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1969

MONTCALM EXPERIMENTAL FARM RESEARCH REPORT

MICHIGAN STATE UNIVERSITY

Agricultural Experiment Station

East Lansing, Michigan

ACKNOWLEDGMENTS

Research personnel working at the Montcalm Experimental Farm have received much assistance in many ways. A special thank you is owed to those 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, owner of the experimental farm for his cooperation and assistance in performing many personal services.

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Montcalm Experimental Farm Research Report - 1969

by

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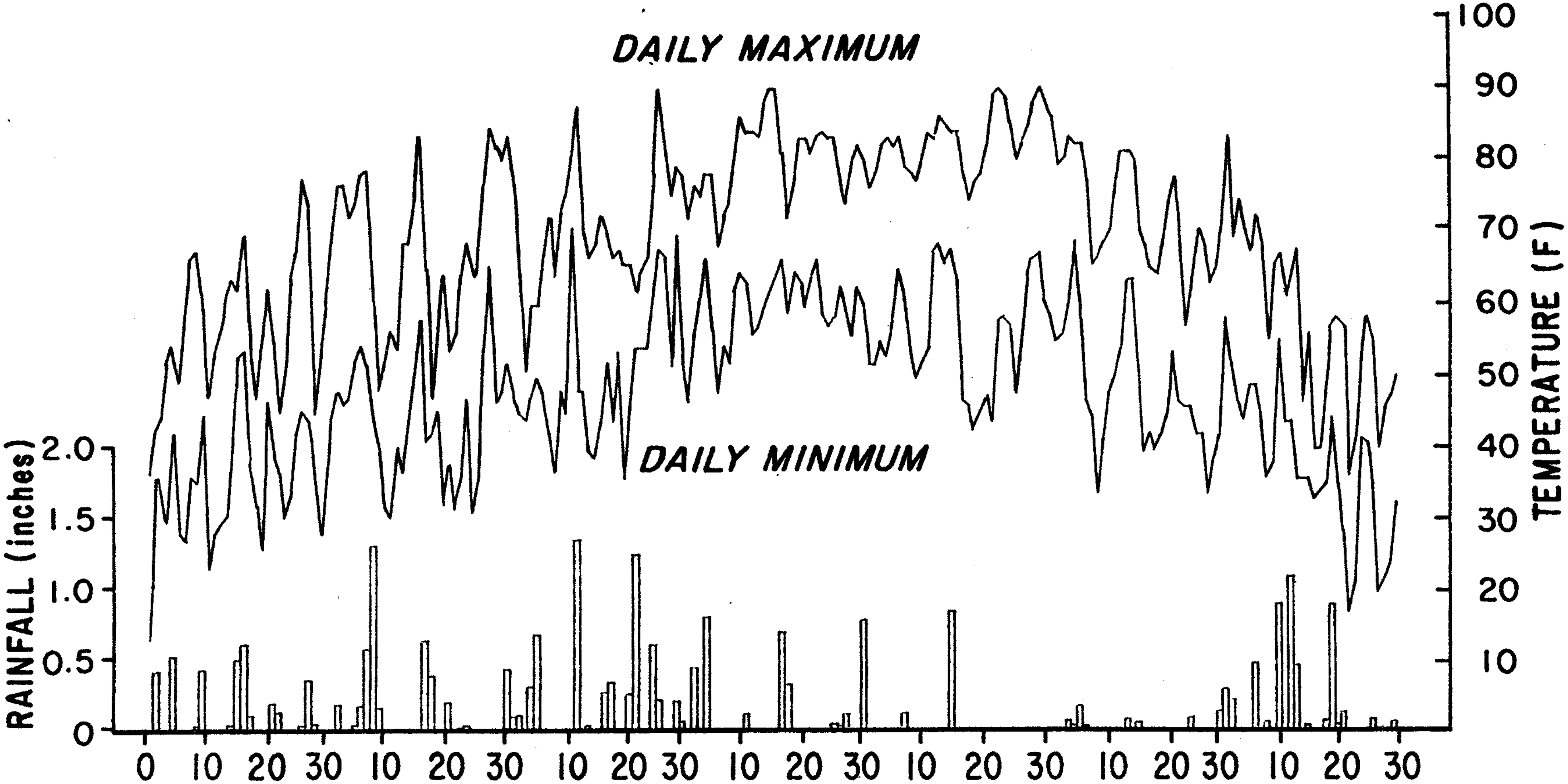
INTRODUCTION

The Montcalm Experimental Farm was first established in 1966 with the first experiments being conducted in 1967. The farm is owned by 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 center of the largest potato production area in Michigan. Crops commonly used in the potato rotation and other high value cash crops are also being investigated at this experimental farm.

This research report is the first attempt to coordinate all of the research being conducted at the Montcalm Experimental Farm into a single report. The purpose of this report is to make available the results of the 1969 experiments. Much of the data is incomplete and should serve mainly as a progress report. It should be emphasized that the results presented here represent only one year's data and that before any definite conclusions can be drawn several years of data would be desirable.

Weather conditions at the Montcalm Experimental Farm for 1969 were quite similar to 1968. Daily temperatures and rainfall were recorded and are shown graphically in Figure 1. Total rainfall during the period of April through October amounted to 23.3 inches. Above normal rainfall was observed in June and October. August was a very dry month with only .58 inches of precipitation being recorded. Irrigation during this critical month was very beneficial. The maximum temperature recorded in 1969 was 90^{o}F which occurred on five different days during the summer. In 1968 there were six days with temperatures of 90^{o}F or higher.



	APRIL	MAY	JUNE	JULY	AUGUST	SEPT.	OCTOBER
AVERAGE MONTHLY TEMP.	Max. 56°	67°	70°	80°	82°	73°	58°
	Min. 35°	43°	50°	59°	56°	49°	38°
RAINFALL	3.33 inches	3.65 inches	6.18 inches	2.63 inches	1.79 inches	.58 inches	5.15 inches

Crop Management and Cultural Studies of Potatoes at the Montcalm Experimental Farm - 1969

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Introduction

Many of the potato crop management studies conducted at the Montcalm Experimental Farm have been designed to obtain answers to problems of current concern and interest to the Michigan potato industry. The 1969 projects were concerned with variety evaluations, seed type and spacings, crop maturity as it relates to subsequent seed quality, and the effects of Ethrel on potato production.

1. Effect of time of sidedressing on yield, specific gravity and chip quality of several new chipping varieties. (Incomplete Data)

Varieties evaluated:

Haig
Jewel
Katahdin
Kennebec
Lenape
Merrimack
Norchip
709
Superior

Planted: May 2, 1969 Harvested: Sept. 11-12,1969
Fertility: Plow down 120 lbs. K_2O, 50 lbs. N
Planter 800 lbs/A 12-12-12

Sidedress treatments:
1. check - no sidedress
2. 40 lbs N June 10
3. 80 lbs N "
4. 80 lbs N June 18
5. 120 lbs N "
6. 40 lbs N June 10 + 40 lbs N June 18

Results:

Table 1. The yield of several potato varieties in response to different sidedressing treatments. Cwt/A, 1 7/8 minimum size.

	Katahdin	Superior	Haig	Norchip	Kennebec	MSU-709	Jewel	Merrimack	Lenape
1. Check	308	243	189	271	309	403	275	241	265
2. 40 lbs June 10	339	280	241	277	342	345	309	209	332
3. 80 lbs June 10	345	280	273	265	359	387	325	231	311
4. 80 lbs. June 18	329	270	250	277	395	426	353	225	330
5. 120 lbs. "	345	280	219	304	368	327	306	216	350
6. 40 lbs. June 10 + 40 lbs. June 18	345	267	267	280	327	371	325	254	304
Variety Average:	339	270	240	281	350	377	319	229	315
Ave. Spec. Gravity	1.069	1.071	1.064	1.077	1.074	1.073	1.084	1.086	1.093

Discussion

Samples from each variety and each treatment have been placed in storage at both 55°F and at 40°F to determine chip quality at varying intervals after storage. Reconditioning ability will also be determined.

The length of the growing season from planting to harvest was 132 days and supplemental irrigation was used to maintain adequate soil moisture levels.

Following is a brief comment on each variety:

Katahdin - The 40 lbs. N sidedressed early resulted in a substantial yield increase over the check plot. There was only a slight increase with the 80 or 120 lb. rate. The split application was equal to 80 lbs. N applied early. The lowest specific gravity occurred at the 120 lb. rate with a 1.067 compared to a 1.072 at the 80 lb N applied early.

Superior - Similar yield response to Katahdin.

Haig - The Haig variety showed a moderately high degree of "leaf speckle" which was most severe on the check plot. There was a very marked response to both the 40 and 80 lb. N applied early. It appears from these data that the Haig variety has a very heavy requirement for supplemental N early in its growth and development. Under the 1969 conditions a delay in this application even with higher rates did not give a yield increase over the early applications. There appeared to be no benefit from a split application of 40 lbs N applied twice over 80 lbs. applied early.

Norchip - This variety did not respond to the 40 or 80 lbs N applied either early, late or in split applications, but did produce 33 cwt/A more at the 120 lb N rate than did the check treatment.

Kennebec - This variety did respond to additions of supplemental N up to 80 lbs. The 120 lb N resulted in the lowest specific gravity at 1.072.

MSU-709 - This seedling was erratic in its yield response, yet it was the highest yielding variety in this trial. Further studies will be needed to determine its nitrogen requirements. The tubers were very uniform in shape and had a very low percentage of tubers less than 1 7/8" diameter.

Jewel - This is a new variety obtained from New York and one which exhibited several desirable features. Throughout the growing season it showed the most vigorous vine growth with a characteristic erect, sturdy and open-type of vine which could be desirable from the standpoint of efficient light utilization and as a desirable factor from a disease standpoint.

Merrimack - This variety did not respond to supplemental N. This is the latest maturing variety in the trial and at the time of harvest it was still actively growing so perhaps the full effect of any sidedress treatments had not materialized.

Lenape - This is a variety developed by Penn. State and the U.S.D.A. and had the highest specific gravity in this trial.

The comments mentioned above reflect only the yield and specific gravity response under the 1969 growing conditions. The effect on chip quality is equally as important and this data is not yet recorded. It is planned that these studies will be continued again in 1970.

2. Effect of the use of "Ethrel" on potatoes. (Preliminary data only)

"Ethrel", produced by Amchem Products, Inc. is the name for 2-chloroethylphosphonic acid. The material releases ethylene directly to plant tissue which has certain physiological effects regulating plant development. This study was strictly exploratory to determine what effects, if any, it may have on potatoes and plant development. Preliminary studies two years ago suggested it may have some effect on tuber set and subsequent yields and this study was an effort to pursue this further.

Variety: Sebago   Planted: May 13, 1969

Fertilization: Plow down 50 lbs N + 120 lbs. K_2O
Planter 800 lbs 12-12-12
Sidedress 80 lbs N

Treatments: (knapsack sprayer at 35 gallons water/A. No surfactant)

		Cwt/A	Specific Gravity
1.	Check - no Ethrel applied	322	1.070
2.	8 oz. July 1	349	1.067
3.	4 oz. "	339	1.065
4.	2 oz. "	398	1.066
5.	1 oz. "	364	1.065
6.	1 oz. July 1 + 1 oz. July 12	352	1.070
7.	2 oz. " + 2 oz. "	311	1.062
8.	1 oz. July 12	460	1.067
9.	2 oz. "	364	1.065
10.	4 oz. July 12	426	1.065

Discussion

First treatments were applied on July 1 when the plants were 15-18 inches tall; stolons averaged 6-8 inches; and tubers were just beginning to form with the largest up to 1/2 inch diameter. The plants were in early to full bud with no open blossoms. The second applications were applied on July 12.

It is apparent that the results are very erratic and do not follow any specific pattern. There was no phytotoxic reaction noted at any of the rates used. Coupled with the variability between treatments there was a similar and very marked variability between plots within certain treatments. Individual plot yield ranged from a low of 275 cwt/A to a high of 614 cwt/A.

Based on these data, plus the observations from the preliminary study two years ago, there is some indication that ethylene may have some effect on certain physiological activities, however, the precise dosage and time of application is uncertain at this time.

3. Russet Burbank Seed Size and Plant Spacings

There have been varying opinions regarding the comparative advantage of different seed types of the Russet Burbank variety and their effect on subsequent yields. This study was designed to compare different seed types with the added variable of different plant spacings.

Variety: Russet Burbank Planted: May 6, 1969

Fertility: Plow down 50 lbs N + 120 lbs K_2O
Planter 800 lbs 12-12-12
Sidedress 80 lbs N

Treatments:

	Seed Type	Plant Spacing
1.	whole seed	8 inches
2.	" "	12 inches
3.	" "	16 "
4.	" "	20 "
5.	split seed 1/	12 "
6.	" "	16 "
7.	cut seed 2/	12 "
8.	" "	16 inches

1/ Split seed represents whole tubers from 2-2 1/4 inch diameter, each of which was split from stem end to apical end.

2/ Cut seed represents larger tubers which were cut into 3 or more seed pieces.

Results:

Table 1. The total yields and grade percentage of Russet Burbanks grown from different seed types and spacings.

Treatment	Total Cwt/A	Greater than 1 7/8"	Less than 1 7/8"	Off-type
whole seed 8"	340	74.4	17.4	8.2
whole seed 12"	306	78.5	15.0	6.5
whole seed 16"	290	81.8	14.1	4.1
whole seed 20"	212	84.9	8.6	6.5
split seed 12"	313	85.3	10.2	4.5
split seed 16"	285	88.0	8.1	3.9
cut seed 12"	291	84.5	10.0	5.5
cut seed 16"	274	84.0	6.2	9.8

Discussion:

It is apparent from these data that the higher yields occurred with the closer plant spacings, however, as one would expect, the greater percentage of "B" size tubers also occurred with these spacings. It is possible that fertility was not adequate to provide sufficient nutrients for the higher plant populations. It is planned to continue this study under varying nitrogen levels to evaluate the plant population and nutrition relationship.

4. Effect of harvest date on subsequent seed quality.

This study was initiated in 1969 so no data is yet available. The objective of this study is to determine the relationship between the maturity, date of harvest and subsequent handling on seed quality. This study is being conducted with the Onaway and the Sebago and consists of five different dates of harvest. The seed is being stored at 40F and the respective weight losses will be determined. The seed from each treatment will be planted in 1970 and its yield potential will be determined.

Potato Variety Studies at the Montcalm Experimental Farm - 1969

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Seedling Populations

Fifty-seven advanced seeding clones were planted in replicated increase plots for yield and quality evaluations. A small collection (46) diploid-haploid hybrids was maintained for further genetic studies at the diploid level. Four hundred and sixty-one selected progenies from the genetic study of dormancy and chipping quality were increased for evaluation as varieties with a potential for the April to July potato chip market. These will be examined at monthly intervals through the storage season.

Overstate Yield and Quality Trial

New varieties and advanced seedling clones from the Michigan State University breeding program were combined in the overstate trials. The favorable growing season resulted in good yields of quality potatoes. Winter tests for storage and cooking quality-chips, french fries, boiling, etc. will complete the evaluation. Only a few of the named varieties appear sufficiently adapted to the Michigan environment to be considered as replacement for the varieties now grown. However, special characteristics such as chip quality and disease resistance, etc. could make others valuable in specific areas. Yield specific gravity and chip data are presented in Table 1.

North Central Regional Trials

Fourteen entries from eight states were compared with three standard varieties. This uniform test in 12 states provide a range of environment for rapid evaluation of promising seedlings. (Table II).

A Potential Variety

MS 709 is a selection from the 1957 cross IA 902-3 X Ia 872-4. It was first grown in the greenhouse in 1958 and in the field in 1959. Its ability to produce high yields of marketable tubers was recognized early and was rapidly increased. In 1965 an acre was grown for observation by the Variety Evaluation Committee of the Michigan Potato Industry Council. MS 709 was recommended for increase.

