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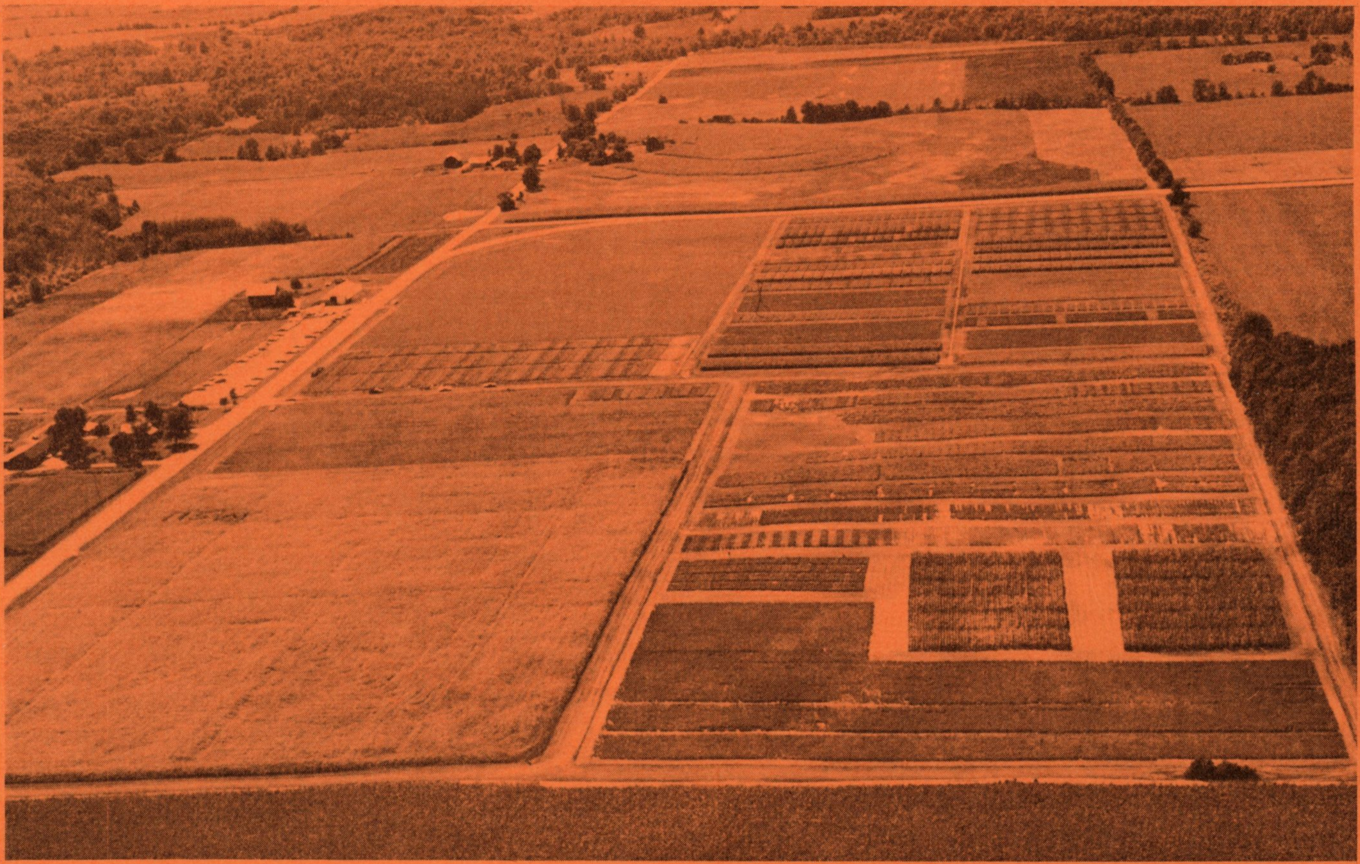
1975 Research Report



MONTCALM EXPERIMENTAL FARM

Michigan State University
Agricultural Experiment Station

ACKNOWLEDGEMENTS

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

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

TABLE OF CONTENTS

MONTCALM BRANCH EXPERIMENT STATION RESEARCH REPORT

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INTRODUCTION

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

This report is designed to coordinate all of the research obtained at this facility during 1975. Much of the data herein reported represents projects in various stages of progress; so results and interpretations may not be final. RESULTS PRESENTED HERE SHOULD BE TREATED AS A PROGRESS REPORT ONLY as data from repeated trials are necessary before definite conclusions and recommendations can be made.

WEATHER

Tables 1 and 2 summarize the 8-year temperature and rainfall data. Average maximum and minimum temperatures for April and September of 1975 were lower than the 8-year average, whereas the average maximum and minimum temperatures in May of 1975 were higher than the 8-year average. Furthermore, the average minimum for April and the average maximum and minimum for September of 1975 were the lowest of any year for the 8-year period of 1968-1975. The average maximum and minimum temperatures for May of 1975 were the highest of any year for the 8-year period.

The 1975 total rainfall of 25.87 inches for the 6-month period of April through September was the second highest for the 8 years for which records at the Farm are available. The 11.25 inches of rain in August was the highest for any year during the 8 years, and almost 4 inches more than the next highest year during this period. Rainfall in April and May was less than the 8-year average.

Irrigation applications of approximately one inch each were made 7 times (July 2, 8, 16, 23, 29 and August 2, 19).

SOIL TESTS

For specific projects where more detailed analysis are needed the results are in the individual reports. Soil test results for the general plot area are:

	Pounds per Acre			
pH	P	K	Ca	Mg
6.3	372	276	908	188

Table 1. The 8-year summary of recorded maximum and minimum temperatures during the growing season at the Montcalm Branch Experiment Station.

Year	April		May		June		July		August		September		6-month average	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1968	61	37	62	41	74	53	80	55	81	58	74	50	73	50
1969	56	35	67	43	70	50	80	59	82	56	73	49	74	49
1970	54	35	65	47	72	55	80	60	80	57	70	51	73	45
1971	53	31	65	39	81	56	82	55	80	53	73	54	76	48
1972	47	30	70	47	72	50	79	57	76	57	69	49	73	48
1973	54	36	63	42	77	58	79	60	80	60	73	48	74	51
1974	57	36	62	41	73	52	81	57	77	56	68	45	70	48
1975	48	28	73	48	75	56	80	57	79	58	65	44	70	49
8-year average	54	34	66	44	74	54	80	58	79	57	71	49		

Table 2. The 8-year summary of precipitation (inches per month) recorded during the growing season at the Montcalm Station.

Year	April	May	June	July	August	September	Total
1968	2.84	4.90	3.74	1.23	1.31	3.30	17.32
1969	3.33	3.65	6.18	2.63	1.79	0.58	18.16
1970	2.42	4.09	4.62	3.67	6.54	7.18	28.52
1971	1.59	0.93	1.50	1.22	2.67	4.00	11.91
1972	1.35	1.96	2.51	3.83	7.28	2.60	19.53
1973	3.25	3.91	4.34	2.36	3.94	1.33	19.13
1974	4.07	4.83	4.69	2.39	6.18	1.81	23.97
1975	1.81	2.05	4.98	2.71	11.25	3.07	25.87
8-year average	2.58	3.29	4.07	2.51	5.12	2.98	20.55

FERTILIZERS USED

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

Banded at planting - 16-8-8 - 600 lbs/A
Sidedressed - 45-0-0 - 192 lbs/A
Red clover plowed down.

HERBICIDES

Preemergence - Lorox at 1 lb/A + Lasso at 2 qts/A

DISEASE AND INSECT CONTROL

The systemic insecticide Temik was applied at planting at 3 pounds per acre.

Foliar fungicide and insecticide sprays, applied with an air blast sprayer, were as follows:

June 27	Bravo + Thiodan
July 11	Bravo + Cygon
July 21	Bravo + Monitor
July 30	Bravo + Cygon
August 11	Bravo + Monitor
August 25	Bravo + Monitor + Copper
September 3	Bravo + Copper

September 5 (Topkill) - Dinitro 2 qt/A + Crop Oil Concentrate 1 qt/A + Copper

NEW VARIETY INTRODUCTIONS

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I. VARIETY CHARACTERISTICS

A more detailed study of new variety characteristics was conducted in 1975 at the Montcalm Research Farm. Eighteen new variety releases, seedlings and standard varieties were compared in a study designed to evaluate variety performance and marketable maturity. The 18 cultivars were planted on May 8 in three separate blocks with each designed for a different date of harvest. The first harvest was made August 8, the second September 3, and the third September 23. Yields, specific gravity, size distribution, chip quality and growth rate were determined for each entry.

Table 1 summarizes the data for all of the varieties for each of the harvest dates. The ranking is according to the growth rate as determined on the September 3 harvest. The Superior and MSU seedling 1111-2 reached their maximum yield by the first harvest on August 8, after which there was no further increase. Those varieties still showing a substantial growth rate at the third harvest were considered as late varieties.

Many of the varieties did not produce acceptable chips. Those showing favorable results were 1111-2, Superior, Bison, Snowchip, and Wischip. The growth rate factor allows one to determine what periods are the most active for yield increase. These data reveal that the most active period for growth in terms of yield increase generally is during August. Those still showing substantial increase during September were Bellisle, Katahdin and AL 37-5, and would be considered as the latest maturing of the total group.

From these data, the following groupings as to marketable maturity were determined:

early	early to mid season	mid season to late	late
MS 1111-2	Onaway	Hudson	MS 645-1
Superior	Snowchip	A 6789-7	Al 3768-19
	Wischip	MS 711-8	Bellisle
	MS 645-2	MS 709	Katahdin
	Bison		AL 37-5
			MS 706-34

Table 2 ranks the varieties according to total yield for each of the harvest dates. Those varieties which appear highest on the list at the initial harvest (early market maturity) frequently end up on the lower end at the late harvest whereas those lower at the initial harvest end up near the top at the later harvest (a late market maturity). Table 3 summarizes the after cooking qualities of each of the several selections tested.

BLE 1 *THE YIELD, SPECIFIC GRAVITY, CHIP QUALITY AND GROWTH RATE OF SEVERAL VARIETIES ON 3 DIFFERENT HARVEST DATES.*

	August 8, 1975				September 3, 1975					September 23, 1975				
ariety	Total cwt/A	US No 1 cwt/A	S.G.	Chip[2] Rate	Total cwt/A	US No 1 cwt/A	Growth[1] Rate cwt/A/day	S.G.	Chip[2] Rate	Total cwt/A	US No 1 cwt/A	Growth[1] Rate cwt/A/day	S.G.	Chip[2] Rate
-1111-2	287	257	1.066	3	276	248	-	1.065	4	237	222	-	1.058	3
perior	265	248	1.072	3	268	239	-	1.072	3	259	226	-	1.070	3
son	317	271	1.064	2	353	329	2.2	1.068	2	388	340	0.6	1.064	3
owchip	329	298	1.072	5	410	381	3.2	1.074	3	378	353	-	1.067	3
schip	307	279	1.076	3	407	374	3.7	1.077	2	395	351	-	1.074	2
645-2	317	279	1.068	7	399	374	3.7	1.080	6	385	349	-	1.078	5
away	354	337	1.068	9	450	437	3.8	1.070	7	429	407	-	1.065	8
37-5	298	239	1.068	7	398	368	5.0	1.071	6	462	402	1.7	1.070	4
dson	246	218	1.067	8	410	381	6.3	1.074	6	410	349	-	1.069	7
3768-19	324	296	1.093	6	490	462	6.4	1.100	4	515	482	1.0	1.091	4
709	226	206	1.069	3	393	384	6.8	1.069	4	407	378	-	1.066	5
ellisle	211	193	1.076	7	406	367	6.7	1.082	6	510	454	4.4	1.083	4
706-34	240	209	1.063	8	413	396	7.2	1.068	7	448	418	1.1	1.070	7
atahdin	213	201	1.067	8	421	401	7.7	1.074	6	486	460	2.6	1.070	7
711-8	190	176	1.068	7	399	382	7.9	1.073	4	410	382	-	1.068	6
645-1	282	257	1.075	9	516	481	8.6	1.081	4	546	498	0.9	1.079	5
6789-7	200	161	1.065	7	427	396	9.0	1.075	5	437	392	-	1.068	8

Growth rate expressed as yield increase between harvests in terms of cwt. per acre per day.

