)	41	49	42	38	42	43
5 lb ($ZnSO_4$)(d)	40	51	42	53	41	52
P Level (average)	39	41	43	41	--	--
LSD (.05) Treatments	--	--	--	--	NS	7
LSD (.05) P Levels	Yield = NS		PPM Zn = NS			
LSD (.05) Treatments within P Levels	NS	10	NS	10	--	--
LSD (.05) P Levels within Treatments	NS	5	NS	5	--	--

(a) Low P = 22 lb P/A banded 1971.
(b) High P = 300 lb P/A broadcast 1968 and 1971 + 22 lb P/A banded 1968, 69 & 71
(c) Zinc broadcast in 1968.
(d) Banded annually 1968, 69 and 71.

Planted: June 4, 1971 Harvested: Sept. 17, 1971
Harvest Area: 233 sq. ft. Row Spacing: 28 inches
Plant Spacing: 4 inches Irrigation:
Previous Crop: Red clover Basic Fertilizer: 50-50-50
Soil Test: pH = 6.5, P range = 437 to 305, K = 220, Zn range = 3.0 to 12.9

Preplant Incorporated and Preemergence Herbicide Combinations for Weed Control in Navy Beans

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Gratiot navy beans were planted and treated June 14 on a McBride sandy loam (2.0% organic matter). The design of the experiment was a randomized block with three replications. Rainfall was .89 inches within 10 days after application and planting.

The weeds present were lambsquarter (Chenopodium album), pigweed (Amaranthus retroflexus) and barnyardgrass (Echinochloa crusgalli). The plots were visually rated July 15.

Two herbicides, EPTC, 2 lb/A and trifluralin, 1/2 lb/A, were preplant incorporated, then chloromben, 2 lb/A, fluorodifen, 3 lb/A, dinoseb + chloramben (2:1) 1 gal/A and dinoseb, 3 lb/A, were applied preemergence in combination with the preplant treatments. EPTC, 2 lb/A, in combination with the preemergence treatments controlled 96-100% of the total weed population, with the exception of chloramben, 2 lb/A, which controlled 73% of the ragweed population. Trifluralin, 1/2 lb/A, in combination with the preemergence treatments did not give more than 73% control of any of the three weed species.

The preemergence treatments when applied alone did not give complete control of the two broadleaf species and no control of barnyardgrass. Under these soil and weather conditions it was possible to obtain increased weed control at lower herbicide rates with preplant-preemergence combinations.

Preplant Incorporated and Preemergence Weed Control Evaluations in Navy Beans. Montcalm Co., 1971.

Planted: June 14, 1971 Treated: June 14, 1971
Rated: July 15, 1971

Weeds Present: pigweed, lambsquarter, barnyardgrass

Soil Type and Organic Matter: McBride sandy loam, 1.5%

Trmt.	Preplant Inc.		Preemergence			Weed Control Rating		
No.	Trmt.	Rate lb/A	Trmt.	Rate lb/A	Injury	Pigweed	Lambsquarter	Barnyard-grass
1	Eptam	3			0.0	9.3	9.6	10.0
2	Treflan	3/4			0.0	5.3	9.3	4.6
3	Eptam+Treflan	2+1/2			0.0	9.3	10.0	10.0
4	Lasso	2			0.0	9.6	9.0	7.3
5	USB-3584	1/3			0.0	3.0	9.0	1.0
6	USB-3584	2/3			0.0	6.6	9.3	7.3
7	USB-3584	1 1/3			2.3	7.0	10.0	7.6
8	No treatment	---			0.0	0.0	0.0	0.0
9a	Eptam	2	Amiben	2	0.0	7.3	10.0	10.0
10a	"	"	Preforan	3	0.0	10.0	10.0	10.0
11a	"	"	Dynoram	1 gal	0.0	10.0	10.0	10.0
12a	"	"	DNBP	3	0.0	9.6	10.0	10.0
9b	Treflan	1/2	Amiben	2	0.0	5.0	6.3	3.3
10b	"	"	Preforan	3	0.0	9.0	1.3	3.0
11b	"	"	Dynoram	1 gal	0.0	6.3	7.3	1.6
12b	"	"	DNBP	3	0.0	5.3	7.3	0.0

Continued.

Trmt. No.	Preplant Inc. Trmt.	Rate lb/A	Preemergence Trmt.	Rate lb/A	Injury	Weed Control Rating Pig-weed	Lambs-quarter	Barnyard-grass
9c	No trmt.	---	Amiben	2	0.0	0.6	1.6	1.0
10c	"	---	Preforan	3	0.0	7.0	0.0	0.0
11c	"	---	Dynoram	1 gal	0.0	2.6	10.0	0.0
12c	"	---	DNBP	3	0.0	2.3	10.0	0.0
13	-----	---	Preforan+Lasso	2+1 1/2	0.0	10.0	0.0	2.0
14	-----	---	Lasso+Amiben	1 1/2+1 1/2	0.0	4.6	0.0	3.6
15	-----	---	Eptam+11E	3 + 1 gal	0.0	0.0	0.0	0.0

0 - no injury and no control; 10 - complete control or kill