Selection of disease free seed of MS 709 was initiated in 1966 and climaxed in 1969 with 250 cwt. of seed for distribution or additional testing.

MS 709 is a mid-season variety that produces high yields of smooth thick oval tubers with shallow eyes. It sizes practically all tubers set with less than 5% "B" size. It makes good potato chips at time of harvest. Approximately one-half acre produced approximately 190 cwt. in 1969. These were processed in Lansing and were very acceptable to the chip company.

This variety will be recommended for the early Michigan market areas. It will provide an August chipping potato as well as an attractive sample for the tablestock market.

TABLE I

Overstate Yield Trials

Montcalm County 1969

Planted: May Harvested: October

Variety	Cwt/Acre Total	US#1	%	Specific Gravity	Chip Rating 60° November 20 1 white 10 very dark
MS 706-34	481	437	90.8	1.075	7
Norchief	478	411	86.0	1.076	4
MS 735-1	466	429	92.1	1.085	5
Emmet	441	391	88.7	1.078	4
Lenape	439	397	90.4	1.097	3
MS 711-8	433	372	85.9	1.072	7
MS 709	431	422	97.9	1.079	7
Peconic	429	364	84.8	1.083	2
Onaway	400	360	90.0	1.069	8
MS 503	387	347	89.6	1.078	5
Wyred	385	351	91.2	1.069	7
Kennebec	383	345	90.1	1.077	6
Katahdin	377	341	90.4	1.072	4
Sebago	377	323	85.6	1.073	6
MS 647-65	375	333	88.8	1.082	3
MS 706-32	360	320	88.9	1.072	7
MS 506	358	268	74.8	1.078	6
Wauseon	350	300	85.7	1.074	3
MS 706-1	350	277	79.0	1.077	6
Jewel	347	329	94.8	1.089	2
MS 711-3	341	287	84.1	1.085	4
Ia 1111-2	333	298	89.4	1.069	6
Alamo	331	287	86.7	1.064	7
Monona	325	271	83.3	1.070	2
MS 58	316	270	85.4	1.082	4
Merrimack	308	279	90.6	1.089	5
Norchip	300	246	82.0	1.077	3
Haig	300	231	77.0	1.069	4
Superior	295	260	88.1	1.070	4
Platte	293	244	83.2	1.066	3
Minn 148	291	262	90.0	1.066	6
MS 321-38	289	200	69.2	1.087	4
Bake King	287	246	85.7	1.083	7
MS 646-30	285	216	75.8	1.083	4
Hi Plain	283	248	87.6	1.076	4

TABLE II SUMMARY SHEET

Variety	Ave. Mat.	Most Representative Scab Area Type	Ave. Yield	Ave. Yield US #1	Ave. Percent US #1	Ave. Total Solids	Total Solids Per Acre	Gen.* Merit Rating	General Notes
		A-T	cwt/A	cwt/A	%	%	lbs.		
Early to medium early									
ND 6948-14R	2	2-1	420	378	90	15.6	6552	2	smooth uniform
La 12-157	3	0-0	217	177	80	15.8	4229		deep apical end
Norland	2	0-0	309	286	92	16.0	4944		smooth poor color
Cobbler	2	1-4	384	326	84	17.3	6643		long smooth type
MS 709	2.5	0-0	472	461	97	19.4	9157	1	smooth uniform
Medium to late									
I 6413	2	0-0	403	392	97	17.7	7133	5	smooth some air chec
B 5400-8	2.5	2-3	284	238	83	19.9	5652		smooth small run
B 5415-6	4.0	0-0	438	426	97	18.0	7884	4	flat type
B 5960-13			seed	not	received				
Wisc 664	3.25	0-0	384	349	90	20.5	7642		very deep eyes
Minn 140	2.5	0-0	194	146	75	20.7	4016		smooth, small
Minn 172	3.0	0-0	275	253	92	15.6	4290		rough skin
Neb 16.55-1	3		376	409	91	18.2	7444		flat deep apex
Neb 48.57-3	3.5	3-1	474	434	91	20.1	9527		red brown rough ski
Neb 91.57-18	3.25	1-4	372	394	94	17.5	6895		flat deep eyes
ND 5761-5	3	1-3	323	271	83	19.2	6202		deep apex
ND 6993-13	3.25	0-0	271	217	80	18.8	5095	3	good russet, long
Red Pontiac	4.5	1-4	465	428	92	16.7	7765		poor color
Average			356.5	328.5	88.7	18.0	6533.5		

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

Soil Fertility Research on Potatoes at the Montcalm Experimental Farm - 1969

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Description of Experimental Area

The Montcalm experimental area is composed primarily of two soil types -- Montcalm and McBride sandy loam. The soil on which all of the fertility experiments were conducted has been classified as McBride sandy loam. Average soil test values for the surface soil before the experiments were initiated in 1967 and 1968 are shown in Table 1. A crop rotation of potatoes followed by red kidney beans and then sweet corn has been established. All experimental plots received supplemental irrigation water when needed as indicated by moisture tensiometers.

Table 1. Average Soil Test Data of Surface Soil

Soil pH	6.4
Soil P	255 lbs P/A
Soil K	249 lbs K/A
Soil Ca	837 lbs Ca/A
Soil Mg	161 lbs Mg/A
Soil Zn	6 ppm Zn

Experimental Results and Discussion

Six types of soil fertility experiments with potatoes were conducted in 1969. Approximately 8.4 inches of irrigation water was applied to all potato experiments during July, August and September.

Rate and Time of Nitrogen Application

This experiment was planted May 5 and harvested September 29, 1969. Russet Burbank and Sebago varieties were planted in 32 inch rows 14 and 10 inches apart respectively. Basic fertilizer applied was 100 lbs. P_2O_5 and 200 lbs. of K_2O per acre banded at planting time. Nitrogen treatments were either broadcast on the rye cover crop and plowed down before planting, banded at planting time or sidedressed several weeks after planting. All of the nitrogen was supplied as ammonium nitrate.

Results of this experiment are recorded in Table 2. Yields were nearly doubled with 120 lbs. of N banded at planting time. Although banding the N at planting time was superior to broadcast treatments prior to planting, sidedressed N was the most efficient in producing top yields. Much of the N applied early in the season is believed to have been lost by leaching. Sidedressed N was more readily available later in the season when the crop needed it most.

Size of potatoes was closely associated with yield. Because of the oblong shape of the Russet Burbank potato, the Sebago variety graded out much better. Neither time nor rate of nitrogen had any significant effect on the specific gravity of these potatoes.

Rate and Time of Potassium Application

This experiment was planted May 7 and harvested September 30, 1969. Varieties used and seed spacing were the same as the N rate and time experiment. Basic fertilizer applied was 65 lbs. N and 100 lbs. P_2O_5 per acre banded at planting time. Additional nitrogen was sidedressed several weeks after planting at a rate of 120 lbs. N per acre. Potassium was supplied as KCl either broadcast and plowed down prior to planting or banded at planting time. One treatment which consisted of 240 lbs. K_2O per acre was applied in the fall of 1968.

Results of this experiment are shown in Table 3. Yield and size of potatoes increased with the first and second increment of K_2O applied. Yields for the higher rates of K_2O were not significantly greater than the 120 lb. rate. Likewise, no differences were observed between the broadcast and banded applications.

Specific gravity decreased almost linearly with increasing rates of K_2O applied with the greatest depression where 480 lbs. K_2O per acre was applied. Specific gravity was affected similarly by broadcast, banded, and fall applied K_2O. It is generally believed, however, that fall applied and broadcast applications of K_2O should be superior to banding where large amounts of K_2O per acre are being applied because of the minimizing effect on specific gravity.

Potassium Carrier Study

This experiment was planted May 13 and harvested September 25, 1969. Russet Burbank and Lenape varieties were planted at 14 inch spacings in 32 inch rows. Basic fertilizer applied was 65 pound N, 50 pounds P_2O_5 and 150 pounds K_2O per acre banded at planting time. An additional 120 pounds of N was sidedressed several weeks after planting.

Results of this experiment are shown in Table 4. Yields of the Lenape variety were quite variable due to the variability in stand. Sources of potassium had no significant affect on any of the measured variables. Specific gravity of the Lenape variety was significantly higher than the Russet Burbank variety. Yields of the two varieties, however, were comparable.

Zinc-Phosphorus Study

This experiment was planted May 13 and harvested September 26, 1969. Russet Burbank seed potatoes were planted in 32 inch rows at 14 inches apart. Basic fertilizer applied with 65 pounds N, 50 pounds P_2O_5 and 200 pounds of K_2O per acre banded at planting time with an additional 120 pounds N per acre, sidedressed several weeks after planting. The zinc materials used in this study were zinc sulfate, AZCo C100 and AZCo 12. The AZCo materials are basic slag materials submitted by the American Zinc Company for evaluation. These materials were evaluated at two soil phosphorus levels. The high phosphorus level was established in 1968 when 300 pounds of P per acre (687 pounds P_2O_5) were applied to half of each replication.

Results of this experiment are shown in Table 5. Zinc treatments did not significantly increase the variables measured. Yields tended to be larger at the high soil phosphorus level, however, this was not significant at the 5 percent level probability. Although there would appear to be a slight increase in yield from one of the zinc treatments, it should be reemphasized that this is not a significant difference and that yields in 1967 for the same treatment were slightly depressed at the same location.

Zinc-Copper-Phosphorus Study

This experiment was established in 1969 as a result of some information on one row plots in 1968. The experiment was planted May 13 and harvested September 25, 1969. Seeding rate, basic fertilizer and irrigation practices were essentially the same as the previous experiment. The objective of this experiment was to compare a zinc-copper material called Zink-Cu submitted by the Eagle Pitcher Ind. Co. with an equivalent amount of zinc as zinc sulfate. Both materials were banded so as to supply five pounds zinc per acre. The Zink-Cu material also supplied 0.8 pounds Cu per acre.

Results of this experiment are shown in Table 6. Neither yield nor size were significantly affected by these two materials. Both materials, however, appeared to significantly reduce the specific gravity of these potatoes. The previous experiment indicated no such affect, therefore, the meaning of this significant difference is not clear.

Table 2. Effects of rate and time of nitrogen application on yield, size and specific gravity of irrigated Russet Burbank and Sebago potatoes.

Nitrogen Application (a)				Russet Burbank			Sebago			Average Effects		
Broad-cast	Band-ed	Side-dressed	Total	Yield (cwt/A)	A Yield (b) (cwt/A)	Sp. Gr.	Yield (cwt/A)	A Yield (b) (cwt/A)	Sp. Gr.	Yield (cwt/A)	A Yield (b) (cwt/A)	Sp Gr
-------Lbs N/A----------												
0	0	0	0	166	111	1.080	234	214	1.072	200	162	1.07
0	60	0	60	285	226	1.080	355	334	1.068	320	280	1.07
0	120	0	120	342	278	1.080	423	398	1.072	382	338	1.07
120	0	0	120	324	266	1.082	404	382	1.072	364	324	1.07
60	60	0	120	335	275	1.080	401	380	1.072	368	327	1.07
120	60	0	180	360	307	1.080	463	442	1.071	411	375	1.0
180	60	0	240	344	282	1.078	458	433	1.074	401	357	1.0
0	60	60	120	366	322	1.079	465	447	1.069	415	385	1.0
0	60	120	180	378	332	1.081	485	469	1.070	432	401	1.0
60	60	180	300	380	323	1.078	458	440	1.070	419	381	1.0
LSD (.05) treatments										57	60	NS
LSD (.05) treatments within varieties				64	68	NS	64	68	NS			
LSD (.05) varieties within treatments				44	47	NS	44	47	NS			

(a) Broadcast, Banded and Sidedress N treatments were applied 4/25/69, 5/15/69 and 6/25/69 respectively.

(b) Minimum of 1 7/8 inches.

Table 3. Effects of rate and time of potassium application on yield, size and specific gravity of irrigated Russet Burbank and Sebago potatoes.

Potassium Application lbs of K_2O per acre (a)			Russet Burbank			Sebago			Average Effects		
Broadcast	Banded	Total	Yield (Cwt/A)	A Yield (b) (Cwt/A)	Sp. Gr.	Yield (Cwt/A)	A Yield (b) (Cwt/A)	Sp. Gr.	Yield (Cwt/A)	A Yield (b) (Cwt/A)	Sp. Gr.
0	0	0	281	218	1.084	360	344	1.074	320	281	1.079
0	60	60	310	257	1.082	422	402	1.073	366	329	1.078
0	120	120	327	264	1.082	412	390	1.071	369	327	1.076
0	180	180	318	267	1.080	427	410	1.072	372	339	1.076
0	240	240	320	256	1.080	430	407	1.070	375	331	1.075
360	120	480	341	285	1.078	448	423	1.065	395	354	1.071
60	0	60	317	257	1.083	413	395	1.072	365	326	1.078
120	0	120	331	282	1.081	445	429	1.074	388	356	1.078
240	0	240	332	277	1.080	447	425	1.072	389	351	1.076
240F	0	240	329	267	1.081	458	442	1.070	393	354	1.076
LSD (.05) treatment									26	27	.003
LSD (.05) treatments within varieties			35	35	.004	35	35	.004			
LSD (.05) varieties within treatments			32	22	.004	32	22	.004			

(a) Applied as KCl either broadcast and plowed down before planting as banded at planting time.

(b) Minimum of 1 7/8 inches.

Table 4. Effects of different sources of potassium on yield, size and specific gravity of irrigated Russet Burbank and Lenape potatoes.

Source of Potassium (a)	Russet Burbank Yield (cwt/A)	Russet Burbank A Yield[b] (cwt/A)	Russet Burbank Sp.Gr.	Lenape Yield (cwt/A)	Lenape A Yield[b] (cwt/A)	Lenape Sp.Gr.	Average Effects Yield (cwt/A)	Average Effects A Yield[b] (cwt/A)	Average Effects Sp.Gr.
None	323	256	1.081	319	305	1.095	321	280	1.088
Potassium Chloride	355	283	1.080	333	320	1.094	344	301	1.087
Potassium Nitrate	341	271	1.080	320	310	1.092	330	291	1.086
Potassium Sulfate	323	257	1.081	269	257	1.092	296	257	1.086
Potassium Carbonate	331	270	1.079	291	283	1.094	311	276	1.087
LSD (.05) treatments	---	---	-----	---	---	-----	NS	NS	NS
LSD (.05) treatments x variety interactions	NS	NS	NS	NS	NS	NS	---	---	----

(a) Applied at a rate of 150 lbs K_2O per acre.

(b) Minimum of 1 7/8 inches.

Table 5. Effect of zinc treatments on yield, size and specific gravity of irrigated Russet Burbank potatoes at two soil phosphorus levels. (a)

Treatment (lbs Zn/A)	High P (a)	Low P (b)	Average Effects
		Total Yield (cwt/A)	
None	377	367	372
25 lbs ($ZnSO4$) (c)	367	377	372
50 lbs (AZCo C100) (c)	381	375	378
5 lbs (AZCo 12) (d)	385	372	379
5 lbs ($ZnSO_4$) (d)	397	392	395
LSD (.05)	NS	NS	NS
		A Yield (cwt/A)	
None	293	285	289
25 lbs ($ZnSO_4$) (c)	292	295	293
50 lbs (AZCo C100) (c)	312	304	308
5 lbs (AZCo 12) (d)	310	275	293
5 lbs ($ZnSO_4$) (d)	316	320	318
LSD (.05)	NS	NS	NS
		Specific Gravity	
None	1.079	1.079	1.079
25 lbs ($ZnSO_4$) (c)	1.075	1.077	1.076
50 lbs (AZCo C100) (c)	1.076	1.078	1.077
5 lbs (AZCo 12) (d)	1.078	1.078	1.078
5 lbs ($ZnSO_4$) (d)	1.078	1.077	1.078
LSD (.05)	NS	NS	NS
		Phosphorus Effects	
	High P	Low P	LSD (.05)
Total yield (cwt/A)	382	372	NS
A yield	304	295	NS
Specific gravity	1.077	1.078	NS

(a) High P = 300 lbs P/A Broadcast - 1968

(b) Low P = 22 lbs P/A Banded - 1969

(c) Broadcast in 1968

(d) Banded annually for 2 years

Table 6. Effect of zinc and copper treatments on yield, size and specific gravity of irrigated Russet Burbank potatoes at two soil phosphorus levels.