Chip ratings expressed on scale of 1 to 10. The smaller the number the lighter the chip color.

TABLE 2 *THE RANKING OF ALL VARIETIES FOR TOTAL YIELD & MARKETABLE YIELD FOR EACH OF THE HARVEST DATES.*

	August 8			September 3			September 23	
Variety	Total	No 1	Variety	Total	No 1	Variety	Total	No 1
Onaway	354	337	MS 645-1	516	481	MS 645-1	546	498
Snowchip	329	298	AL 3768-19	490	462	AL 3768-19	515	482
AL 3768-19	324	296	Onaway	450	437	Katahdin	486	460
MS 645-2	317	279	Katahdin	421	401	Bellisle	510	454
Wischip	307	279	A 6789-7	427	396	MS 706-34	448	418
Bison	317	271	MS 706-34	413	396	Onaway	429	407
MS 1111-2	287	257	MS 709	393	384	Al-37-5	462	402
MS 645-1	282	257	MS 711-8	399	382	A 6789-7	437	392
Superior	265	248	Hudson	410	381	MS 711-8	410	382
AL 37-5	298	239	Snowchip	410	381	MS 709	407	378
Hudson	246	218	Wischip	407	374	Snowchip	378	353
MS 706-34	240	209	MS 645-2	399	374	Wischip	395	351
MS 709	226	206	AL 37-5	398	368	Hudson	410	349
Katahdin	213	201	Bellisle	406	367	MS 645-2	385	349
Bellisle	211	193	Bison	353	329	Bison	388	340
MS-711-8	190	176	MS 1111-2	276	248	Superior	259	226
A 6789-7	200	161	Superior	268	239	MS 1111-2	237	222
Overall average	271	243		402	376		418	380

TABLE 3 *THE RATING OF AFTER COOKING DARKENING OF SEVERAL VARIETIES AT 0, 1 AND 24 HOURS AFTER COOKING.*

	Rating of after cooking darkening 1/		
Variety	0 hours	1 hour	24 hours 2/
Bellisle	1	1	2
Bison	2	2	4
Hudson	1	1	2
Katahdin	2	2	2
Onaway	2	2	4
Snowchip	2	4	4
Superior	1	2	3
Wischip	2	2	3
MS 645-1	2	2	2
MS 645-2	1	2	4
MS 1111-2	1	1	2
MS 709	1	1	2
MS 706-34	1	2	3
MS 711-8	1	1	2
AL 37-5	1	1	1
AL 3768-19	2	2	3
A 6789-7	1	1	1

1/ Ratings based on relative degree of darkening after cooking, 1=no darkening and 5=considerable overall darkening.
2/ Rating at 24 hours is after sample was stored at normal refrigerator temperature

VARIETY OBSERVATIONS

Bellisle - a 1974 release from New Brunswick, Canada. A late maturing variety primarily for fresh pack with a high specific gravity. Has some resistance to common scab, late blight and Fusarium storage decay. It is susceptible to verticillim wilt and leaf rot. Appearance was generally good.

Bison - released in 1974 from North Dakota. A red skin variety with very good skin color. Tubers are attractive with shallow eyes. Although it had a low specific gravity it produced very acceptable chips. The foliage has a very characteristic appearance being quite upright and dark colored early in its growth.

Hudson - a later maturing release from New York. Very similar to Katahdin in most characteristics. Primarily a fresh pack variety.

Snowchip - released in 1974 by Alaska and USDA as a desirable chipping potato. It was medium in specific gravity and did produce acceptable chips at the second and third harvests. It responded as an early to mid-season variety. It is reported to have a short rest period similar to Ontario, one of its parents.

Wischip - released in 1974 by Wisconsin and Frito Lay, Inc. Wischip has been in our trials two years. In 1974 it exhibited serious speckle leaf infection with a resulting very low yield whereas in 1975 the speckle leaf condition was not observed and the yield and quality response was very favorable. It has an attractive appearance, medium specific gravity and very acceptable chips. Continued studies will be made in 1976.

MS 1111-2 - an early Michigan seedling. Specific gravity is low however it did produce acceptable chips. Emergence and initial growth are less vigorous than Onaway and Superior. It did yield comparable to Superior but less than Onaway and reached its maximum yield by early August.

MS 645-1 - a late maturing seedling with high yield potential. Some irregularity in tuber shape and roughness in larger tubers. It has a deep eye and sets heavy. It was the highest yielder at the second and third harvests.

MS 645-2 - performed as a late-mid season cultivar and similar to 645-1 in specific gravity and chipping, but lower in yield. It too has a heavy set and deep eye.

MS 706-34 - performed as a late variety. It yielded well on both the second and third harvests. Specific gravity is low and it did not make acceptable chips. It did however have good tuber size and good general appearance as a fresh pack potato.

MS 711-8 - a later maturing seedling with medium to low specific gravity and unacceptable as a chipper at each harvest.

Alaska 37-5 - an unreleased red seedling which is late maturing. It is medium in specific gravity and does have good skin color.

Alaska 3768-19 - ranked in the top 3 for yields at each harvest so appears to set and size tubers early, yet it continues to add tonnage and performs as a late maturing seedling. Exceptionally high specific gravity at each harvest in spite of the wet August and early September when most others were lower than normal.

A-6789 - a seedling obtained from Idaho which performed very well in 1974 trials. It has good size, round white tubers, however, it did not yield as well in 1975 as in 1974. Specific gravity fluctuated between harvests but appears to be medium to low.

II. *VARITEY INTRODUCTION*

The seed introduction plots continued again at two locations; the Wayne Lennard Farm in Newberry and the MFSA at East Lansing. At East Lansing, 92 crossings were screened in 10 hill plots. These crosses were made in recent years and represent cultivars with both white and yellow flesh. Eleven of these were selected as the most outstanding and all the tubers were harvested. Tubers for tuber unit planting in 1976 will be selected out for developing a seed increase plot and the remainder will be evaluated in a performance trial at the Research Farm. Thirty six were completely discarded as being unacceptable as a potential variety. In most cases tuber shape and/or other defects were the major criteria for discard. The remaining 45 were considered worthy of a continued evaluation and from these 5 small whole tubers were selected for the 5 hill, planting at the MEF in 1976 and 10 tubers were selected for tuber unit planting in East Lansing. Considerable emphasis in 1975-76 is being placed on the tuber unit technique to permit more intensive screening, roguing and selection.

At the Wayne Lennard Farm 8 seedlings and 2 named varieties in various stages of increase were grown. The numbered selections are 503, 1111-2, 623, 706-34, 711-8, 645-1, 645-2 and 003-69. From these seedlings 169 hill selections were made for the hill index program and clonal plantings in 1976. In addition 900 pounds of tubers for tuber unit screening were also selected. The balance, totalling 56 cwt will be used for clonal increase plantings in 1976. The named varieties included in the new introductions program are Wischip, Hudson, Bison and Jewel.

Five commercial plantings of the seedling 1111-2 were also evaluated. It is an early maturing seedling however emergence, growth, general vigor, and yield were rated as poorer when compared to Onaway. It was comparable to Superior in yield but did not rate as well for chipping. The general appearance for the fresh pack was rated as better than Onaway. Appearance and shape are considered as its strong points.

RUSSET BURBANK SEED PERFORMANCE

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Foundation Russet Burbank seed was planted on three different dates and harvests made on four different dates in 1972, 1973 and 1974. The plantings were identified as early (May 2-9), intermediate (May 18-20) and late (May 31-June 4). The four harvests were 1. (Aug. 15-16), 2. (Sept. 1-3), 3. (Sept. 15-17) and 4. (Oct. 1-4). Table 1 summarizes the average number of days between planting and harvest for each treatment during the duration of the study.

Table 1. The number of days between planting and harvest of potatoes collected for seed performance studies.

Planting Time	Harvest time			
	1 (Days)	2 (Days)	3 (Days)	4 (Days)
early	100	117	133	149
intermediate	89	105	121	137
late	75	92	107	123

Samples were collected from each combination of treatments (12 total) and stored for two weeks at approximately 65 F, to allow for suberization, and then stored at 40 F until planted the following year. Approximately one week before planting, the samples were removed from storage, warmed to 50-55 F, cut and hand planted. Planting dates (early May) and harvest dates (mid September) were the same for all samples when seed performance was evaluated.

Determinations of emergence, vigor, visual virus leaf roll, yield, size distribution and specific gravity were made.

RESULTS

Data presented in Table 2 shows the yield for the combined 3 years. The yield from seed harvested at the third and fourth dates was less than from the earlier harvests. This response was consistent for each of the three years and was most dramatic in 1973. The overall average for harvest dates showed a continued yield decrease with harvests 3 and 4. A review of the overall yeild averages for the planting dates shows less effect with delayed planting, however the best yields were obtained with seed obtained from the earliest planting.

Table 3 summarizes the yield results by harvest date for each of the 3 years. There were differences between years reflecting in part seasonal growing conditions. In 1973 yields from seed harvested at the latest date were reduced by 32% from that grown from seed harvested at the earliest date. In 1974 it was reduced by 11% and by 13% in 1975. Another contributing factor to the reduced yields with the later harvested seed was the increased incidence of visible virus leaf roll. The incidence of leaf roll based on visual sysptoms increased significantly with delayed harvests (Table 4), indicating that the hazard of late season virus leaf roll infection becomes a major concern as the season advances after mid August. The levels of virus leaf roll in this study were exceptionally high and this reflects the insect conditions of the area where the study was conducted. Studies to evaluate insect control programs which includes untreated areas were located nearby so the aphid pressure was very high, however the relative trend of increasing incidence of late season virus leaf roll infection with delayed harvest was readily apparent.

Table 4 also shows that the risk of a late season virus leaf roll spread becomes greater with a late planting. Seed taken from plots planted late and harvested at the fourth interval contained more than twice the leaf roll than from seed planted at the early or intermediate stage. The data for the overall average for planting dates shows the incidence of leaf roll to be similar with the early and intermediate plantings but more than doubled with the late planting. The reasons for the greater leaf roll in the late planted seed may be: the plant has more green foliage and is more succulent (less mature) and is more attractive to aphids; the translocation mechanism in the less mature plant may be more productive and efficient and transfers the virus infection to the tubers more readily; more aphids at this time of the season are carriers of the virus and thereby potential transmitters; or the virus and foliar growth patterns are such that it is more difficult to obtain complete foliage coverage for aphid control.

Ratings of emergence and early plant vigor are closely related to the subsequent yields. Seed taken from the early harvested plots consistently had earlier and more uniform emergence, the greatest vigor and the highest yields. Seed taken from plots at the late harvest consistently had the lowest vigor ratings.

The effect of planting date and harvest date had little effect on the production of tubers smaller than 1-7/8 inch, off type or over 10 ounces. The effect on size distribution was noted in the 1-7/8" to 10 ounce potatoes with the greater production of tubers in this size range occurring from seed harvested early. There was no effect on specific gravity.

