1983 MONTCALM FARM RESEARCH REPORT

MICHIGAN STATE UNIVERSITY AGRICULTURAL
EXPERIMENT STATION

IN COOPERATION WITH

THE MICHIGAN POTATO INDUSTRY COMMISSION

THE MICHIGAN POTATO INDUSTRY COMMISSION

To Michigan Potato Growers and Shippers:

This Potato Research Report is the result of the research that was carried on by Michigan State University at the Montcalm Research Farm, Entrican, Michigan as well as other potato research projects conducted during 1983.

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

Thank you.

Sincerely,

Roy H. Kaschyk
Executive Director

RHK:kk

THE MICHIGAN POTATO INDUSTRY COMMISSION • 500 N. HOMER STREET • LANSING, MICHIGAN 48912 • (517) 373-3783

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1983 POTATO RESEARCH REPORT

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INTRODUCTION

The Montcalm Branch Experiment Station was established in 1967. This report marks the completion of 17 years of potato research studies at this facility. This report is designed to summarize all of the research conducted at the Montcalm Research Farm during 1983 plus that conducted at other locations. Much of the data reported herein represents projects in various stages of progress, so results and interpretations may not be final. RESULTS PRESENTED HERE SHOULD BE TREATED AS A PROGRESS REPORT ONLY as data from repeated trials are usually necessary before definite conclusions and recommendations can be made.

WEATHER

Tables 1 and 2 summarize the fifteen year temperature and rainfall data recorded at the Research Farm. Maximum temperatures during April and May were 7 degrees cooler than the 15 year average and minimum temperatures were 5 degrees cooler which resulted in very slow emergence. Temperatures changed dramatically in June, July, and August with the average maximum higher than the 15 year average. In June there were 10 days above 81 F and 2 days over 90 F. In July there were 19 days over 81 F and 6 days that it exceeded 90 F and in August there were 17 days and 2 days, respectively. The unseasonably warm growing season, and particularly the warm nights, resulted in reduced yields and specific gravity.

Although rainfall from April through September was nearly that of the 15 year average during the months of June, July, and August it was approximately one half of the normal. The high air temperatures and reduced rainfall placed additional stress on the crop. As a consequence, it was necessary to irrigate 17 times throughout the summer.

SOIL TESTS

Soil test results for the general plot area were:

pH	P	K	Ca	Mg
6.2	573	232	853	160

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

Year	April		May		June		July		August		September		6-Month Average	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1969	56	35	67	43	70	50	80	59	82	56	73	49	74	49
1970	54	35	65	47	72	55	80	60	80	57	70	51	73	45
1971	53	31	65	39	81	56	82	55	80	53	73	54	76	48
1972	47	30	70	47	72	50	79	57	76	57	69	49	73	48
1973	54	36	63	42	77	58	79	60	80	60	73	48	74	51
1974	57	36	62	41	73	52	81	57	77	56	68	45	70	48
1975	48	28	73	48	75	56	80	57	79	58	65	44	70	49
1976	58	35	63	41	79	57	81	58	80	53	70	46	71	48
1977	62	37	80	47	76	50	85	61	77	52	70	53	75	50
1978	50	31	67	45	78	50	81	56	82	57	75	52	72	49
1979	50	33	66	44	74	55	82	57	77	55	76	47	71	49
1980	49	31	69	42	73	50	81	58	81	58	70	49	71	48
1981	56	35	64	39	73	50	77	51	78	53	67	47	69	46
1982	53	28	72	46	70	44	80	53	76	48	66	44	70	44
1983	47	28	60	38	76	49	85	57	82	57	70	46	70	46
15-yr. avg.	54	33	67	43	75	52	81	57	79	55	70	48	72	48

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

Year	April	May	June	July	August	September	Total
1969	3.33	3.65	6.18	2.63	1.79	0.58	18.16
1970	2.42	4.09	4.62	3.67	6.54	7.18	28.52
1971	1.59	0.93	1.50	1.22	2.67	4.00	11.91
1972	1.35	1.96	2.51	3.83	7.28	2.60	19.53
1973	3.25	3.91	4.34	2.36	3.94	1.33	19.13
1974	4.07	4.83	4.69	2.39	6.18	1.81	23.97
1975	1.81	2.05	4.98	2.71	11.25	3.07	25.87
1976	3.27	4.03	4.22	1.50	1.44	1.40	15.86
1977	1.65	0.46	1.66	2.39	2.61	8.62	17.39
1978	2.34	1.35	2.55	1.89	5.90	2.77	16.80
1979	2.58	1.68	3.77	1.09	3.69	0.04	12.85
1980	3.53	1.65	4.37	2.64	3.21	6.59	21.99
1981	4.19	3.52	3.44	1.23	3.48	3.82	19.68
1982	1.43	3.53	5.69	5.53	1.96	3.24	21.38
1983	3.47	4.46	1.19	2.44	2.21	5.34	19.11
15-yr. avg.	2.69	2.81	3.71	2.50	4.28	3.49	19.48

FERTILIZERS USED

The previous crop was alfalfa which was plowed down in the spring of 1983. Except for the specific fertility studies where the fertilizers are specified in the report, the following fertilizers were used on the potato plot area:

plowdown	0-0-60	200 lbs/A
banded at planting	20-10-10	500 lbs/A
sidedress prior to hilling	46-0-0	125 lbs/A
sidedress at hilling	46-0-0	125 lbs/A

HERBICIDES

Early preemergence alachlor (Lasso) at 2 lbs/A followed by a delayed preemergence application of metribuzin (Lexone) at ½ lb/A.

INSECT AND DISEASE CONTROL

Temik was applied at planting at 3 lbs/A. The foliar fungicide applications were initiated on July 13 with 8 applications of Bravo. Foliar insecticides used were Pydrin on July 1, 25, and August 2 and Cygon on August 25.

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

1983-MICHIGAN POTATO VARIETY EVALUATIONS

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A. *DATES OF HARVEST*

The 1983 dates-of-harvest study was conducted at the Montcalm Research Farm. Three complete plantings and four replications of all varieties were made on May 4 in individual plots 10 feet x 34 inches. Plant spacing within the row was 12 inches.

The previous crop was alfalfa and 250 lbs/A of 0-0-60 were plowed down, 500 lbs/A of 20-10-10 were applied with the planter, and two sidedress applications of 46-0-0 at 150 lbs/A each were applied in June prior to hilling. Aldicarb (Temik 15G) was applied at 20 lbs/A at planting. Alachlor (Lasso) was applied at early preemergence at 2 lbs/A and metribuzin (Lexone) at ½ lb/A at delayed preemergence. The plots were irrigated 17 times and foliar insecticides and fungicides were applied as needed.

The weather stress was very severe in 1983 with cool and wet soil conditions at planting followed by slow emergence and early growth. This was followed by extremely hot and dry weather throughout most of the growing season. Total rainfall April through September was 19.11 inches which is very comparable to the 15 year average, however, rainfall during June, July, and August was only 5.84 inches or about 50% of normal. Average maximum temperatures were substantially above normal during this same period. There were 14 days with temperatures about 90° F and there were many nights that temperatures did not drop below 70° F.

Results:

Table 1 summarizes the yields, size distribution, and specific gravity of the several cultivars at each harvest. Average yields on August 9 were well below the normal average with only 74% U.S. No. 1 size. The severe weather caused below normal performance of several varieties. Individual varieties such as Shepody, Ontario, and Russet Burbank were substantially below 60 cwt/A of marketable potatoes. Average total yields increased by 71% by August 31 harvest and the yield of U.S. No. 1 (marketable size) increased by 95% which reflects the fact that tuber sizing for many varieties was delayed. Even at the late harvest several varieties still had a high percentage of tubers under two inches.

Table 2 summarizes the internal defects, chip ratings, and black spot damage. Vascular discolorations were fairly prevalent, however, these were predominately classed as slight and would not cause any market problem. Those noted as severe would clearly show in a processed potato chip, however. Internal necrosis was minimal and hollow heart was not as severe as anticipated. Chip scores except for Onaway and Ontario were all rated as very good.

Table 3 summarizes the after-cooking-darkening ratings which were determined on December 7 after storage at 52° F. Varieties which showed the greatest degree of darkening were Ontario and Snowchip. Several selections showed increased darkening as the tubers were allowed to cool which is not desirable from a consumers standpoint.

Variety Observations:

Atlantic - Yielded above average at all harvest dates with high specific gravity, excellent chip quality, and no after cooking darkening was observed. Tubers do slough after boiling because of high dry matter.

Chipbelle - Yielded below the average at each harvest and highest in specific gravity.

Jemseg - An early maturing variety that sets and sizes tubers early. Second highest yielder at 97 day harvest but still substantially below Onaway. Variety tends to have a light set which contributes to larger sizing. Specific gravity and chip quality is better than Onaway. Foliage showed severe wilt-type early dying.

Katahdin - A late maturing variety which sized tubers well by the third harvest.

Onaway - The highest yield at both the first and second harvests and no internal defects.

Ontario - Very late maturity as evidenced by the poor sizing. High percentage of pick outs due to second growth and heat sprout. Considerable after cooking darkening.

Russet Burbank - Very poor sizing and high percentage of pick outs. Hollow heart noted at both the second and third harvests.

Shepody - Late maturing and a high percent of pick outs, mostly off-type and growth crack. Some scab noted. A long, white with higher specific gravity than Russet Burbank. Processes well for frozen french fries. May be susceptible to mosaic virus in foliage.

Snowchip - Late maturing and highest yield at 142 day harvest. Higher marketable yield than Ontario with less pick outs. Similar to Ontario in after cooking darkening at two hours after cooling. Some severe vascular discoloration noted.

Yukon Gold - Medium maturity, golden flesh, and susceptible to scab. Tubers sized well. Optimum marketable yield in 115 days.

MS700-79 - Medium maturity with below average yields. No internal defects and chips well out of field. May have susceptibility to virus-mosaics.

MS700-83 - Medium-late maturity and above average yields. Round white, uniform appearance with minimal internal defects. Good chips out of field and no after-cooking-darkening. Yielded well in Presque Isle County demonstration plot and highest specific gravity. Also yielded above average in Bay County harvest August 17.

MS701-22 - Medium-late maturity, round white with below average yields.

MS702-80 - Round white, medium maturity, and medium specific gravity. Minimal internal defects and good chip quality. Some scab tolerance.

MS702-91 - Late maturing, round to oblong, white with yields substantially above average. Some internal necrosis and hollow heart noted. Good culinary qualities.

MS704-10 - Medium maturity, round, golden flesh cultivar with high specific gravity. Minimal internal defects and good chip color.

MS704-17 - Medium-late maturity with high yields. Round white with susceptibility to scab.

MS714-10 - Medium maturity with average yields. Oblong in shape and medium specific gravity. Some hollow heart noted.

MS716-15 - Medium maturing, round white with average yields, and high specific gravity.

MS718-6 - Medium-late maturity with average yields. Some after cooking darkening noted.

B7154-10 - Being deleted because of serious growth cracks and low specific gravity.

B7805-1 - Being deleted because of poor stands at all locations and below average yields.

B9540-62 - An oblong to long russet from the USDA-Beltsville breeding program. Low yields and specific gravity and poor tuber sizing as evidenced by high percentage of B size tubers. Some after-cooking-darkening after cooked tubers were allowed to cool.

C-13 - A medium-early selection from the Campbell breeding program. The yield performance was lower than normal and growth crack was more prevalent than usual.

Table 1. Yield, size distribution, and specific gravity of several potato varieties harvested on three different dates in Michigan. 1983.

	August 9 (97 Days)							August 31 (119 Days)							September 23 (142 Days)						
	Yield cwt/A		Percent Size Distribution					Yield cwt/A		Percent Size Distribution					Yield cwt/A		Percent Size Distribution				
Variety	Total	No. 1	<2"	2-3¼	>3¼	Pick Outs	Specific Gravity	Total	No. 1	<2"	2-3¼	>3¼	Pick Outs	Specific Gravity	Total	No. 1	<2"	2-3¼	>3¼	Pick Outs	Specific Gravity
Snowchip	247	168	30	66	2	2	1.067	420	349	15	75	8	2	1.074	584	484	15	71	13	2	1.071
MS-702-91	262	167	34	64	0	2	1.075	462	409	12	85	4	0	1.078	534	475	10	78	11	1	1.076
Onaway	410	370	9	76	14	1	1.067	578	515	7	69	20	4	1.066	532	505	5	76	20	0	1.065
MS-700-83	272	204	23	71	4	2	1.078	467	412	11	73	15	1	1.080	501	450	10	70	20	0	1.078
MS-704-17	281	243	13	74	12	1	1.077	522	508	2	59	38	0	1.077	494	469	5	60	35	0	1.073
Shepody	106	56	47	53	0	0	1.075	377	202	16	49	5	30	1.077	492	321	11	44	21	24	1.080
Ontario	45	8	82	18	0	0	1.063	189	77	37	41	0	23	1.061	475	302	17	61	3	19	1.070
Atlantic	264	199	24	75	0	1	1.088	418	373	11	85	5	0	1.089	432	375	13	82	5	0	1.090
Katahdin	183	133	27	73	0	0	1.064	406	366	10	72	18	0	1.069	419	380	9	72	19	0	1.067
R. Burbank	137	52	58	38	0	4	1.072	422	187	31	43	1	25	1.077	417	171	30	40	1	29	1.075
MS-716-15	233	158	32	66	2	0	1.090	379	325	14	72	14	0	1.089	407	357	12	78	10	0	1.087
MS-718-6	143	106	26	74	0	0	1.075	341	308	10	77	13	0	1.078	396	369	6	63	31	1	1.078
MS-704-10	302	205	32	67	1	1	1.085	425	381	11	80	10	0	1.085	392	340	13	81	5	0	1.083
MS-714-10	191	114	40	60	0	0	1.077	410	341	17	77	6	0	1.078	388	313	18	70	11	2	1.073
Chipbelle	210	143	30	68	0	2	1.084	362	306	13	72	13	3	1.094	373	304	17	82	0	2	1.093
MS-702-80	233	150	35	64	0	1	1.074	370	319	14	80	6	0	1.075	371	317	15	80	5	0	1.074
Yukon Gold	254	199	20	73	6	2	1.078	391	349	11	75	14	0	1.079	346	303	12	75	13	0	1.076
B-7154-10	276	218	20	75	4	1	1.062	404	349	11	76	10	3	1.062	342	273	14	74	6	6	1.058
C-13	237	203	13	82	3	2	1.077	354	326	6	79	13	2	1.075	331	286	11	78	9	2	1.070
MS-700-79	202	171	14	83	2	1	1.084	345	322	7	78	15	0	1.085	313	282	10	73	17	0	1.082
Jemseg	318	289	9	79	12	0	1.075	337	321	4	74	22	0	1.070	302	279	7	82	10	1	1.066
B-7805-1	206	172	16	82	2	1	1.068	304	274	9	81	10	1	1.069	296	258	10	68	20	3	1.068
MS-701-22	185	143	23	75	2	0	1.078	291	260	10	78	11	1	1.082	282	252	11	80	10	0	1.079
B-9540-62	216	143	34	64	2	0	1.071	297	230	23	66	12	0	1.072	248	181	27	68	5	0	1.069
AVERAGE	226	167					1.075	386	325					1.077	403	335					1.075

Table 2. Internal defects[1], chip scores, and bruising damage of several potato varieties in Michigan. 1983.

	August 31 Harvest					September 23 Harvest				
Variety	VAS DIS	INT NEC	H H	Chip[2] Score	%[3] Bruise Free	VAS DIS	INT NEC	H H	Chip[2] Score	%[3] Bruise Free
Atlantic	3 sl	0	0	1.0	94	3 sl	0	0	1.0	90
Chipbelle	2 sl	0	0	1.0	66	6 sl 2 sev	0	0	1.0	95
Jemseg	2 sl	0	0	1.5	86	4 sl	0	0	2.0	89
Katahdin	5 sl	0	1	1.5	66	7 sl 3 sev	0	0	1.5	87
Onaway	3 sl	0	0	3.0	87	5 sl	0	0	3.5	95
Ontario	3 sl	0	0	3.0	-	0	0	0	3.0	-
R. Burbank	0	0	1	2.0	72	5 sl	0	4	2.0	88
Shepody	4 sl	0	1	2.0	100	3 sl	0	0	2.0	92
Snowchip	3 sl 1 sev	0	0	1.5	81	7 sl 4 sev	1	0	1.5	96
Yukon Gold	3 sl	0	0	1.5	82	8 sl	0	0	2.0	93
MS700-79	0	0	0	1.0	60	0	0	0	1.0	83
MS700-83	0	0	0	1.0	74	2 sl	0	0	1.5	86
MS701-22	0	0	0	1.0	43	0	0	0	1.5	86
MS702-80	0	0	0	1.0	88	0	0	0	1.0	93
MS702-91	7 sl	0	1	1.0	87	0	2	0	1.5	85
MS704-10	0	0	0	1.0	76	1 sl	0	0	1.5	84
MS704-17	2 sl	0	0	1.5	67	3 sl	0	0	1.5	80
MS714-10	1 sl	0	0	1.5	67	0	0	2	2.0	95
MS716-15	1 sl	0	0	1.0	76	4 sl	0	0	1.0	92
MS718-6	1 sl	0	3	1.0	50	8 sl	0	2	1.5	89
B7154-10	5 sl	0	0	1.0	-	-	-	-	-	-
B7805-1	1 sl	0	1	1.5	-	-	-	-	-	-
B9540-62	5 sl	0	0	1.5	90	10 sl	0	0	1.0	80
C-13	3 sl	0	0	1.0	80	7 sl	0	1	1.5	-

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

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

[3]Bruising evaluation run by Ore-Ida; damage noted primarily as black spot which is determined after peeling.