Treatment (a) (lbs Zn/A)	High P	Low P	Average Effects
		Total Yield (cwt/A)	
None	355	328	341
5 lbs ($ZnSO_4$)	348	348	348
5 lbs Zn + .8 lbs Cu (Zn-Cu)	337	342	339
LSD (.05)	NS	NS	NS
		A Yield (cwt/A)	
None	292	259	276
5 lbs ($ZnSO_4$)	286	289	287
5 lbs Zn + .8 lbs Cu (Zn-Cu)	292	285	289
LSD (.05)	NS	NS	NS
		Specific Gravity	
None	1.083	1.084	1.083
5 lbs ($ZnSO_4$)	1.081	1.081	1.081
5 lbs Zn + .8 lbs Cu (Zn-Cu)	1.081	1.079	1.080
LSD (.05)	NS	NS	(.002)
		Phosphorus Effects	
	High P	Low P	LSD (.05)
Total yield (cwt/A)	347	340	NS
A yield (cwt/A)	290	278	NS
Specific Gravity	1.082	1.082	NS

(a) Banded at planting time

Weed Control in Potatoes at the Montcalm Experimental Farm

1969

W. F. Meggitt
Department of Crop and Soil Sciences

The treatments in Table 1 were evaluated for weed control in potatoes in 1969. In addition, Eptam at 4 lb/A was applied as a preplant incorporated treatment. The weed population was very sparce in the test area making it difficult to get a good evaluation of the treatments. In general the most effective treatments were Lorox at 2 lb/A; Patoran at 2 and 3 lb/A; Maloran at 2 lb/A. In all cases the control was enhanced by the addition of a crop oil. Eptam as a preplant treatment provided good control.

Table 1 also shows the yields from various herbicide treatments. Generally there was no significant differences among the yields.

Potatoes - Montcalm Farm

Table 1. Burbanks - 1969 Herbicide Study

Treatment	Rate	Cwt/A A's
Lorox	1 1/2	218
Lorox	2	189
Patoran	2	191
Patoran	3	195
Enide + DNBP	1 gal	226
Lorox + Sun 11E	1 1/2 + 1 gal	196
Lorox + Paraquat	1 + 1/2 pt	188
Lorox + Lasso	1 + 2	192
Maloran	2	195
DNBP + Dalapon	4 1/2 + 3	203
Patoran + Sun 11E	2 + 1 gal	221
No Treatment	----	216
Eptam	4	221

The treatments and results from the studies on potato vine killing are listed in Table 2 and 3. An early variety (Onaway) and a later variety (Burbank) were included in these studies. It would appear that there is considerable variability in the yields. The fact that the highest yield of the Burbank variety occurred in that area harvested first at the time of application of vine killing treatments is not explainable.

The most effective vine killing materials were Paraquat + X-77; sodium arsenite, Dow General + diesel fuel. In the case of the Onaway variety, effective kill was obtained by the lower rate of each treatment. The later maturing varieties have larger vine cover and require more chemical for effective kill.

Table 2. Potatoes - Montcalm Farm

Onaways - 1969 Vine Killing

Treatment	Rate	Cwt/A - A's	Sp. Gravity
Paraquat + X-77	1 pt. + .1%	322	1.073
"	2 pt. + .1%	309	1.071
Sodium Arsenite + X-77	6 lb. + .1%	321	1.071
Mobil Oil 534	10 gal	363	1.070
Dow General + Diesel Fuel	3 pt. + 5 gal	305	1.071
" " "	4 pt. + 5 gal	313	1.069
Liquid N 28%	2 (7.5 gal)	357	1.074
"	2 (15 gal)	369	1.070
"	15 gal	364	1.074
"	30 gal	385	1.070
Harvest at final	----	343	1.074
Harvest at treatment	----	322	1.072

Table 3. Potatoes - Montcalm Farm

Burbanks - 1969 Vine Killing

Treatment	Rate	Cwt/A A's	Sp. Gravity
Paraquat + X-77	1 pt. + .1%	224	1.079
"	2 pt. + .1%	186	1.079
Sodium Arsenite + X-77	6 lb. + .1%	207	1.079
Mobil Oil 534	10 gal	196	1.077
Dow General + Diesel Fuel	3 pt. + 5 gal	231	1.081
" "	4 pt. + 5 gal	227	1.079
Liquid N 28%	* 50 gal	186	1.077
" "	* 42 gal	218	1.079
flaming		211	1.080
flaming		208	1.076
Harvest at final	---	198	1.081
Harvest at treatment	---	243	1.082

*Liquid N put on straight
No water

Entomology Research at Montcalm Experimental Farm--1969

Arthur L. Wells

Department of Entomology*

Field research was conducted at the Experimental Farm in 1969 to further evaluate experimental compounds or formulations of soil insecticides on the insects and nematodes infesting potatoes and field beans. The study to determine the role of nematode control in a cash crop rotation which had been instigated in 1968, was continued. Another phase of entomological research has been the monitoring of the flight patterns of cutworm and European corn borer moths by maintenance of a blacklight trap at the farm. Each of these research projects will be presented and discussed individually.

A. Evaluation of Soil Systemic Insecticides on Potatoes

Purpose. When soil applications of systemic insecticides were first introduced into agriculture potato growers were the first to see their potential in their farming programs. Since then they have been widely accepted as an integral part of the potato industry. As new formulations of the standard materials are developed it is necessary to evaluate them in the field in comparison with recommended formulations. New experimental compounds with a potential of controlling nematodes as well as insects must also be evaluated under Michigan conditions and if shown to have promise often require residue samples for registration and labeling procedure.

The plots were established on May 12 and 13 using Russet Burbank whole seed in 14 in. spacing. Standard recommendations of fertilizer (50 lb. N and 200 lb. K_2O plowdown, 800 lb. 12-12-12 at planting, and 50 lb. N sidedressed at hilling) and herbicide (Lorox preemergence) were followed in the plot. The plots consisted of three replications of 17 treatments, each consisting of 4 - 50 ft. rows. After laying out the area soil samples were taken from each plot and analyzed in the Nematology Laboratory for determination of nematode populations. The broadcast treatments were distributed on the soil surface and roto-vated into the soil 6 in. The band treatments were applied in a 4 in. band on the seed in the open furrow prior to covering by hand. The split-band treatment was applied on each side of the seed furrow below the surface with a V-belt seeder.

The insect populations were sampled three times (July 1, 24 and August 14) with an insect net. Each sample consisted of ten sweeps across the center rows of each treatment. The insect counts are presented in Table 1. Nematode counts were determined by sampling the soil from each treatment on July 30 and again at harvest on September 30, 1969. The tubers from the center two rows were graded at the time of harvest and weighed for yield determination.

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*All nematode samples were analyzed by Mrs. Natalie Knobloch and Dr. John Knierim, Nematology Laboratory, Dept. of Entomology, M.S.U.

Table 1. Evaluation of Soil Systemic Insecticides on Potatoes

Material	Lb Act[a] /A	Placement	Potato Leaf-hoppers	Aster Leafhoppers	Miridae (Plant Bugs)	Aphids	Potato Flea Beetles	Parasites and Predators	Nemastd/pt Soil[d] 5/12	Nemastd/pt Soil[d] 7/30	Yield & Grade Cwt/A	Yield & Grade %A
			Total Insects Collected									
Thimet 15% Gran	3	Band	1	4	9	10	0	3	51	651	310	80
Thimet 6 EC	3	Band	3	5	9	5	1	1	96	659	338	90
Thimet 6 EC	6[b]	Band	1	0	1	0	1	0	136	1880	297	92
Disyston 15% Gran	3	Band	2	0	11	3	1	4	99	912	352	91
Disyston 6 EC	3	Band	2	3	7	4	0	1	147	1027	332	88
Bay 68138 15% Gran	6	Brdcst	4	0	14	12	5	7	107	187	403	88
Bay 68138 3 SC	6	Brdcst	7	0	16	27	2	6	43	136	381	87
Lannate 5% Gran	3	Band	7	0	16	64	4	3	72	801	318	81
Temik 10% Gran	2	Band	1	1	9	9	2	4	96	168	352	88
Temik 10% Gran	3	Band	1	1	2	3	1	4	72	421	335	83
Temik 10% Gran	5	Spl-Band	1	0	5	8	1	2	64	96	324	84
Temik 10% Gran	20[c]	Brdcst	0	0	2	0	0	4	108	20	345	83
Furadan 10% Gran	2	Band	0	1	12	106	0	3	139	1331	321	88
Furadan 10% Gran	3	Band	1	2	4	136	0	4	133	1339	338	86
NC-6897 5% Gran	3	Band	3	4	21	28	2	7	179	1227	317	87
TH-427 5% Gran	3	Band	3	2	15	38	12	2	64	963	332	81
Untreated	-	-	9	3	19	36	7	6	84	1190	325	87

[a]Rates based on 34 in. rows (15,390 row ft/A); Liquid band treatments applied low volume; liquid broadcast treatments applied in water at rate of 150 gal. water per A.

[b]Totals for one replication only. [c]Totals for two replications. [d]Root lesion nematode, *Pratylenchus penetrans*

Results. No phytotoxic symptoms were noted in any of the treatments. Insect population were too low on the sampling dates for comparison among the treatments. The aphid populations did not increase significantly later in the growing season. A random soil sample taken from the area on April 16 estimated the nematode population at 144 Pratylenchus penetrans (root lesion nematode) per pint of soil and was approximately the same at planting. By midsummer the population had increased in all but the treatment of nematocidal compounds (Bay 68138 and Temik). The soil samples taken at harvest were not analyzed for nematodes. There were no differences in grade of the tubers among the treatments. It appears that the Bay 68138 treatments increased the yield some. The Low Volume treatments of Thimet and Disyston were similar to corresponding granular formulations. Samples of soil and tubers were taken from the Temik plots and samples of tubers were taken from the Thimet LV treatments for residue determination to aid in registration data.

B. Evaluation of Soil Systemics on Dry Beans

Purpose. The use of soil applications of systemics insecticides have also been widely used in the dry bean industry for aphid, leafhopper and Mexican bean beetle control. As with the potatoes it is necessary to reevaluate current control recommendations as well as new formulations or new compounds. These new formulations also require residue samples of the crop for registration support.

The plots were established on June 10 and 12 using a white bean (Sanilac) and dark red kidney beans (Charlevoix) planted at recommended rates of seed, fertilizer (240 lb. 5-20-20 + Mn and Zn) and incorporated herbicide (Eptam). Three replications of 17 insecticides were applied broadcast and rotovated in prior to planting, banded beside seed, in-row with seed or treated fertilizer. Soil samples for nematode determination were taken on April 16 and from the Bay 68138 broadcast treatment (compared with untreated check) on July 30 and at harvest on September 15. The data are summarized in Table 2.

Table 2. Soil Treatments for Bean Insect and Nematode Control

Material	Lb Act** /A	Placement	Yield (Bu/A) Sanilac	Charlevoix
Thimet 15% Gran	1	Band	27	21
Thimet 6 EC	1	Band	29	21
Thimet 6 EC	2	Band	28	23
Disyston 15% Gran	1	Band	27	21
Disyston 6 EC	1	Band	25	20
Disyston-Fertilizer	1	Fert	26	23
Bay 68138 15% Gran	1	Band	27	22
Bay 68138 15% Gran	6	Brdcst	32	23
Lannate 5% Gran	1	Band	25	19
Furadan 10% Gran	1	In-row	35	21
NC-6897 5% Gran	1	Band	29	20
TH-427 5% Gran	1	Band	22	18
TD-8550 10% Gran	1	Band	21	20
DS-13182 10% Gran	1	Band	26	20
N-2596 10% Gran	1	Band	24	22
Untreated	-	--	28	22

**In-row and band treatments based on 30 in. rows (17,424 row-ft/A).

Results. No significant insect populations developed in the plots during the growing season. None of the treatments caused phytotoxic symptoms in the seedlings. The spring sampling of the soil indicated a population of 152 *P. penetrans* nematodes per pint of soil in the plot area. By mid-summer (July 30) the population was determined to be 855/pt. in the untreated and 573/pt. in the Bay 68138 broadcast treatment. The counts at harvest in the same plots were 1339 *P. penetrans* and 141 *Paratylenchus sp.* in the untreated and 213 and 0 respectively in the Bay 68138 plot. There was no apparent effect on the yields.

C. THE ROLE OF NEMATODE CONTROL IN CASH CROP PRODUCTION

Location: Montcalm Experimental Farm, Entrican, Michigan

Cooperators: Arthur Wells and Richard Chase

Period of Study: Initiated in April 1968 and to be continued as long as data, time and support warrants.

Purpose of Study: To determine the benefits derived from nematode control in selected rotations of cash crops. Soil fumigants applied annually and as needed will be compared with a broadcast application of a granular nematocide and an untreated control plot.

Species of Nematode: Pratylenchus penetrans, root lesion nematode.

Soil Treatments to be Compared

Annual Fumigation (FA): Soil fumigated with DD at 24 gallons per acre on April 24, 1968. Fall fumigated with Vorlex at 10 gallons per acre on October 11, 1968. Fumigated with Vorlex at 10 gallons per acre on October 25, 1969.

Fumigation as Needed (FN): Soil fumigated with Telone at 20 gallons per acre on April 24, 1968.

Granular Nematocide (Bay): Soil treated with broadcast application of Bay 68138 15% Granular at 40 lb. per acre (6 lb. actual/A.) on May 13, 1968. Soil disced immediately after.

Untreated Control (Unt.): No soil treatments applied.

Rotations to be Studied

Plot	1968	1969	1970	1971 (Repeat)
1	Potatoes	Potatoes	Potatoes	Potatoes
2	Potatoes	Potatoes	Dry beans	Potatoes
3	Dry beans	Cucumbers	Potatoes	Dry beans
4	Cucumbers	Sweet corn	Potatoes	Cucumbers
5	Sweet corn	Potatoes	Dry beans	Sweet corn

PLOT OUTLINE

	Granular Nematocide Temik--Spring '68 Bay 68138--Spring '69	Untreated (Unt.)		Fumigate as Needed (FN) Telone--Spring '68	Fumigate Annually (FA) DD--Spring '68 Vorlex--Fall '68 Fall ' 69
	Plot 5		Spray Alley		
	4				
IV	3				
	2				
	1				
	5				
	4				
III	3				
	2				
	1				
	5				
	4				
II	3				
	2				
	1				
	5				
	4				
I	3				
	2				
	1				
	← 40' →	← 40' →	15'	← 40' →	← 40' →

N ↑

Plots 23' wide

PLOT 1 (Potatoes 1968, 1969)

Variety and Spacing: Sebago (whole seed 9 in. spacing)
Kennebec (cut seed 9 in. spacing)
Russet Burbank (whole seed 14 in. spacing)

Fertilizer: 50 lb N and 200 lb K_2O plowdown, 800 lb 12-12-12 at planting and 50 lb N sidedressed.