Table 2. The total yield (cwt/A) of Russet Burbanks planted with seed from different planting and harvest dates the previous year. (Combined 3 year data)

Planting*	Harvest Date* 1	2	3	4	Overall Average for Planting Dates
early	392	392	364	347	374
intermediate	389	370	348	320	357
late	396	392	345	296	357
overall average for harvest dates	392	385	352	321	

* Planting and harvest date variables refer to management performed the previous year.

Table 3. The total yield (cwt/A) of Russet Burbanks from seed harvested at 4 different dates for each of three years.

Year	Harvest Date 1	2	3	4	Yearly Average
1973	369	366	311	251	320
1974	376	383	347	333	360
1975	432	405	401	378	404
overall average for harvest dates	392	385	352	321	

Table 4. The incidence of virus leaf roll observed from seed planted and harvested at different dates the previous year. (Combined 3 year data)

Planting	Harvest Dates 1	2	3	4	Overall Average for Planting date
	%	%	%	%	%
early	0.4	7.4	7.4	19.1	8.6
intermediate	0.9	7.8	9.1	16.5	8.6
late	1.2	9.6	27.8	37.8	19.1
overall average for harvest dates	0.9	8.3	14.8	24.4	

SOIL FERTILITY STUDIES WITH POTATOES

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Two soil fertility experiments were conducted in 1975. One was a liming study to evaluate the effect of lime on the incidence of scab disease, yield and quality of potatoes. This was the third year for this study.

The second was a study to evaluate the application of nitrogen fertilizer through the irrigation water on yield and quality of potatoes. Nitrogen fertilizer applied through the irrigation system during the growing season was compared with nitrogen applied at planting time.

LIME STUDY

This experiment was initiated in 1973 and included two rates of lime and two sources. In 1975 lime was again applied at a rate of 4 tons per acre to two previously limed areas bringing the total lime application for these two treatments to 6 and 8 tons per acre in a 3 year period. The lime was spring applied, disked and plowed prior to planting. The soil pH in 1973 was 6.1 not critically low for potato production but the interest here was primarily on the effect of lime on the occurrence of scab disease.

The results of this study are shown in table 1. Yields for the Kennebec variety were not significantly affected by liming although there was some variation in yield. For the Katahdin variety there appears to be one treatment (4 tons of lime in 1973) which gave a significant yield increase. This kind of increase has not been consistent over the last three years and may be due to unusual variation in yield. Scab disease was not a problem in any of the plots. Only minor amounts of scab were observed as indicated by the ratings of "1." Size and specific gravity were also unaffected by the lime treatment.

After 3 years of study we have not observed any increase in scab as it might be related to liming even though we have used varieties moderately susceptible to the disease. It is doubtful however that liming above pH 6.0 will increase potato yields. More efficient utilization of fertilizers may be one reason for liming above pH 6.0, especially if other crops are used in the rotation with potatoes.

NITROGATION (NITROGEN-IRRIGATION) STUDY

Efficient utilization of nitrogen fertilizer has been of much concern to potato growers because of the ease with which nitrogen can be lost from sandy soils. One method of increasing this efficiency is to add the nitrogen in small amounts at frequent intervals to meet the requirement of plant uptake and to keep the concentration of the nutrient in the soil at a high level at all times. In this study a planting time application of nitrogen fertilizer (96 lbs/acre) was compared with a weekly and biweekly application of nitrogen applied through the irrigation water. The biweekly treatment was limited to two 20 lb. Nitrogen applications. The weekly application was 20 lbs. N per acre for four weeks. Both treatments were started on July 9, 1975.

The results of this study are shown in table 2. None of the measured properties were found to be significantly different from the treatment at planting time. In the three previous years, yields were improved by adding nitrogen through the irrigation system. The N application at planting time (96 lbs. N/acre) gave a better yield than expected in 1975.

TABLE 1. EFFECT OF LIME ON YIELD, SIZE AND SPECIFIC GRAVITY OF IRRIGATED KENNEBEC AND KATAHDIN POTATOES

		Kennebec						Katahdin					
Lime Treatments[a]	Soil pH[c]	Total Yield	Over 3¼"	1-7/8" to 3¼"	Less than 1-7/8"	Specific Gravity	Scab[b] Rating	Total Yield	Over 3¼"	1-7/8" to 3¼"	Less than 1-7/8"	Specific Gravity	Scab Rating
		cwt	- - - - - - - - % - - - -										
No lime	6.0	316	16	75	9	1.070	1	342	25	70	5	1.069	1
2 ton (1973) 4 ton (1975)	6.4	321	15	75	11	1.068	1	297	23	70	7	1.069	1
4 ton (1973) 4 ton (1975)	6.5	340	14	75	11	1.070	1	304	23	71	6	1.069	1
2 ton (1973)	6.4	333	10	77	13	1.070	1	321	26	69	6	1.069	1
4 ton (1973)	6.9	350	14	76	10	1.068	1	370	25	69	6	1.072	1
L.S.D. (.05)	.3	NS	NS	NS	NS	NS	NS	48	NS	NS	NS	NS	NS

(a) Lime was applied on an equivalent basis using a neutralizing value of 100 for pure calcium carbonate.
(b) Ratings on a scale at 10 with 1 being the lowest incidence of scab.
(c) Spring 1975 before lime was reapplied.

Planted: May 13, 1975
Row Spacing: 32 inches
Basic Fertilizer: 600 lbs 16-8-8
Seed Spacing: 10 inches
Irrigation: 7 inches
Harvested: October 18, 1975
Harvest Area: 133 sq. ft.
Soil Tests P = 299, K = 244, Ca = 1251, Mg = 221

TABLE 2. EFFECT OF NITROGEN FERTILIZER ON YIELD, SIZE AND SPECIFIC GRAVITY OF IRRIGATED KENNEBEC AND RUSSET BURBANK POTATOES.

	Kennebec					Russet Burbank					
Nitrogen[a] Applications	Total Yield	Over 3¼"	1-7/8" to 3¼"	Less than 1-7/8"	Specific Gravity	Total Yield	Over 10 oz	1-7/8" to 10 oz	Less than 1-7/8"	Off Type	Specific Gravity
(lbs N/A)	cwt	- - - - - - - - - - %	- - - - -								
96 (planting time only)	326	14	76	11	1.073	319	8	67	17	8	1.083
136 (2-20 lb N Nitrogen) biweekly	348	12	76	12	1.072	360	6	70	16	7	1.083
176 (4-20 lb N Nitrogation) weekly	323	13	77	10	1.072	294	9	66	18	7	1.081
L.S.D. (.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	

(a) Planting time nitrogen consisted of 600 lbs of 16-8-8. Nitrogation treatments were accomplished by injecting 28% N solution into the irrigation line.

Planted: May 14, 1975
Row Spacing: 34 inches
Basic Fertilizer: 600 lbs 16-8-8
Seed Spacing: 12 inches
Irrigation: 7 inches
Harvested: October 19, 1975
Harvest Area: 142 sq. ft.

WEED CONTROL IN POTATOES

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On May 28th 17 preemergence treatments were applied to Russet Burbank potatoes planted on May 15. None of the potatoes were emerged at this time. On June 7th, four postemergence treatments were applied; two in combination with preemergence treatments and two where no previous treatments had been made.

The pigweed and barnyard grass infestations were light and all of the preemergence treatments gave 100% control of both of these weeds. RE17111 when applied postemergence gave something less than 100% control.

There was considerable injury from RE17111 both pre and postemergence and there will be no further testing of it. FMC25213 also gave a fair amount of injury and probably will not be tested again.

Lasso at 2 pounds per acre plus either Sencor/Lexone at 3/8 pound active ingredient or Lorox at 3/4 pound active ingredient has given excellent results over the past three years.

Herbicides for Weed Control in Potatoes, Montcalm Research Farm, 1975.

Planted: May 15, 1975
Treated: Pre: May 28, 1975
Post: June 7, 1975
Rated: July 10, 1975

Variety: Russet Burbank
Soil Type: Loamy Sand
Organic Matter: 2.0%

Weeds Present: Pigweed, Barnyardgrass.

Tmt. No.	Treatments	Rates lbs/A	Injury	Weed Control Ratings PW	Weed Control Ratings BG
	Pre				
1.	Sencor/Lexone+Lasso	1/2+2	0.0	10.0	10.0
2.	Sencor/Lexone+Lasso	3/8+2	0.0	10.0	10.0
3.	Lorox+Lasso	3/4+2	0.0	10.0	10.0
4.	Lorox+Lasso	1+2	0.0	10.0	10.0
5.	Lorox	1 1/2	0.0	10.0	10.0
6.	Sencor/Lexone	1/2	0.0	10.0	10.0
7.	Premerge+Lasso	4+2	.7	10.0	10.0
8.	RE 17111	1	.7	10.0	9.7
9.	RE 17111	2	4.0	10.0	10.0
10.	RE 17111	3	5.3	10.0	10.0
	Pre POST				
11.	RE17111 + RE17111	1+1	6.3	10.0	10.0
12.	RE17111	1	5.7	9.7	7.0
13.	RE17111	2	8.0	10.0	8.0
14.	Sencor/Lexone+Sencor/Lexone	1/2+1/4	0.0	10.0	10.0
	Pre				
15.	FMC 25213	2	2.3	10.0	10.0
16.	FMC 25213+Sencor/Lexone	1.5+1/2	.3	10.0	10.0
17.	Hoe 23408+Sencor/Lexone	1.5+1/2	0.0	10.0	10.0
18.	Hoe 23408+Premerge	1.5+4	0.0	10.0	10.0
19.	Hoe 23408+Lorox	1.5+1	0.0	10.0	10.0
20.	NO TREATMENT				

0 = No control and no injury; 10 = complete control or kill.

1975 MICHIGAN POTATO-NEMATODE SURVEY

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ABSTRACT

Root-lesion nematodes (Pratylenchus penetrans, P. crenatus and P. neglectus) were recovered from 63.6% of 162 Michigan potato fields studied during the 1975 growing season (2% of state acreage). The root-lesion nematode was considered to be of potential economic significance in 56% of the total number of locations (Table 2). The northern root-knot nematode (Meloidogyne hapla) was found in 26.5% of the sites and believed to be an economic threat in 18% of fields surveyed. Half of the fields were treated with chemical nematicides in 1975 and nematode control was excellent (Table 1). Additional information about pesticide usage and efficacy, potato varieties, crop rotations, and the population density, frequency of occurrence and distribution of a number of plant parasitic nematodes was also obtained. A detailed report of this project was presented to the Michigan Potato Industry Commission on November 24, 1975.

INTRODUCTION

During the past four years the Michigan State University Nematology Research Program has studied the economics, pathology, biology and control of the root-lesion nematode (Pratylenchus penetrans) associated with potato production. In 1975 the Michigan Potato Industry commission funded a project to determine the extent of the geographical distribution, frequence of occurrence and nature of the population density of root-lesion nematodes associated with Michigan potato production. Information from this survey, combined with data about the pathology, biology and control of root-lesion nematodes associated with potatoes will be used to provide a relatively accurate estimate of economic losses and their geographical distribution. This information will also be used by the Cooperative Extension Service and the potato industry in providing growers with the educational materials and specific recommendations necessary to minimize Michigan potato losses caused by the root-lesion nematode. As a by-product of this investigation, information was also collected about several other nematodes, usage of nematicides in the 1975 potato crop, and various other data pertaining to Michigan potato production.

METHODS

Approximately 2% of Michigan's potato acreage was sampled for occurrence and population density of plant-parasitic nematodes. The state was divided into thirteen potato growing areas of three different acreage categories (Table 2).