Table 3. Determinations of after-cooking-darkening of several potato cultivars.

	After Cooking Darkening[1]	
	0 Hours	2 Hours
Atlantic	1.0	1.0
Chipbelle	2.0	2.0
Jemseg	1.5	2.5
Katahdin	1.5	2.5
Onaway	1.5	2.0
Ontario	1.5	3.5
Russet Burbank	1.0	1.0
Shepody	1.0	1.0
Snowchip	1.5	3.5
Yukon Gold	1.0	1.0
MS700-79	1.5	2.0
MS700-83	1.0	1.5
MS701-22	1.0	1.5
MS702-80	1.0	1.0
MS702-91	1.0	1.5
MS704-10	1.0	1.5
MS704-17	1.0	1.5
MS714-10	1.0	1.0
MS716-15	1.0	1.0
MS718-6	1.5	2.5
B9540-62	1.0	2.5
C-13	1.0	1.0

[1] Samples stored 75 days at 52° F. Tubers peeled and sliced in half from stem end to apical end. Samples steam boiled for 35 minutes. Readings made at completion of boiling and at two hours after tubers were cooled. 1 = light with no darkening; 5 = overall gray to black darkening.

B. USDA-BELTSVILLE TRIALS

Four separate trials evaluating selections from the USDA-Beltsville potato breeding program were conducted in 1983. Cultural, fertility, and management practices used were the same as described in the dates of harvest study. Two studies were with russet and round white selections made from the Chapman Farm (Presque Isle, Maine) seed plot harvests in September, 1982. Two studies (russets and whites) were inter-regional trials conducted in conjunction with several other states.

Tables 4 and 5 summarize the yield data obtained from the 1982 Chapman Farm selections. Tuber sizing was limited as evidenced by the high percentage of tubers under 2" and the low percentage of tubers over 3¼" diameter. In terms of overall performance no selections were judged to be better than Atlantic. Selections B8682-4, B9769-18, and B9792-9 will be tested again in 1984.

Sizing of the russet selections was very poor and specific gravity readings were below 1.075, a minimum level desired in long russets in Michigan. All selections, however, were substantially better than Russet Burbank in terms of pick outs and off type tubers. Selections B9752-7 and B9400-5 will be tested again in 1984.

Tables 6 and 7 summarize the yield data for the round whites and russets in the USDA-Beltsville inter-regional trial. All round-white selections yielded less than Atlantic and specific gravity readings were lower also. Foliar maturities for both the round-whites and russets were noted as medium-early to medium. The latest maturing selections as noted on August 20 were B8706-7 and G670-11 and comparable to Kennebec, Atlantic, and Russet Burbank. Hollow heart was noted in only Kennebec and G670-11 and no internal necrosis was noted. Considerable jelly end rot was noted on B9596-2.

Table 8 summarizes the yield data for the 13 cultivars which were selected at harvest from the approximately 225 eight hill plantings from the USDA-Beltsville seedlings. Four selections were deleted after harvest from further testing because of low specific gravity and severe vascular discoloration in B8687-8.

Table 4. Yield, size distribution, and specific gravity of several round white selections from the USDA-Beltsville breeding program.

Cultivar	Yield cwt/A		Percent Size Distribution				Specific Gravity
	Total	No. 1	<2"	2-3¼	>3¼	Pick Outs	
B9769-18	605	432	26	70	2	3	1.066
Atlantic	490	438	11	82	8	0	1.087
B8682-4	490	394	19	74	7	1	1.076
B8702-18	429	388	9	87	3	1	1.065
B8687-3	423	338	21	76	3	0	1.062
B9792-9	396	359	9	82	9	1	1.073
B9539-9	365	215	41	59	0	0	1.077
B8687-13	342	292	14	80	6	1	1.064
B9510-5	329	252	23	70	7	2	1.069
B9527-1	302	233	22	77	0	2	1.079
Superior	300	260	10	82	5	4	1.069
B9516-8	219	206	6	91	4	0	1.078
AVERAGE	391	317					1.072

Planted May 6; Harvested September 12, 1983.

Table 5. Yield, size distribution, and specific gravity of several russet selections from the USDA-Beltsville breeding program.

Cultivar	Yield cwt/A		Percent Size Distribution				Specific Gravity
	Total	No. 1	<2"	2-3¼	>3¼	Pick Outs	
B9752-7	503	411	18	61	21	2	1.068
B9400-5	475	388	15	43	40	3	1.069
R. Burbank	444	209	23	43	5	30	1.071
B9729-6	327	200	40	58	2	0	1.070
B9740-1	321	235	26	64	9	1	1.062
B9569-2	300	194	36	58	7	0	1.065
B9738-2	300	169	42	54	3	2	1.068
B9752-3	263	119	46	44	2	9	1.066
AVERAGE	366	240					1.067

Planted May 6; Harvested September 12, 1983.

Table 6. Yield, size distribution, and specific gravity of several round white cultivars. Inter-regional trial.

Cultivar	Yield cwt/A Total	No. 1	Percent Size Distribution <2"	2-3¼	>3¼	Pick Outs	Specific Gravity	Chip Scores[2]
Atlantic	364	324	11	85	4	0	1.079	1.5
B8091-8	339	289	15	82	3	0	1.073	2.0
G670-11[1]	327	277	10	76	8	5	1.075	2.5
B8706-7	314	281	9	80	10	2	1.065	1.5
Onaway	304	262	12	75	12	3	1.057	3.5
B9340-13	293	250	15	85	0	0	1.072	2.0
B9384-4	291	204	30	70	0	0	1.066	1.0
B9140-32	276	241	13	87	0	0	1.077	1.0
B9224-6	262	227	13	82	5	0	1.061	1.5
Kennebec[1]	241	175	20	69	4	8	1.059	2.0
Superior	239	212	7	82	6	4	1.059	2.0
B9192-1	233	214	8	88	3	0	1.060	1.5
AVERAGE	290	246					1.067	

Planted May 6; Harvested September 15, 1983.

[1]Selections from University of Guelph, Ontario Canada.

[2]Samples processed October 19. PC/SFA scale; 1 = lightest, 5 = dark and unacceptable.

Table 7. Yield, size distribution, and specific gravity of several russet cultivars. Inter-regional trial.

Cultivar	Yield cwt/A Total	No. 1	Percent Size Distribution <4 oz	4-10 oz	>10 oz	Pick Outs	Specific Gravity	Comments
B9553-6	476	372	17	62	17	5	1.065	Severe heat sprout
Belrus	318	167	46	50	3	1	1.074	
B9398-2	302	173	40	51	6	3	1.073	
R. Burbank	298	66	38	22	0	40	1.065	
B9648-9	275	143	46	51	1	3	1.056	Dark russet
B9596-2	270	141	36	45	7	12	1.058	25% jelly end rot
B9523-10	231	121	41	51	2	6	1.055	Some growth crack
B9540-62	222	112	44	49	2	5	1.062	Some vascular discoloration
Gold Rus	191	87	51	46	0	3	1.068	Some growth crack and vascular discoloration
AVERAGE	287	153					1.064	

Planted May 6; Harvested September 2, 1983.

Table 8. Yield, size distribution, and specific gravity of several cultivars selected at harvest from eight-hill plantings of USDA-Beltsville selections.

	Yield cwt/A		Percent Size Distribution				
Cultivar	Total	No. 1	<2"	2-3¼	>3¼	Specific Gravity	Comments
B8687-8	404	336	17	83	0	1.076	Severe vascular discoloration-discarded
B8687-10	471	413	13	77	10	1.071	Round, smooth
B8751-6	538	452	16	79	5	1.079	Round, smooth slightly flattened
B9541-45	384	375	3	83	14	1.070	Medium deep eyes-discarded
B9581-10	461	413	10	79	11	1.075	Oval, medium eye depth, slight net
B9638-11	452	336	25	72	3	1.084	Smooth, slightly flattened
B9718-2	404	221	45	48	7	1.063	Russet, discarded-low specific gravity
B9792-6	461	403	13	77	10	1.086	Round to oblong, deep eyes
B9792-84	576	499	13	80	7	1.085	Slight net, deep eyes
B9792-111	557	481	14	79	7	1.089	Deep eyes, some scab
B9792-119	500	471	6	77	17	1.081	Deep eyes, slight net, some scab
B9792-191	470	432	8	84	8	1.069	Discarded-low specific gravity
B9922-11	461	375	19	56	25	1.082	Russet, oblong, slightly flat

C. *OVERSTATE DEMONSTRATION TRIALS*

Yield data were collected from two commercial farm locations in 1983. These were established as demonstration plantings and are not replicated plots. Plots were located at the Henry Mulders Farm in Munger and at the Wilks Farm in Posen. At the Mulders Farm the entire variety planting was harvested and graded and these data are reported in Table 9. Severe growth cracks were noted in B7154-10 and a very poor stand and heat sprout were noted with B7805-1. Both are being discontinued from any further testing in Michigan.

At the Wilks Farm three 15 foot areas from each variety were harvested, graded, and averaged to determine yield performance which is summarized in Table 10. Superior, MS704-17, MS700-83, and C-13 were located in sprayer rows so their yield potential was likely reduced. Considerable pick outs was noted with Yukon Gold, Ontario, C-13, and Jemseg and this was primarily severe growth cracks, knobby tubers, second growth and tuber greening. MSU seedling 700-83 produced good yields with a minimum of grade outs.

Table 9. The yield, size distribution, specific gravity, and chip quality of several potato varieties. Bay County, Henry Mulders Farm, Munger, Michigan. 1983.

			Percent Size Distribution					
Variety	Total (cwt/A)	U.S. No. 1 (cwt/A)	2-3¼"	Over 3¼"	Under 2"	Pick Outs	Specific Gravity	Chip Score[1]
Jemseg	356	319	82	8	7	3	1.070	1.5
Onaway	349	299	85	1	12	2	1.065	2.0
B7154-10	347	298	84	1	12	3	1.061	1.5
MS700-83	323	273	82	3	15	1	1.072	1.0
Yukon Gold	255	215	81	4	13	3	1.072	1.5
Oceania	250	227	88	3	9	0	1.073	1.0
C-13	194	156	78	2	19	0	1.066	1.0
B7805-1	122	108	82	7	11	0	1.058	1.5
AVERAGE	275	237					1.067	

Planted April 27; Harvested August 15, 1983.

[1]PC/SFA scale; 1 = lightest, 5 = dark and unacceptable.

Table 10. The yield, size distribution, and specific gravity of several potato varieties. Presque Isle County, Wilks Farms, Posen, Michigan. 1983.

			Percent Size Distribution				
			U.S. No. 1				
Variety	Total	U.S. No. 1[1]	2-3¼	Over 3¼	Under 2"	Pick Outs[2]	Specific Gravity
	(cwt/A)	(cwt/A)					
Katahdin	409	352	50	36	5	9	1.068
Snowchip	377	330	70	17	8	5	1.076
Yukon Gold	385	328	60	25	3	12	1.077
700-83	358	319	82	7	10	1	1.084
704-17	332	308	77	16	7	0	1.078
Onaway	329	292	65	24	4	7	1.066
Ontario	332	273	73	9	8	10	1.070
Superior	260	236	74	17	9	0	1.075
Atlantic	241	214	79	10	11	0	1.083
C-13	252	207	64	19	3	14	1.075
Jemseg	184	145	44	36	4	16	1.068
AVERAGE	314	273					1.075

Planted June 7; Harvested October 12, 1983.

[1]U.S. No. 1's consists of potatoes 2-3¼" plus those over 3¼".

[2]Pick outs consisted mainly of growth cracks, knobs, irregular shape, and serious greening.

EVALUATIONS OF CULTIVARS FOR FROZEN PROCESSING

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J. Fuller and R. Smith, Ore-Ida Foods, Inc.

Advanced seedlings from the USDA-Aberdeen, Idaho potato breeding program were evaluated for early and late harvests. Total yields, size distribution solids, external and internal defects, and percent sugars as determined by fry color were recorded.

Seven selections for the early harvest were planted on May 5 and harvested on August 25. Six selections for the late harvest trial were also planted on May 5 and harvested on September 29. Seven selections from the 1982 8-hill screening were planted on May 5 and harvested on August 25 and 45 new 8-hill selections were planted for adaptability selection.

RESULTS

Table 1 summarizes the yield performance of the advanced, early variety evaluations.

Table 1. ADVANCED EARLY VARIETY EVALUATIONS - ORE-IDA.

Variety	Yield(cwt/A) Total	No. 1	Percent Size Distribution Under 4 oz.	4-6	6-10	Over 10	No. 2's	HH/ No. Cut	Specific Gravity	Percent Solids	Maturity	Percent Sugars 0	1	2	3	4	Sugar Ends %	Bruise Free %
A76147-2	459	317	21	27	31	11	11	0/20	1.070	18.6	Late	60	15	10	0	15	5	86
Onaway	366	260	22	27	32	12	7	0/20	1.062	16.9	Med-Early	60	30	10	0	0	0	80
A77155-4	325	200	27	29	23	9	13	1/20	1.068	18.1	Med-Early	100	0	0	0	0	0	80
A76260-16	309	180	38	34	21	4	4	0/20	1.066	17.6	Med-Early	100	0	0	0	0	0	76
A71991-5	308	226	17	26	35	12	10	1/20	1.070	18.5	Medium	100	0	0	0	0	0	83
Shepody	280	145	29	26	21	4	20	4/20	1.076	19.8	Late	95	5	0	0	0	15	75
A68678-9	245	150	37	26	23	11	4	0/20	1.068	18.0	V. Late	100	0	0	0	0	0	83
Average	327	211							1.069	18.2								

A76147-2 - Emergence was noted to be very early with good vine growth and vigor. Maturity was rated as late. Yields were well above average, except tubers did not size as desired. At harvest, severe skinning and considerable growth crack were noted.

Worthy of further testing.

Onaway - Used as a reference variety, particularly for yield. It is not considered a processing potato.

A77155-4 - Emergence was noted as being early with average vine growth and vigor. A trace of mosaic was noted. Maturity was med-early and similar to Onaway. Tuber appearance was noted as satisfactory, however, there was a high percentage of No. 2's.

Worthy of further testing.

A76260-16 - Early emergence with a weaker type vine which appeared to show early senescence with wilt type symptoms. Considerable scab was noted on several tubers. Specific gravity was low, small size, and low score on bruising.

Questionable for further testing.

A71991-5 - Later in emergence with a small vine. Maturity was rated medium with severe wilt symptoms noted. Specific gravity average with good tuber sizing. At harvest, some tubers showed considerable growth crack.

Questionable for further testing because of low yield.

Shepody - Average in emergence and vine growth. Late maturity. Highest percentage of No. 2's and hollow heart. Highest specific gravity. May be a better producer with reduced irrigation. Acreage grown in Canada is primarily not irrigated. At harvest, growth cracks and scab were severe.

Suggest evaluation for one more year.

A68678-9 - Average in emergence and vine growth. Trace of mosaic. Very late maturity.

Suggest discontinuing because of lateness and low yield.

Table 2 summarized the performance of the advanced, late maturity varieties.

Table 2. ADVANCED LATE VARIETY EVALUATIONS - ORE-IDA, 1983.

Variety	Yield(cwt/A) Total	Yield(cwt/A) No. 1	Percent Size Distribution Under 4 oz.	4-6	6-10	Over 10	No. 2's	HH/ No. Cut	Dry Matter	Maturity	Bruise Free %	Plot No.	Natural Sugars 0	1	2	3	4	SF
A76147-2	580	424	12	18	35	21	15	0/40	18.1	Late	87	102	100	0	0	0	0	15
												102	90	0	0	0	15	20
												203	90	0	0	10	0	15
												303	90	0	0	0	15	20
												402	70	0	0	0	30	25
												402	100	0	0	0	0	20
A72685-2	358	240	29	24	27	16	5	18/40	19.3	V. Late	63	101	85	0	0	15	0	20
												205	80	5	0	15	0	15
												302	90	10	0	0	0	20
												404	90	5	5	0	0	0
Shepody	341	199	17	19	24	14	25	2/40	19.2	Late	97	106	100	0	0	0	0	20
												204	100	0	0	0	0	10
												304	100	0	0	0	0	20
												401	100	0	0	0	0	5
A7411-2	323	215	18	18	25	24	17	3/40	21.3	V. Late	87	103	100	0	0	0	0	0
												201	100	0	0	0	0	0
												301	100	0	0	0	0	0
												406	100	0	0	0	0	0
R. Burbank	312	120	46	21	14	3	16	4/40	18.1	Late	96	105	100	0	0	0	0	35
												202	missing					
												306	75	0	0	5	0	40
												405	90	0	0	0	10	20
A7668-2	271	149	41	27	23	5	5	11/40	19.1	V. Late	76	104	100	0	0	0	0	10
												206	100	0	0	0	0	5
												305	100	0	0	0	0	20
												403	100	0	0	0	0	15

A76147-2 - Very good yields and sizing and free of hollow heart. Good early emergence and vigorous vine growth. Good tuber type, however, growth cracks were severe in some cases.