Herbicide Treatment: Lorox applied preemergence

Systemic Insecticide: Thimet 15% Gran (3 lb Act/A.) banded

Foliar Insecticide: Thiodan or Diazinon + Sevin applied with fungicide on 10 day schedule.

Date Planted: May 13, 1969

Date Harvested: Oct. 8 and 9, 1969

Treatment	Nematodes/pt			Yield and % Grade A: Sebago		Kennebec		Burbank	
	May 13	July 30	Sept 30	CWT	%A	CWT	%A	CWT	%A
FA	0	0	6	441	92	514	94	431	89
FN	42	106	34	429	90	438	92	381	84
Bay	54	2	2	380	90	422	90	371	86
Unt	168	110	742	371	87	382	92	343	86

PLOT 2 (Potatoes 1968, 1969)

Agronomic data same as for Plot 1.

FA	0	2	10	458	93	468	95	425	88
FN	24	74	168	419	91	414	93	409	83
Bay	8	0	2	422	92	467	94	410	85
Unt	220	142	974	394	89	404	93	352	86

PLOT 3 (Beans 1968; Cucumbers, 1969)

Variety: Pioneer Hybrid and Spartan Progress

Fertilizer: 50 lb N and 200 lb K_2O plowdown and 240 lb of 5-20-20 at planting

Herbicide Treatment: Alanap + premerge applied post-plant

Date Planted: June 10, 1969; Replanted: July 2, 1969

Foliar Insecticide: Thiodan or Diazinon + Sevin applied with fungicide on 10 day schedule.

Treat-ment	Nematodes/pt Soil May 13	July 30	Aug. 14	Harvest Data
FA	2	0	6	Not taken due to
FN	11	56	128	uneven stand in all
Bay	22	0	32	treatments
Unt	424	32	526	

PLOT 4 (Cucumbers, 1968; Sweet corn, 1969)

Variety: Golden Bantam and Jubilee

Fertilizer: 50 lb N and 200 lb K_2O plowdown and 240 lb of 5-20-20 at planting

Herbicide Treatment: Atrazine + Ramrod applied post-plant

Date Planted: June 10, 1969

Foliar Insecticide: Thiodan or Diazinon + Sevin applied with fungicide on 10 day schedule.

Date Harvested: September 3, 1969

Treat-ment	Nematodes/pt 5/13	7/30	9/3	Golden Bantam No./60 ft Hills	Stalks	Ears	CWT/A	Jubilee No./60 ft. Hills	Stalks	Ears	CWT/A
FA	4	0	0	48	103	76	80	63	90	89	143
FN	0	44	2	42	80	62	62	61	75	77	127
Bay	10	0	20	41	92	74	80	58	82	73	129
Unt	48	20	94	38	95	83	88	55	83	84	151

PLOT 5 (Sweet corn, 1968; Potatoes, 1969)

Agronomic data same as for Plot 1.

Treat-ment	Nematodes/pt			Yield and % Grade A					
				Sebago		Kennebec		Burbank	
	May 13	July 30	Sept 30	CWT	%A	CWT	%A	CWT	%A
FA	4	2	4	454	92	489	94	399	89
FN	12	98	104	408	90	446	92	379	90
Bay	68	28	12	456	92	469	93	456	88
Unt	384	398	1214	437	92	440	94	393	88

Results. The area which had been fumigated in the fall of 1968 (FA) was effective in reducing the nematode count in all the plots and provided the highest yields of all variety of potatoes in Plots 1 and 2 (2nd year potatoes) but only the Kennebecs in Plot 5 (potatoes after corn). The FN treatment (fumigated in spring of 1968) was still effective in retarding nematode build-up and provided a higher yield than the untreated area. The Bay 68138 granular treatment provided excellent nematode control which resulted in a higher yield of potatoes than the untreated control area. It is apparent that while the granular treatment provided the same degree of nematode control as the FA treatment, some other factor such as the fall preparation of the soil or the fumigant itself effected the plant response. This could possibly be the result of a better utilization of the soil nutrients by the plant. The appearance of the vine growth in the different treatments was very noticeable prior to harvest. Although the treatments resulted in yield differences, they did not affect the quality (% Grade A) or specific gravity of the tubers.

The cucumbers in plot 3 were not harvested as a result of poor emergence and stand. The nematode populations were monitored during the growing season with differences in the treatments similar to those in the potato plots. The counts under the sweet corn (Plot 4) did not build up as they did in the other plots. Hill counts, stalks per hill, harvestable ear production and yield by weight were taken in the sweet corn plot with no apparent differences in the treatments. After the yields were taken the stalks were cut and carried off the FA treated area so they would not interfere with the fumigation. As soon as the potatoes were harvested the FA area was plowed, disced and fumigated with Vorlex at 10 gallons per acre. The ground was cultipacked immediately after and left undisturbed for two weeks. The corn stalks were replaced on the FA area prior to discing and planting to rye cover for the winter.

BLACKLIGHT TRAP RECORDS, MONTCALM COUNTY, MICHIGAN
1969

Theron Comden, Trap Tender,
John Newman and Paul Lockwood, Identification and Recording

Date	Army-worm	European Corn Borer	Black Cut-worm	Variegated Cutworm	Spotted Cutworm	Clover Looper	Dingy Cutworm	Yellow Striped Armyworm	Celery Looper	Green Cloverworm	Corn Ear-worm	Tomato Horn-worm	Glassy Cutworm	Dark Sided Cutworm
7/7	77	0	4	2	3	0	0	0	7	0	0	0	3	0
7/18	13	0	6	1	3	5	0	0	1	0	0	0	1	0
7/19	19	0	4	0	2	41	0	0	0	0	0	0	5	0
7/20	8	0	7	2	0	12	0	0	0	0	0	0	9	0
7/21	6	0	9	0	4	9	0	0	0	0	0	0	4	0
7/22	15	0	4	0	0	117	0	0	1	1	0	0	2	0
7/23	9	0	5	0	1	25	0	0	0	0	0	0	3	1
7/24	2	0	5	0	0	28	0	0	0	3	0	0	4	0
7/27, 28	10	0	9	1	5	98	0	0	2	2	0	0	9	3
7/29, 30	11	0	3	3	7	218	1	0	6	0	0	0	14	2
8/6	2	6	2	2	0	76	1	0	9	1	0	1	11	1
8/7	7	15	1	0	2	42	3	0	4	1	0	0	8	4
8/8	11	10	5	1	1	37	5	1	8	6	0	1	12	6
8/9	6	18	4	3	2	11	9	0	6	2	0	0	6	7
8/10	5	14	6	5	6	14	19	3	7	3	0	1	12	9
8/11	14	8	2	3	7	12	23	2	2	3	0	0	9	4
8/12	11	54	2	0	3	11	11	1	11	3	0	0	11	2
8/13	16	68	3	2	8	8	17	3	12	4	0	0	9	4
8/14	10	65	4	4	6	9	24	1	7	7	0	1	3	2
8/15	42	108	7	4	9	7	38	0	11	4	0	0	6	1
8/16	89	46	5	3	7	6	13	1	8	4	1	1	5	4
8/17	120	68	3	7	6	2	34	0	12	3	2	2	9	3
8/18	141	59	14	9	8	10	49	2	16	8	5	0	11	7
8/19	110	62	19	8	16	8	54	0	14	6	7	0	8	2
8/20	97	41	22	14	11	6	61	0	12	7	9	0	4	0
8/23	161	30	21	13	12	11	50	3	11	9	4	0	7	0
8/24	82	12	17	12	8	0	32	0	9	6	3	1	6	1
8/25	124	8	14	16	11	2	47	1	12	9	5	0	6	3
8/26	157	21	23	19	16	4	39	3	11	7	7	0	4	0
8/28	116	41	12	8	9	12	112	0	16	6	2	4	19	0
9/4	128	7	21	12	12	2	21	0	8	8	5	0	3	0
9/5	141	4	19	19	9	0	22	3	4	6	0	0	6	0
9/6	94	8	22	11	6	1	18	1	3	3	3	2	4	1
9/14	162	6	17	8	11	0	14	0	6	5	6	0	2	0
9/15	116	3	24	14	4	1	11	4	2	6	0	0	0	0
9/16	139	3	22	9	3	2	16	1	0	4	4	1	4	0

D. Blacklight Trapping Station

Purpose. Many species of cutworms attack cultivated crops in Michigan, some of which are of more importance than others. Certain species have definite flight patterns during the growing season while others are more erratic and may be active over a longer period of time. It is important that these flights be monitored so that egg laying activity can be predicted and control measures can be advised. By comparing the overall flight pattern (numbers, time of year, climatic conditions, etc.) of a given species with another area and with previous years, trends or outbreak conditions may be thwarted by chemical control. Included in the table are certain species which have caused damage in the Montcalm County area in previous years.

Results. Since the trapping period started in early July, early flight activity of some of the moths are not recorded. One of these species is the first generation of the European corn borer which is becoming of more concern to potato growers in the Montcalm area. The numbers and length of activity of the second generation in August are the result of the heavy spring population which caused damage to corn and potatoes. Outbreak populations of the green cloverworm did not occur on beans as indicated by the flight pattern, however, the clover looper was extremely active in July. The black cutworm, often a problem on potatoes did not appear in damaging numbers. Armyworm moth populations were extremely high in late summer after a late spring generation. The trapping program will start earlier in 1970 to monitor the early flights of these species.

Weed Control in Dry Beans at the Montcalm Experimental Farm - 1969

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Generally in 1969 effective weed control was obtained from preemergence treatments as shown in Table 1. The amount and pattern of rainfall in early June made conditions ideal for moving the herbicide into the soil and obtaining good control on weeds as germination occurred. However, if rainfall does not occur in 4 to 5 days after application control from preemergence herbicides is not effective. Under conditions where rainfall is limited or does not occur during the period shortly after application the preplant incorporated herbicides are most effective. The preplant incorporated treatments, Treflan, Eptam and Planavin were less effective due to a high degree of leaching from the area near the soil surface.

The yields are shown in Table 1.

Table 1. Evaluation of Preemergence Herbicide Applications on Kidney and Navy Beans at Montcalm Experimental Farm, Montcalm County.

Trt.		Rate	Weed Control Ratings[1]		Injury[1]			
No.	Treatment	lb/A	Bd.Lv.	Grass	Kidney	Bu/A	Navy	Bu/A
1.	Eptam	3	5.4	8.9	0.0	18.1	0.0	32.6
2.	Eptam	4	7.9	10.0	0.0	17.9	0.0	30.4
3.	Treflan	1	8.8	8.0	0.0	12.8	0.0	22.4
4.	Eptam + Treflan	2¼+3/4	8.1	10.0	0.0	17.4	0.3	32.2
5.	Amiben (salt)	2	9.6	9.8	0.0	20.8	0.0	30.2
6.	Amiben (salt)	3	9.9	10.0	0.0	25.2	0.0	33.9
7.	Amiben (ester)	3	9.7	10.0	0.0	18.9	0.0	30.7
8.	Amiben + Lasso	2+1	9.9	9.9	0.3	30.6	0.3	35.7
9.	Amiben + Lasso	2+2	10.0	10.0	3.3	25.6	1.0	28.8
10.	Lorox + Lasso	3/4+2	9.7	10.0	1.0	25.6	1.3	32.0
11.	Lorox + Lasso	1/2+2	10.0	10.0	0.6	24.8	2.0	29.6
12.	Preforan	4	9.5	0.0	0.0	28.6	0.3	35.3
13.	Lorox + Amiben	1/2+2	9.3	10.0	0.0	24.3	0.0	32.6
14.	Planavin	1 1/2	8.1	9.8	0.0	22.4	0.3	33.6
15.	Amiben (ester)	2	9.5	9.2	0.0	24.4	0.0	31.6
16.	Control		0.0	0.0	0.0	19.3	0.0	25.2

[1] 0 = No control or injury; 10 = Complete control or kill

Soil Fertility Research on Red Kidney Beans at the Montcalm Experimental Farm 1969

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Experimental Results and Discussion

Five types of fertility experiments were conducted with red kidney beans in 1969. Charlevoix red kidney beans were planted June 10 and 11 and harvested September 12 and 15, 1969. A plant population of approximately 58,500 plants per acre in 28 inch rows was obtained. Weeds were controlled with 3 lbs. Eptam per acre applied as a preemergence herbicide. Approximately 2 inches of supplemental irrigation water were applied in August. All banded fertilizer was applied 2 inches to the side and 1 inch below the seed.

Residual Nitrogen Study

This experimental area received no nitrogen in 1969. The objective of the experiment was to evaluate any residual or carry-over nitrogen from the nitrogen treatments on potatoes in 1968. Red kidney beans planted in this experimental area received a basic fertilizer application of 25 lbs P_2O_5 and 50 lbs. K_2O per acre banded at planting time.

Results of this experiment are presented in Table 1. Nitrogen treatments applied in 1968 had no effect on yields of 1969 red kidney beans. Note that all yields are approximately 15 bushels below the average yields of the other experiments which received 40 lbs N per acre in 1969. This would indicate that red kidney beans did respond to N in 1969. This implies that we cannot expect any N carry-over on this soil in years with similar rainfall. Any nitrogen remaining after the previous crop has matured is lost through leaching or denitrification.

Rate and Time of Potassium Application

This experiment received a basic fertilizer application of 40 lbs N and 50 lbs P_2O_5 per acre banded at planting time. Potassium treatments were either broadcast and plowed down prior to planting or banded at planting time.

Results of this experiment are shown in Table 2. Red kidney beans did not respond to the various rates of placements of K fertilizer. Soil tests would indicate that little or no response could be expected with red kidney beans at this location.

Table 1. Effects of residual nitrogen on yields of irrigated red kidney beans.

lbs of N per acre (a)	Yield (Bu/A)
0	25
60	24
120	26
180	28
240	26
LSD (.05) treatments	NS

(a) Applied as NH_4NO_3 in 1968.

Table 2. Effects of rate and time of potassium application on yield of irrigated red kidney beans.

Potassium Application lbs of K_2O per acre (a)			Red Kidney Beans
Broadcast	Banded	Total	Yield (Bu/A)
0	0	0	36
0	20	20	39
0	40	40	38
0	60	60	36
0	80	80	39
120	40	160	38
20	0	20	39
40	0	40	39
80	0	80	38
LSD (.05) treatments			NS

(a) Applied as KCl

Nitrogen Carrier Study

This experiment received a basic fertilizer application of 40 lbs N, 25 lbs P_2O_5 and 50 lbs K_2O per acre banded at planting time. The sources of nitrogen used were ammonium sulfate, ammonium nitrate, calcium nitrate, urea and anhydrous ammonia.

Results of this experiment are shown in Table 3. Although the anhydrous ammonia treatment was applied 2 weeks later than the other treatments, yields were not affected differently by any of the treatments.

Potassium Carrier Study

This experiment received a basic fertilizer application of 40 lbs N, 25 lbs P_2O_5 and 50 lbs K_2O per acre banded at planting time. One of the treatments involved, however, did not receive potassium.

The results of this experiment are recorded in Table 4. Once again, red kidney beans did not respond to any of the treatments.

Zinc-Phosphorus Study

Basic fertilizer used in this experiment was 40 lbs N, 25 lbs P_2O_5 and 40 lbs K_2O per acre banded at planting time. The high phosphorus treatment which consisted of 300 lbs. P per acre (687 lbs P_2O_5) was established on half of each replication in 1968. Two residual zinc treatments (25 lbs $ZnSO_4$ and 50 lbs AZCo C100) were established in 1968. The other two zinc treatments have been applied annually starting in 1968.

The results of this experiment are shown in Table 5. None of the zinc treatments had any effect on yields of irrigated red kidney beans. The soil test for zinc in this experimental area varies from 3 to 7 parts per million. At the present existing soil pH level of 6.4, this should be sufficient zinc available for all crops used in these experiments. Very little is known about zinc toxicity under acid soil conditions, therefore, zinc is not recommended on soils with chemical properties similar to this McBride sandy loam.