[1]Sincere appreciation is expressed to Mr. Jack Bailey and Kathy Ries for conducting the survey and tabulating the data, respectively.

A total of 162 potato sampling sites were selected in cooperation with local extension offices. Each site represented five acres and was sampled twice during the growing season (early-mid season and mid-late season). The number of sites selected in each region was based on an approximation of the percentage of the total state potato acreage.

RESULTS

Approximately 50% of the potato acreage surveyed was treated with a nematicide in 1975. This was a direct result of the registration of Temik 15 G, and probably about a 10-fold increase in potato acreage under chemical nematode control. In regards to the survey, this increase in nematicide application was unfortunate, and had to be taken into consideration in evaluation of the data. Both fumigant and granular nematicides were applied to mineral and organic soils. The usage of Temik 15 G and DiSyston varied greatly among geographical areas.

The five potato varieties previously investigated at M.S.U. in regard to their susceptibility to root-lesion nematode damage, accounted for 46% of the sites surveyed. Norchip, Monona and Sebago were the most frequently encountered varieties for which root-lesion nematode susceptibility information is not available. Variety usage varied greatly with geographical area.

While a majority of the sites studied were under some type of crop rotation, at lease 27% of the fields were planted with potatoes on a continuous basis. Small grains were by far the most frequent crops rotated with potatoes. Clover, which enhances populations of root-lesion nematodes was used in 12% of the rotations; whereas, sudax, which is detrimental to root-lesion nematode populations was used in 3% of the rotations.

Root-lesion nematodes were recovered from 63.6% of the sites investigated. *Pratylenchus penetrans* was by far the most common species. *P. crenatus* and *P. neglectus* were also present, and frequently concomitantly with *P. penetrans*. The northern root-knot nematode (*Meloidogyne hapla*) and cyst nematodes (*Heterodera* (*Heterodera*) spp.) were found in 19.1 and 6.2% of the fields, respectively. No cysts resembling *Heterodera* (*Globodera*) spp. were recovered from any of the survey sites.

Fields treated with nematicides generally had considerably lower populations of root-lesion, root-knot or cyst nematodes at early-mid season and mid-late season sampling dates than fields not treated with a nematicide (Table 1). The population density of these nematodes varied considerably between sites and among geographical areas. All three genera of nematodes were recovered from both mineral and organic soil.

Taking into consideration nematode population density, frequency of occurrence, nematicide usage and nematode economic threshold level, it was estimated the root-lesion nematode was a potential economic problem in 56% of the fields studied (Table 2). Potential root-lesion nematode problems existed in all fourteen geographical areas, having a range of 31-100% probable problem sites. The northern root-knot nematode was considered a potential economic threat in 18% of the fields investigated, and not found to be a potential problem in ten of the thirteen geographical areas.

Table 1. Influence of nematicides on plant parasitic nematodes associated with Michigan potatoes.[1]

Nematode and treatment	Nematodes per 100 cm^3 soil		Nematodes per gram root	
	Early-mid-season	Mid-late-season	Early-mid-season	Mid-late-season
Root-lesion (*Pratylenchus* spp.)				
With nematicide	3.6	6.5	3.7	3.5
No nematicide	7.8	35.4	16.5	74.8
Northern root-knot (*Meloidogyne hapla*)				
With nematicide	8.0	28.4	--	--
No nematicide	164.1	36.8	--	--
Cyst (*Heterodera* (*Heterodera*) spp.)				
With nematicide	0.6	0.0	--	--
No nematicide	3.1	1.0	--	--

[1] Based on a 1975 survey of *circa* 2% of the state potato acreage.

Table 2. Estimation of extent and distribution of plant parasitic nematode problems in Michigan potato production.[1]

Area and number of fields sampled	% of fields with probable nematode problem	
	Root-lesion nematode	Northern root-knot nematode
Allegan (12)	75	17
Antrim (10)	80	50
Bay (36)	31	18
Delta (6)	100	50
Emmet (3)	100	33
Houghton (10)	100	40
Iron (10)	50	20
Jackson (9)	56	0
Manistee (3)	100	0
Monroe (9)	67	11
Montcalm (39)	56	0
Presque Isle (10)	50	50
Van Buren (5)	40	20
Michigan (162)	56	18

[1]Based on a 1975 survey of <u>circa</u> 2% of the Michigan potato acreage.

INTEGRATED NEMATODE POPULATION MANAGEMENT FOR MINIMIZING LOSSES IN POTATO PRODUCTION[1]

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Department of Botany and Plant Pathology

INTRODUCTION

In recent years much has been learned about the economics, pathology, biology, and control of the root-lesion nematode (Pratylenchus penetrans) in relation to Michigan potato production. Specific aspects of soil fumigation, granular nematicide application, use of nematode-tolerant potato varieties and cultural alteration of nematode tolerance limits have been investigated. All of the information from these studies, however, has not yet been integrated into a grower-oriented nematode population management program designed to minimize losses in potato production. The objectives of this investigation were to develop and field evaluate an integrated nematode population management program designed to minimize losses in potato production. Information from the study will be used by the Cooperative Extension Service in the development of future nematode recommendations and educational programs.

PROCEDURE

Soil fumigation, granular nematicide application, use of nematode tolerant varieties, and alteration of the plant nematode tolerance limit was integrated and evaluated in field experiments at the Montcalm and Sodus Research Facilities during the 1974 and 1975 growing season.

RESULTS

In seven experiments conducted in 1974 and 1975 at two Michigan Research Farms, nematodes were responsible for mean yield losses of 22% for the root-lesion tolerant variety Russet Burbank, and 39% for the root-lesion nematode-susceptible variety Superior (Table 1). On an annual basis, root-lesion nematode populations were temporarily reduced enough to prevent economic losses through the use of granule nematicides applied at-planting, in-row soil fumigants applied in the fall or spring and broadcast soil fumigants applied in the fall or spring. In general subsoiling beneath the planting row appeared to increase the tolerance of potato plants to root-lesion nematodes (Table 2).

The 1974 data summarized above was presented to the Michigan Potato Industry Commission in the 1974 Nematology Report to the Commission. Much of it has since appeared in the American Phytopathological Society, Fungicide and Nematicide Tests: Results of 1974 (Volume 30). The 1975 data summarized above is presented in the last two sections of this report.

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[1]Sincere appreciation is expressed to Mrs. Natalie Knobloch and Mr. John Davenport for their assistance with this research and many extra hours of loyal dedication.

Table 1. Influence of root-lesion nematodes on potato productivity in seven experiments conducted during 1974 and 1975.

Potato variety, location year and experiment	Yield with nematode control (ctw/A)	Yield without nematode control (ctw/A)	Loss (%)	Initial root-lesion nematode population density (no./100 cm^3 soil)
Russet Burbank				
Montcalm Potato Research Farm				
1974	471	380	16	4
1975	399	278	29	20
Sodus Vegetable Research Farm				
1974	348	272	22	10
1975	261	222	15	5
Mean of 4 experiments	370	288	22	10
Superior				
Montcalm Potato Research Farm				
1975 Experiment No. 1	171	95	44	20
1975 Experiment No. 2	415	241	42	34
Sodus Vegetable Research Farm				
1975	101	70	31	5
Mean of 3 experiments	229	135	39	20

Table 2. Influence of subsoiling beneath the planting row on potato production in four experiments conducted during 1974 and 1975.

Location, potato variety and year	Yield (ctw/A) Commercial land preparation	Yield (ctw/A) Subsoiling beneath the planting row
Montcalm Potato Research Farm		
Russet Burbank		
1974	260a[1]	286b
1975	278a	314a
Superior		
1975	95a	75a
Sodus Vegetable Research Farm		
Russet Burbank		
1975	222a	281a
Superior		
1975	70a	113a

[1]Row means followed by the same letter are not significantly different (P = 0.05).

1976 NEMATICIDE EVALUATIONS

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Temik 15 G and Vorlex were evaluated separately and in combination for control of root-lesion nematodes associated with two cultivars of potatoes grown at the Michigan State University Montcalm and Sodus Experimental Farms. Vorlex was applied in-row on April 15, 1975 at Sodus and on May 8, 1975 at Montcalm. A single subsoil shank was used to apply half of the fumigant at 6 inches and half at a soil depth of 18 inches. Temik 15 G was applied in the seed piece furrow at planting (May 16, 1975, at Sodus and May 23, 1975, at Montcalm). In both locations, each treatment was replicated five times in a randomized block design. Each plot at Montcalm was 50 ft in length and contained eight rows, 34 inches apart. Four consecutive rows in each plot were planted with the root-lesion nematode-tolerant cultivar, Russet Burbank and four with the root-lesion nematode-susceptible cultivar, Superior. Each plot at Sodus was 50 ft in length and contained two rows, 36 inches apart. The south half of each row was planted with Russet Burbank and the north half with Superior. The plots were maintained under commercial irrigation, fertilizer, insect and disease control programs throughout the growing season. Soil samples were taken and analyzed for root-lesion nematodes before treatment (April 15, 1975, at Sodus and May 8, 1975, at Montcalm), mid-season (July 2, 1975, at Montcalm and July 24, 1975, at Sodus), and at harvest (September 9, 1975, at Sodus and August 21-22, 1975, and September 8-9, 1975, at Montcalm for the Superiors and Russet Burbanks, respectively). The center two rows of each cultivar in each plot at Montcalm were harvested, graded and analyzed for quality; whereas, at Sodus, all of the tubers were harvested and evaluated.

At the Montcalm Experimental Farm, both Temik 15 G and Vorlex significantly reduced mid-season populations of root-lesion nematodes and resulted in significant increases in the tuber yields of both Russet Burbank and Superior potatoes. Both chemicals enhanced the size of Superior, but not Russet Burbank tubers. No additional nematode control or yield increase resulted from the combined use of both materials. At this location, the mean preplant population density was 20 root-lesion nematodes per 100 cm^3. The horizontal distribution of initial population was reasonably uniform ($\sigma = 21.9$), with no significant differences among the treatments. At the Sodus Experimental Farm, the preplant root-lesion nematode population density was 5 per 100 cm^3 of soil. The horizontal distribution was not uniform ($\sigma = 81.6$); however, there were no statistically significant differences among treatments. Neither of the pesticides or the combination resulted in a significant decrease in the root-lesion nematode population. Significant yield increases occurred only in plots treated with Vorlex. The Montcalm Experimental Farm was typical of a root-lesion nematode problem site, and responded as expected. The primary soil-borne problem at the Sodus Experimental Farm, however, was probably not of a nematological origin, and most likely fungal in nature. These results may partially explain why some growers must continue to use a broad spectrum soil fumigant in potato production; while others can obtain adequate nematode control with a granular nematicide.

Seven formulations of non-fumigant nematicides were evaluated for control of root-lesion nematodes associated with potato (cv Superior) at the Michigan State University Montcalm Experimental Farm. Each treatment was replicated four times in a randomized block design, with each plot consisting of four rows, 34-inches apart and 50 ft in length. All of the non-fumigant nematicides and the DiSyston 6 LC insecticide control were applied in the planting furrow, at planting on May 13-14, 1975. The potatoes were maintained under commercial fertilizer, irrigation, insect and disease control programs. Soil samples were taken for root-lesion nematode analysis before planting (May 13, 1975), at mid-season (July 2, 1975) and at harvest (August 20, 1975). The center two rows of each plot were harvested, graded and analyzed for quality.