Worthy of testing in 1984.

A72685-2 - Early emergence with average vine growth. Very late maturity and severe hollow heart. Poor tuber sizing and also lower score on bruise test.

Concern for lateness of maturity for Michigan conditions.

Shepody - Similar results as in early trial. Considerable external tuber defects.

Suggest evaluation for one more year.

A7411-2 - Early emergence, however, vine growth was noted as irregular. Very late maturity and highest solids. Some growth crack and scab noted. Tuber type was noted as above average overall.

Suggest testing again in 1984.

R. Burbank - Very poor sizing and type in 1983.

A7668-2 - Average emergence with subsequent good vigor and vine type. Trace of mosaic. Very late maturity and tuber shape is oblong to round. Low yields and severe hollow heart.

Questionable for further testing because of low yield, lateness, and poor tuber sizing.

Table 3 shows the results of the preliminary variety trials. These selections were made from the 1982 8-hill observation trials.

Table 3. PRELIMINARY VARIETY EVALUATIONS - ORE-IDA.

Variety	Yield(cwt/A) Total	Yield(cwt/A) No. 1	Percent Size Distribution Under 4 oz.	4-6	6-10	Over 10	No. 2's	HH/ No. Cut	Dry Matter %	Bruise Free %	Plot No.	Natural Sugars 0	1	2	3	4	SF
A77629-7	550	413	11	10	32	35	14	8/20	17.5	62	103	100	0	0	0	0	40
											201	missing					
A78242-5	518	431	8	12	31	41	10	0/20	19.0	81	105	100	0	0	0	0	0
											202	100	0	0	0	0	5
A7854-6	450	314	17	17	33	21	13	7/20	18.4	76	101	100	0	0	0	0	10
											205	100	0	0	0	0	0
R. Burbank	371	154	42	22	16	5	17	4/20	18.8	100	107	100	0	0	0	0	5
											203	100	0	0	0	0	5
Onaway	344	268	22	24	34	20	1	0/20	17.1	90	106	95	0	0	5	0	20
											204	50	40	0	30	0	15
A7876-1	282	154	42	18	23	14	4	16/20	18.4	---	104	90	5	0	5	0	15
											206	80	5	0	15	0	20
A7532-1	231	129	42	32	19	5	3	2/20	18.8	81	102	100	0	0	0	0	0
											207	100	0	0	0	0	0

A77629-7 - Emergence and vine growth were average with late maturity. Size distribution was desirable with a high percentage of large tubers, however, they were generally rough.

Continuation questionable because of rough tubers, lower solids, and hollow heart.

A78242-5 - Very quick emergence and good vine growth and vigor. Three mosaic plants were noted. Size distribution, solids, and freedom from hollow heart were all very desirable. Tubers were generally smooth with only a trace of scab.

Worthy of evaluation in 1984.

A7854-6 - Emergence and vine growth were below average. Tubers were badly skinned at harvest and hollow heart was substantial.

Questionable for 1984 evaluation because of hollow heart and lateness.

R. Burbank - Very poor tuber sizing even though emergence and early growth appeared above average.

Onaway - Used as a reference variety primarily for yield.

A7876-1 - Poor tuber sizing and severe hollow heart and growth crack.

Discard from further tests.

A7532-1 - Emergence and early growth noted as below average. Rugose and mild mosaic both present. Some growth crack at harvest.

Suggest deletion because of poor yields.

THE EFFECT OF CHLORINE WASH SOLUTIONS ON CUT SEED POTATOES

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Chlorine wash treatments have been used on cut seed potatoes on several Michigan potato farms. Chlorine is an alternative to conventional seed treatments due to its reduced cost, the elimination of dusts in the air, and the resulting cleaner seed and planter. However, questions as to its specific effect on cut seed remain unanswered.

Objectives

1. To determine the effect of different rates of chlorine on suberization.

2. To determine the optimum rate for chlorine wash solutions.

3. To compare the effectiveness of chlorine as a seed treatment alternative.

4. To determine the effect of various post-treatment storage conditions on chlorine treated seed.

Laboratory Studies

Initially, a microscope study was performed to determine the effect of different rates of chlorine on suberin layer formation. Five days after treating cut tubers with chlorine (Table 1), thin sections were made perpendicular to the cut surface. These sections were stained and the thickness of the suberin layer was measured under a microscope.

As reported in previous studies, increasing rates of chlorine produced a thicker suberin layer.

Table 1. Effect of different rates of chlorine on the thickness of suberin layer formation, as measured using staining techniques.

Chlorine Rate	Suberin Layer Thickness
100 ppm Cl	10.9
500 ppm Cl	13.2
1000 ppm Cl	13.4
5000 ppm Cl	23.4

A weight-loss method was used to evaluate the effect of different rates of chlorine on suberization. Using a cork borer, uniformly sized cylinders of tuber tissue were cut from Russet Burbank tubers. Each cylinder was dipped for 10 seconds in chlorine (Figure 1) and then allowed to suberize for either 5 or 11 days. The cylinders were weighed before and after drying for 3 hours in an oven at 95-105°F, and the percent weight lost was calculated. The amount of weight (water) lost during drying should be inversely proportional to the degree of suberin layer development, a thicker suberin layer reducing water loss.

The results (Figure 1) indicate the cylinders treated with increasing chlorine rates lost more weight (water) during drying than those treated with water or low rates of chlorine. This indicates that the high chlorine rates produced a less effective water-vapor barrier (suberin layer). This retardation was evident even after 11 days of suberization.

The ability of the suberin layer of chlorine-treated tuber tissue to resist invasion by the dry rot fungus Fusarium roseum was investigated. Disks of tuber tissue were cut from Russet Burbank tubers using a cork borer, and dipped in a chlorine solution (Figure 2). After the disks were suberized for various periods of time ranging from 2 hours to 8 days, 0.1 ml of water containing Fusarium spores was placed on each disk. After 5 days the disks were rated for extent of decay (1 = 0-5% of disk decayed, 5 = 75-100% decay).

The results (Figure 2) show, for disks suberized 2 hours after treatment, increasing rates of chlorine caused more Fusarium decay than the lower chlorine rates, water, or no treatment. As the suberization period increased, the difference between the high and low chlorine rates became less. After 8 days of suberization, all treatments had essentially no decay, except for disks treated with the highest rates of chlorine. These results suggest high chlorine rates delay suberization, but do not permanently impair it.

Contrary to anatomical observations of cut tubers which show that increasing chlorine rates cause thicker suberin layer formation, it appears that they cause a less effective water vapor and pathogen barrier to develop. These physiological measurements of the degree of suberin layer formation are undoubtly more important than anatomical measurements. However, low chlorine concentrations, such as might be used in seed-washing treatments, show no adverse effect when compared to no treatment.

Field Experiments

Two field experiments examining chlorine wash treatments were performed during the 1983 growing season. In these experiments, the chlorine wash treatments were applied using a spray nozzle, as cut seed passed under it on a conveyor.

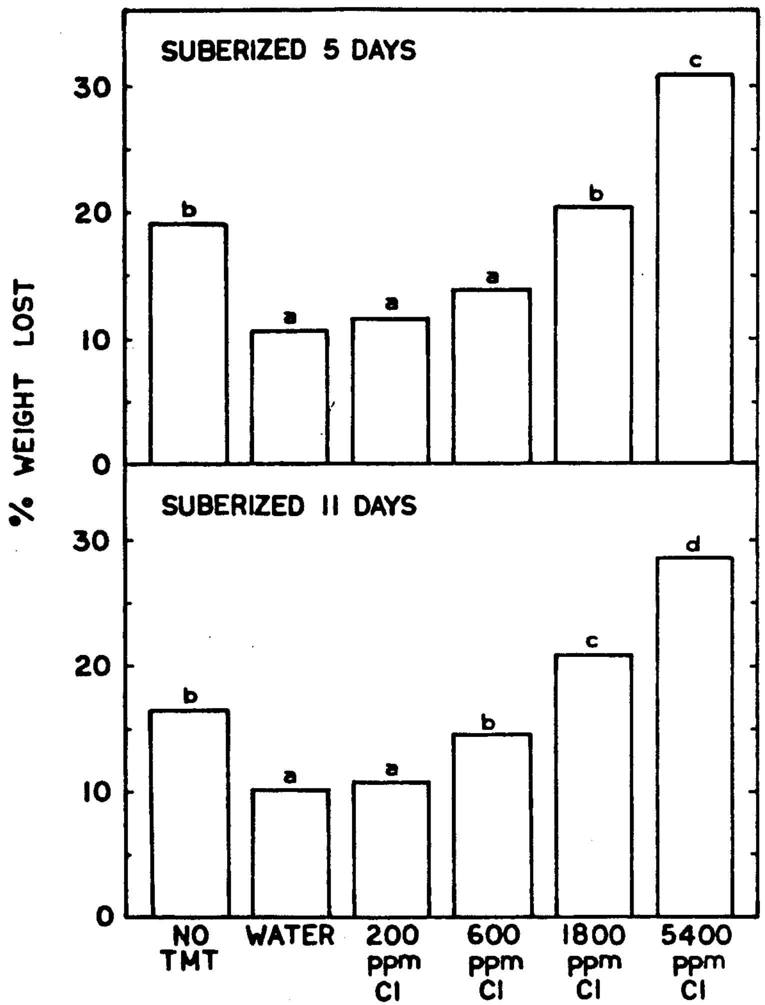


Figure 1. Percent weight lost during drying by cylinders of tuber tissue treated with different rates of chlorine. Cylinders were suberized 5 or 11 days before drying. Treatments with the same letter are not significantly different.

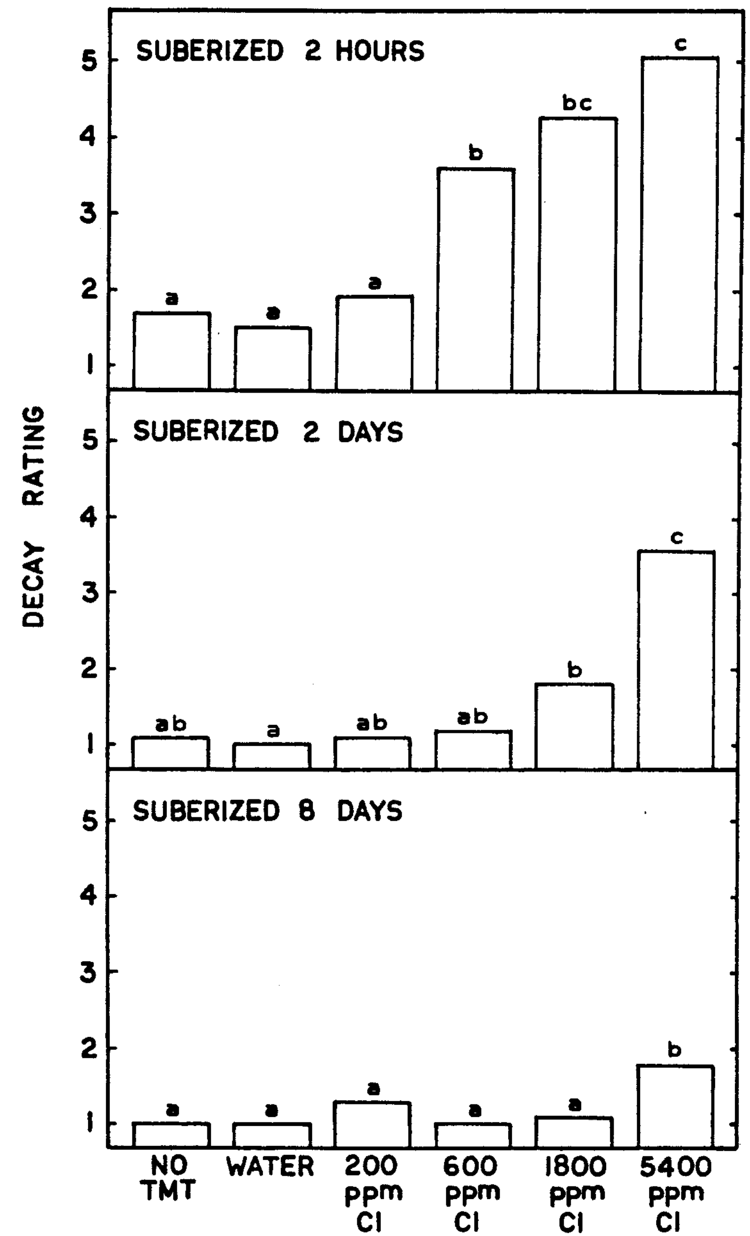


Figure 2. Decay ratings of tuber disks treated with different rates of chlorine. After suberization, a drop of water containing <u>Fusarium</u> spores was placed on each disk. 1 = 0-5% decay, 5 = 75-100% decay. Treatments with the same letter are not significantly different.

Field Experiment #1

This study was performed in cooperation with Crooks Potato Farms, Montcalm County, and evaluated the effect of 4 seed treatments and several post-treatment storage conditions on seed performance. The grower provided the larger quantities (approximately 100 lbs) of cut Monona seed required to simulate the different storage conditions. One of 4 seed treatments was applied at the back of the seed cutter: a) no treatment, b) water wash, c) 2400 ppm Cl wash, and d) captan-streptomycin dust (3/4 lb/100 lbs seed). Treated seed was then given one of nine storage treatments:

a) plant treated seed within 4 hours.
b) hold seed 2 days at 52°F with good ventilation.
c) hold seed 2 days at 52°F with poor ventilation.
d) hold seed 2 days at ambient air temp. with good ventilation.
e) hold seed 2 days at ambient air temp. with poor ventilation.
f) hold seed 5 days at 52°F with good ventilation.
g) hold seed 5 days at 52°F with poor ventilation.
h) hold seed 5 days at ambient air temp. with good ventilation.
i) hold seed 5 days at ambient air temp. with poor ventilation.

The good and poor ventilation treatments were achieved by storing seed in an open or plastic-wrapped burlap bag, respectively. The ambient air temperature treatment involved storing seed in an uninsulated shed and allowing the air temperature to follow daily fluctuations. Seed was planted May 13-16 in 10' x 34" plots with four replications, and standard cultural practices were followed. Plots were harvested September 15.

Results

After storage, untreated seed stored 5 days at ambient air temperature with poor ventilation had 13% rotted seed pieces and was the only treatment in which storage decay was observed.

Both the chlorine wash and captan-streptomycin seed treatments produced better stands and yield than untreated seed (Figure 3 and 4). There was no significant difference in stand or yield between the water or chlorine wash treatments, suggesting the washing action of the water is at least partially responsible for the beneficial effect on seed performance of the chlorine treatment.

Storage conditions appeared to have no effect on stand (Table 2). The only observed storage effect on yield was related to storage period. Seed stored 5 days between treatment and planting produced better yields than seed stored 2 days. The longer storage period may have allowed the cut surfaces to heal more completely before planting. The observation of no significant effect due to storage ventilation treatment suggests that the plastic bags did not severely restrict ventilation, the seed carried low levels of disease inoculum, or the holding period was too short.

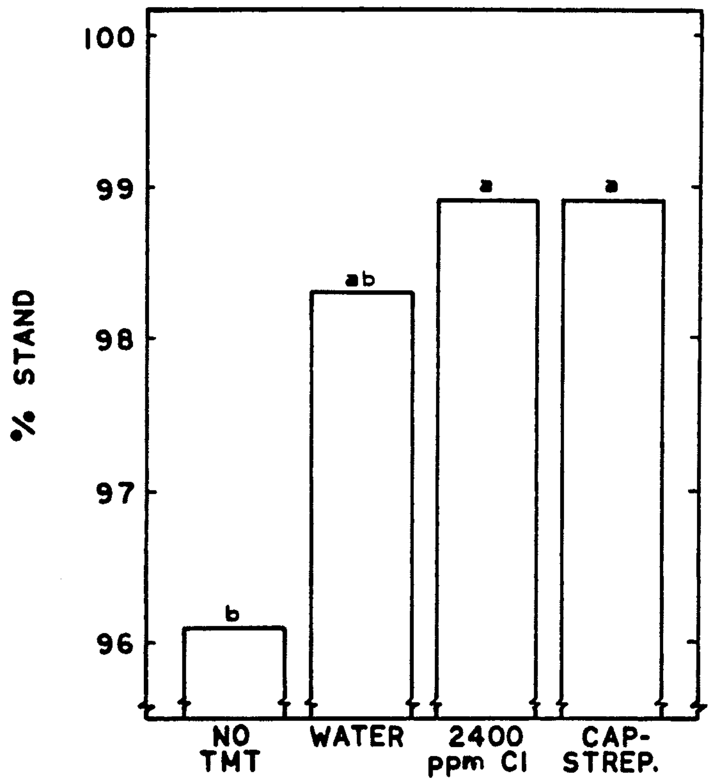


Figure 3. Percent stand produced by seed given one of four seed treatments. Treatments with the same letter are not significantly different.