Table 3. Effect of different sources of nitrogen on yield of irrigated red kidney beans.

Source of Nitrogen	Red Kidney Beans Yield (Bu/A)
Ammonium sulfate[a]	39
Ammonium nitrate[a]	40
Calcium nitrate[a]	41
Urea[a]	42
Anhydrous ammonia[b]	42

(a) Banded June 10, 1969

(b) Sidedressed June 24, 1969

Table 4. Effect of different sources of potassium on yield of irrigated red kidney beans.

Source of Potassium (a)	Red Kidney Beans Yield (Bu/A)
None	41
Potassium Chloride	42
Potassium Nitrate	41
Potassium Sulfate	41
Potassium Carbonate	41
LSD (.05) treatments	NS

(a) Applied at a rate of 50 lbs K_2O per acre.

Table 5. Effect of zinc treatments on yield of irrigated red kidney beans at two soil phosphorus levels.

Treatment (lbs Zn/A)	Yield (Bu/A) High P (a)	Low P (b)	Average Effects
None	37	35	36
25 lbs ($ZnSO_4$) (c)	35	35	35
50 lbs (AZCo C100) (c)	34	35	35
5 lbs (AZCo 12) (d)	30	33	32
5 lbs ($ZnSO_4$) (d)	27	32	30
LSD (.05)	NS	NS	(4)
		Phosphorus Effects	
Phosphorus levels	34	33	
LSD (.05)	NS		

(a) High P = 300 lbs P/A Broadcast - 1968

(b) Low P = 9 lbs P/A Banded - 1969

(c) Broadcast in 1968

(d) Banded annually for 2 years

Seeding Rate, Row Spacing, Fertility Level and Growth Regulator Studies on Red Kidney Beans at the Montcalm Experimental Farm - 1969

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Two experiments were conducted in 1969. The first experiment involved the application of TIBA (triiodobenzoic acid) on Charlevoix kidney beans which were planted at approximately 80 pounds of seed per acre on row spacings of 7, 14, 21 and 28 inches. A uniform fertilizer rate of 500 pounds of 6-24-12 fertilizer was added over these areas with 250 pounds per acre of this fertilizer being broadcast prior to planting and 250 pounds being used as a planting time fertilizer being banded below and to the side of the seed. The second experiment involved interactions between row spacing, seeding rate, and fertilizer level using Charlevoix red kidney bean as a test crop. Row spacings of 7, 14, 21 and 28 inches with seeding rates of approximately 40 and 80 pounds of seed per acre and fertility levels of 0, 500 and 1,000 pounds of 6-24-12 per acre being the treatments. A uniform nitrogen application was given to the entire test area so that the fertilizer variables were really only phosphorus and potassium. Results of these experiments are shown in Tables 1 and 2.

In the TIBA experiment, there was an increase in the yield of beans grown on 7- and 14-inch rows in both years due to the addition of TIBA at about the first flower stage of development. TIBA rates of 0, 10 and 20 grams per acre of the material in foliar application were used and the yield increase was obtained only with the narrow row spacings at the 10 gram level. Apparently 20 grams of material was too much and retarded yield. These data suggest that on field beans, TIBA may be effective in increasing yields in narrow row spacing culture systems at high fertility levels and high plant populations.

In the second experiment there was a significant increase in bean production from 7- and 14-inch rows as compared to 21- and 28-inch rows, with the narrower rows resulting in a 10-20 percent increase in the amount of bean production. It is our opinion, however, that the additional labor costs involved in cultural practices needed with narrower row systems more than offset the advantages obtained. The principal problem is in weed control, but mechanization for this type of system in general will be a problem. There was no significant response to increased seeding rate or to fertilizer application in either of the two years.

Table 1. Effect of rate of TIBA application at four spacings on yield of irrigated Charlevoix red kidney beans.

Treatment TIBA grams/A	Row Spacing (inches) 7	14	21	28	Average
	BU/A				
			1968		
0	44.5	36.3	34.6	34.0	37.4
10	47.3	42.4	43.8	34.2	41.9
20	38.3	35.4	40.2	29.0	35.7
Average	43.3	38.0	39.5	32.4	
			1969		
0	43.2	52.1	47.3	41.9	46.1
10	51.3	54.3	41.4	42.6	47.4
20	43.8	46.0	43.4	38.6	43.0
Average	46.1	50.7	44.0	41.0	

Table 2. Effects of row spacings at three fertilizer levels on yield of irrigated Charlevoix red kidney beans.

Row Spacings (inches)	Fertilizer Levels (lbs/A) [a] 40 lbs/A Seeding Rate 0	500	1000	Ave.	80 lbs/A Seeding Rate 0	500	1000	Ave.
	Bu/A							
	1968							
7	41.9	44.1	38.8	41.6	37.9	39.8	38.6	38.7
14	37.2	36.8	32.9	35.6	42.5	42.4	42.5	42.4
21	42.0	40.4	35.8	39.4	44.8	41.5	39.4	41.9
28	35.6	36.2	31.6	34.4	39.2	33.3	34.3	35.6
Average	39.2	39.4	34.8	(37.8)	41.1	39.2	38.7	(39.6)
	1969							
7	38.5	47.6	41.5	42.5	42.1	49.0	48.8	46.6
14	46.7	42.6	46.5	45.2	49.3	43.8	42.1	45.0
21	44.8	43.3	40.2	42.7	35.6	40.9	41.6	39.3
28	25.7	34.7	34.2	31.5	39.6	39.5	38.9	39.3
Average	38.9	42.1	40.6	(40.5)	41.6	43.3	42.8	(42.5)

(a) Rates of 250 and 750 lbs. 0-24-12 per acre were broadcast and plowed down prior to planting on areas which were subsequently brought to 500 and 1000 lbs. acre of fertilizer by banding 250 lbs. 6-24-6 + 1% Zn at planting time. Zero fertilized plots received 15 lbs N per acre as NH_4NO_3 broadcast and plowed down prior to planting.

Corn Hybrids, Plant Population and Irrigation Experiments at the Montcalm Experimental Farm - 1969

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Research at the Montcalm Experimental Farm in 1969 included three experiments: (1) Response of 63 corn hybrids (50 commercial and 13 experimental) with and without irrigation, (2) Effect of four plant populations (15,200; 19,400; 23,300; 27,400) with and without irrigation for five Michigan Certified corn hybrids. (3) Response of five upright leaf experimental corn hybrids at four plant populations (14,700; 18,800; 22,900; 27,000) with and without irrigation.

Similar experiments were also conducted in 1968 so that two year summaries are included in this report.

Bouyoucous soil moisture blocks at 6", 12", 18", 24" levels were maintained in irrigated and unirrigated plots. Irrigation was applied so that block readings did not fall below 50% water holding capacity during July and August. Four irrigations, 1.5 inches each, for 6" water were applied in 1969 and five irrigation, 7.5" water, were applied in 1968. Table 1 presents soil moisture readings for 1968 and 1969.

Response of Corn Hybrids -- Irrigated vs Not Irrigated

Table 2 presents agronomic information for 63 hybrids in 1969 with two year averages for those hybrids that were also included in the 1968 test.

1969 results - Irrigated corn averaged 146.0 bushels compared to 85.5 not irrigated, a difference of 60.5 bushels for irrigation. The range (highest and lowest) in yields for the 63 hybrids were: irrigated = 184.9 to 96.7; not irrigated = 108.6 to 56.3 bushels. The highest yielding hybrid irrigated, Pioneer 3773 (2X) yielded 83.7 bushels more irrigated than when not irrigated, 184.9 vs. 101.2. The lowest yielding hybrid not irrigated, Weather Master EPX-2P (2X), yielded 81.9 bushels more when irrigated, 138.2 vs 56.3. The lowest response to irrigation, 23.7 bushels (96.7 vs. 73.0) came from an early maturing hybrid, Northrup King PX417 (3X). Thus, hybrid response to irrigation was not entirely related to relative yielded ability of hybrids. Some of the lower yielding hybrids gave a large response to irrigation while others gave a small response. Likewise, some of the high yielding hybrids gave a large response to irrigation while others gave a moderate response.

Nine of the 17 hybrids that were significantly better than average in yield irrigated were also significantly better than average in yield without irrigation. Nine of the 13 hybrids that were significantly better than average in yield without irrigation were also significantly better than average in yield when irrigated.

The correlations of irrigated yields with unirrigated yields were highly significant -- .839 in 1969 and .860 in 1968. There was a strong tendency, in both years, for the high yielding hybrids not irrigated to be also high yielding when irrigated. Likewise, the low yielding hybrids tended to be relatively low in both unirrigated and irrigated plots. Seventy to 75 percent of the variation in yield was due to this relationship. High yielding hybrids for irrigation could be selected from unirrigated plots and vice versa with reasonable accuracy. For the present array of hybrids, it would not be necessary always to test under both irrigated and unirrigated conditions. With unlimited testing resources, it would be desirable to test under both conditions to reduce the mistakes in hybrid selection. With limited resources for testing and a willingness to accept a lower level of accuracy in hybrid selection, test results from either irrigation or no irrigation could be extrapolated to the other condition.

Hybrids significantly better than average in yield when irrigated in 1969 were (in order of early to late maturity): Northrup King PX446 (Sp), Northrup King PX476 (3X), Exp. 67-3111 (3X), Exp. 67-2103 (2X), Blaney B401 (2X), Exp. 67-3123 (3X), Jacques 951E, Michigan 400, Exp. 67-3120 (3X), Funk Bros. G17A, Exp. 67-3110 (3X), Michigan 402-2X (2X), Exp. 66-2025 (2X), Pioneer 3773 (2X), Michigan 500-2X (2X), Michigan 555-3X (3X), Michigan 568-3X (3X), DeKalb XL45 (2X).

Hybrids significantly better than average yield not irrigated in 1969 were (in order of early to late maturity); Northrup King PX446 (Sp), Exp. 67-2103 (2X), Exp. 67-3123 (3X), Michigan 400, Supercrost 163 (3X), Exp. 67-3120 (3X), Weather Master EPX-3P (2X), Exp. 67-164 (3X), Exp. 67-3110, Exp. 66-2025 (2X), Michigan 463-3X (3X), Pioneer 3773 (2X), Northrup King PX 525 (Sp), Michigan 555-3X (3X), Michigan 568-3X (3X).

<u>1968 results.</u> Detailed results for 1968 are available in <u>Michigan Corn Performance Trials - 1968</u>, Crop Science mimeo, and in <u>Corn Hybrids Compared for 1969</u>, Extension Bulletin 431.

Irrigated yields averaged 40.1 bushels more than unirrigated yields, 136.1 vs 96.0, Table 2. The highest yielding hybrid in both irrigated and unirrigated was Michigan 555-3X (3X) with yields of 182.2 and 123.2, a difference of 59.0 bushels for irrigation. The largest responses to irrigation were 61.8 bushels with DeKalb XL304 (3X), 132.0 vs. 70.2, and 61.6 bushels with Michigan 500-2X (2X), 180.4 vs 118.4.

Fourteen of 18 hybrids significantly better than average in yield irrigated were also significantly better than average in yield without irrigation. Fourteen of 16 hybrids significantly better than average in yield without irrigation were also significantly better than average in yield when irrigated.

Omitting experimental hybrids, those significantly better than average yield irrigated in 1968 were (in order of increasing maturity): Michigan 275-2X (2X), Northrup King PX446 (2X), Pioneer 3911 (2X), Michigan 500-2X (2X), Northrup King 525 (Sp), Northrup King PX519 (Sp), Michigan 568-3X (3X), Pioneer 368, Michigan 555-3X (3X), DeKalb XL45 (2X).

Hybrids significantly better than average yield not irrigated were (experimentals omitted): Michigan 275-2X (2X), Pioneer 3911 (2X), Michigan 402-2X (2X), Michigan 500-2X (2X), Northrup King PX519 (Sp), Pioneer 3773 (2X), Michigan 568-3X (3X), Pioneer 368, Michigan 555-3X (3X), DeKalb XL45 (2X).

<u>Two-year summary</u>. Table 3 presents a two-year summary of yields and stalk lodging for 63 hybrids tested in 1969 and 56 in 1968.

Table 1. Percent water holding capacity during July and August 1968 and 1969 for irrigated and non-irrigated corn plots. Montcalm Exp. Farm

Date	Irrigated Soil depth - inches				Not Irrigated Soil depth - inches			
	6	12	18	24	6	12	18	24
1968								
July 26	90	92	100+	95	27	36	41	100+
Aug. 5	100+	100+	100+	100+	19	25	35	100+
Aug. 15	77	87	100+	98	18	18	19	83
Aug. 22	93	94	100+	100+	18	18	19	21
Aug. 29	91	94	100+	100+	18	18	18	19
Sept. 4	98	100+	100+	98	21	20	20	20
Sept. 12	94	98	100+	98	20	18	18	21
Sept. 17	93	98	100	98	19	18	18	20
Sept. 27	100+	100+	100+	100	68	59	85	96
1969								
July 12	88	100+	100+	100+	100+	100+	100+	100+
July 17	50	70	90	95	70	100	100+	100+
July 24	55	60	80	88	78	92	100	100
Aug. 1	100	100+	100+	100+	65	95	100+	100+
Aug. 8	65	72	95	98	38	45	62	85
Aug. 13	100	90	100	100	21	25	50	55
Aug. 20	88	70	90	80	18	22	34	30
Aug. 26	90	77	92	68	20	20	23	20
Sept. 1	100	100+	100+	100+	20	18	18	20
Sept. 9	90	95	100+	100+	20	18	18	20

<u>1968 Irrigation = 7 1/2"</u>

July 16 = 1 1/2 inches
Aug. 2 = 1 1/2 "
Aug. 12 = 1 1/2 "
Aug. 20 = 1 1/2 "
Sept. 7 = 1 1/2 "

<u>1969 Irrigation = 6"</u>

July 26 = 1 1/2 inches
Aug. 8 = 1 1/2 "
Aug. 14 = 1 1/2 "
Aug. 27 = 1 1/2 "