All of the non-fumigant nematicide and nematicide-insecticide combinations resulted in significantly lower mid-season root populations of root-lesion nematodes (Table 2). Temik 15 G, however, was the only chemical that maintained the root population low throughout the entire growing season. There were no statistically significant differences among the treatments for the soil populations at any of the three sampling dates. The mean preplant population density was 34 root-lesion nematodes per 100 cm^3 of soil, and the horizontal distribution of the initial population relatively uniform ($\sigma = 16.5$), with no significant differences among the treatments. While the only statistically significant yield differences among the treatments were between Temik 15 G and the DiSyston control (174.1 ctw per acre increase), all of the yields were greater than those of the DiSyston control. Yield responses to the granular formulations of Nemacur appeared to be better than those associated with the liquid formulations. There were no significant differences among the treatments in the specific gravities of the tubers.

Table 1. Influence of Temik and Vorlex on potato yields and root-lesion nematodes.

Location, cultivar, treatment, method or application and rate per acre	*Pratylenchus penetrans* (7/22-24/75) 100g soil	g root	Tuber yield (ctw/acre) Grade A	Jumbo	Total
Montcalm Experimental Farm					
Russet Burbank					
Control (nontreated)	30a[1]	250a	232a	18a	278a
Subsoil beneath planting row	32a	165a	268ab	17a	314ab
Temik 15 G (20.0 lb, in-row)	15a	0b	297bc	21a	371bc
Vorlex (6.0 gal, in-row)	11a	18b	335c	28a	390c
Temik 15 G (20.0 lb, in-row) plus Vorlex (6.0 gal, in-row)	17a	21b	315bc	27a	371bc
Superior					
Control (nontreated)	83b	99c	75de	18b	95d
Subsoil beneath planting row	55b	188c	57d	15b	75d
Temik 15 G (20.0 lb, in-row)	33c	5e	138e	65c	207e
Vorlex (6.0 gal, in-row)	10c	80d	144e	61c	209e
Temik 15 G (20.0 lb, in-row) plus Vorlex (6.0 gal, in-row)	16c	17de	133e	66c	171e
Sodus Experimental Farm					
Russet Burbank					
Control (nontreated)	11d	44f	138f	0d	222f
Subsoil beneath planting row	17d	3f	194fg	0d	281fg
Temik 15 G (20.0 lb, in-row)	8d	3f	162f	0d	261f
Vorlex (6.0 gal, in-row)	0d	2f	274g	0d	390h
Temik 15 G (20.0 lb, in-row) plus Vorlex (6.0 gal, in-row)	0d	0f	212fg	0d	351gh
Superior					
Control (nontreated)	17e	47g	59h	2e	70i
Subsoil beneath planting row	39e	88g	102hi	2e	113ij
Temik 15 G (20.0 lb, in-row)	6e	0g	90h	2e	101ij
Vorlex (6.0 gal, in-row)	0e	2g	164i	8e	183j
Temik 15 G (20.0 lb, in-row) plus Vorlex (6.0 gal, in-row)	0e	0g	160i	1e	173j

[1]Comparable column means followed by the same letter are not significantly different (P=0.05) according to the Student-Newman-Kuels Multiple Range Test. Experimental sites and cultivars were analyzed separately.

Table 2. Influence of non-fumigant nematicides on potatoes and lesion nematodes.

Treatment and rate per acre	Pratylenchus penetrans/g root tissue		Tuber yield (ctw/acre)			
	7/2/75	9/2/75	Grade B	Grade A	Jumbo	Total
DiSyston 6 LC (0.5 gal)	257.5a[1]	463.0a	8.8a	217.9a	14.0a	240.9a
Nemacur 15 G (20.0 lb)	12.5b	251.3ab	10.9a	322.2a	19.7a	353.0ab
Nemacur plus DiSyston 7.5 + 7.5 G (40.0 lb)	63.5b	427.3a	11.4a	351.7a	21.7a	384.8ab
Nemacur 3 S (1.0 gal)	130.0b	271.5ab	6.4a	252.7a	11.7a	270.9ab
Nemacur 3S plus DiSyston 6 LC (1.0 gal + 0.5 gal)	45.0b	172.8ab	8.6a	273.2a	15.4a	297.1ab
Furadan 10 G (30.0 lb)	30.5b	1523.5a	8.2a	269.2a	23.9a	301.3ab
Vydate 10 G (40.0 lb)	5.0b	281.8a	14.2a	299.3a	16.5a	330.0ab
Temik 15 G (20.0 lb)	22.8b	21.8b	9.5	367.3a	38.2a	415.0b

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

OZONE INJURY TO POTATOES - 1975

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Injury to potatoes from photochemical oxidants of which ozone is the most important in Michigan was not a problem in the commercial producing areas of Michigan in 1975. Injury, however, was severe in the potato breeding plots adjacent to the south edge of the Michigan State University campus by mid July.

The air pollution monitoring station of the MSU Environmental Improvement Program was also situated on the south edge of the campus within 1.5 miles of the breeding plots. At this station, ozone levels were constantly recorded throughout the summer. Two major episodes of high ozone levels occurred; one in late June-early July, and another, less intense, in late July-early August.

Injury of sensitive potato varieties and selections was severe within two weeks following the late June-early July exposure. During this episode, ozone levels exceeded 50 parts per billion (ppb) for over 6 hours on each of 7 days during the 8 day period between June 26 and July 3. Levels exceeded 80 ppb for 11 hours on July 2. On 3 days, 100 ppb was exceeded for at least a short time.

Reactions of varieties and selections to this exposure were prompt and are shown in Table 1. Rows in the breeding plots were spaced approximately 6 ft apart which accounts to some extent for the severe response. Wischip and Snowchip were severely injured. In contrast, a new variety from Washington, Nooksack,was highly tolerant. Severe injury of some selections was in marked contrast to the tolerance exhibited by others. Advanced selections in the breeding program varied considerably in response. Although ozone injury is not regularly present in Michigan potato growing areas, tolerant varieties and selections should be identified for future use.

Ozone injury was not confined to the field. In the greenhouses on the MSU campus both potato and bean plants being grown for transfer to the air pollution research facility in the field were severely injured during the late June-early July episode.

Plant foliage acts as a sink to absorb or adsorb ozone and remove it from the air. Potatoes growing vigorously and closely crowded under normal field conditions protect each other because ozone is removed, at least in part, from the air by the heavy foliage mass. Injury when vines are dense and vigorous may be confined to the outside or topmost leaves of the plants. If exposure to high ozone levels occurs early in the season when plants have not yet closed the rows, injury should be much more severe than if exposure to high levels occurs later in the season after a heavy foliage mass has been established. Cultural practices which encourage early season vigor and early, abundant vine growth are helpful so that plants are able to withstand episodes of high ozone levels. Furthermore, potato varieties and selections differ widely in sensitivity or tolerance to ozone. Tolerant selections should be identified and tolerance incorporated into varieties suitable for production in Michigan.

TABLE 1. AIR POLLUTION INJURY
TO POTATOES

7/22/75 Observations of Plots South of
Michigan Crop Improvement Buildings

None to Slight

Nooksack	645-1
103-59	645-2
106-13	1111-2
107-2	002-408
132-55	004-16
303-2	
303-4	
305-25	

Slight - Moderate

R. Arenac	002-152
305-18	002-215
711-8	002-302
	004-165

Moderate

107-3	503
235-2	002-378
302-1	003-22
305-24	004-341
307-1	
307-6	

Severe

Wischip	231-1
Snowchip	235-3
227-1	307-5
	004-198

Very Severe

204-1
002-191

POTATO INSECT RESEARCH

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Department of Entomology

Two potato insect research projects were conducted at the Montcalm Experimental Farm in 1975. One project was a continuation of a study initiated in 1974 to better understand the effects of different insect control programs and harvest management on quality of potato seed and the other was an evaluation of soil systemic insecticides on foliar insects.

A. Evaluation of Insect Control Programs and Harvest Management on Seed Quality

The insect populations on plots under the following insect control programs were monitored during the 1974 growing season:

Single Systemics plus Foliars: Thimet 15 G applied at planting time (May 10) at 3 lb ai/Acre and a weekly commercial control program starting at hilling and continuing to harvest.
Double Systemics: Thimet 15 G applied at planting time and Disyston 15 G sidedressed at 3 lb ai at the time of hilling (June 24).
Double Systemics plus Foliars: The systemics applied as above with the additional foliar program.
Untreated: Foliar fungicide treatments only.

The plots using Foundation Russet Burbank and Premier Foundation Sebago seed were sample harvested at two week intervals starting August 19 and continuing until October 7. Adjacent rows were top killed at the same time and after wilting, half of the plots were sprayed with foliar insecticides to prevent aphid population build up during this period. After the harvest season 150 tuber samples of whole "B" size seed from each plot was submitted to the Florida testing program for evaluation. Duplicate "A" size tubers from each plot treatment were saved for replanting at the Montcalm Farm in 1975.

One seed piece was cut from each of the seed and planted in four replications of 23 hills each on May 15 (Russet Burbank) and Sebago (May 19) to compare the viability of the seed and virus readings with the results from the Florida test. Temik 15 G was applied at planting time and a full commercial foliar program was applied during the growing season. The virus readings on all of the plots were made by the Michigan Crop Improvement Association inspectors on July 23. The vines were top-killed in mid September and harvest was completed in October to determine yield, size distribution and specific gravity of the tubers. The results of the Florida test and the 1975 field data are summarized in Tables 1 and 2.

Results

The Florida data appeared to have followed the trend observed in other research plots since the earlier harvested material in both varieties had better stands and leaf roll readings than in the later harvested plots. Comparable trends were evident in the 1975 plots but they didn't appear to affect

Table 1. The effect of insect control programs, vine killing and harvest dates on quality of seed, total yield, size distribution and specific gravity (Russet Burbank)

Insect Control Program (1974)	Vines Killed	Insect. Applied	Harvest	Fla Test Percent Stand	Fla Test Percent L.R.	MEF % L.R.	Cwt /A	% by Size Distribution B's	A's	10 oz +	Off Type	Specific Gravity
Untreated	--	--	Aug 20	95	1	4	351	3	56	14	27	1.075
Sngl Syst + Fol	--	--	Aug 19	95	0	1	330	4	55	16	25	1.074
Dbl Syst	--	--	Aug 20	--	--	1	316	3	58	18	21	1.079
Dbl Syst + Fol	--	--	Aug 19	97	4	1	327	5	53	19	23	1.073
Untreated	Aug 20	--	Oct 17	86	1	1	319	3	56	14	27	1.075
Sngl Syst + Fol	Aug 20	--	Oct 17	91	1	1	333	3	59	15	23	1.073
Dbl Syst	Aug 20	--	Oct 17	82	2	1	318	4	58	18	20	1.075
Dbl Syst + Fol	Aug 20	--	Oct 17	88	3	5	347	3	56	18	23	1.075
Untreated	Aug 20	Aug 23	Oct 17	81	5	10	289	4	65	13	18	1.073
Sngl Syst + Fol	Aug 20	Aug 23	Oct 17	91	2	3	304	4	57	15	24	1.075
Dbl Syst	Aug 20	Aug 23	Oct 17	94	3	7	299	4	57	20	19	1.074
Dbl Syst + Fol	Aug 20	Aug 23	Oct 17	92	0	0	328	3	55	19	23	1.073
Untreated	--	--	Sep 5	93	5	9	327	4	57	20	19	1.075
Sngl Syst + Fol	--	--	Sep 4	91	6	3	298	4	61	15	20	1.073
Dbl Syst	--	--	Sep 5	94	5	7	316	3	64	17	16	1.075
Dbl Syst + Fol	--	--	Sep 4	93	4	5	319	3	52	20	25	1.071
Untreated	Sep 5	--	Oct 17	95	12	9	287	4	54	22	20	1.073
Sngl Syst + Fol	Sep 5	--	Oct 17	84	1	8	323	3	53	14	30	1.074
Dbl Syst	Sep 5	--	Oct 17	89	8	11	280	3	58	11	28	1.074
Dbl Syst + Fol	Sep 5	--	Oct 17	81	6	7	281	5	52	18	25	1.076