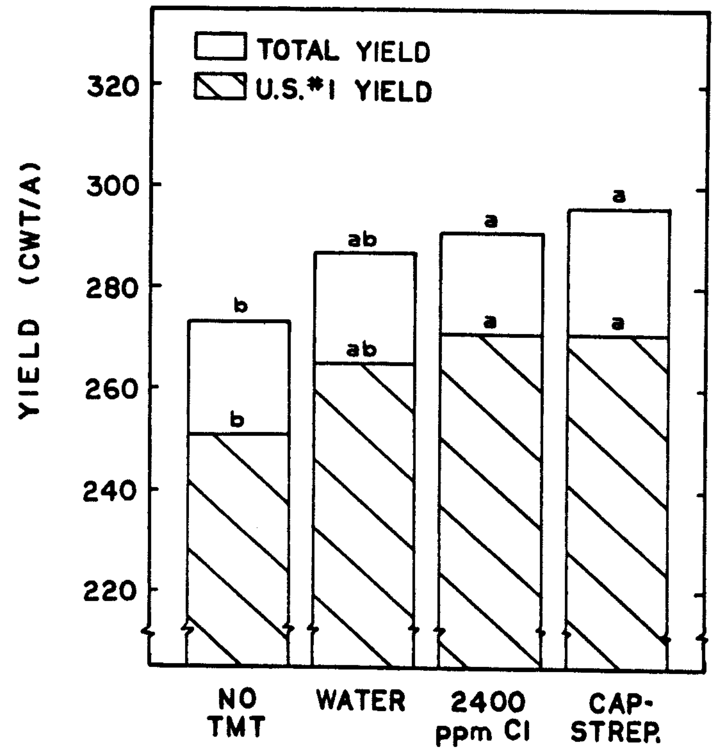


Figure 4. Total and U.S. #1 yield produced by seed given one of four seed treatments. Treatments with the same letter are not significantly different.

Table 2. Percent stand and yield produced by seed given various storage treatments. Means are averaged over seed treatments and other storage treatments. Means within the same column and storage treatment followed by the same letter are not significantly different.

Treatment	Stand (%)	Total Yield (cwt/A)	U.S. #1 Yield (cwt/A)
Storage Period			
0 days	98.7 a	284 ab	262 ab
2 days	97.6 a	276 b	254 b
5 days	98.7 a	299 a	276 a
Storage Temperature			
52°F	97.0 a	289 a	268 a
ambient air temp.	98.9 a	285 a	262 a
Storage Ventilation			
good	98.1 a	287 a	263 a
poor	97.8 a	287 a	267 a

Field Experiment #2

This experiment evaluated the effect of several chlorine wash treatments on 3 varieties over a range of spring soil conditions. Atlantic, Russet Burbank, and Monona seed was cut, treated, and planted on May 4, May 16, and June 1. The 8 seed treatments were:

a) no treatment, inoculated with *Fusarium* spores.
b) water wash, inoculated with *Fusarium* spores.
c) 500 ppm Cl wash, inoculated with *Fusarium* spores.
d) 2000 ppm Cl wash, inoculated with *Fusarium* spores.
e) captan-streptomycin dust, inoculated with *Fusarium* spores.
f) water wash, not inoculated.
g) 500 ppm Cl wash, not inoculated.
h) 2000 ppm Cl wash not inoculated.

In the inoculated treatments, whole seed was dipped 3 minutes in water containing *Fusarium* spores the day before it was cut, treated, and planted. At each planting date, a separate planting of only the Atlantic treatments was made. After 35-40 days, these plots were dug and rated for stand and seed-piece decay whereas the main 3 variety planting was harvested 125-126 days after planting.

Results

In almost all cases there was no significant difference between the inoculated and non-inoculated treatments. Therefore, means were averaged for the inoculated and non-inoculated treatments with the same chlorine level.

Figure 5 shows the percent stand of the Atlantic planting for the 3 planting dates. In the May 4 planting, the captan-streptomycin treatment was significantly better than all treatments except the untreated check. The water treatment produced the poorest stand.

There were no differences in stand due to seed treatment in the May 16 planting. In the June 1 planting, however, the high chlorine treatment reduced the stand significantly compared to the other treatments.

In the 3 variety planting that was grown to maturity, the Russet Burbank and Monona varieties produced excellent stands, and seed treatment differences were not significant.

To show the relationship between treatment and yield, Figure 6 shows the yield produced by the variety Atlantic in the main planting that was grown to maturity. Stand and yield are well correlated for the first two plantings, as treatment differences were similar to those for percent stand. In the third planting, however, they were not correlated, as the captan-streptomycin treatment produced a larger yield than any other treatment, and the 2000 ppm Cl treatment yield was not lower than the other treatments.

The overall yields produced by the seed treatments, averaged over varieties and planting dates, are shown in Figure 7. The captan-streptomycin dust treatment produced the highest total and U.S. #1 yield, better than all treatments, except the high chlorine treatment.

The yield from the water treated seed was significantly lower than the captan-streptomycin and high chlorine treated seed. In this experiment, it appears any benefit of the chlorine wash treatments is not due to their washing effect but to the chlorine in the wash, since the water treatments had the poorest yield.

Specific gravity measurements for 3 inoculated treatments (no treatment, 500 ppm Cl, and 2000 ppm Cl) were made for each variety at each planting date (Figure 8). Under the conditions of this experiment, the average specific gravity increased slightly as the chlorine concentration increased. This increase is not likely due to any direct effect of the chlorine treatments, but possibly to the more vigorous stands produced from the chlorine-treated seed.

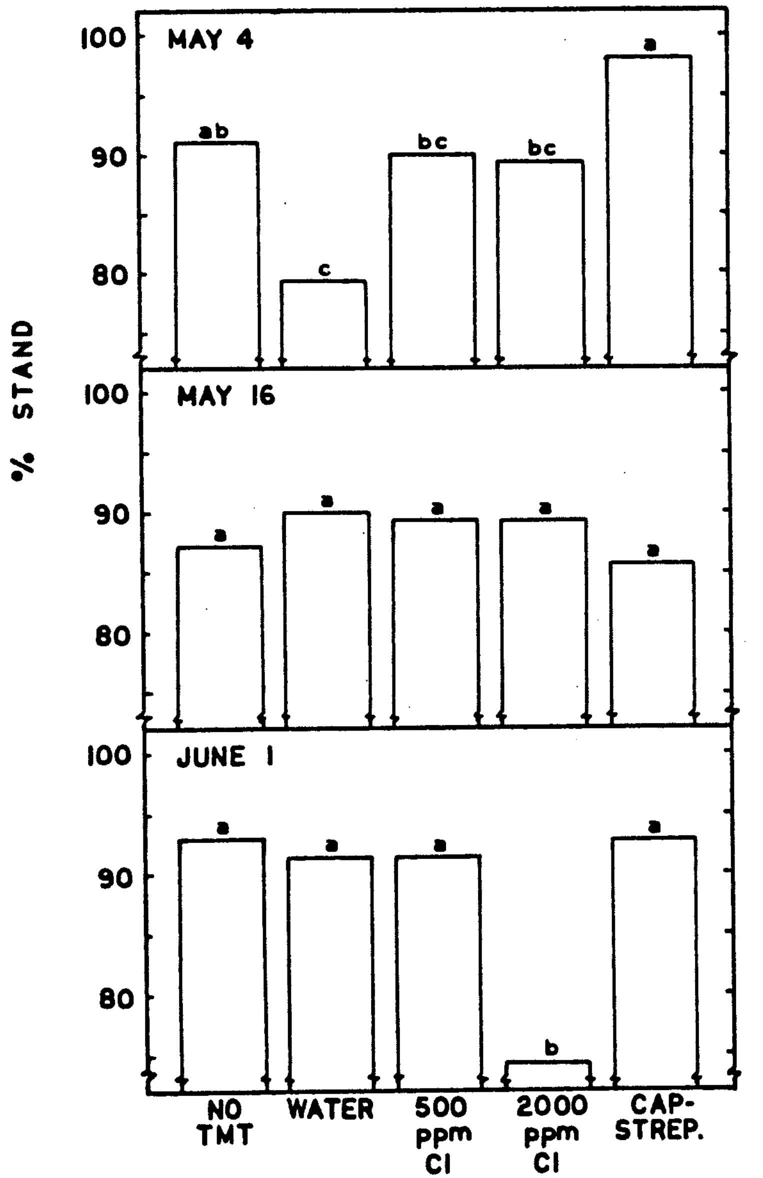


Figure 5. Percent stand produced by Atlantic seed with 5 seed treatments and planted on 3 separate dates. Treatments with the same letter are not significantly different.

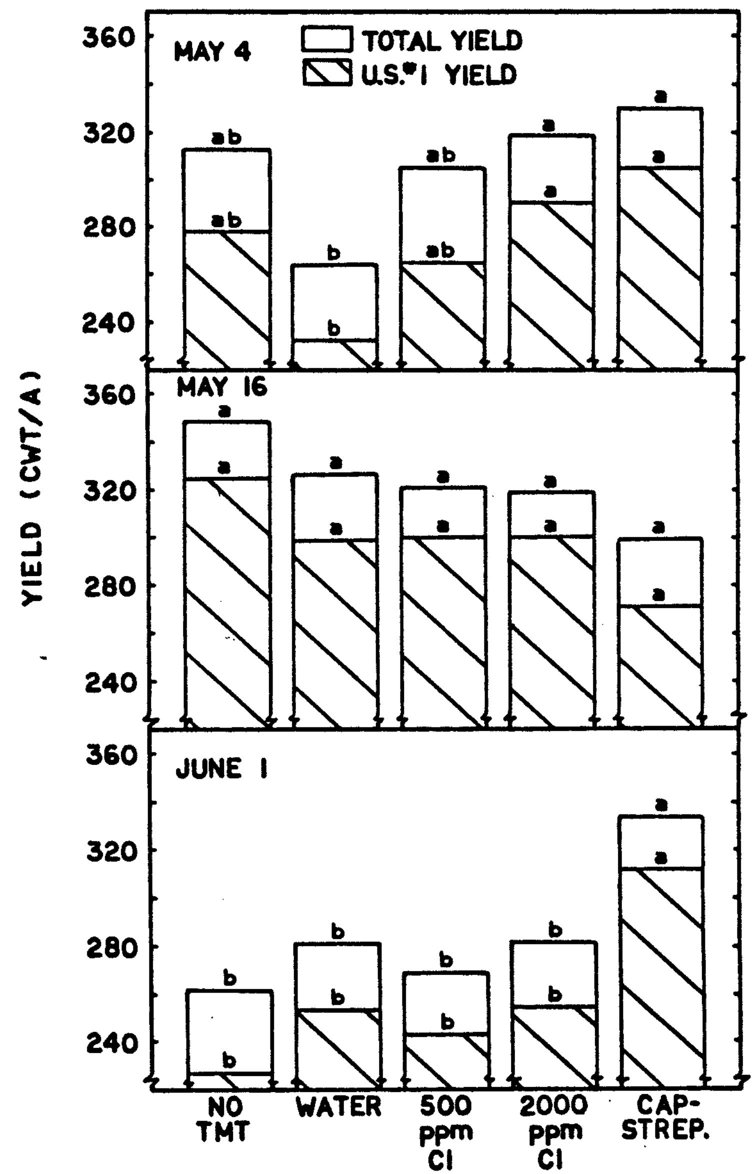
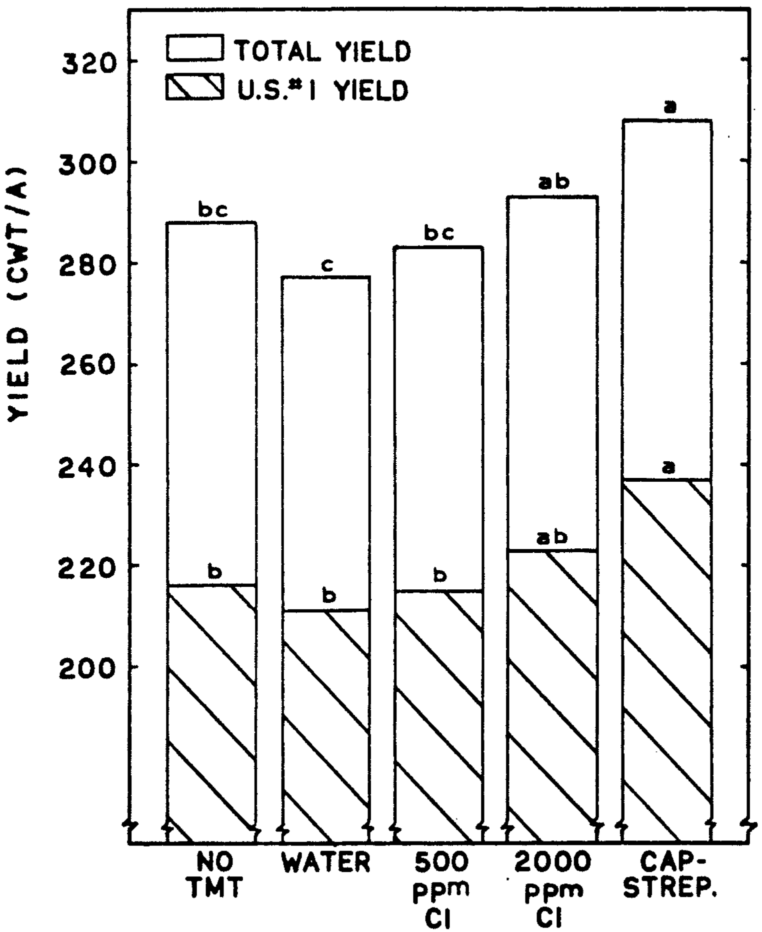


Figure 6. Total and U.S. #1 yield produced by Atlantic seed with 5 seed treatments and planted on 3 separate dates. Treatments with the same letter are not significantly different.



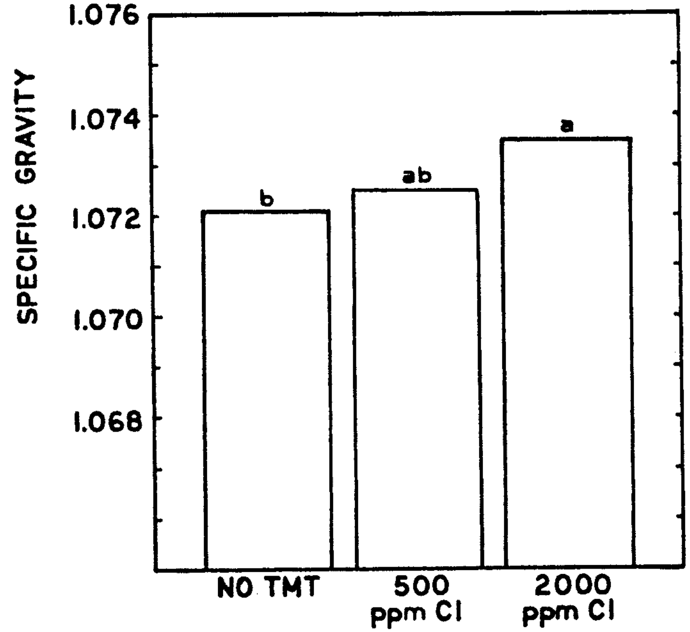


Figure 7. Total and U.S. #1 yield produced by seed given one of five seed treatments. Means are the average of the 3 varieties and the 3 planting dates. Treatments with the same letter are not significantly different.

Figure 8. Specific gravity of tubers produced by seed given one of 3 seed treatments. Means are the average of 3 varieties and 3 planting dates. Treatments with the same letter are not significantly different.

Conclusion

Tentative conclusions that can be drawn from these studies are:

- excessively high rates of chlorine may inhibit suberization and decrease stands.
- rates of 500-2000 ppm Cl are fairly effective as seed tints, though not better than a captan-streptomycin dust tint.
- chlorine under the conditions of this study did not adversely affect seed that is stored 2-5 days after tint.