Table 2. NORTH CENTRAL MICHIGAN

Montcalm County Trial

One and Two Year Averages - 1969, 1968 Zone 3

Hybrid	% Moisture 1969	% Moisture 2 Yrs.	Bushels Per Acre 1969 Irr.	Bushels Per Acre 1969 Not	Bushels Per Acre 2 Years Irr.	Bushels Per Acre 2 Years Not	% Stalk Lodging 1969 Irr.	% Stalk Lodging 1969 Not	% Stalk Lodging 2 Yrs. Irr.	% Stalk Lodging 2 Yrs. Not	% Root Lodging-69 Irr.	% Root Lodging-69 Not
Michigan 200	20.0	--	116.3	69.8	--	--	1.9	16.9	--	--	0.0	0.0
Northrup King PX428 (3X)	20.1	--	114.0	79.2	--	--	4.0	11.9	--	--	0.0	0.0
Blaney B220 (3X)	20.8	--	116.5	67.3	--	--	1.6	21.3	--	--	0.0	0.0
Northrup King PX417 (3X)	21.1	--	96.7	73.0	--	--	7.8	20.0	--	--	0.0	0.0
Jacques JX952	21.3	24	114.8	92.0	111	91	1.6	12.1	2	7	0.0	0.0
Michigan 270	21.5	22	114.4	88.0	119	91	10.6	23.0	8	17	0.0	0.0
Northrup King PX442 (Sp)	21.8	--	122.7	86.3	--	--	3.3	11.9	--	--	0.0	0.0
Michigan 275-2X (2X)	22.0	23	150.3	93.0	157	101	3.4	27.8	2	18	0.0	0.0
Mich. Exp. 65-2002A (2X)	22.1	24	140.8	86.9	149	98	8.2	20.3	5	10	0.0	0.0
Cowbell SX24 (2X)	22.2	24	121.7	75.5	122	74	4.1	19.7	3	12	0.0	0.0
Michigan 250	22.2	24	126.9	82.9	136	91	5.6	19.2	5	13	0.0	0.0
Michigan 280	22.3	23	139.1	83.6	151	96	3.1	14.2	3	14	0.8	0.0
Weather Master EPX-2P(2X)	22.5	--	147.8	79.3	--	--	2.3	13.7	--	--	0.0	0.0
Pioneer 3854	22.5	24	121.4	73.0	116	77	0.8	23.0	0	16	0.0	0.0
Mich. Exp. 67-3119 (3X)	22.8	--	139.1	85.0	--	--	2.7	14.7	--	--	0.0	0.0
Michigan 300	23.0	--	149.4	91.3	--	--	0.8	18.1	--	--	0.0	2.4
Weather Master EPX-1(2X)	23.3	--	138.2	55.3	--	--	10.9	57.8	--	--	0.0	0.0
2Northrup King PX446 (Sp)	23.6	25	158.9	101.1	156	96	2.4	18.8	2	11	0.0	0.0
Weather Master EPX-1P(2X)	23.6	--	148.4	90.1	--	--	8.5	30.7	--	--	0.0	0.0
Mich. Exp. 67-165 (3X)	23.8	--	156.1	92.6	--	--	3.7	7.0	--	--	0.0	1.0
1Northrup King PX476 (3X)	23.9	--	157.9	91.6	--	--	0.8	18.6	--	--	0.0	0.0
Pioneer 388	24.0	25	127.2	70.4	114	74	3.3	19.2	4	11	0.0	0.0
Pioneer 3956 (2X)	24.1	--	152.4	79.5	--	--	0.0	11.5	--	--	0.0	0.0
1Mich. Exp. 67-3111 (3X)	24.2	--	159.8	93.5	--	--	4.8	18.6	--	--	0.0	0.0
2Mich. Exp. 67-2103 (2X)	24.3	--	171.3	108.6	--	--	1.8	5.8	--	--	0.0	0.0
DeKalb XL304 (3X)	24.4	26	119.0	75.9	126	73	2.3	14.4	2	9	1.5	0.0
Pioneer 3911 (2X)	24.6	25	148.4	92.2	153	101	8.5	24.4	4	16	0.0	0.0
1Blaney B401 (2X)	25.2	26	169.9	89.3	153	94	4.6	9.8	2	9	0.0	0.0
2Mich. Exp. 67-3123 (3X)	25.5	--	160.2	96.1	--	--	3.4	19.7	--	--	0.0	0.0
Teweles SXT14 (2X)	25.5	26	127.4	76.7	117	74	1.6	14.5	1	11	0.0	0.0
1Jacques JX951E	25.5	26	157.9	87.7	137	85	0.8	21.5	0	12	0.0	0.0
Northrup King PX22 (2X)	25.5	27	132.9	76.3	131	84	0.0	26.8	0	15	0.0	0.0
Weather Master EP30 (3X)	25.6	27	151.8	74.3	123	70	0.8	19.5	0	12	0.0	0.0
Super Crost S19 (2X)	25.6	26	153.9	91.5	151	97	0.8	10.9	1	8	0.0	0.0
2Michigan 400	25.7	26	160.3	96.6	151	97	2.3	8.3	2	8	0.0	2.5
Super Crost 163 (3X)	25.7	27	141.5	96.1	142	95	0.8	8.7	1	5	0.8	0.0
1Mich. Exp. 67-3120 (3X)	26.1	--	163.1	103.7	--	--	2.3	20.8	--	--	0.0	0.0
1Funk Bros. G17A	26.2	27	165.7	89.1	157	94	5.0	12.1	3	9	0.0	0.0
2Weather Master EPX-3P(2X)	26.2	26	143.1	98.8	130	90	0.0	15.0	0	9	0.0	0.0
Mich. Exp. 67-3118 (3X)	26.3	--	147.4	80.7	--	--	7.6	24.2	--	--	0.8	0.0

Table 2 continued. Montcalm County

2Mich. Exp. 67-164	26.3	--	150.7	100.8	--	--	5.8	20.2	--	--	0.0	0.0
2Mich. Exp. 67-3110	26.3	--	178.0	104.3	--	--	0.8	23.4	--	--	0.0	0.0
1Michigan 402-2X (2X)	26.3	26	164.8	98.4	157	105	7.4	24.4	4	16	0.0	0.0
DeKalb XL315 (3X)	26.4	28	130.6	72.4	135	76	3.2	17.8	2	10	0.0	0.0
Weather Master EP35 (3X)	26.7	--	144.7	82.5	--	--	1.6	18.5	--	--	0.0	0.0
2Mich. Exp. 66-2025 (2X)	26.9	--	172.2	99.4	--	--	3.3	17.9	--	--	0.0	0.0
DeKalb XL24 (2X)	27.1	--	149.0	88.1	--	--	1.5	11.0	--	--	0.0	0.0
2Michigan 463-3X (3X)	27.3	28	154.8	95.1	155	100	2.4	19.5	3	12	0.0	0.0
Funk Bros. G4287 (3X)	27.3	27	149.9	88.2	146	90	3.1	14.8	3	7	0.0	0.8
Teweles SXT61 (3X)	27.3	28	153.3	93.7	151	101	2.3	5.6	1	4	0.0	0.0
Northrup King KE497	27.3	28	137.6	80.4	126	84	4.6	22.3	3	15	0.0	0.0
DeKalb XL306 (3X)	27.3	--	153.5	75.3	--	--	0.8	23.6	--	--	0.0	0.0
Wolverine 59	27.6	--	138.0	80.5	--	--	7.3	11.8	--	--	0.0	0.0
Mich. Exp. 67-360 (2X)	27.7	--	127.9	84.9	--	--	0.0	10.0	--	--	1.2	6.0
2Pioneer 3773 (2X)	27.7	28	184.9	101.2	164	109	0.0	15.2	1	8	0.0	0.0
Funk Bros. G4222 (2X)	28.0	29	141.8	81.2	137	91	1.6	14.5	2	9	0.0	0.0
1Michigan 500-2X (2X)	28.0	28	173.5	94.6	177	107	1.7	13.9	1	9	0.0	1.6
Pioneer 368	28.3	29	148.1	93.4	152	100	1.5	14.2	2	9	0.0	0.0
2Northrup King PX525(SP.)	29.1	29	156.4	94.9	155	98	0.8	19.0	1	11	0.0	0.0
2Michigan 555-3X (3X)	29.1	30	173.7	101.7	178	113	0.8	13.8	0	8	0.0	0.0
2Michigan 568-3X (3X)	29.2	30	157.9	104.3	162	111	1.6	17.1	1	9	0.0	0.0
1DeKalb XL45 (2X)	30.4	31	167.1	83.2	163	94	2.3	8.9	1	5	0.0	0.8
Mich. Exp. 67-462 (2X)	30.7	--	156.3	85.6	--	--	1.0	10.8	--	--	0.0	0.0
Average	25.1	26	146.0	85.5	143	92	2.9	17.5	2	11	0.1	0.2
Range	20.0 to 30.7	22 to 31	96.7 to 184.9	56.3 to 108.6	111 to 178	70 to 113	0.0 to 10.9	5.6 to 57.8	0 to 8	4 to 18	0.0 to 1.5	0.0 to 6.0
Least significant diff.	0.8	0.6	12.8	9.4	6	5						

1 - Significantly better than average yield, irrigated 1969.
2 - Significantly better than average yield, not irrigated 1969.

	1969	1968
Planted	May 3	May 4
Harvested	Oct. 31	Oct. 26
Soil type	Montcalm sandy loam	Montcalm sandy loam
Previous crop	Sorghum-sudan seeded to rye in fall.	Sorghum-sudan seeded to rye in fall.
Population	19,500	19,600
Rows	30"	30"
Fertilizer	205-160-160	236-190-190
Soil test: pH	6.2	6.2
P	242 (very high)	256 (very high)
K	237 (high)	220 (high)
Irrigation	6.0"	7.5"

Table 3. Average, highest and lowest yields and % stalk lodging for 63 hybrids in 1969 and 56 hybrids in 1968 with 2 year averages.

Year	Average		Highest Yielding Hybrids		Lowest Yielding Hybrids	
	Irrigated	Not Irrig.	Irrigated	Not Irrig.	Irrigated	Not Irrig.
			Yields			
1969	146.0	85.5	184.9	108.6	96.7	56.3
1968	136.1	96.0	182.2	123.2	92.2	65.4
2 Yr. Ave.	141.0	90.8	183.6	115.9	94.5	60.9
			% Stalk Lodging			
1969	2.9	17.5	10.9	57.8	0.0	5.6
1968	1.1	4.3	5.0	13.9	0.0	0.0
2 Yr. Ave.	2.0	10.9	8.0	35.9	0.0	2.8

Yield. Irrigated corn averaged 50.2 bushels more than unirrigated, 141.0 vs 90.8. The highest yielding hybrids averaged 67.7 bushels more when irrigated (183.6 vs 115.9) and the lowest yielding hybrids averaged 33.6 bushels more (94.5 vs 60.9).

Dr. C. R. Hoglund, M.S.U. Department of Agricultural Economics, has calculated that an increased yield of about 40 bushels per acre is needed to "break even" on corn irrigation costs. These costs will vary depending on type of equipment, labor requirements, acres irrigated, etc. Irrigation response of the highest yielding hybrids was twice as great as the response of the lowest yielding hybrids, 67.7 vs 33.6 bushel increases from irrigation. Profitability from irrigation was good for high-yield hybrids. Irrigation profits from low-yield hybrids were marginal.

Stalk lodging. All of the corn irrigation experiments in 1968 and 1969 at the Montcalm Experimental Farm have shown a striking and consistent difference in stalk lodging between non-irrigated and irrigated corn. Stalk lodging averaged 5.5 times more for non-irrigated corn, 10.9 vs 2.0%.

Stalk rot develops more readily and rapidly in dead or dying plants. Premature death or retardation from leaf blights, drouth, etc. disposes the plant to attack by stalk rotting fungi, Gibberella and/or Diplodia, earlier. Irrigated plants remained green with active growth longer than non-irrigated plants.

Stalk lodging for high yielding hybrids averaged much higher than low yielding hybrids for both irrigated and unirrigated -- 8.0 vs 0.0% for irrigated and 35.9 vs 2.8% for non-irrigated.

Yellow Leaf Blight. Ratings for Yellow Leaf Blight, *Phyllosticta* sp., were made on August 19, 1969 by Joe Clayton, Botany and Plant Pathology. The total of rating scores (0 to 3) was 312 for non-irrigated corn and 578 for irrigated corn. YLB disease ratings averaged twice as high for the irrigated plots. Moisture and humidity are considered to be important factors facilitating the spread and development of this fungus disease.

YLB is a relatively new leaf disease on corn in Michigan and other nearby states. It first became noticeable in 1968 with much wider prevalence and severity in 1969. The causal organism is capable of overwintering in Michigan and other northern states on corn refuse. Infection on corn can start early the following season. In contrast, Northern Leaf Blight (*Helminthosporium turcicum*) which has appeared periodically in Michigan for many years does not overwinter here. NLB infection occurs as a result of spores moving progressively northward from southern states, and infection usually occurs in late summer with relatively little damage.

Hybrids X Population X Irrigation

Table 4 and 5 present average yields for five corn hybrids at four plant populations (15M, 19M, 23M, 27M) irrigated and non-irrigated in 1968 and 1969. Stalk lodging and moisture content of grain are given in Tables 6 and 7. Two-year averages for population X irrigation are in Table 8.

Table 4. Average yields for 5 corn hybrids at 4 plant populations not irrigated and irrigated. Montcalm - Comden Farm. 1968.

Hybrid		Plant Population 15,000	19,200	23,100	27,300	Average
Michigan 275-2X	Not Irrigated	122.2	133.7	94.6	59.6	102.5
"	Irrigated	148.7	165.7	193.2	184.7	173.1
	Difference=bu.	26.5	32.0	98.6	125.1	70.6
	Difference=%	21.7	23.9	104.2	209.8	68.9
Exp. 65-2002	Not Irrigated	106.1	133.7	93.4	75.8	102.3
"	Irrigated	144.5	192.7	218.4	205.5	190.3
	Difference=bu.	38.4	59.0	125.0	129.7	88.0
	Difference=%	36.2	44.1	133.8	171.1	86.0
Exp. 65-2002A	Not Irrigated	104.2	119.6	114.1	118.3	114.1
"	Irrigated	142.4	172.7	183.7	177.8	169.2
	Difference=bu.	38.2	53.1	69.6	59.5	55.1
	Difference=%	36.7	44.4	61.0	50.3	48.3
Exp. 65-2002B	Not Irrigated	119.6	138.9	126.3	99.8	121.2
"	Irrigated	132.8	151.9	188.1	176.8	162.4
	Difference=bu.	13.2	13.0	61.8	77.0	41.2
	Difference=%	11.0	9.4	48.9	77.1	34.0
Michigan 402-2X	Not Irrigated	117.5	125.1	106.8	93.6	110.8
"	Irrigated	148.9	163.7	182.2	147.4	160.6
	Difference=bu.	31.4	38.6	75.4	53.8	49.8
	Difference=%	26.7	30.9	70.6	57.4	44.9
Average	Not Irrigated	113.9	130.2	107.0	89.4	110.2
"	Irrigated	143.5	169.3	193.1	178.4	171.1
	Difference=bu.	29.6	39.1	86.1	89.0	60.9
	Difference=%	26.0	30.0	80.5	99.5	55.3

Least significant differences: among hybrid x population x irrigation yields=12.1 bu.
among hybrid x population averages = 6.5 bu.
among population x irrigation averages = 7.4 bu.

Planted--May 4
Soil type--Montcalm sandy loam
Rows = 30"
Harvested--Oct. 26
Previous crop=Sorghum-sudan seeded to rye in fall
Fertilizer = 236-190-190
Soil test: pH = 6.2, P = 256 (very high), K = 220 (high)
Irrigation: Five times, 1.5" each, mid July to September 7. Total 7.5 inches.
Cooperator: Theron Comden, Entrican

Table 5. Average yields for 5 corn hybrids at 4 plant populations not irrigated and irrigated. Montcalm - Comden Farm. 1969.

Hybrid		Plant Population 15,200	19,400	23,300	27,400	Average
Michigan 280	Not Irrigated	89.5	107.8	87.1	77.2	90.4
" 280	Irrigated	128.9	141.8	160.3	136.1	141.8
	Difference=bu.	39.4	34.0	73.2	58.9	51.4
	Difference=%	44.0	31.5	84.0	76.2	56.7
Michigan 275-2X	Not Irrigated	93.8	123.4	92.9	78.9	97.3
" 275-2X	Irrigated	109.1	148.9	183.8	131.3	143.3
	Difference=bu.	15.3	25.5	90.9	52.4	46.0
	Difference=%	16.3	20.7	97.8	66.4	47.2
Exp. 65-2002A	Not Irrigated	91.4	102.3	101.0	90.9	96.4
" 65-2002A	Irrigated	127.7	155.7	157.5	132.8	143.4
	Difference=bu.	36.3	53.4	56.5	41.9	47.0
	Difference=%	39.7	52.2	55.9	46.0	48.7
Michigan 402-2X	Not Irrigated	88.1	109.2	106.5	105.6	102.4
" 402-2X	Irrigated	134.2	172.8	183.4	164.5	163.7
	Difference=bu.	46.1	63.6	76.9	58.9	61.3
	Difference=%	52.3	58.2	72.2	55.8	59.9
Michigan 500-2X	Not Irrigated	90.5	100.0	91.1	78.8	89.9
" 500-2X	Irrigated	127.7	168.4	180.9	174.2	162.8
	Difference=bu.	37.2	68.4	89.8	95.4	72.9
	Difference=%	41.1	68.4	98.5	121.0	81.0
Average	Not Irrigated	90.7	108.5	95.7	86.3	95.3
"	Irrigated	125.5	157.5	173.2	147.8	151.0
	Difference=bu.	34.8	49.0	77.5	61.5	55.7
	Difference=%	38.3	45.2	80.9	71.2	58.4

Least significant difference: among hybrid x population x irrigation yields=10.2 bu.
among hybrid x irrigation averages = 5.5 bu.
among population x irrigation averages = 6.3 bu.