Untreated	Sep 5	Sep 11	Oct 17	85	16	20	258	5	56	13	26	1.072
Sngl Syst + Fol	Sep 5	Sep 11	Oct 17	91	8	4	328	3	58	19	20	1.075
Dbl Syst	Sep 5	Sep 11	Oct 17	93	11	5	336	4	55	19	22	1.074
Dbl Syst + Fol	Sep 5	Sep 11	Oct 17	95	4	7	339	3	55	19	23	1.074
Untreated	--	--	Sep 17	79	4	8	312	5	58	13	24	1.075
Sngl Syst + Fol	--	--	Sep 16	84	8	4	292	3	54	15	28	1.072
Dbl Syst	--	--	Sep 17	86	23	24	289	4	55	13	28	1.074
Dbl Syst + Fol	--	--	Sep 16	84	6	9	294	4	51	18	27	1.073
Untreated	Sep 18	--	Oct 9	76	6	8	320	3	56	19	22	1.073
Sngl Syst + Fol	Sep 18	--	Oct 9	83	9	11	335	4	56	16	24	1.077
Dbl Syst	Sep 18	--	Oct 9	69	6	5	316	4	55	18	23	1.074
Dbl Syst + Fol	Sep 18	--	Oct 9	71	1	3	305	3	58	18	21	1.075
Untreated	--	--	Oct 7	85	3	8	333	4	52	20	24	1.075
Sngl Syst + Fol	--	--	Oct 7	71	1	4	262	6	56	17	21	1.076
Dbl Syst	--	--	Oct 8	62	6	12	268	4	47	15	34	1.072
Dbl Syst + Fol	--	--	Oct 7	70	1	3	348	4	53	16	27	1.074

Table 2. The effect of insect control programs, vine killing and harvest dates on quality of seed, total yield, size distribution and specific gravity (Sebago)

Insect Control Program (1974)	Vines Killed	Insect. Applied	Harvest	Fla Test Percent Stand	Fla Test Percent L.R.	MEF % L.R.	Cwt /A	% by Size Distribution to 1 7/8"	% by Size Distribution 1 7/8"-3 1/4"	% by Size Distribution 3 1/4" +	Specific Gravity
Untreated	--	--	Aug 20	98	1	7	359	3	73	24	1.065
Sngl Syst + Fol	--	--	Aug 19	97	0	3	384	3	74	23	1.068
Dbl Syst	--	--	Aug 20	93	0	3	297	3	71	26	1.063
Dbl Syst + Fol	--	--	Aug 19	98	1	9	353	3	64	33	1.065
Untreated	Aug 20	--	Oct 17	85	1	2	335	3	71	26	1.065
Sngl Syst + Fol	Aug 20	--	Oct 17	76	0	2	309	3	63	34	1.065
Dbl Syst	Aug 20	--	Oct 17	85	9	12	310	3	63	34	1.063
Dbl Syst + Fol	Aug 20	--	Oct 17	91	0	5	356	3	72	25	1.066
Untreated	Aug 20	Aug 23	Oct 17	87	1	3	338	3	67	30	1.066
Sngl Syst + Fol	Aug 20	Aug 23	Oct 17	83	3	2	339	3	67	30	1.066
Dbl Syst	Aug 20	Aug 23	Oct 17	89	7	18	324	3	78	19	1.063
Dbl Syst + Fol	Aug 20	Aug 23	Oct 17	81	10	8	351	3	66	31	1.068
Untreated	--	--	Sep 5	100	1	5	393	3	71	26	1.065
Sngl Syst + Fol	--	--	Sep 4	91	2	5	337	4	68	28	1.064
Dbl Syst	--	--	Sep 5	89	6	10	281	4	68	28	1.063
Dbl Syst + Fol	--	--	Sep 4	98	12	3	371	3	63	34	1.064
Untreated	Sep 5	--	Oct 17	90	8	3	363	3	67	30	1.060
Sngl Syst + Fol	Sep 5	--	Oct 17	88	5	11	362	2	62	36	1.067
Dbl Syst	Sep 5	--	Oct 17	83	16	9	349	3	68	29	1.066
Dbl Syst + Fol	Sep 5	--	Oct 17	75	6	4	335	3	70	27	1.065

Untreated	Sep 5	Sep 11	Oct 17	85	5	7	338	2	62	36	1.066
Sngl Syst + Fol	Sep 5	Sep 11	Oct 17	87	10	10	303	3	55	42	1.065
Dbl Syst	Sep 5	Sep 11	Oct 17	85	22	5	297	3	71	26	1.063
Dbl Syst + Fol	Sep 5	Sep 11	Oct 17	83	9	4	337	3	72	25	1.065
Untreated	--	--	Sep 17	85	1	3	334	3	74	23	1.064
Sngl Syst + Fol	--	--	Sep 16	92	9	15	342	3	69	28	1.064
Dbl Syst	--	--	Sep 17	89	10	9	309	3	60	37	1.065
Dbl Syst + Fol	--	--	Sep 16	73	8	5	347	3	67	30	1.064
Untreated	Sep 18	--	Oct 9	84	3	4	370	3	71	26	1.066
Sngl Syst + Fol	Sep 18	--	Oct 9	88	0	7	396	2	67	31	1.066
Dbl Syst	Sep 18	--	Oct 9	85	6	11	315	4	67	29	1.064
Dbl Syst + Fol	Sep 18	--	Oct 9	91	12	5	323	3	62	35	1.064
Untreated	--	--	Oct 7	79	9	7	313	3	63	34	1.066
Sngl Syst + Fol	--	--	Oct 7	70	11	7	317	3	72	25	1.066
Dbl Syst	--	--	Oct 8	81	16	13	323	3	69	28	1.065
Dbl Syst + Fol	--	--	Oct 7	61	10	11	287	3	63	34	1.065

the yields significantly. This could have been the response from the Temik treatment and the excellent growing season which minimized the differences between the plots. A statistical analysis of the data might show differences, however.

B. Evaluation of Soil Applications of Systemic Insecticides

Twelve treatments of granular formulations of six insecticides were evaluated for foliar insect control on Russet Burbank potatoes. The plots were established on May 19 in three replications of four 50 foot rows each. Eleven of the plots received in-row treatments at planting and two of these and one previously untreated plot received side dress applications at the time of hilling on June 23. The plots were checked for flea beetle damage prior to hilling but since damage was very slight no data were tabulated. The plots were rated for overall appearance and vigor on July 1 and foliar insect populations sampled on July 16, 30 and August 8 by taking ten sweeps with an insect net on the foliage of each plot. Leaf samples were taken on July 30 to compare aphid numbers with those determined by the sweep samples. The insect data are shown in Table 3. The plots were top-killed in mid September and harvested in October for yield and size distribution evaluation (Table 4).

Results

The differences in plant response to certain treatments early in the season as shown by the plot ratings have been noted in previous research. It is probably due to protection from soil organisms when the plants were small. The major differences in insect control were seen in the late aphid population in the Furadan and CGA 30017 treatments when compared with the lower numbers in the other treatments including the untreated plots.

The Colorado potato beetle population at the farm has been increasing the last two years and caused serious damage to certain treatments. This defoliation was too severe in July to get meaningful aphid data from the leaf samples so they are not included in the table. The best season control was given by Thimet, Furadan, Temik and Dacamox while the other treatments would require foliar applications for adequate second generation beetle control. The ratio of larvae to adults in the samples indicate the second generation beginning in late July.

The effects of early plant response and beetle protection is reflected in the yields since the highest yields were in the Furadan, Temik and Dacamox treatments although the tuber size is comparable in all of the plots. The additional side dress application of Disyston appeared to reduce the beetle population and increase the yield over the single application. The split application of Temik was comparable to the single application at planting or sidedressed.

Table 3. Stand Ratings and Insect Populations on Insecticide Evaluation Plots

Material and Formulation	Time of* Treatment	Lb Tox** per A.	Stand*** Rating	Total Insects Collected**** Pot Leaf Hopper	Ast Leaf Hopper	Tarnish Plnt Bug	Aphids	Colorado Potato Beetle Jul/16	Jul/30	Aug/8
Thimet 15G	P	3 lb	4.0	17	16	16	28	0	3	36
Disyston 15G	P	3 lb	2.0	38	28	14	13	10	8	180
Disyston 15G	P+S	3 + 3 lb	3.0	36	30	18	8	3	6	123
Furadan 10G	P	3 lb	2.0	20	13	20	186	0	0	2
Temik 15G	P+S	1 1/2 + 1 1/2 lb	1.0	12	11	12	7	0	0	3
Temik 15G	P	3 lb	1.0	11	8	7	11	0	1	0
Temik 15G	S	3 lb	2.3	13	13	15	15	0	0	16
CGA 30017 5G	P	2 lb	3.0	28	34	25	96	0	15	139
CGA 30017 5G	P	3 lb	2.3	33	17	16	82	1	8	131
Dacamox 10G	P	2 lb	1.0	10	9	18	54	0	0	6
Dacamox 10G	P	3 lb	1.0	2	13	15	21	0	1	5
Dacamox 10G	P	6 lb	2.7	4	7	16	19	0	0	12
Untreated	--	--	3.2	13	9	8	21	18	17	210
						% Larvae		89%	26%	90%
						% Adults		11%	74%	10%

*Time of treatment: P = at planting; S = at sidedressing

**Rates based on 34 in. rows

***Stand rating: 1-Excellent, even stand; -- 4-Small and uneven

****Total insects collected 30 sweeps/plot on July 16, 30 and Aug 8

Table 4. Harvest Data from Insecticide Evaluation Plots

Material and Formulation	Time of Treatment	Lb Tox per A.	Yield/A. Cwt	Yield/A. Bu	% by Size Distribution to 1 7/8	1 7/8-10 oz	10 oz +	Off	Specific Gravity
Thimet 15G	P	3 lb	186	310	5	66	7	22	1.077
Disyston 15G	P	3 lb	180	300	7	72	8	13	1.077
Disyston 15G	P+S	3 + 3 lb	194	323	6	65	13	17	1.078
Furadan 10G	P	3 lb	228	380	5	64	8	23	1.076
Temik 15G	P+S	1 1/2 + 1 1/2 lb	238	396	3	62	14	21	1.080
Temik 15G	P	3 lb	224	374	4	66	14	16	1.080
Temik 15G	S	3 lb	233	388	5	69	10	16	1.075
CGA 30017 5G	P	2 lb	185	309	6	76	4	14	1.075
CGA 30017 5G	P	3 lb	177	295	5	71	5	19	1.076
Dacamox 10G	P	2 lb	226	377	5	73	7	15	1.077
Dacamox 10G	P	3 lb	239	399	4	61	18	17	1.079
Dacamox 10G	P	6 lb	215	358	4	66	8	22	1.076
Untreated*	--	--	174	290	7	74	6	13	1.076

*Mean of three untreated plots

BEAN VARIETY - STRAINS OF RHIZOBIUM TEST

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During the winter of 1974-75, Dr. Joe Burton of the Nitragin Company of Milwaukee, Wisconsin, tested under greenhouse conditions 6 cultivars sent to him from Michigan State University against 6 strains of Rhizobia, the N-fixing bacterium. He found evidence of some specific variety X strain effects. We agreed to test these same varieties and strains in a field trial in 1975 to see if there showed up any practical advantage or difference in the field.