BIOLOGY AND CONTROL OF RHIZOCTONIA AND SCAB DISEASES OF POTATO

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INTRODUCTION

Rhizoctonia and scab diseases of potato have increased in prevalence in Michigan in recent years. One possible reason for this is seed borne inoculum. In addition to surface and pitted scabbing of tubers by the scab pathogen, this pathogen can also cause cankers on stems, stolons, etc. Similarly, Rhizoctonia has been reported to cause a scab like disfiguration of tubers as well as cankers of stems, sprouts and stolons. The general objectives of the reported research were, therefore, to evaluate the possible involvement of tuber borne inoculum in these diseases and to further evaluate the causes of scab-like tuber disfiguration and cankering of stems, sprouts and stolons.

RESULTS

I. Characterization of organisms causing sprout, stem and stolon cankers

Cankering of sprouts, stolons and stems is of potential importance due to stand reduction and/or delayed emergence, reduction of tuber set, and girdling of stems which may result in aerial tuber formation, respectively. Studies were carried out to determine the identity of some of the organisms causing these symptoms.

Onaway potato, planted on 16 May 1983 at MEF, was used for the sampling. The tubers used for the planting were selected for the presence of both scab lesions and Rhizoctonia black scruf sclerotia. Sampling was performed on 1 and 17 June 1983 by digging up entire plants. Sprouts, stems and stolons exhibiting brown lesions were analyzed for the presence of pathogens by standard technique. Ten hills were sampled each time.

The first sampling demonstrated a high level of sprout killings (Table 1). Isolations from the lesioned tissue yielded Rhizoctonia in over 90% of the samples. No _Streptomyces_ or _Colletotrichium_ were detected. _Fusarium_ was found in several samples which also had _Rhizoctonia_. The cool, wet weather at this time may have contributed to the symptom expression, as no tuber sampled was free of sprout-tip killing or sprout cankers.

The second sampling date concentrated on stem and stolon canker (Table 1). Numerous dark brown stem cankers were observed on samples from each hill. These lesions tended to be somewhat sunken and often 1 cm or more in size. Most of these cankers yielded _Rhizoctonia_. Many tan to light brown lesions several mm in size were also observed. These lesions yielded Streptomycetes upon isolation onto water agar. Many small, dark brown lesions also appeared on most of the plants. Some of these flecks appeared slightly above ground as well as underground. These flecks yielded Colletotrichum and Rhizoctonia. The above ground flecks yielded primarily Colletotrichum. A similar pattern was observed on stolons. Large dark brown cankers yielded Rhizoctonia and some Colletotrichum. Light brown lesions yielded Streptomycetes. Although no complete girdling of stems or stolons was observed, the results suggest that the potential for this does occur.

II. Further characterization of organisms causing scab-type symptoms.

Tubers exhibiting scab symptoms were collected at MEF, in Tuscola County at the scab disease resistance trial and via MSU/CES and MCIA from Montcalm, Kent and Antrim counties were tested for the presence of pathogens capable of causing surface disfiguration. Streptomycete were associated with common, raised and pitted scab type lesions. A severe russetting and roughening of tuber skin observed on several tubers as associated with Rhizoctonia but not Streptomycetes. This condition looked very much like coalesced scab lesions, but had a great deal of Rhizoctonia mycelium associated with the lesion. Several tubers with a flaky, slightly grey scab-like lesion were associated with Colletotrichum infections. These results indicate that more than one type of organism is capable of causing scab like disfiguration in Michigan, with Streptomyces and Rhizoctonia responsible for most of the symptoms.

III. Effect of formaldehyde seed treatment on expression of Rhizoctonia and Scab.

Field Trials:

Onaway B size seed, selected for presence or absence of Rhizoctonia black scruf were used. The seed pieces with no visible scruf were considered "good" seed; the remaining seed was used for planting after a 5 minute dip in 2% formaldehyde, dust with NTN 19701 (an experimental Rhizoctonia fungicide provided by Mobay Chemical Co.) or left untreated. Plantings were performed on May 16 and June 1. Each treatment was replicated four times per planting time. Eight hills per treatment per time period were sampled on 16 July for stem cankering assessment (Table 2). Tubers harvested on September 20, were evaluated for yield (Table 3). The tubers resulting from treated seed or from clean seed had fewer or no scruf sclerotia and a smoother, whiter skin than tubers developed from scruf infested seed.

Greenhouse Trails:

Scabby or scruf covered B sized seed was dip treated for 5 minutes with 2% formaldehyde or with distilled water. After drying, the tubers were planted in steamed soil. For Rhizoctonia, the tubers were planted 2" above the bottom of a 6 inch pot and watered daily. Tubers were evaluated for cankers when sprouts were 2-3" tall. For scab, the tubers were planted in pots which had a 3 inch layer of steamed soil upon which a wide mesh screen was placed. The seed piece was placed on this screen and then covered with steamed soil. The plants were top watered with emergence. They were then bottom watered to allow for optimal scab development conditions in the tuberization zone. The results (Table 4) indicate that formaldehyde has a beneficial effect on preventing the development of scab and rhizoctonia from infected seed. The pot design used for the scab trials is being currently tested as a way to test for scab in infested field soil and will be tested for use in examining treatments which may result in scab reduction (e.g. pH adjustment, water potential, varietal resistance).

The results strongly suggest that treatment of seed pieces with formaldehyde can have a significant effect on the expression of Rhizoctonia with respect to seed borne inoculum. Although total yields were not appreciably effected, the distribution of sizes and quality was positively effected by seed treatment or use of disease free seed. Greenhouse studies also indicate that formaldehyde has a positive effect on reducing scab development from infected seed. The relative importance of tuber borne inoculum vs. soil borne for both diseases will be continued using the pot techniques described above.

IV. Development of a Rhizoctonia screening test

A standardized technique for screening the resistance of tuber sprouts to Rhizoctonia solani was developed. This technique should be useful in screening large numbers of varieties in a short period of time.

Tubers of Onaway potato were treated with 2% formaldehyde for 5 minutes. After air drying, the tubers were kept in the dark to allow sprouting. When sprouts were 3 mm in length, the eye containing the sprout was removed with a melon baller. The sprout was then placed on 2 inches of steamed soil in a deep plastic pan. A 7 mm disc of Rhizoctonia solani was placed 3 mm from each sprout, and then the sprouts were covered with 3 inches of steamed soil. The soil was watered and the entire pan placed in a growth chamber at 60°F. Two weeks later the sprouts were removed from the soil, washed and examined for canker formation.

Results thus far indicate that very uniform infection can be obtained this way, and thus should be a good technique for resistance screening.

V. Disease resistance screenings.

Disease resistance screenings for scab and observations on Rhizoctonia-related tuber disfiguration were made at Cass City, MI. The results (table 5) indicate there are a number of varieties which may have a suitable level of resistance to scab. In addition, preliminary observations also indicate some varietal differences with regard to scurf.

TABLE 1

ORGANISMS ASSOCIATED WITH CANKERING

SAMPLES[a]	RHIZOCTONIA	STREPTOMYCETES	COLLETOTRICHUM
June 1, sprouts	19/20	0/20	0/20
June 16, stems	16/20	4/20	8/20
June 16 stolons	3/20	3/20	6/20

[a]Samples consisted of two sprouts, stems or stolons exhibiting cankers from each of ten hills. Onaway potato, planted on May 16, was used for these samplings.

TABLE 2

EFFECT OF SEED TREATMENT ON RHIZOCTONIA STEM CANKERING

TREATMENT	RHIZOCTONIA STEM CANKER COVERAGE[b]	
	May 16 planting	June 1 planting
G	2.1[c]	1.8[c]
F	1.1	0.9
N	0.2	0.3
B	14.1	12.3

[a]G = good or clean seed
F,N,B = Scurf infested seed treated with formaldehyde, NTN 19701 or water, respectively

[b]Evaluated on July 16 and Aug 1 for the May 16 and June 1 plantings, respectively

[c]Values are percent of underground stem covered by canker

TABLE 3

EFFECT OF SEED TREATMENT ON TUBER YIELD AND QUALITY

MAY 16 PLANTING

TREATMENT[a]	YIELD (cwt/A)				
	Total	B's	No. 1	Over 10 oz	Culls
G	376.7	49.3	262.4	21.9	43.1
F	360.3	26.6	276.3	27.6	29.8
N	371.7	35.6	276.3	6.4	53.4
B	366.6	46.8	204.0	25.5	90.3
			JUNE 1 PLANTING		
G	349.2	28.2	216.5	42.9	61.6
F	342.4	35.1	240.1	24.7	42.5
N	386.7	34.0	248.6	51.0	53.1
B	350.5	31.8	183.4	51.4	83.9

[a]G = Good seed
F,N,B - Scurf infested seed treated with formaldehyde, NTN 17901 or left untreated, respectively.

TABLE 4

EFFECT OF FORMALDEHYDE ON SEED BORNE RHIZOCTONIA AND SCAB

TREATMENT[a]	RHIZOCTONIA[b]	SCAB[c]
WATER	12.1	38/46
Formaldehyde	0.1	3/52

[a]Tubers dip treated with distilled water or 2% formaldehyde for 5 minutes.

[b]Rhizoctonia = Percent area of stems covered by cankers and one month after planting (15 plants/treatment).

[c]Scab = Number of scabby tubers/total tubers at 3 months after planting (15 plants/treatment).

TABLE 5
SCAB RATINGS

VARIETY	SCAB TYPE[a]	SCAB RATING[b]	RHIZOCTONIA OBSERVATIONS[c]
700-79	C	0.9	RS, some scurf
700-83	DP	1.2	some scurf
701-22	C	1.2	some scurf
702-80	C	0.2	scurf
702-91	DP,R	1.3	scurf
704-10	DP,R	1.3	some RS, scurf
704-17	DP	3.2	some scurf
714-10	C	1.1	RS, some scurf
716-15	C	1.1	mild RS, scurf
718-6	R	2.1	RS, some scurf
B9540-29	-	0.0	RS, some scurf
B9540-55	C	0.4	little scurf
B9540-62	C	0.1	little scurf
B9553-6	C	0.5	some RS, scurf
B7154-10	C,R	1.4	little RS, scurf
B7805-1	DP	1.1	RS, scurf
B9540-53	-	0.0	RS, scurf
A72685-2	C	0.9	RS, scurf
Atlantic	R	1.4	some scurf
Belchip	C	o.6	RS, some scurf
Belrus	-	0.0	some scurf
Centennial	R,DP	0.5	some scurf
Chipbelle	DP	1.5	scurf
Crystal	DP	1.4	some scurf
Denali	C,R	2.1	RS, some scurf
Jemseg	C	0.5	little scurf
Katahdin	C	1.1	some scurf
Kennebec	C	1.0	some RS, scurf
Monona	C	2.3	RS, scurf, rough cracks
Oceania	C	0.4	RS, scurf
Onaway	C	0.1	RS, scurf
Pungo	C	0.3	RS, some scurf
Rideau	C	0.4	little scurf
Rosa	DP	1.8	some RS, scurf
R. Burbank	C	0.1	little scurf
Ontario	C	0.4	RS in cracks, scurf
Sebago	C	1.6	RS in crack, RS
Shepody	C	0.3	some scurf
Snowchip	C,R	2.3	scurf, some RS
Yukon	R,DP	2.0	RS, some scurf

[a]C=common; R=raised; DP=deep pitted; -=no scab.

[b]0=no scab; 1=1-10% scab coverage; 2=11-20%; 3=21-40%; 4=Over 40%. Results based on 80 tubers per variety.

[c]RS=russet scab; scurf=sclerotia of <u>Rhizoctonia solani</u>.

WEED CONTROL IN POTATOES (RESEARCH REPORT)

Investigators: *W. Meggitt, R. Leep, R. Chase, G. Powell, and R. Kitchen*
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Studies were conducted at the Montcalm Farm and in the Upper Peninsula on the control weeds in potatoes. The results of herbicide treatments at the Montcalm Farm for control of broadleaf weeds and barnyardgrass are shown in Table 1. In 1983, EPTAM as a preplant incorporated treatment did not provide effective control of annual grass. This was probably due to poor incorporation as the soil was wet at time of second pass. There was a light rain after application, but not enough to move the herbicide into the soil. It is felt there was loss of EPTAM due to volatilization. Yields from treatments with EPTAM, where poor control resulted, were reduced. Applications of Fusilade applied postemergence gave excellent control of barnyardgrass, however, broadleaved weeds became serious and resulted in severe yield reductions. Treatments with Lexone or Sencor or R-40244 (Racer) preemergence, provided excellent control of broadleaved and grass weeds and thereby no yield reductions when used with EPTAM. Combinations of Lasso or Dual with Lexone or Sencor either preemergence or delayed preemergence as in previous years gave excellent weed control and no yield reduction. Lasso and Dual performed similarly with no significant differences in yield. PPG 844, a new experimental, offers promise for postemergence control of broadleaved weeds.

Postemergence grass herbicides offer an excellent approval to complete control of barnyardgrass without potato injury. Crop oil concentrate was necessary to provide maximum control with grass herbicides.

Potato yields again were somewhat variable, but there was no significant yield reduction when weeds were controlled with both soil and foliage applied herbicides.

A second experiment involved the study of conventional hilling and early hilling in a system that considered several herbicides and time of application.

The data in Table 2 shows the weed control and yields of 4 varieties in the conventional hilling treatments. Application of herbicides after early hilling resulted in mechanical damage to potatoes from the tractor and therefore yields were not considered meaningful. In general, the treatments listed in Table 2 are those available to the grower with the exception of Fusilade, which does not have a registration for potatoes at present time. There were no significant differences in yields among any herbicide treatments on any variety. All herbicides at all times of application gave nearly complete weed control with only the EPTAM + Lexone/Sencor being at 90%.

Table 1. Weed Control Evaluations in Potatoes, Montcalm County, Michigan 1983.

Date Planted: 5/6/83
Variety: Russett Burbank
Row Spacing: 34"
Plot Size: 102" x 50'
No. of Replications: 3
Incorporation Equipment: Springtooth Drag x 2

*COC - Crop Oil Concentrate
**Treatments 1-3, 7, 8 sprayed post prior to hilling.

Date Treated: PPI - 5/6/83
PRE - 5/6/83
Delayed PRE (DP) - 5/26/83
POST - 6/22/83
Date Rated: Early - 6/22/83
Late - 7/27/83
Soil Texture: Loamy Sand
Organic Matter: 2.0%
Soil pH: 6.2

Weeds Present: Redroot pigweed, Common lambsquarter and Barnyardgrass

Trt. No.	Treatments	Rate (lb/A)	6-22-83 Rrpw	Colq	Bygr	Injury	7-27-83 Rrpw	Colq	Bygr	Yield CWT/No. 1
	PPI									
1.	Eptam + [Fusilade + COC* (POST)]**	4 + [1/8 + 1 qt]	0.0	0.0	2.0	0.0	1.7	1.7	10.0	95
2.	Eptam/R33865 + [Fusilade + COC (POST)]**	3 + [1/8 + 1 qt]	0.0	0.0	4.3	0.0	2.3	2.3	10.0	146
3.	Eptam/R33865 + [Fusilade + COC (POST)]**	4 + [1/8 + 1 qt]	0.0	0.0	4.7	0.0	4.3	4.3	10.0	189
4.	Eptam + [R40244 (PRE)]	3 + [1/4]	10.0	10.0	9.3	1.3	10.0	10.0	6.7	237
5.	Eptam + [R40244 (PRE)]	3 + [1/2]	10.0	10.0	9.8	0.3	10.0	10.0	8.7	285
6.	Eptam + [R40244 (PRE)]	3 + [1]	10.0	10.0	9.8	0.3	10.0	10.0	8.3	277
7.	Eptam + [R40244 (POST)]**	3 + [1/2]	0.0	0.0	3.3	0.0	7.0	10.0	1.3	137
8.	Eptam + [R40244 (POST)]**	3 + [1]	0.0	0.0	0.7	0.0	10.0	10.0	2.0	139
9.	Eptam + [Lexone/Sencor (DP)]	3 + [1/2]	10.0	10.0	10.0	0.3	9.7	10.0	9.3	295
	PRE									
10.	R40244	1/2	10.0	10.0	9.2	0.0	10.0	10.0	8.3	296
11.	R40244	1	10.0	10.0	10.0	1.0	10.0	10.0	9.3	271
12.	Lasso + Lexone/Sencor	2 + 1/2	10.0	10.0	10.0	0.0	10.0	10.0	10.0	293
13.	Dual + Lexone/Sencor	2 + 1/2	10.0	10.0	10.0	0.0	10.0	10.0	10.0	297

Table 1: Weed Control Evaluations in Potatoes, Montcalm County, Michigan 1983 (Continued)

Trt. No.	Treatments	Rate (lb/A)	6-22-83 Rrpw	6-22-83 Colq	6-22-83 Bygr	6-22-83 Injury	7-27-83 Rrpw	7-27-83 Colq	7-27-83 Bygr	Yield CWT/No. 1
	PRE									
14.	Prowl + Lexone/Sencor	1 1/2 + 1/2	10.0	10.0	10.0	0.0	10.0	10.0	9.7	283
15.	Surflan + Lexone/Sencor	3/4 + 1/2	10.0	10.0	9.7	0.7	10.0	10.0	10.0	269
16.	Lasso + [Lexone/Sencor (DP)]	2 + [1/2]	10.0	10.0	10.0	0.0	10.0	10.0	10.0	312
17.	Dual + [Lexone/Sencor (DP)]	2 + [1/2]	10.0	10.0	10.0	1.0	10.0	10.0	10.0	269
18.	Dual + PPG 844	2 + 1/5	10.0	10.0	10.0	0.0	8.7	9.7	10.0	281
19.	Dual + PPG 844	2 + 2/5	10.0	10.0	10.0	0.3	9.7	9.7	10.0	275
20.	No Treatment	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73
									(LSD) =	46

Table 2. Weed Control and Variety Study in Potatoes, Montcalm County, Michigan 1983.