Planted--May 3 Harvested--Oct. 31
Soil type--Montcalm sandy loam Previous crop=Sorghum-sudan seeded to rye in fall
Rows = 30" Fertilizer = 205-160-160
Soil test: pH = 6.2, P = 242 (very high), K = 237 (high)
Irrigation: 1.5" each on July 26, August 8, 14, 27. Total = 6.0 inches
Cooperator: Theron Comden, Entrican

Table 6. Average stalk loding percentages and moisture content of grain for 5 corn hybrids at 4 plant populations not irrigated and irrigated. Montcalm - Comden Farm. 1968.

Hybrid		Plant Populations 15,000	19,200	23,100	27,300	Ave.	Average % moisture in grain
Michigan 275-2X	Not Irrigated	4.9	3.9	25.2	28.3	15.6	24.0
" 275-2X	Irrigated	0.0	0.0	2.1	3.2	1.3	24.9
Exp. 65-2002	Not Irrigated	0.0	3.1	4.1	22.8	7.5	25.4
" 65-2002	Irrigated	1.1	0.7	4.7	5.3	3.0	26.2
Exp. 65-2002A	Not Irrigated	3.9	6.3	12.3	20.7	10.8	25.4
" 65-2002A	Irrigated	1.0	0.7	3.7	3.4	2.2	26.3
Exp. 65-2002B	Not Irrigated	3.8	3.7	7.4	12.0	6.7	27.1
" 65-2002B	Irrigated	0.0	0.8	1.3	0.5	0.7	27.0
Michigan 402-2X	Not Irrigated	3.9	8.3	11.7	18.2	10.5	29.2
" 402-2X	Irrigated	1.1	0.0	1.7	4.7	1.9	29.5
Average	Not Irrigated	3.3	5.1	12.1	20.4	10.2	
"	Irrigated	0.6	0.4	2.7	3.4	1.8	
Average % moisture in grain	Not Irrigated	26.4	26.2	25.9	26.4		26.2
Average % moisture in grain	Irrigated	26.6	27.2	26.6	26.6		26.8

Table 7. Average stalk lodging percentages and moisture content of grain for 5 corn hybrids at 4 plant populations not irrigated and irrigated. Montcalm Exp. Farm. 1969.

Hybrid		Plant Populations 15,200	19,400	23,300	27,400	Ave.	Average % Moisture in Grain
Michigan 280	Not Irrigated	15.5	18.3	21.6	19.4	18.7	21.8
"	Irrigated	3.7	5.8	5.8	7.5	5.7	23.5
Michigan 275-2X	Not Irrigated	24.4	25.9	26.3	34.7	27.8	22.3
"	Irrigated	1.9	0.8	0.6	2.5	1.5	24.9
Exp. 65-2002A	Not Irrigated	16.3	26.7	31.3	30.5	26.2	22.5
" "	Irrigated	1.5	2.8	6.9	10.1	5.3	23.7
Michigan 402-2X	Not Irrigated	21.6	26.4	32.8	43.8	31.2	24.9
"	Irrigated	2.9	2.6	3.2	3.8	3.1	27.0
Michigan 500-2X	Not Irrigated	14.9	19.6	27.9	43.8	26.6	27.2
"	Irrigated	1.9	1.5	0.6	2.3	1.6	29.9
Average	Not Irrigated	18.5	23.4	28.0	34.4	26.1	
"	Irrigated	2.4	2.7	3.4	5.2	3.4	
Average % Moisture in grain	Not Irrigated	23.6	23.4	24.3	23.6		23.7
Average % Moisture in grain	Irrigated	24.9	26.2	25.9	26.2		25.8

Yield. Non-irrigated yields peaked for all hybrids at the 19,000 plant population and decreased at 23,000 and 27,000. Irrigated yields peaked at 23,000 and decreased at 27,000. With irrigation, yields continued to increase up to 23,000 (183.2 bu.) while without irrigation yields increased up to 19,000 population (119.4 bu.), Table 8.

The highest yield was 218.4 bushels for Exp. 65-2002 at 23,100 population irrigated in 1968. This hybrid was not included in the 1969 experiments. In 1969, highest yields were 183.8, 183.4 and 180.9 for Michigan 275-2X, 402-2X and 500-2X respectively, at 23,300 irrigated. Without irrigation, the high yields were 123.4, 109.2 and 100.0 for these three hybrids at 19,400. Michigan 500-2X is a late maturing hybrid in the Montcalm area of Michigan.

Response to irrigation averaged 32.2, 44.0, 81.8 and 75.2 bushels for populations of 15,100, 19,300, 23,200 and 27,300 respectively for the two year period. Irrigation profits at either 15,100 or 19,300 were submarginal or near-marginal using the 40 bushel per acre cost-of-irrigation value of Dr. C. R. Hoglund. Profits at 23,200 population were good. Irrigation at a 27,300 population would appear questionable since the average yield was about equal to that at 15,100. Even though the response to irrigation at 27,300 was high, profitability would be questionable compared to average yield at 19,300 without irrigation.

Stalk lodging. Stalk lodging was consistently much higher without irrigation than with irrigation, 18.2 vs 2.6%. Lodging increased consistently with increased plant population without irrigation, averaging about 5% increase for each additional 4,000 plants per acre. With irrigation, lodging increased only about 1% for each additional 4,000 plant population. The plots were harvested relatively early in both years, October 26, 1968 and October 31, 1969. Lodging would probably increase rapidly with later harvests.

Moisture content of grain at harvest. The effect of either irrigation or plant population on grain moisture was small. Irrigated corn averaged .6% higher in moisture in 1968 and 2.1% higher in 1969. Differences due to population were smaller and showed no consistent trend in either year.

Upright Leaf Hybrids X Population X Irrigation

Photosynthetic efficiency of hybrids with an upright leaf pattern in narrow rows at high plant populations might be higher than for those with a more horizontal leaf pattern. Theoretically, a more vertical leaf canopy should expose more total leaf surface to more sunlight with less shading of lower leaves than a horizontal leaf canopy.

The experimental upright leaf single-cross hybrids used in these experiments have a leaf angle of about 45-60° with the soil surface. Liguless leaf hybrids have more erect leaves, 70-80° angles. Their leaves are more subject to shredding and breaking from wind action and yields have not been as good in our tests.

One experimental upright leaf single-cross, MS 153 X W410A, was used in the 1968 experiment at four populations with and without irrigation, Table 9. Five single-crosses were used in the 1969 experiment, Tables 10 and 11.

Table 8. Two-year average yields and stalk lodging for four plant populations not irrigated and irrigated. Montcalm Exp. Farm 1968-1969.

	Plant Population				
	15,100	19,300	23,200	27,300	Average
	Yield - Bushels Per Acre				
Not Irrigated	102.3	119.4	101.4	87.9	102.8
Irrigated	134.5	163.4	183.2	163.1	161.1
Difference = bu.	32.2	44.0	81.8	75.2	58.3
Difference = %	31.5	36.8	80.7	85.5	56.7
	% Stalk Lodging				
Not Irrigated	10.9	14.3	20.1	27.4	18.2
Irrigated	1.5	1.6	3.1	4.3	2.6

Table 9. Average yields for an experimental upright leaf single-cross hybrid, MS153 x W410A, at four plant populations not irrigated and irrigated. Montcalm Exp. Farm, 1968.

	Plant Population				
	15,500	19,800	23,300	27,400	Average
Not Irrigated	121	131	120	73	111
Irrigated	155	184	204	177	180

Least significant difference = 11 bushels

Planted - May 4
Harvested - October 26
Soil type - Montcalm sandy loam
Previous crop - Sorghum-sudan seeded to rye in fall
Rows = 30"
Fertilizer - 236-190-190
Soil test: pH = 6.2, P = 256 (very high), K = 220 (high)
Irrigation = 7.5 " mid-July to September 7

Table 10. Average yields of 5 experimental upright leaf single-cross corn hybrids at 4 plant populations not irrigated and irrigated. Montcalm Exp. Farm. 1969.'

Hybrid		Plant Population				
		14,700	18,800	22,900	27,000	Average
A295 x MS153	Not Irrigated	103.2	112.9	113.1	102.0	107.8
" "	Irrigated	114.2	143.5	158.2	121.7	134.4
	Difference = bu.	11.0	30.6	45.1	19.7	26.6
	Difference = %	10.7	27.1	39.9	19.3	24.7
A295 x Pa. 54	Not Irrigated	101.3	113.5	99.2	96.4	102.6
" "	Irrigated	129.9	155.6	128.8	131.6	136.4
	Difference = bu.	28.6	42.1	29.6	35.2	33.8
	Difference = %	28.2	37.1	29.6	36.5	32.9
A295 x MS214	Not Irrigated	87.2	88.7	75.0	63.3	78.6
" "	Irrigated	113.6	149.3	120.4	118.9	125.6
	Difference = bu.	26.4	60.6	45.4	55.6	47.0
	Difference = %	30.2	68.3	60.5	87.8	59.7
MS153 x Pa. 54	Not Irrigated	83.5	89.9	89.0	86.9	87.3
" "	Irrigated	125.4	135.9	131.7	110.3	125.8
	Difference = bu.	41.9	46.0	42.7	23.4	38.5
	Difference = %	50.1	51.1	48.0	26.9	44.1
MS153 x W410A	Not Irrigated	112.4	145.8	103.5	91.2	113.2
" "	Irrigated	147.8	187.1	201.0	154.9	172.7
	Difference = bu.	35.4	41.3	97.5	63.7	59.5
	Difference = %	31.5	28.3	94.2	69.8	52.6
Average	Not Irrigated	97.5	110.2	96.0	88.0	97.9
"	Irrigated	126.2	154.3	148.0	127.5	139.0
	Difference = bu.	28.7	44.1	52.0	39.5	41.1
	Difference = %	29.4	40.0	54.1	44.8	42.0

Least significant differences: among hybrid x population x irrigation yields=11.1 bu.
among hybrid x irrigation averages = 5.9 bu.
among population x irrigation averages = 6.5 bu.

Planted - May 3 Harvested - October 31
Soil type - Montcalm sandy loam Previous crop- Sorghum-sudan seeded to rye in fall
Rows = 30" Fertilizer = 205-160-160
Soil test: pH = 6.2, P = 242 (very high), K = 237 (high)
Irrigation: 1.5"each on July 26, August 8, 14, 27. Total = 6.0 inches
Cooperator: Theron Comden, Entrican

Table 11. Average stalk lodging percentages and moisture content of grain for 5 experimental upright leaf single-cross corn hybrids at 4 plant populations not irrigated and irrigated. Montcalm Exp. Farm. 1969.

Hybrid		Plant Population					Average % Moisture in Grain
		14,700	18,800	22,900	27,000	Ave.	
A295 x MS153	Not Irrigated	7.5	10.6	10.2	10.2	9.6	26.2
" "	Irrigated	0.0	6.5	5.5	6.1	4.5	28.4
A295 x Pa. 54	Not Irrigated	10.6	16.7	18.8	19.1	16.3	26.1
" "	Irrigated	1.5	2.8	7.7	9.1	5.3	27.4
A295 x MS214	Not Irrigated	6.6	9.5	12.9	15.9	11.2	25.3
" "	Irrigated	0.0	2.2	8.5	3.8	4.9	25.5
MS153 x Pa. 54	Not Irrigated	14.6	14.6	16.5	28.0	18.4	25.9
" "	Irrigated	0.7	3.8	5.7	8.4	4.7	25.2
MS153 x W410A	Not Irrigated	3.6	2.9	5.7	19.0	7.8	31.8
" "	Irrigated	1.5	3.7	4.7	4.1	3.5	32.6
Average	Not Irrigated	8.6	10.9	12.8	18.4	12.7	
"	Irrigated	0.7	3.8	6.4	7.3	4.7	
Average % Moisture in grain	Not Irrigated	25.7	27.3	27.2	28.0		27.1
Average % Moisture in grain	Irrigated	27.7	27.9	27.6	28.1		27.8

The highest yield in 1968 for MS153 X W410A was 204 bushels per acre at 23,800 population irrigated. The best yield unirrigated was 131 bushels at 19,800 population. Exp. 65-2002 (2X) with a more normal horizontal flat leaf patterns produced 218.4 bushels, Table 4, with a 23,100 population irrigated in an adjacent experiment in the same field. It yielded 133.7 bushels without irrigation at 19,200.

MS153 X W410A was the highest yielding of the five upright leaf hybrids in 1969. It is late in maturity for the Montcalm area. The highest yield was 201.0 bushels at 22,900 irrigated and 145.8 unirrigated at 18,800. Michigan 275-2X and Michigan 402-2X with yields of 183.8 and 183.4 at 23,300 irrigated were highest among five horizontal leaf hybrids in an adjacent experiment in the same field. Their best yields without irrigation were 123.4 and 109.2 at 19,400 population.

The best upright leaf hybrid, MS153 X W410A, yielded less in 1968 and more in 1969 than the best horizontal leaf hybrid. For the two years, it averaged 202.5 bushels per acre irrigated and 138.4 without irrigation. The best horizontal leaf hybrids in the adjacent experiments averaged 201.1 irrigated and 128.6 unirrigated. With the hybrids used here, there was no consistent indication that the best upright leaf hybrid was superior to the best horizontal leaf hybrid.

Average stalk lodging without irrigation for the upright leaf hybrids, Table 11, was about half that for the horizontal leaf hybrids, Table 7, 12.7 vs 26.1%. With irrigation and lower incidence of lodging, the average breakage was similar for the two groups of hybrids 4.7 and 3.4%. Upright leaf hybrids also showed a marked and consistent increase in stalk lodging without irrigation and lodging increased with increasing plant populations.

Summary

Irrigation response of the highest yielding hybrids was twice as great as the response of the lowest yielding hybrids, 67.7 vs 33.6 bushel increases from irrigation. The highest yielding hybrids averaged 67.7 bushels more when irrigated (183.6 vs 115.9) and the lowest yielding hybrids averaged 33.6 bushels more (94.5 vs 60.9) for two year averages. Profitability from irrigation was good for high-yield hybrids. Irrigation profits from low-yield hybrids were marginal.

Response (irrigated yield-unirrigated yield) to irrigation was not entirely related to relative yielding ability of corn hybrids. Large responses were made by most high-yield and by some low-yield hybrids.

There was a close relationship, significant correlation, between irrigated and unirrigated yields of hybrids. High-yield hybrids without irrigation tended to be high in yield when irrigated.

Five hybrids with the highest two-year average irrigated yields were: Michigan 555-3X, Michigan 500-2X, Pioneer 3773, DeKalb XL45, and Michigan 568-3X. These were all relatively late in maturity for the Montcalm area. Five hybrids with highest unirrigated yields were: Michigan 555-3X, Michigan 568-3X, Pioneer 3773, Michigan 500-2X, and Michigan 402-2X. Four of the five highest were common to both groups, irrigated and non-irrigated.