The field experiment consisted of 7 bean strains and 6 strains of Rhizobia, plus a Control, grown in a split-plot design with four replications. Individual plots consisted of 1 row, 20 feet long. No fertilizer was used. Herbicide (Eptam) at rate of 4 pints/acre was used. The experiment was planted on June 19. Irrigation by sprinkler was applied as necessary to maintain normal growth. The soil is a McBride sandy loam. A 1-year old stand of Red Clover was plowed down in May, before planting in June.

The yield data from this experiment are presented in Table 1. Differences among varieties and among strains of inoculant were both highly significant, but we could detect no significant variety X strain interaction.

There are several observations of interest:

1. In confirmation of results obtained in 1974 at the Bean and Beet Farm for 3 different commercial inoculants, the Seafarer yielded as well at the Control level as with the average of the 6 inoculame, although in 2 cases, Rhizobial strains K17 and K36, yields appeared to be significantly increased. Montcalm red kidney, as at the Bean and Beet Farm in 1974, responded to inoculation in 4 of the 6 strains, yielding on the average over all strains 1.8 bags of beans more when inoculated than when not.

2. The unreleased navy line, #0686, yielded poorly with no inoculation and responded significantly to inoculation in 4 of the 6 Rhizobial strains. It yielded significantly less than the control in 2 of the 6 cases, including the commercial "D" strain.

3. Black Turtle Soup and Jamapa, also a black bean, yielded very well in the Control, but really yielded extra-ordinarily high, about 2.5 bags better, when inoculated. Strain K17 was particularly effective on these 2 varieties; they yielded about 4 bags better with strain K17. Other strains were no better than the Control.

4. For Pinto #114, the average of the inocula was no better than the Control, but individual strains gave both significantly higher and lower yields than the Control.

5. NEP-2, a white-seeded mutant of a tropical black bean and in other tests quite comparable to Black Turtle Soup in yield, was the only variety which yielded significantly better under no inoculation (Control) than when inoculated. There was a difference of 4 bags between Control and the average of the Rhizobial strains.

General Comments: We do not know with assurance how far to extrapolate from these results. It appears that inoculation was favorable to yield increases in some varieties but not in all, and inoculation seemed to cause a decrease in one variety.

Furthermore, not all strains are uniformly "good" over all varieties or uniformly "bad" over all varieties. There seem to be specific favorable effects and specific unfavorable effects in certain instances.

It could be that these data would not be confirmed in another year. At no time could we see visually any difference in color or growth in the plots. We must recall, also, that we got good yields in most cases with no fertilizer used on any plot. The nursery was planted late, had no shortage of water at any time during the growing season, and was harvested late. The range in yield of the varieties greatly exceeded the range in yields as related to the different Rhizobial strains.

The fact that a one-year old stand of Red Clover had been plowed down in May ahead of seeding this trial on June 19, surely implies a higher level of nitrogen in the soil than we would have preferred for this kind of experiment had we had a choice of sites. It may have elevated the yields on the Control plots and narrowed the difference between control and treated plots. Or it may only have raised the base level on both sites. We do not know to what extent our results have been affected by the plow down.

Table 1 . Average yield in pounds/acre, over 4 replications, of 7 varieties of beans inoculated with 6 different strains of Rhizobiam.

	RHIZOBIUM STRAINS							
ENTRY	CONTROL	127K12	127K14	127K17	127K26	127K36	Com."D"	Means over treatments
#0686 (navy)	1667.3*	1951.5	1906.0	1876.2	1951.5	1600.5	1570.0	1789.0 (1809.3)**
Seafarer (navy)	2056.7	1866.7	2088.1	2191.7	1703.5	2199.6	1869.9	1996.6 (1986.6)
Black Turtle Soup	2675.3	3130.6	2978.3	3216.9	3088.2	3113.3	2703.5	2986.6 (3038.5)
NEP-2 (white)	2304.8	2196.4	1951.5	1880.9	1651.6	1705.0	2072.4	1966.1 (1909.6)
Jamapa (black)	2697.3	3103.9	3122.7	3114.9	2891.9	2703.5	2750.6	2912.1 2947.9
Pinto #114	2951.6	3237.3	2810.3	3105.5	2789.9	2943.8	2609.3	2921.1 (2916.0)
Montcalm (kidney)	1521.3	1813.4	1794.5	1763.1	1551.2	1758.4	1526.0	1675.4 (1701.1)
Mean over varieties	2267.8	2471.4	2378.8	2449.9	2232.5	2289.2	2247.4	2321.0 (2329.9)

* A difference between variety-strain values in this table of 32.6 pounds is necessary for significance at the 5% level.

**Numbers in parentheses are means not including the control.

Test #5210 *CRANBERRY SELECTIONS*

ENTRY	YIELD IN LBS. CLEAN SEED/ACRE	GMS/100 SEEDS
41497	2436.6	60.25
41498	2537.1	63.00
41499	2705.1	49.00
Michicran	2934.3	55.75

The purpose of this test was to compare for yield and seed size the selections of cranberry beans which remain from earlier screening experiments. The objective has been to find a cranberry bean of larger seed size than Michicran, and equal to it in yield, for certain European markets. It appears that we have acceptable seed size. However, though there was not a statistically significant difference among the lines, the Michicran appears to be a better yielder than the 2 larger seeded selections. Further testing is required to confirm this yield difference.

Test #5211 *RED KIDNEY SELECTIONS, STANDARD VARIETIES OF KIDNEYS, AND 2 PINTOS.*

ENTRY	YIELD IN POUNDS CLEAN SEED/ACRE*
41048	2640.74
41050	2774.19
41051	2709.82
41056	2501.01
41060	2756.92
41070	2742.79
41071	2791.46
41072	2413.09
41073	2741.22
41080	2709.82
Charlevoix DR Kidney	2494.73
Montcalm DR Kidney	2480.60
Mecosta LR Kidney	2504.15
Manitou LR Kidney	2639.17
Pinto 114	3056.79
Ouray Pinto	2615.62

*Differences in yield were not significant.

The selections were made at the Bean and Beet Farm in 1974 in an attempt to get some earlier maturing light reds than Manitou or Mecosta without sacrificing yield. There were no significant differences in yield, and the wet weather at the end of the growing season precluded getting good maturity data. Most of the lines yielded as good as Manitou and Mecosta, but we will have to have another years trial to get a more accurate fix on maturity. Some re-selections were made.

CORN HYBRIDS, PLANT POPULATION AND IRRIGATION

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Table 1 presents performance data for 75 commercial corn hybrids evaluated in 1975 with irrigation and without irrigation. A total of nine inches of water were applied in seven applications on July 2, 8, 16, 23, 29, August 11 and 19. Bouyoucous soil moisture blocks were placed at 6, 12, 18 and 24-inch depths in both irrigated and unirrigated plot areas.

Irrigated yields averaged 29.3 bushels per acre more than unirrigated -- 153.9 vs. 124.6. Hybrids ranged from 106.3 to 206.5 irrigated and 80.4 to 157.2 without irrigation. Hybrids significantly better than the average yield (arranged in order of increasing grain moisture content at harvest) are listed below. Fifteen of the 17 hybrids were in the highest yielding group for both irrigated and unirrigated plots. Two hybrids yielded above 200 bushels per acre. The correlation of irrigated with unirrigated yields was highly significant, .932, indicating a close relationship between relative yields of hybrids in both situations.

Irrigated	Unirrigated
Northrup King PX32 (2X)	Northrup King PX32 (2X)
Michigan 4122 (2X)	Michigan 4122 (2X)
Michigan 407-2X (2X)	Michigan 407-2X (2X)
Funk 26516 (3X)	Funk 26516 (3X)
Blaney B606 (2X)	Blaney B606 (2X)
Asgrow RX53 (2X)	Asgrow RX53 (2X)
Wolverine W166 (2X)	Northrup King PX529 (3X)
Funk G-4321 (2X)	Wolverine W166 (2X)
Security SS105 (2X)	Funk G-4321 (2X)
Michigan 5802 (2X)	Super Crost S27 (2X)
Migro M-1130 (2X)	Security SS105 (2X)
Pioneer 3716 (3X)	Michigan 5802 (2X)
P-A-G SX69 (2X)	Migro M-1130 (2X)
Acco UC3301 (2X)	Pioneer 3716 (3X)
Pioneer 3535 (2X)	P-A-G SX69 (2X)
	Acco UC3301 (2X)
	Pioneer 3535 (2X)

Table 1 NORTH CENTRAL MICHIGAN Zone 3

Montcalm County Trial - Irrigated vs. Not Irrigated

One, Two, Three Year Averages - 1975, 1974, 1973

Hybrid (Brand - Variety)	% Moisture 1975	% Moisture 2 yrs.	% Moisture 3 yrs.	Bushels per Acre 1975 Irrig	Bushels per Acre 1975 Not Irrig	Bushels per Acre 2 years Irrig	Bushels per Acre 2 years Not Irrig	Bushels per Acre 3 years Irrig	Bushels per Acre 3 years Not Irrig	% Stalk lodging 1975 Irrig	% Stalk lodging 1975 Not Irrig	% Stalk lodging 2 years Irrig	% Stalk lodging 2 years Not Irrig	% Stalk lodging 3 years Irrig	% Stalk lodging 3 years Not Irri
Michigan 275-2X (2X)	21.8	25	24	133.6	101.0	122	104	116	101	10.4	10.6	6	5	6	6
DeKalb XL311 (3X)	21.8	26	24	106.3	80.4	104	83	104	85	5.2	2.3	3	1	3	2
Michigan 280 (4X)	21.8	25	24	122.8	91.5	119	97	113	97	10.2	9.8	6	7	5	6
Michigan 2853 (3X)	21.9	25	--	129.0	100.4	126	104	--	--	5.6	6.8	4	4	--	--
Funk G-4195 (3X)	22.0	28	26	133.2	109.1	122	108	115	101	7.2	3.8	4	2	3	4
Michigan 2833 (3X)	22.1	25	24	123.4	100.7	118	102	116	102	8.8	5.7	5	3	5	4
DeKalb XL12 (2X)	22.3	29	28	124.2	102.8	120	104	115	101	16.8	18.7	8	9	7	7
Migro M-1020 (2X)	22.5	28	--	139.8	113.5	123	108	--	--	2.3	3.9	1	3	--	--
Wolverine W128 (2X)	22.7	25	25	122.2	100.6	114	100	111	95	4.7	0.0	5	2	3	2
Migro M-0101 (2X)	22.7	26	--	140.7	109.6	126	104	--	--	4.6	3.5	2	3	--	--
Super Crost 1692 (2X)	22.8	27	26	130.7	104.2	125	108	119	102	2.4	4.7	1	3	2	3
Michigan 333-3X (3X)	22.9	26	25	144.5	114.8	134	115	128	112	2.3	8.1	2	4	3	3
Super Crost 1610 (2X)	23.1	25	--	136.0	107.6	122	106	--	--	2.9	0.6	1	1	--	--
Asgrow 2222 (2X)	23.2	--	--	129.4	106.9	--	--	--	--	0.8	1.6	--	--	--	--
Northrup King PX20 (2X)	23.2	26	--	135.3	111.4	122	106	--	--	7.6	4.4	4	2	--	--
Blaney B302 (2X)	23.2	27	--	142.1	114.7	131	113	--	--	0.7	3.1	0	3	--	--
Pioneer 3955 (3X)	23.3	--	--	147.1	124.6	--	--	--	--	4.7	0.8	--	--	--	--
Michigan 3093 (3X)	23.5	--	--	158.0	125.7	--	--	--	--	3.1	1.5	--	--	--	--
Blaney B401 (2X)	23.5	--	--	157.1	130.3	--	--	--	--	5.8	2.2	--	--	--	--
Pioneer 3965 (3X)	23.5	25	--	137.0	115.3	121	108	--	--	1.5	0.8	1	0	--	--
Funk G-4141 (2X)	23.6	--	--	156.0	114.5	--	--	--	--	1.6	0.0	--	--	--	--
Funk G-4252 (3X)	23.7	29	28	143.5	113.1	132	108	117	100	5.6	2.1	3	1	3	2
Pioneer 3958 (2X)	23.9	28	27	160.0	127.5	136	113	123	106	0.7	3.1	0	2	1	2
Asgrow RX42 (2X)	24.0	28	26	142.9	130.5	131	118	127	114	0.0	0.0	0	0	1	1
DeKalb XL15A (2X)	24.1	30	28	130.3	105.2	117	103	112	100	12.0	13.7	6	7	5	5