Date Planted: 5/11/83
Variety: Onaway, Monona, Burbank, Atlantic
Row Spacing: 34"
Plot Size: 136" x 50'
No. of Replications: 3
Incorporation Equipment: Springtooth Drag x 2

*COC = Crop Oil Concentrate

Date Treated: PPI - 5/11/83
PRE - 5/11/83
Delayed PRE (DP) - 5/26/83
POST - 6/22/83
Date Rated: Late - 7/27/83
Soil Texture: Loamy Sand
Organic Matter: 2.0%
Soil pH: 6.2

Weeds Present: Redroot pigweed, Common lambsquarter and Barnyardgrass

Trt.		Rate	7-27-83			Yield, CWT/No. 1			
No.	Treatments	(lb/A)	Rrpw	Colq	Bygr	Onaway	Monona	Burbank	Atlantic
	PPI								
1.	Eptam + [Lexone/Sencor (DP)]	4 + [1/2]	9.0	10.0	9.0	394	329	311	448
	PRE								
2.	Lasso + [Lexone/Sencor (DP)]	2 + [1/2]	10.0	10.0	9.7	377	365	302	505
3.	Dual + [Lexone/Sencor (DP)]	2 + [1/2]	10.0	10.0	10.0	415	346	299	460
	DP								
4.	Lexone/Sencor + [Fusilade + COC* (POST)]	1/2 + [1/4 + 1 qt]	10.0	10.0	10.0	417	415	315	461
	PPI								
5.	Eptam + [Lexone/Sencor (DP)] + [Dual + Lexone/Sencor (Layby)]	4 + [1/2] + [1 + 1/4]	10.0	10.0	10.0	417	357	254	462
	PRE								
6.	Lasso + [Lexone/Sencor (DP)] + [Lasso + Lexone/Sencor (Layby)]	2 + [1/2] + [1 + 1/4]	9.7	10.0	9.7	370	405	258	452
7.	Dual + [Lexone/Sencor (DP)] + [Dual + Lexone/Sencor (Layby)]	2 + [1/2] + [1 + 1/4]	10.0	10.0	10.0	399	393	280	505
					(LSD) =	52	46	48	57

BIOLOGY & CONTROL STRATEGIES FOR INSECT PESTS OF POTATOES

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Department of Entomology

Research in 1983 was aimed at:

1. Continued evaluation of insecticide resistance in Michigan Colorado potato beetles,

2. Demonstration of pest management techniques for control of resistant potato beetles,

and

3. Preliminary evaluation of an imported egg parasitoid of the Colorado potato beetle.

4. European corn borer management research was also planned, but populations and damage in potatoes were very low.

Summary of Results

1) Laboratory evaluation of insecticide toxicity indicated varying levels of tolerance to Temik. Preliminary feeding trials supported the conclusion that significant levels of resistance are present. The parathion resistance reported in 1982 appeared to be very unstable and did not persist in the laboratory or in the field in subsequent generations of beetles without heavy selection pressure. Sevin resistance was present in what appeared to be a genetically mixed form with individuals from the same population being either susceptible or highly resistant.

2) The pest management demonstration in Monroe County was conducted in a field that began with up to 4-5 beetles per plant after Temik treatment. Results showed that resistant beetles could be kept below economic levels using careful scouting, choice of insecticides, and precise timing of applications. Reduced frequency of insecticide application and proper choice of materials should help slow the rate of resistance build-up.

3) Experiments with the egg parasitoid, Endovum puttleri (a tiny wasp) showed it to be difficult to rear in the laboratory and to require precise timing for release. Host eggs must be less than 24 hours old for attack to be successful.

4) A corn borer management plan was circulated to a number of potential cooperators for evaluation and followed up by phone calls, visits and contacts with scouts. No significant infestations or damage were reported.

Insecticide Resistance

Laboratory trials were conducted as before, using precise topical applications of technical grade insecticides. Beetles used were all field-collected and were fed untreated potato foliage during the experiments.

Treatment of Monroe County beetles with Sevin (carbaryl) caused 45% mortality at a moderate dose, but the remaining 55% of the population appeared to be completely immune to doses as high as could be applied (Fig. 1). Studies with parathion showed none of the extreme resistance reported in 1982 from a field that had been treated weekly with parathion. However, all locations in 1983 showed 10-20X resistance compared to the beetles from Antrim County (Table 1). Topical studies with Temik (aldicarb) showed only moderate differences between the Antrim County (susceptible) beetles and the other locations (Table 2). The low slope of the relationships for the commerical fields in 1983, however, indicates that a few individuals may be showing high levels of tolerance. LD_{50} values for Temik (and probably also other materials) varied widely from date to date. Beetles collected in the spring were much less tolerant to Temik than individuals collected from the summer generation (Table 3). This type of variation has been shown on the East Coast and reflects the overall vigor of the individual and the stress of overwintering and perhaps the previous insecticide treatment history. These and results from the East Coast indicate that spring treatment will be much more effective in reducing populations than fall treatment.

The overall resistance picture is one that appears to be fairly widespread and may be rapidly changing.

Preliminary feeding trials were conducted with Colorado potato beetle adults on potato foliage treated in the field under normal commercial conditions. Temik was applied at 3 lb. ai/A at planting (4-6 weeks before the test). Pydrin was applied at 0.2 lb. ai/A (3 days before the test). Although beetles from other locations were not evaluated, it is known that the foliage from the Montcalm Experimental Farm was toxic to beetles at that location. Samples of the foliage were collected and frozen for residue analysis.

There was no mortality of any of the beetles fed Temik-treated foliage, regardless of location where the foliage was collected (Table 4). Pydrin, 3 days after treatment, caused some mortality. Residue analysis results are not available at the time of this report.

Colorado Beetle Pest Management Demonstration

A plot was set up on the Horkey farm in Monroe County, where severe beetle problems had existed in 1982. The field was scouted every week and treatments applied with a boom sprayer as needed. One half of the field was treated generally according to M.S.U. recommendations (treat if adults and larvae = more than one per plant) and the other half was treated at the grower's option. A small corner of the field was left largely untreated during the season to evaluate the effectiveness of the control programs and act as a biological control plot.

Temik was applied at planting, but gave very little control two weeks after plant emergence and beyond. In view of the cost and our desire to minimize selection for Temik resistance, this treatment should not have been applied.

Adequate (and nearly identical) control was obtained in both halves of the field. Treatments were applied every 1-3 weeks, with generally no more than one insecticide applied at a time (Table 5). The only major difference in beetle populations between the two sides of the field occurred in late July when the M.S.U. plot showed primarily eggs and adults while the other side of the field had mostly larvae (Fig. 2). This was perhaps caused by early season sprays changing the age structure of the two populations.

Plant vigor and foliage was generally less on the M.S.U. side of the field and yields were lower (estimated total yield 91 lbs/100 row ft vs. 158 lbs/100 row ft on the other side of the field).

Biological Control

Endovum puttleri were reared in the laboratory on eggs from a potato beetle culture. Adults or pupae were released on two occasions, once in a "biological control" plot in the Monroe County field and once at the Montcalm County research farm. No parasitized eggs were found at either location. In one case, the plot was accidently sprayed the day after release, killing the parasitoids and eliminating their hosts. In the other release, potato beetle egg densities were low and not as many parasitoids were available from the laboratory for release. Results of a number of researchers experimenting with E. puttleri were also generally discouraging. This research will not be pursued in Michigan in 1984. However, given the amount of time and effort being expended by researchers and the outstanding success of biological control against other pests (such as the cereal leaf beetle and alfalfa weevil in Michigan), biological control will undoubtably be a major potato beetle management tool in the future.

European Corn Borer Management

A management program, along with instructions for evaluating the effectiveness of the program and the impact of corn borers on potato yield was developed. This program was not intended as a general practice, but for experimental purposes. No data was obtained on effectiveness or impact of corn borers due to low population levels in potatoes.

Acknowledgments: Thanks to Karl Horkey for his cooperation; Paul Marks, and Andrea Adams for their help.

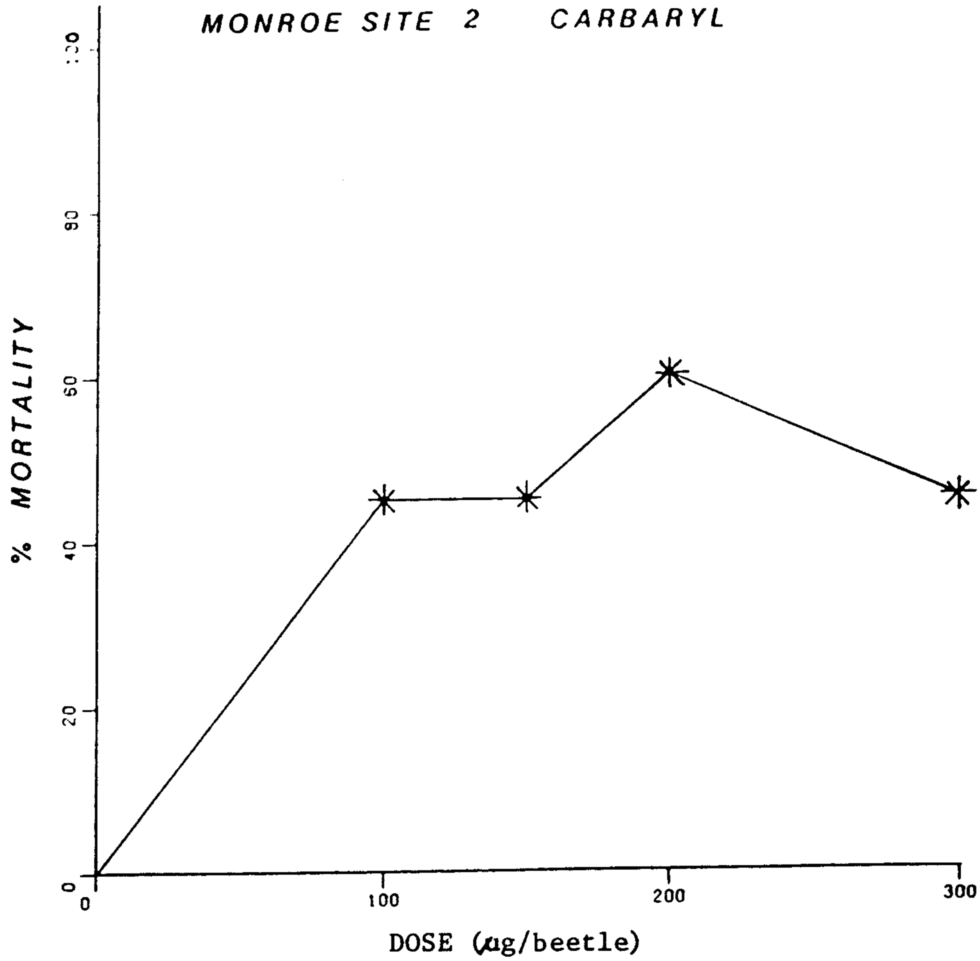

Figure 1. Susceptibility of Colorado potato beetles to carbaryl (Sevin).

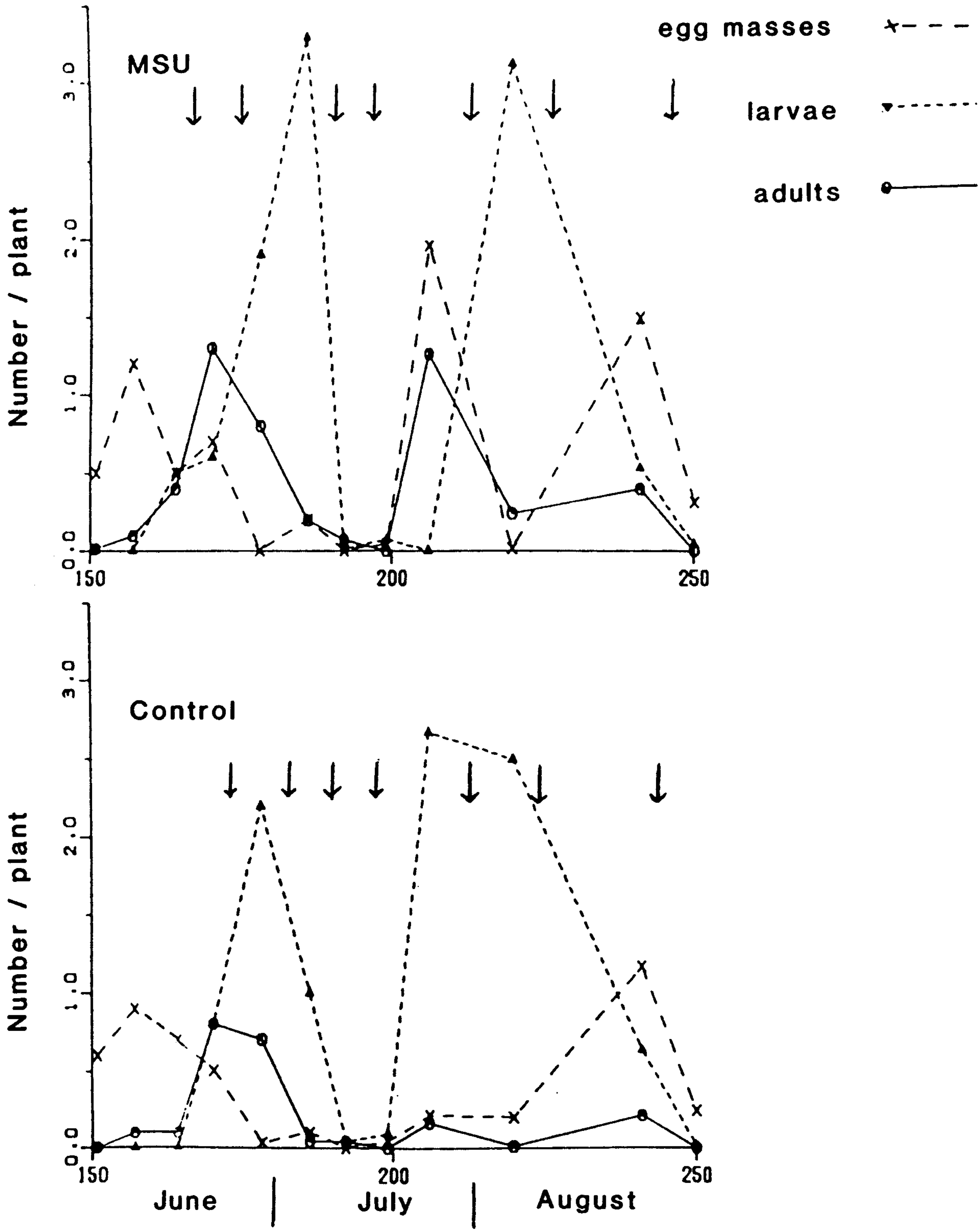

Figure 2. Population densities of Colorado potato beetle eggs, larvae and adults in Monroe Co. demonstration field (arrows denote insecticide treatments).

Table 1

Susceptibility of Colorado Potato

Beetles to Parathion

(LD_{50} = dose causing 50% mortality)

PARATHION

		LD_{50} (µl/beetle)		Slope
Antrim		.0005		1.9
Montcalm		.009		3.4
Monroe	field 1	.113	(1982)	1.3
		.010	(1983)	–
	field 2	.001	(1982)	2.1
		.005	(1983)	1.8

Table 2

Susceptibility of Colorado Potato Beetles

to Temik (LD_{50} = dose causing 50% mortality)

ALDICARB

		LD_{50} (µg/beetles)		Slope
Antrim		4.0		1.0
Montcalm		9.6		0.7
Monroe	field 1	8.4	(1982)	4.0
		11.8	(1983)	0.8
	field 2	2.2	(1982)	2.6
		17.5	(1983)	0.8

Table 3

Susceptibility of Colorado Potato Beetles

Collected on 3 Dates to Temik

ALDICARB

		LD_{50} (μg/beetle)
Monroe field 2	Aug 1982	2.2
	May 1983	0.5
	Aug 1983	17.5

Table 4

Preliminary Colorado Potato Beetle

Feeding Trials with Temik-treated Foliage

June 15-20, 1983

	Food	% Mortality (5 days)*	
Field-Collected Beetles (Monroe Co.)	Untreated	0	a
	Temik (Monroe Co. site 1)	0	a
	Temik (Montcalm Exp. Farm)	5	a
	Temik + Pydrin (0.2 lb. ai/A, 3 days post-spray) (Monroe Co. site 1)	15	ab
	Temik + Pydrin (0.2 lb.ai/A, 3 days post spray) (Monroe Co. site 2)	25	ab
Lab-Cultured Beetles (Monroe Co. Source)	Untreated	0	a
	Temik (Monroe Co. site 1)	0	a
	Temik (Montcalm Exp. Farm)	5	a
	Temik + Pydrin (0.2 lb ai/A,3 days post spray) (Monroe Co. site 1)	10	a
	Temik + Pydrin (0.2 lb. ai/A, 3 days post spray) (Monroe Co. site 2)	35	b

* Means followed by the same letter are not significantly different (SNK test, $p > 0.05$).