Stalk lodging averaged 5.5 times higher without irrigation, 10.9 vs 2.0%. Highest yielding hybrids had more stalk lodging than low yielding hybrids for both irrigated and non-irrigated conditions -- 8.0 vs 0.0% for irrigated and 35.9 vs 2.8% for non-irrigated.

Infection with Yellow Leaf Blight was almost twice as high for irrigated plots.

Non-irrigated yields peaked at a plant population of 19,000 (119.4 bu.) and then decreased significantly at 23,000 and 27,000. Irrigated yields continued to increase with population to a peak of 23,000 plants (183.2 bu.) and decreased significantly at 27,000.

Response to irrigation averaged 32.2, 44.0, 81.8 and 75.2 bushels for populations of 15,100, 19,300, 23,200 and 27,300 respectively. Irrigation profits at either 15,100 or 19,300 were sub-marginal or near-marginal using the 40 bushel per acre cost-of-irrigation value from Dr. C. R. Hoglund, Department of Agricultural Economics. Profits at 23,200 population were good. Irrigation profits at 27,300 appeared to be questionable since the average yield was about equal to that at 19,000 irrigated.

Stalk lodging increased consistently with increased plant population without irrigation, averaging about 5% more lodging for each additional 4,000 plants per acre. With irrigation, lodging increased only about 1% for each additional 4,000 plant population.

The effect of either irrigation or plant population on grain moisture at harvest was small. Irrigated corn average .6% higher in moisture in 1968 and 2.1% higher in 1969. Grain moisture differences due to plant population were small and inconsistent in both years.

The best experimental upright leaf single-cross hybrid was not consistently better than the best horizontal leaf hybrids. The highest yield in 1968 was 218.4 bushels for Exp. 65-2002 (2X), an experimental horizontal leaf single-cross hybrid irrigated at 23,100 population. The highest yield in 1969 was 201.0 bushels for MS153 X W410A, an experimental upright leaf single cross irrigated at 22,900 population.

Soil Fertility Research on Sweet Corn at the Montcalm Experimental Farm -1969-

M. L. Vitosh

Department of Crop and Soil Sciences

Experimental Results and Discussion

Five types of fertilizer experiments with sweet corn were conducted in 1969. All of these experiments were planted May 15 and 16 and harvested August 18 and 19, 1969. The nitrogen rate and time experiment and the nitrogen carrier study were planted to the Early Jubilee variety. Weeds were controlled with 1.6 lbs atrazine plus 0.5 lbs 2,4-D per acre applied as an early postemergence herbicide. A plant population of 18,000 plants per acre in 28 inch rows was obtained in each experiment and all treatments were replicated four times. Approximately 2.5 inches of irrigation water was applied to each experiment during the first and second weeks of August. All banded fertilizer was placed 2 inches to the side and 1 inch below the seed. Yields of sweet corn were harvested when the kernels were in the milk stage.

Rate and Time of Nitrogen Application

This experiment received a basic fertilizer application of 50 lbs P_2O_5 and 100 lbs K_2O per acre banded at planting time. The nitrogen treatments were either broadcast and plowed down prior to planting, banded at planting time, or sidedressed several weeks after planting.

Results of this experiment are shown in Table 1. Banded nitrogen again proved superior to broadcasting before planting and is a much more efficient method of applying nitrogen on this particular soil. Likewise, sidedressing nitrogen was more efficient in supplying nitrogen to sweet corn than either banding or broadcasting before planting. When higher rates of nitrogen are used, however, differences in methods of application are not as great.

Rate and Time of Potassium Application

This experiment received a basic fertilizer application of 60 lbs N and 50 lbs P_2O_5 per acre banded at planting time. An additional 60 lbs of N was sidedressed several weeks after emergence. Potassium treatments were either broadcast and plowed down prior to planting or banded at planting time.

Results of this experiment are recorded in Table 2. Although yields were not significantly affected by the K treatments, a slight decrease was noted with all K treatments when compared to the no K treatment. Symptoms similar to Mg deficiency were observed in this experiment. The soil test Mg level which was 156 lbs Mg per acre normally would not indicate Mg deficiency. However, with certain varieties or plant species, there have been instances where the addition of K created an imbalance which reduces the uptake of Mg by the plant. Further study of this K-Mg interrelationship is needed to explain the results of this experiment.

Table 1. Effects of rate and time of nitrogen application on yield of irrigated sweet corn.

Nitrogen Application[a] lbs of N per acre				Yield (Cwt./A)
Broadcast	Banded	Sidedressed	Total	
0	0	0	0	42
0	30	0	30	92
0	60	0	60	108
60	0	0	60	87
30	30	0	60	109
60	30	0	90	125
90	30	0	120	123
0	30	30	60	118
0	30	60	90	127
30	30	30	90	118
LSD (.05) Treatments				18

(a) Broadcast, banded and sidedress N treatments were applied 4/25/69, 5/15/69 and 6/25/69 respectively.

Table 2. Effects of rate and time of potassium application on yield of irrigated sweet corn.

Potassium Application lbs of K_2O per acre (a)			Sweet Corn
Broadcast	Banded	Total	Yield (cwt/A)
0	0	0	150
0	20	20	129
0	40	40	129
0	60	60	133
0	80	80	135
120	40	160	128
20	0	20	140
40	0	40	134
80	0	80	140
LSD (.05) treatments			NS

(a) Applied as KCl

Nitrogen Carrier Study

The objective of this experiment was to evaluate several sources of nitrogen fertilizer on yield of sweet corn. The sources of N used were ammonium sulfate, ammonium nitrate, calcium nitrate, urea, and anhydrous ammonia. Nitrogen was applied at a rate of 75 lbs N per acre. All treatments were banded at planting time except the anhydrous ammonia treatment, which was sidedressed approximately 6 weeks after planting. In addition to N fertilizer, sweet corn received 50 lbs P_2O_5 and 100 lbs K_2O per acre banded at planting time.

Results of this experiment are shown in Table 3. The late application of anhydrous ammonia produced yields which were significantly better than the other treatments. Rainfall between the time of planting and the time of application of anhydrous ammonia probably caused significant losses of the N applied at planting time. It is our opinion that any of the other sources of nitrogen would have been equally as good as anhydrous ammonia had they been applied at the same time.

Table 3. Effect of different sources of nitrogen on yield of irrigated sweet corn.

Source of Nitrogen	Sweet Corn Yield (cwt/A)
Ammonium sulfate [a]	113
Ammonium nitrate [a]	106
Calcium nitrate [a]	104
Urea[a]	116
Anhydrous ammonia[b]	130
LSD (.05) treatments	16

(a) Banded May 16, 1969

(b) Sidedressed June 24, 1969

Potassium Carrier Study

The influence of four sources of K on yields of sweet corn was studied in this experiment. All treatments except one which received no K, received a basic fertilizer application of 75 lbs N, 50 lbs P_2O_5 and 50 lbs K_2O per acre banded at planting time.

Results of this experiment are shown in Table 4. Yields of sweet corn were not significantly affected by the addition of potassium from any of the sources used. Likewise, there was no difference in yields due to sources of potassium. Soil tests for K indicates plenty of available K in this soil for growth of sweet corn.

Table 4. Effect of different sources of potassium on yield of irrigated sweet corn.

Source of Potassium (a)	Sweet Corn Yield (cwt/A)
None	132
Potassium Chloride	132
Potassium Nitrate	138
Potassium Sulfate	127
Potassium Carbonate	124
LSD treatments	NS

(a) Applied at a rate of 50 lbs K_2O per acre.

Zinc-Phosphorus Study

This experiment received a basic fertilizer application of 100 lbs N, 20 lbs P_2O_5 and 60 lbs K_2O per acre banded at planting time in 1969. The high phosphorus treatment which consisted of 300 lbs P per acre (687 lbs P_2O_5) on half of each replication was established in 1967. Two of the zinc treatments (25 lbs $ZnSO_4$ and 50 lbs AZCo C100) were also established in 1967. The other two zinc treatments (5 lbs AZCo 12 and 5 lbs $ZnSO_4$) have been applied annually for 3 years including 1969. These treatments were banded with the fertilizer at planting time.

Results of this experiment are recorded in Table 5. Yields were not affected by zinc treatments or phosphorus levels. An early growth response on the high phosphorus treatments was observed, however, as in many cases, it was not reflected in the yield.

Table 5. Effect of zinc treatments on yield of irrigated sweet corn at two soil phosphorus levels.

Treatment (a) (lbs Zn/A)	Yield (cwt/A) High P (a)	Low P (b)	Average Effects
None	139	126	133
25 lbs ($ZnSO_4$) (c)	137	132	135
50 lbs (AZCo C100) (c)	131	132	132
5 lbs (AZCo 12) (d)	136	135	136
5 lbs ($ZnSO_4$) (d)	138	137	138
LSD (.05)	NS	NS	NS
		Phosphorus Effects	
Phosphorus levels	136	132	
LSD (.05)	NS		

(a) High P = 300 lbs P/A Broadcast - 1967

(b) Low P = 9 lbs P/A Banded - 1969

(c) Broadcast in 1967

(d) Banded annually for 3 years

Tomato Research at the Montcalm Experimental Farm

1969

C. W. Nicklow and J. D. Downes
Department of Horticulture

Two replicates of a split plot factorial experiment involving N and K fertilizers, two early tomato varieties, and three intended plant populations from field seeding were planted on the Montcalm Experimental Farm on May 16, using several Stanhay seeders mounted on a tool bar to plant 4 and 5 rows 8 to 12 inches apart on five feet beds. The tomato seedlings had begun to emerge by May 31, but subsequent heavy rains caused some stand loss.

Both varieties, New Yorker and Heinz 1630, produced very acceptable yields of canning tomatoes harvested over the period September 5 to September 25. The tomatoes were fairly firm, relatively free of cracking, ground scars, stains and rots, smooth and possessed good color and flavor where moderate to high rates of N were applied. In guard beds where no fertilizer was applied, maturity was advanced but color was not so well developed and the flavor was rather flat.

The production of late season canning tomato crops from direct field seedings as far north as Entrican appear feasible. The relationships among fertility, plant populations, earliness, yields and quality remain to be determined. When the analysis of the data obtained has been completed, some information on these points will be available.

Peppermint Research at the Montcalm Experimental Farm - 1969

M. L. Vitosh

Department of Crop and Soil Sciences

In 1941 Michigan grew approximately 21,000 acres of mint. Today there are about 5,000 acres of mint grown in Michigan. The decrease is due to a disease, Verticillium wilt. Many mint producing areas became infested with this disease and as a result the crop has either been abandoned or forced to move to new areas. Today all of Michigan's mint is grown on muck land. With proper fertilization and irrigation this crop can be successfully grown on mineral soils. Much of the mint in the Pacific Northwest is now grown on mineral soils.

In 1969 an experiment was established at the Montcalm Experimental Farm to evaluate the cultural practices of growing peppermint on a mineral soil. A number of fertilizer and herbicide treatments were studied. Disease-free peppermint roots were planted April 25 in 32-inch rows. Herbicide treatments were applied several weeks after planting. The plots were harvested August 8 and 15. The samples were allowed to dry in the field for several days and then distilled at the East Lansing Muck Farm. The oil yields are shown in Table 1.

Although the yields were quite adequate, they were slightly less than was anticipated from the observations made throughout the growing season. Some heating of the plant material did occur during shipments to East Lansing, which might be responsible for the lower yields. Harvesting may also have been too early which is indicated by the higher yields of the second harvest. It is our opinion that peppermint should yield about 55 pounds and spearmint about 60 pounds per acre.

Table I.

Peppermint Fertility and Herbicide Study - 1969

Treatment			Mean Yield (lbs oil/acre)
$N-P_2O_5-K_2O$ (lbs/A)		Herbicide (Rate/Acre)	
0-0-0	+	1/2 lb. Sinbar	21
60-50-100	+	1/2 lb. Sinbar	30
120-50-100	+	1/2 lb. Sinbar	39
180-50-100	+	1/2 lb. Sinbar	41
120-0-0	+	1/2 lb. Sinbar	33
120-50-100	+	No Sinbar	19
120-50-100	+	1 lb. Sinbar	41
1st Harvest		(8/6/69)	32
2nd Harvest		(8/15/69)	36

Oil yields increased from nitrogen fertilizer up to 180 pounds per acre and slightly from phosphorus and potassium fertilizer. One-half pound of sinbar per acre gave good weed control. Oil yields from the no sinbar treatment were greatly reduced because of vigorous weed competition. It appears that smaller amounts of herbicides are adequate for weed control on mineral soils than needed on organic soils.

Prospective mint farmers should make a careful study of the cost of erecting a still especially in a locality where there are no other mint producers with whom arrangements can be made for distillation. Also, farmers should consider the availability of labor to plant, harvest and distill the crop. Soil and irrigation requirements for this crop are very similar to potato production on sandy soils. Prices received by growers for peppermint and spearmint oils depend on demand, quality and carryover from previous years.

Lupine Research at the Montcalm Experimental Farm in 1969

H. L. Kohls

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Research with lupines in the last few years has shown that selected varieties of two species; blue lupines, Lupinus angustifolius and white lupines, L. albus, may be a suitable source of high protein feed for livestock and an excellent green manure crop to add nitrogen and organic matter to the soil. The nodules are as large as hickory nuts and reports from other states indicate lupines add about as much nitrogen to soil as alfalfa and sweet clover.

Lupine varieties in Michigan are large seeded annuals. The plants are upright in growth and 3 to 4 feet high. The leaves are 2-4 inches across and have 7-9 leaflets per leaf. Flowers are formed in spikes at the tip of main stalk and tips of side branches. The flowers on blue lupines are blue, pink, or white. The seeds are round and are mottled gray, brown or completely white. White lupines have white or blue flowers and the seeds are white or tan and are much larger than the seed of blue lupines.

Lupines are grown on sandy, acid soils but white lupines require and respond to good soil more than blue lupines. Planting in April in Montcalm County has given better results than later plantings. Harvesting of blue lupines is usually in late August and the white in early September. They can be harvested with any good commercial grain combine. Blue lupines shed their seed at maturity and care must be exercised at harvest to get the most possible seed.

Blue lupines in Michigan usually yield 1300 to 1500 pounds of grain per acre and the white about 1500 to 1700 pounds. This year at the Montcalm Experimental Farm blue lupines ranged from 800 to 1150 pounds per acre with a protein range of 27 to over 30 percent. The white lupines yielded 2078 to 2491 pounds of seed per acre with 31 to 36 percent protein. The same varieties of white lupines on heavier ground went as high as 3102 pounds of grain per acre.

A large number of plant selections were made in the field and from these several plants have been found that appear to be alkaloid free and early. Several crosses were made in the field last summer and more will be made in the greenhouse this winter to develop alkaloid-free varieties that; in the blue lupines, do not shed seed readily at maturity. Early maturing in both blue and white varieties is also very desirable and will be added to alkaloid-free strains.

Seed of two varieties developed here were increased on the farm last season. They are being fed in comparison to soybean meal as a source of protein for dairy calves. Dr. Huber of the Dairy Department is in charge of this work and reports the calves on lupines are making satisfactory gains.

A trial in chemical weed control, in cooperation with Dr. Meggitt, on the Montcalm Farm showed that weeds such as lambsquarter, redroot and annual grasses in lupines were controlled satisfactorily by the use of Lorox at 1 lb. per acre plus 2 lbs. of Amiben. Lorox at 3/4 lb. plus Lasso at 1 1/2 lbs. per acre also gave satisfactory control. Both treatments were used as preemergence sprays and cultivation was not necessary.

Tentative plans for 1970 are to continue the lupine breeding, variety testing, chemical weed control work, increase the seed of two varieties, one blue and one white lupine variety for further feeding trials and possible release to growers. A trial is being considered, with Dr. Thompson, to compare lupines and sudangrass hybrids as a green manure crop for potatoes on the Montcalm Experimental Farm.