Table 1 Continued

	Michigan 3102 (2X)	24.3	29	--	157.3	131.1	141	124	--	--	3.5	2.4	2	1	--	--
	Acco UC 2301 (2X)	24.6	29	28	158.7	132.7	138	119	133	115	7.4	17.1	4	9	5	6
	Blaney B442 (3X)	24.7	--	--	128.4	113.3	--	--	--	--	6.9	5.8	--	--	--	--
	Michigan 396-3X (3X)	25.2	30	28	160.6	128.3	144	122	139	119	0.0	0.8	0	0	1	1
	Funk G-4343 (2X)	25.3	31	29	164.2	135.1	133	109	126	107	6.9	7.1	3	4	3	3
	Blaney 7305 (2X)	25.3	30	--	156.5	133.2	132	119	--	--	2.1	5.1	1	3	--	--
	Cowbell 7300 (2X)	25.6	31	30	144.8	122.3	123	106	120	104	7.9	6.1	4	3	5	3
	Michigan 410-2X (2X)	25.9	31	29	157.6	132.9	145	123	141	119	5.5	4.9	3	3	3	4
1,2	Northrup King PX32 (2X)	26.1	30	--	168.2	135.6	143	121	--	--	4.4	5.3	2	3	--	--
	Pioneer 3785 (2X)	26.2	32	--	146.0	123.7	129	113	--	--	0.0	0.8	0	0	--	--
	Blaney B443 (3X)	26.3	--	--	155.1	121.4	--	--	--	--	4.7	0.8	--	--	--	--
1,2	Michigan 4122 (2X)	26.3	--	--	179.3	140.4	--	--	--	--	0.8	0.0	--	--	--	--
	Acco DC231 (4X)	26.3	32	30	139.7	113.7	116	101	107	96	11.0	7.6	6	5	7	4
	Cowbell 102 (2X)	26.3	--	--	129.0	107.2	--	--	--	--	4.9	10.2	--	--	--	--
	Pride R290 (2X)	26.5	32	30	157.4	133.7	145	124	133	114	7.9	6.8	4	4	4	4
	Funk G-L2384 (Sp.)	26.5	--	--	140.9	112.4	--	--	--	--	14.1	14.7	--	--	--	--
1,2	Michigan 407-2X (2X)	26.6	31	29	168.6	137.5	151	130	145	126	3.5	0.0	2	1	3	2
	Migro M-1212 (2X)	26.7	33	31	153.7	127.7	132	116	130	117	1.5	3.6	2	2	2	1
	Funk G-4288 (3X)	26.7	32	30	155.4	132.5	136	121	134	118	10.3	11.3	5	6	5	4
1,2	Funk 26516 (3X)	26.8	--	--	168.5	136.3	--	--	--	--	1.4	1.5	--	--	--	--
	Michigan 572-3X (3X)	26.8	33	31	156.4	128.1	139	122	137	120	7.1	5.7	4	3	3	3
1,2	Blaney B606 (2X)	26.8	33	--	176.8	143.5	143	123	--	--	3.6	3.6	2	2	--	--
	Acco U 334 (3X)	27.0	--	--	167.0	123.7	--	--	--	--	12.1	5.1	--	--	--	--
	Michigan 5443 (3X)	27.1	--	--	167.7	131.7	--	--	--	--	3.6	5.4	--	--	--	--
	Pride 4404 (2X)	27.1	--	--	169.7	129.7	--	--	--	--	0.8	1.5	--	--	--	--
1,2	Asgrow RX53 (2X)	27.2	30	28	169.3	138.3	146	126	141	124	0.0	0.8	0	0	0	1
2	Northrup King PX529 (3X)	27.3	33	--	165.6	138.7	136	124	--	--	5.6	7.5	3	4	--	--
1,2	Wolverine W166 (2X)	27.3	--	--	179.3	137.8	--	--	--	--	5.6	8.6	--	--	--	--
	Cowbell 4100 (2X)	27.6	33	--	140.4	111.4	126	106	--	--	7.2	3.8	4	2	--	--
1,2	Funk G-4321 (2X)	27.7	33	31	181.1	148.7	157	132	146	126	2.3	0.7	1	0	3	1

Table 1 Continued

Super Crost 1901 (2X)	28.1	33	--	155.5	118.8	145	119	--	--	1.7	1.6	1	1	--	--
Cardinal SX105 (2X)	28.2	32	--	166.1	134.7	144	121	--	--	3.1	3.6	3	2	--	--
Super Crost 825 (2X)	28.2	33	30	145.8	114.6	130	110	126	108	0.7	1.6	0	1	1	1
Funk G-4444 (2X)	28.7	33	32	166.4	135.0	140	128	143	124	3.8	2.8	2	2	3	2
Asgrow RX64 (2X)	28.7	33	--	153.6	133.1	136	123	--	--	3.0	6.2	2	3	--	--
Pioneer 37[illegible] (2X)	28.8	33	31	166.5	132.6	142	121	137	118	3.8	3.7	2	2	3	2
Northrup King PX46 (2X)	28.8	--	--	154.0	131.7	--	--	--	--	2.2	0.8	--	--	--	--
2 Super Crost 827 (2X)	28.8	33	31	160.1	140.5	133	113	133	115	2.2	6.5	1	3	2	3
Funk G-4366 (3X)	28.9	34	32	170.2	131.8	138	115	137	117	1.5	6.0	1	3	2	3
Michigan 575-2X (2X)	28.9	34	--	167.4	135.2	148	126	--	--	4.6	4.5	2	2	--	--
Funk G-[illegible]302 (Sp.)	29.4	35	--	158.8	122.3	139	115	--	--	8.8	15.5	5	8	--	--
Cowbell 7440 (2X)	29.7	34	--	167.4	125.9	143	122	--	--	0.7	0.0	1	1	--	--
1,2 Security SS105 (2X)	29.8	--	--	173.1	145.7	--	--	--	--	0.7	5.9	--	--	--	--
1,2 Michigan 5802 (2X)	29.8	--	--	187.6	151.3	--	--	--	--	0.0	1.4	--	--	--	--
1,2 Migro M-1130 (2X)	30.2	35	33	170.3	138.8	149	123	142	120	4.9	4.9	2	2	2	3
1,2 Pioneer 3716 (3X)	30.3	--	--	172.7	137.4	--	--	--	--	4.5	2.1	--	--	--	--
1,2 P.A.G. SX69 (2X)	31.5	35	33	169.9	141.6	138	122	138	120	3.5	2.8	2	2	2	3
1,2 Acco UC 3301 (2X)	31.5	35	33	206.5	157.0	163	131	155	127	1.4	1.4	1	1	3	4
1,2 Pioneer 3535 (2X)	31.6	--	--	200.8	157.2	--	--	--	--	2.3	0.8	--	--	--	--
Cowbell 7480 (2X)	32.0	36	--	147.4	124.1	132	119	--	--	7.0	7.8	4	4	--	--
Average	26.1	30	29	153.9	124.6	134	115	128	111	4.5	4.6	3	3	3	3
Range	21.8 to 32.0	25 to 36	24 to 33	106.3 to 206.5	80.4 to 157.2	104 to 163	83 to 132	104 to 155	85 to 127	0.0 to 16.8	0.0 to 18.7	0 to 8	0 to 9	0 to 7	1 to 7
Least significant difference	1.2	0.9	0.7	14.2	10.9	8	7	5	5						

1 Significantly better than average yield, irrigated 1975.
2 Significantly better than average yield, not irrigated 1975.

Table 1 Continued

	1975	1974	1973
Planted	May 7	May 4	May 8
Harvested	Oct. 15	Oct. 26	Oct. 17
Soil Type	Montcalm sandy loam	Montcalm sandy loam	Montcalm sandy loam
Previous Crop	Clover	Sorghum - sudan seeded to rye in fall	Sorghum - sudan seeded to rye in fall
Population	20,700	20,500	18,700
Rows	30"	30"	30"
Fertilizer	255-110-110	150-120-170	277-130-130
Irrigation	9 inches	8 inches	5 inches
Soil Test: pH	6.5	6.1	5.6
P	268 (very high)	340 (very high)	297 (very high)
K	257 (high)	198 (high)	175 (medium)

Farm Cooperator: Theron Comden, Lakeview

County Extension Director: James Crosby, Stanton

Table 2 gives the average, highest and lowest yields for corn hybrids irrigated and not irrigated for an 8-year period, 1968-1975. The average yielding hybrid has given a response of 44 bushels to irrigation. The highest yielding hybrids have responded with 59 bushels added yield while the lowest yielding hybrids have given only 27 bushels added yield with irrigation. These results demonstrate the importance of choosing high yielding hybrids to maximize returns from irrigation with little, if any, additional cost.

Plant Population x Irrigation

Five hybrids at four plant populations irrigated and not irrigated were grown in each of eight years, 1968-1975, Table 3. Over the eight-year period, a population of 23,300 has given the highest average yield (171 bushels) when irrigated while 19,200 has given the highest yield (117 bushels) without irrigation. The 23,300 population irrigated gave the highest yield in seven of the eight years.

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

Table 2. Average, highest and lowest yields for corn hybrids irrigated and not irrigated for 8 years, 1968-1975.

Year	No. of hybrids tested	Average		Highest		Lowest	
		Irrigated	Not Irrigated	Irrigated	Not Irrigated	Irrigated	Not Irrigated
1975	75	154	125	207	157	106	80
1974	76	112	103	134	122	65	58
1973	72	114	101	138	120	78	73
1972	72	157	137	206	179	99	91
1971	56	163	28	211	42	91	11
1970	64	144	103	194	128	95	70
1969	63	146	86	185	109	97	56
1968	56	136	96	182	123	92	65
Averages		141	97	182	123	90	63

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Table 3. Average yield at four plant populations irrigated and not irrigated for eight years, 1968-1975.

Year	15,300		19,200		23,300		27.600	
	Irri-gated	Not Irri-gated	Irri-gated	Not Irri-gated	Irri-gated	Not Irri-gated	Irri-gated	Not Irri-gated
1975	158	136	183	164	196	151	172	146
1974	118	100	130	111	135	98	120	94
1973	108	97	134	116	128	106	108	102
1972	152	132	187	159	191	149	161	144
1971	173	37	189	35	191	20	181	11
1970	122	91	144	112	158	93	151	85
1969	126	91	158	109	173	96	148	86
1968	144	114	169	130	193	107	178	89
Average	138	100	162	117	171	103	152	95