Table 5

Treatment Schedule for Monroe Co.

Demonstration Field

1983

Date	M.S.U.	Grower
6/16	Pydrin 2.4EC, ½ pt.	none
6/23	Guthion 50WP, 1 lb.	Guthion 50WP, 1 lb.
7/2	none	Guthion 50WP, 1 lb.
7/9	Pydrin 2.4EC, ½ pt.	Pydrin 2.4EC, ½ pt.
7/13	Pydrin 2.4EC, ½ pt.	Pydrin 2.4EC, ½ pt.
	+ Imidan 50WP, 1 lb.	+ Imidan 50WP, 1 lb.
7/26	Parathion 8EC, ½ pt.	Parathion 8EC, ½ pt.
8/29	Pydrin 2.4EC, ½ pt.	Pydrin 2.4EC, ½ pt.
	+ Imidan 50WP, 1 lb.	+ Imidan 50WP, 1 lb.

1983 MICHIGAN POTATO NEMATOLOGY RESEARCH REPORT

G.W. Bird
Department of Entomology

1982 Nematode Survey.-A nematode survey of Michigan potato production was conducted in 1982 to determine the impact of nematicides on Michigan potato productivity. The procedure and sites were the same as those used in the 1975 survey. Both studies were sponsored by the Michigan Potato Industry Commission.

The 1982 survey consisted of 96 potato fields in fifteen different potato growing regions. Often the same locations as surveyed in 1975 were sampled. Each sample site represented five acres. Approximately 1.2% of the 1982 Michigan potato acreage of the region.

Eighty-nine percent of the sites in the 1982 survey were treated with an at-planting systemic nematicide-insecticide (Table 1); this was 4% more than were treated in 1975. Five different materials were used for pre-plant or at-planting nematode or insect control, with Temik 15G being the most common. Temik use increased 18% between 1975 and 1982; DiSyston use decreased 26%; Furadan use increased; and Vorlex and Thimet use remained constant. The nematicide-insecticide usage pattern varied greatly among the potato growing regions (Table 2).

Table 1. At-planting nematicide-insecticide use in potato production in Michigan in 1975 and 1982.[1]

Chemical	Acreage treated (%) 1975	1982
At-planting systemic nematicides-insecticides	85	89
Temik	46	64
DiSyston	35	9
Vorlex	2	3
Furadan	1	12
Thimet	1	3
Non-treated	15	11

[1]Based on a survey of 2% of the potato acreage in 1975 and 1.2% in 1982.

Table 2. At-planting systemic nematicide-insecticide use pattern in Michigan in 1982.[1]

Areas	Temik	Vorlex	Thimet	Furadan	DiSyston	No Systemic
Montcalm (14)	100	21	0	0	0	0
Presque Isle (6)	33	0	50	0	0	17
Van Buren (3)	0	0	0	100	0	0
Manistee (3)	0	0	0	100	0	0
Emmet (5)	100	0	0	0	0	0
Delta (8)	0	0	0	0	100	0
Monroe (6)	100	0	0	0	0	0
Antrim (7)	83	0	0	0	0	17
Allegan (13)	14	0	0	42	0	42
Bay (4)	62	0	0	0	0	38
Houghton (4)	0	0	0	50	50	0
Dickinson (4)	100	0	0	0	0	0
Iron (4)	75	0	0	0	25	0
Luce (4)	100	0	0	0	0	0
Jackson (5)	100	0	0	0	0	0

[1]Each field represented 5 acres. 2% of the Michigan potato acreage was included in the survey in 1975 and 1.2% in 1982.

As with the 1975 survey, nematode control with both Temik and Vorlex was observed from an analysis of the survey data (Table 3). Relatively high nematode population densities were associated with the Furadan, DiSyston, and sites not receiving an at-planting systemic insecticide-nematicide treatment.

Table 3. Root-lesion and root-knot nematodes in relation to nematicides-insectides used in Michigan potato production.

Treatment (Sites surveyed)	Nematodes per 100 cm^3 soil [1] Root-lesion	Root-knot
Total (86)	92	42
Temik (57)	35	36
Vorlex (3)	0	0
Furadan (11)	294	32
Thimet (3)	38	4
DiSyston (8)	237	75
No Treatment (7)	95	89

[1]Mid-season sampling of five area portions of potato fields.

Using an initial population density pathogencity threshold of 100 nematodes per 100 cm^3 of soil, the root-lesion nematode was estimated to be a pathogen of potato in 18% of the sites sampled and a potato predisposition agent in 71% of the sites. Compared with 1975, this nematode's role as a pathogen slightly decreased, and increased in its role as a predisposition agent.

A crop loss-benefit analysis associated with the root-lesion nematode in Michigan potato production was conducted. The potential estimated loss was 18%; however, the actual estimated loss was 4% ($1,870.000). Nematicide treatments in 1982 cost Michigan growers $1,256,000. Approximately 37% of this was unnecessary. Management of the root-lesion nematode resulted in an 11% benefit to Michigan potato producers (Table 4). Fifty-six percent of the sites were properly managed to control the root-lesion nematode. Twenty-nine percent of the sites were treated with the nematicide when it was not needed; however, the materials may have been necessary to control other pests. Fifteen percent of the sites would have benefited from additional nematode management.

Although research data are not available for an analysis of the root-knot nematode associated with Michigan potato production, population information about this nematode was recorded throughout the survey. There appeared to be a slight increase in the average root-knot nematode population density associated with Michigan potato production since 1975. The Columbia root-knot nematode has not yet been found in Michigan.

Table 4. Influence of the root-lesion nematode on Michigan potato production in 1982.

Loss-Benefit Analysis	Estimated loss	
	($)	(%)
Estimated potential loss	7,383,400	18
1982 Unnecessary treatment cost	464,000	37
1982 Crop loss estimate	1,870,000	4
1982 Treatment cost	1,256,000	3
1982 Total cost	3,126,000	7
Management System Analysis		
Sites properly managed		56
Sites over-treated		29
Sites needing additional management		15

Evaluation of Nematicides for Control of Root-Lesion Nematode in Potato Production.-The experiment was conducted at the Michigan State University Montcalm Potato Research Farm in Entrican, Michigan. The soil was a MacBride sandyloam. The land was plowed immediately before planting on May 3. Six nematicide treatments were evaluated in a randomized complete block design. Each plot consisted of four rows (15.25 meters length and 0.86 meters apart with 20.5-30.5 centimeters spacing between plants. Mocap 10G, Temik 15G and Oxamyl 10G were applied at planting in the fertilizer furrow. Oxamyl and Mocap were incorporated broadcast applications immediately prior to planting. Mocap was also applied as a sidedress treatment 45 days after planting. Commerical insect, disease and irrigation schedules were used throughout the season. Soil samples for nematode analysis (centrifugation-flotation, 1.14 specific gravity) were taken immediately before planting, at two dates during the growing season, and at harvest on September 13. Root samples were processed for nematodes (shaker technique) for the mid-season samples. The center two rows of each plot were harvested, graded and weighted.

Application of Temik 15G provided excellent control of the root-lesion nematode (Table 5). Similar control was obtrained with incorporated broadcast applications of Mocap 10G and Oxamyl 10G. These three treatments resulted in significantly greater yield of Grade A and total potato tubers.

Table 5. 1983 Michigan potato nematicide trial.

Treatment	Yield (cwt/A)	Revenue increase[1]	Root-lesion nematode per 100 cm^3 soil + g root (8/23/83)
Non-treated Control	328a	-.--	192c
Mocap 10G IF(3.0 lb ai/A)	350ab	$ 61.50	59ab
Mocap 10G 12" B_a (3.0 lb ai/A)	327a	-(73.00)	152bc
Mocap 10G 6" + 6" LB_a (3.0 lb ai/A)	349ab	63.50	97abc
Mocap 10G B_r(9.0 lb ai/A)	388bc	178.50	27a
Temik 15G IF(3.0 lb ai/A)	408c	388.50	10a
Oxamyl 10G 12" B_a (3.0 lb ai/A)	350ab	53.00	132bc
Oxamyl 10G B_r (9.0 lb ai/A)	391bc	187.50	23a

[1]Based on $5.00/cwt for Grad A, $8.00/cwt for oversize, $0.50 for Grade B; less cost of nematicide; less revenue from non-treated control.

1983 Potato Trial, Cornell Michigan, Delta County Summary.-The experimental site had a low to medium population density of root-lesion nematodes at planting (Table ? 1). Excellent control of the root-lesion nematode was obtained through at-planting application of Temik 15G (Table 6). The average tuber yield in the research site was 191.5 cwt/A for the variety Superior and 233 cwt/A for Russet Burbank (Table ? 2). Application of Temik 15G resulted in a 37 cwt/A total tuber yield increase for Superior and a 42 cwt/A total tuber yield increase for Russet Burbank (Table 2). The U.S. #1 tuber yield associated with the Temik treatment was 19 cwt/A greater than DiSyston for Superior and 42 cwt/A greater for Russet Burbank (Table 7). The root-lesion nematode, most likely interacting with the Verticillium-wilt fungus, was the problem in the research site in 1983. Control of this disease complex was obtained with application of Temik 15G at planting. Compared with DiSyston, application of Temik resulted in a net profit increase of $158.50/A for Superior and $230.50/A for Russet Burbank (Table 8).

Table 6. Delta County nematode control.

	Root-lesion Nematode				
	No. per 100 cm^3 soil			No. per gm root	
Variety, Treatment	5/5/83[1]	8/18/83	9/28/83	7/12/83	8/18/83
Superior, DiSyston	13	120	16	5	20
Superior, Temik	13	16	21	0	0
Russet Burbank, DiSyston	13	98	78	32	36
Russet Burbank, Temik	13	9	23	0	0

[1]Average of four samples taken at random throughout the research site. Population density range = 4-22 root-lesion nematodes per 100 cm^3 soil.

Table 7. Delta County potato tuber yield

Variety, Treatment	Tuber Yield (cwt/A) Total	A's	B's	K's	Oversize
Superior, DiSyston	173	138	36	--	0
Superior, Temik	210	157	43	--	10
Russet Burbank, DiSyston	212	117	33	54	2
Russet Burbank, Temik	254	159	37	51	7

Table 8 Delta County potato economic analysis

	Gross ($)[1]				Net ($)
Variety, Treatment	A's	Oversize	B's-K's	Total	($)
Superior, DiSyston	690.00	0.00	18.00	708.00	688.00
Superior, Temik	785.00	80.00	21.50	886.50	846.50
Russet Burbank, DiSyston	585.00	16.00	43.50	644.50	624.50
Russet Burbank, Temik	795.00	56.00	44.00	895.00	855.00

[1]Based on US #1 at $5.00/cwt, Oversize at $8.00/cwt, B's & K's at 0.50/cwt and $40.00 for Temik 15G (3.0 lb a.i./A, and $20.00 for DiSyston 15G (3.0 lb a.i./A).

Integrated Potato Research: Root-lesion Nematode Control Root-lesion nematode (*Pratylenchus penetrans*) population densities at the beginning of the 1983 growing season were significantly greater following alfalfa than after rotation with corn. The influence of the previous crop on nematode populatiion density was still evident at the end of the potato growing season. Nitrogen fertilizer had no direct impact on the population density of the root-lesion nematode.

Temik 15G applied in the fertilizer furrow at-planting at 3.0 lb. a.i./A, Temik 15G plus Vorlex applied as a broadcast soil injection, and Temik 15G plus Vorlex applied as an in-row soil injection significantly reduced population densities of the root-lesion nematode(Table 9). This was determined from an analysis of both soil and root samples taken on August 1, 1983. Nematode population reduction was still evident at the end of the growing season.

Because of very cool soil temperatures in May, population densities of the root-lesion nematode did not increase as much as usual. No significant differences in nematode population densities among the nematicide treatments were detected in samples taken during the first week of July. July is the time in most years when it is easiest to detect the impact of nematode control procedures on population densities.

Control of the root-lesion nematode was correlated with increased tuber yield following crop rotation with both corn and alfalfa, and under both nitrogen fertilizer regimes. All three nematicide treatments resulted in a significant increase in both the gross and net income associated with potato production. The economic advantages of nematicide application following corn were less at the low nitrogen fertilizer level than at the high level. This was not evident with the alfalfa rotation. The nematode control and economic benefits associated with row application of Vorlex were equal to those of the broadcast application with Vorlex. The economic advantages of using both Vorlex and Temik 15G were favorable compared to the use of only Temik 15G, or not using a nematicide.

Table 9. Root-lesion nematode control, MSU Integrated Potato Research Project

Treatment	Root-lesion nematode population density				
	100 cm^3 soil	2.0 g root		2 .0 g roots	soil & roots
	4/20/83	8/1/83	9/28/83	(8/1/83)	8/1/83)
Corn - 75 N					
Check	11.0a	29.7ab	60.8c	35.7b	65.5b
Temik	9.9a	0.0a	14.7ab	0.5a	0.5a
Temik & Vorlex (Broadcast)	3.5a	0.0a	9.7ab	0.3a	0.3a
Temik & Vorlex (Row)	10.5a	0.0a	3.0a	0.2a	0.2a
Corn - 225N					
Check	4.0a	13.7ab	50.3bc	37.5b	51.2ab
Temik	2.5a	0.7a	16.3ab	0.2a	0.5a
Temik & Vorlex (Broadcast)	3.0a	0.0a	4.7a	0.5a	0.5a
Temik & Vorlex (Row)	8.0a	0.7a	1.3a	0.3a	1.0a
Alfalfa - 75 N					
Check	21.5a	60.7c	95.8d	38.8b	99.5b
Temik	23.0a	0.3a	10.7ab	0.7a	1.0a
Temik & Vorlex (Broadcast)	14.0a	0.3a	8.3ab	0.0a	0.3a
Temik & Vorlex (Row)	14.5a	0.0a	15.0ab	0.2a	0.2a
Alfalfa - 225 N					
Check	15.5a	35.0b	127.0e	60.3b	95.3b
Temik	47.0b	0.7a	25.3ab	0.2a	0.8a
Temik & Vorlex (Broadcast)	18.0a	0.7a	20.3ab	0.0a	0.7a
Temik & Vorlex (Row)	20.0a	0.3a	9.0ab	0.0a	0.3a

FUNGICIDE EVALUATIONS ON POTATOES

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A. Early Blight (Alternaria solani)

Russet Burbank potatoes were planted at the MSU Muck Farm on May 17, 1983, in furrows on 32 inch centers, but every second row was left blank so that rows were 64 inches apart. This allowed free movement of tractor and sprayer through the plots without significant vine damage.

Plots were sprayed weekly with a conventional John Bean boom sprayer at 100 psi, using two D2-25 cone nozzles at 45 degree angles on each row. Fungicides were applied in 50 gallons of water per acre. Sprays began on July 19 and terminated on September 7, 1983 (8 applications). Early blight developed naturally in the plots without inoculation. Most disease developed after September 1, when temperatures began to moderate somewhat from the consistently hot weather in July and August.

Plots were visually rated for disease on September 21, 1983, and were harvested October 3-5.

All Dithane M-45 treatments and combinations performed quite well in suppressing early blight, even when applied on a 14-day schedule (Table 1). It should be kept in mind, however, that conditions for disease development were not very favorable, and such results might not occur in another year. Alternating Ridomil MZ-58 and Dithane M-45 on alternate weeks worked very well, and two new formulations of M-45 (FZ flowable and DG dispersable granules) also performed well. Griffin's experimental formulations of Maneb (designated GX) looked quite good.

Surprisingly, Difolatan and Bravo did not perform very well under these conditions for early blight control.

B. Late Blight (Phytophthora infestans)

In spite of repeated inoculations, no late blight developed in these plots due to the unusually hot, dry weather in 1983.

Table 1. Disease reaction and yields of potato (cv. Russet Burbank) treated with fungicides for disease control (1983).

Material	Rate/Acre Active	Rate/Acre Formulation	Frequency (Days)	Disease[x] Rating	Yield (lbs[z] per 50 feet of row)
Ridomil MZ-58			14 (alternate		
and Dithane M-45 80W	1.16 lb	2 lb	14 weeks)	1.3 a[y]	134.4 abc
Dithane M-45 80W	1.6 lb	2 lb	7	1.8 ab	132.6 abc
Dithane M-45 68DG	1.36 lb	2 lb	7	1.8 ab	152.5 ab
Dithane M-45 80W	1.6 lb	2 lb			
plus Duter 47.5W	0.3 lb	10 oz	7	1.8 ab	138.6 abc
Dithane M-45 80W	1.6 lb	2 lb	14	1.8 ab	145.0 ab
Dithane M-45 80W	1.2 lb	1.5 lb			
plus RH 7731 50W	0.06 lb	0.12 lb	14	1.8 ab	135.9 abc
Dithane M-45 80W	1.2 lb	1.5 lb			
plus RH 7731 50W	0.125 lb	0.12 lb	14	1.8 ab	130.5 abc
GX 011H	1.6 lb	1.6 qt	7	1.8 ab	146.6 ab
GX 011H	1.2 lb	1.2 qt	7	1.8 ab	149.5 ab
Dithane FZ	1.6 lb	1.6 qt	7	2.0 ab	154.5 a
Dithane M-45 80W	0.8 lb	1.0 lb	14	2.0 ab	134.9 abc
Dithane M-45 80W	0.8 lb	1.0 lb			
plus RH 7731 50W	0.25 lb	0.5 lb	14	2.0 ab	137.8 abc
GX 011H	0.8 lb	0.8 qt	7	2.0 ab	121.6 abc
GX 022	1.6 lb	1.6 qt	7	2.3 abc	138.4 abc
Ridomil MZ-58	1.16 lb	2.0 lb	14	2.5 abc	153.0 ab
Dithane M-45 80W	0.8 lb	1.0 lb			
plus RH 7731 50W	0.125 lb	0.25 lb	14	2.5 abc	132.4 abc
Bravo 500	1.11 lb	2 1/8 pts	7	2.8 abc	137.9 abc
Difolatan 80DG	1.6	2.0 lb	7	3.0 abc	116.9 abc
Bravo 500	0.78 lb	1.5 pt	14	3.5 bc	113.5 abc
Bravo 500	0.78 lb	1.5 pt			
plus DS-59891 24W	0.6 lb	9.6 oz	14	3.5 bc	129.1 abc
RH-7731 50W	0.125 lb	0.25 lb	14	3.5 bc	111.3 bc
RH-7731 50W	0.256 lb	0.5 lb	14	3.5 bc	105.1 c
Bravo 500	1.04 lb	2 pt			
plus DS-59891 25W	0.8 lb	12.8 oz	14	3.8 bc	112.0 abc
Control	---	---	--	4.0 bc	102.1 c
LSD (0.05)				1.3	34.5

[x]Based on a rating scale of 1-5, where 1 = 0-5%, 2 = 6-15%, 3 = 16-35%, 4 = 36-75%, and 5 = >75% of foliage diseased.

[y]Means followed by the same letter do not differ significantly (P = 0.05) according to Duncan's Multiple Range Test.

[z]Potatoes smaller than about 1¼ inches in diameter x 2¼ inches long were not harvested.

THE INFLUENCE OF SELECTED PRODUCTION MANAGEMENT PRACTICES ON POTATO YIELD, QUALITY, AND NUTRITION

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The objective of the 1983 study was to optimize the inputs necessary for maximum tuber yield and excellent quality. From 1977 to 1980 a series of experiments were conducted to examine various nutrient-nematicide interactions. The 1981, 1982 and 1983 experiments are a culmination of the previous studies plus an additional component, crop rotation. In 1983 the Atlantic variety was evaluated in a corn and alfalfa rotation with respect to its response to two nitrogen rates (75, 225 lb N/A) and four nematicide treatments (check, Temik, Vorlex-broadcast and Vorlex-row).

METHODS

In the spring of 1982, 6 blocks of alfalfa and corn were established at the Montcalm Research Farm. The alfalfa was cut periodically and top growth was left for organic matter accumulation. The corn was harvested for grain and stalks left in the field. Standard fertilizer practices were followed for both corn and alfalfa.

The plots were plowed the first week in May and Vorlex applied May 6th. Broadcast Vorlex was applied with multiple chisels spaced 8 inches apart. Row applied Vorlex was applied on 34 inch centers under the row where potatoes were later planted. The broadcast treatment was 10 gallons of Vorlex per acre. The row treatment was 3 gallons of Vorlex per acre. All plots received the same tillage operations but no Vorlex was added to the check and Temik plots. All plots received 750 lbs of a 10-20-20 starter fertilizer at planting which occurred on May 17th. Temik 15G was banded with the starter fertilizer at a rate of 3.0 lbs active ingredient per acre to all plots except the 75 lb N-check and 225 lb N-check. The high N treatment was accomplished by side-dressing 75 lb N/A on June 16 and again on June 27th at hilling. The nitrogen form was urea. Each plot consisted of four 34 inch rows, 50 feet long. Seed placement was 10 inches. The variety was Atlantic.

The experimental design was a split-block design with 6 replications. Each replication was randomly split with the corn and alfalfa rotation. Within each rotation, two nitrogen treatments and four nematicide treatments were completely randomized.

All plots received foliar applied insecticides and fungicides as needed to control insects and diseases based on weekly monitoring by the Montcalm County pest scouts.

Soil samples were taken in April from each rotation block. Petiole samples were taken July 13th and analyzed in the laboratory for N, P, K, Ca, Mg, Zn, Mn, B, Cu, Fe, and Al. The two center rows of each plot were harvested on September 27, graded and weighed. Samples were taken for the determination of specific gravity and internal defects. Bulk samples were also taken from certain treatments and are being evaluated in several storage experiments.

An economic analysis of the data was performed using December prices.

RESULTS

Table 1 is a summary of the yield, economic analysis and specific gravity data. Because of this years experimental design, this is the first time we have been able to analyze rotations statistically. The 1983 data supports our previous data and contention that alfalfa grown just one year prior to potatoes produces the highest yields and economic returns when compared with corn. Specific gravity and small tuber yields (those under 2 inches in diameter) were not affected by the rotation. The data shown in Table 1 is the overall means for the main treatments in this study.

Nitrogen response was similar to the alfalfa response in that the high N rate (225 lb N/A) produced the highest yields and economic returns. Small tuber yield and specific gravity were unaffected by N rate.

Temik increased the yield of U.S. No. 1 potatoes by producing larger tubers and increased the yield of the 2-3 1/4 inch category. The addition of Vorlex (either row or broadcast) to Temik also resulted in significantly higher yields. This increase in yield came in the 2-3 1/4 inch tuber size category. Specific gravity, large tuber yield, and small tuber yield was unaffected by the four nematicide treatments. The greatest economic return from these treatments came from the Temik and the Temik plus Vorlex row-applied treatments. The additional cost of the broadcast application of Vorlex resulted in lower economic returns than row applied Vorlex but comparable returns to the Temik alone treatment.

Table 2 summarizes the three-way interaction effect on yield, specific gravity and economic returns. The U.S. No. 1 yield was significantly increased by the high N rate (225 lb N/A) in the corn-check but not the alfalfa-check. This implies that under a low management system, 75 lb N following alfalfa would be sufficient for maximum yields. The use of Temik and Temik + Vorlex at both N rates and rotations, however, resulted in higher yields of U.S. No. 1 potatoes. The response to these materials was greatest in the corn rotation at the high N rate and at the low N rate in the alfalfa rotation. Temik and high N combine together in the corn rotation to give an increase in large tuber yields, while Temik alone was responsible for most of the increase in large tuber yields in the alfalfa rotation. Vorlex when row applied tended to increase total yield by producing a increase in the 2-3 1/4 inch tuber category.

Specific gravity was unaffected by any of the treatments. Net income and net income over the check (75 lb N corn-check) was greatest for alfalfa, low N and Temik + Vorlex row applied.

Visual analysis for internal defects were inconclusive. A total of 25 tubers from each treatment were cut and visually examined. Slightly more hollow heart was observed in tubers from Vorlex treated plots, particularly in the corn rotation. A low incidence of vascular discoloration and internal necrosis did not appear to be related to any of the treatments. Ten tubers from each treatment were chipped shortly after harvest. All treatments produced excellent chip quality with a rating of 1.0.

In summary these studies have shown that intensive management of potatoes will optimize yield and profit. The nitrogen requirement for potatoes is more than double the requirement when following a corn crop compared to an alfalfa crop which is allowed to build organic matter and fix nitrogen in the soil. The use of Temik for the Atlantic variety, as well as Superior and other varieties tested in previous years, contributes greatly to yield increase and profits regardless of whether the previous crop is corn or alfalfa. Although alfalfa contributes to higher yielding potatoes, a two year economic analysis of the data may not show significantly larger economic returns. The economic returns over a two year period would depend on whether the alfalfa is allowed to be removed and sold. In this experiment alfalfa was clipped and not removed. The price of corn and alfalfa and their yields would also enter into the calculation of the two year economic return. The previous years corn and alfalfa yields were not measured in this study. One would also have to speculate whether yields of potatoes following clipped alfalfa would be better than where the hay is removed.

Nutrient Composition of Potato Petioles

The nutrient composition of potato petioles sampled on July 13th is shown in Table 3. Nitrate nitrogen levels were significantly increased by alfalfa and the high N rate but not by the nematicide treatments. The rotation by N rate interaction shows that adding more than 75 lbs of N increased the nitrate nitrogen (NO_3-N) content when the previous crop was corn but not when the crop was alfalfa. This is in agreement with the yield data. Plants growing at this time of year had plenty of N when the previous crop was alfalfa and only 75 lbs of starter N fertilizer was applied.

The effects of rotation were observed on Ca, Mn and Fe content of potato petioles. Significantly higher levels of Ca and Fe but lower levels of Mn were found in petioles from the alfalfa rotation. Soil test analysis showed higher Ca levels (1191 vs 960) in the alfalfa blocks than the corn blocks. Although pH was not significantly different between alfalfa and corn blocks, soil pH also tended to be higher in the alfalfa blocks (6.2 vs 6.1). This data would help to explain the higher Ca levels in plant tissue and lower Mn levels. Iron (Fe) will often show the opposite trend that Mn does. All plant nutrients except N were found to be in the sufficiency range for optimum growth.

Temik significantly increased the P content and decreased the Mg content of potato petioles; however, the change is small and the values are well above the critical levels. Vorlex significantly reduced the Mn level. This observation has been noted nearly every year. It is possible that the soil fumigant is affecting the soil microorganisms responsible for the oxidation and reduction of soil manganese (Mn). It would appear that Vorlex results in less reduced Mn in the soil causing less Mn to be taken up. Manganese in soil is most readily available in its reduced form. Little or no significance can be concluded from these differences in Mn content because even the lowest levels are above the critical or deficient level.

Several crop by N rate interactions were observed in addition to the one for NO_3-N which was discussed earlier. These were for K, Mg, Cu and B. Little or no confidence can be placed in these statistically significant reactions because all levels are above the critical levels.

Root-lesion Nematode Control

Root-lesion nematode (Pratylenchus penetrans) population densities at the beginning of the 1983 growing season were significantly greater following alfalfa than after rotation with corn (Tables 4 and 5). The influence of the previous crop on nematode population density was still evident at the end of the potato growing season. Nitrogen fertilizer had no direct impact on the population density of the root-lesion nematode.

Temik 15G applied in the fertilizer furrow at planting at 3.0 lb a.i./A, Temik 15G plus Vorlex applied as a broadcast soil injection, and Temik 15G plus Vorlex applied as an in-row soil injection significantly reduced population densities of the root-lesion nematode. This was determined from an analysis of both soil and root samples taken on August 1, 1983. Nematode population reduction was still evident at the end of the growing season.

Because of very cool soil temperatures in May, population densities of the root-lesion nematode did not increase as much as usual. No significant differences in nematode population densities among the nematicide treatments were detected in samples taken during the first week of July. July is the time in most years when it is easiest to detect the impact of nematode control procedures on population densities.

Control of the root-lesion nematode was correlated with increased tuber yield following crop rotation with both corn and alfalfa, and under both nitrogen fertilizer regimes. All three nematicide treatments resulted in a significant increase in both the gross and net income associated with potato production. The economic advantages of nematicide application following corn were less at the low nitrogen fertilizer level than at the high level. This was not evident with the alfalfa rotation. The nematode control and economic benefits associated with row application of Vorlex were equal to those of the broadcast application with Vorlex. The economic advantages of using both Vorlex and Temik 15G were favorable compared to the use of only Temik 15G, or not using a nematicide.

Foliar Disease Ratings

Observations were made on the severity of early blight (Alternaria solani) at four times during the growing season. The severity of early blight in the integrated plot was not as great as last year, and the observed differences were not as great among or between treatments (Tables 6 and 7). In general, the potatoes following alfalfa rotation exhibited less disease symptoms than the corn rotation. High N levels were also associated with less severe disease. Unlike last year, there were no apparent differences among the insecticide treatments with regard to early blight expression. Symptoms of Verticillium wilt were observed in the plot. However, like last year, no significant differences were noted among or between treatments.

Table 1. Main effects of selected production management practices on potato yield, size, quality and income.

	Tuber Yield						Income	
	US No. 1	2-3 1/4	Under 2"	Over 3 1/4"	Total	Specific Gravity	Net Income[1]	Net Income Over Check[2]
	- - - - - - - - cwt/A	- - -	- - -	- - -	- - -	- g/cc -	- - Dollars/A	- - -
Previous Crop								
Corn	368 a	342 a	28	26 a	396 a	1.086	2420 a	420 a
Alfalfa	404 b	368 b	30	37 b	435 b	1.085	2680 b	680 b
Nitrogen Rate								
75 lbs/A	371 a	346 a	30	25 a	401 a	1.086	2450 a	450 a
225 lbs/A	402 b	364 b	29	38 b	431 b	1.085	2650 b	650 b
Nematicide								
Check	347 a	328 a	29	19 a	376 a	1.085	2350 a	350 a
Temik	387 b	351 b	30	36 b	417 b	1.086	2610 bc	610 bc
Temik + Vorlex (Broadcast	406 c	372 c	29	33 b	434 c	1.086	2570 b	570 b
Temik + Vorlex (Row)	406 c	369 c	30	37 b	436 c	1.085	2690 c	690 c

[1] Net income after treatment expenses: N @ 20¢/lb, Temik @ $40/A, Vorlex-row @ $45/A and Broadcast @ $150/A, tubers over 3 1/4" @ $8.65, tubers 2-3 1/4" @ $6.65 and tubers under 2" @ $1.00

[2] Check = corn at 75 lbs N/A with no nematicide applied.

[3] Any two means not followed by the same letter are significantly different by LSD method (P = 0.05).

Table 2. Interaction effects of selected production management practices on potato yield, size, quality and income.

	Tuber Yield						Income	
	US No. 1	2 - 3 1/4"	Under 2"	Over 3 1/4"	Total	Specific Gravity	Net Income[1]	Net Income Over Check[2]
	- - cwt - -					- g/cc -	- - dollars/A - -	
Corn - 75 N								
Check	297	291	28	6	325	1.086	2000	0
Temik	314	300	28	14	342	1.086	2090	90
Temik + Vorlex (Broadcast)	375	357	28	18	403	1.087	2360	360
Temik + Vorlex (Row)	360	347	27	13	387	1.086	2350	350
Corn - 225 N								
Check	354	329	30	25	384	1.085	2390	390
Temik	412	366	28	46	440	1.085	2770	770
Temik + Vorlex (Broadcast)	428	384	27	44	456	1.085	2730	730
Temik + Vorlex (Row)	407	364	29	43	436	1.084	2690	690
Alfalfa - 75 N								
Check	377	353	32	24	409	1.084	2570	570
Temik	420	372	30	48	450	1.086	2860	860
Temik + Vorlex (Broadcast)	393	362	30	31	423	1.087	2500	500
Temik + Vorlex (Row)	430	384	35	46	465	1.085	2890	890
Alfalfa - 225 N								
Check	361	339	25	22	386	1.085	2420	420
Temik	403	365	34	38	437	1.086	2710	710
Temik + Vorlex (Broadcast)	425	385	29	40	454	1.084	2700	700
Temik + Vorlex (Row)	425	381	29	44	454	1.085	2810	810
LSD (.05)	(30)	(26)	(NS)	(11)	(30)		(210)	(210)

[1] Net income after treatment expenses: N @ 20¢/lb, Temik @ \$40/A, Vorlex - row @ \$45/A and broadcast @ \$150/A, tubers over 3 1/4" @ \$8.65, tubers 2 - 3 1/4" @ \$6.65 and tubers under 2" @ \$1.00.

[2] Check = Corn at 75 lbs N/A and no nematicide.

Table 3. Main and interaction effects of selected production management practices on chemical analysis of potato petioles sampled on July 13th.

	NO_3^-N	P	K	Ca	Mg	Mn	Zn	Cu	Fe	B	Al
	-ppm-	- - - - - - -	%	- - - - - - -		- - - - - - - - -	ppm	- - - - - - - -		
Previous Crop											
Corn	10770	0.49	11.71	0.97	0.47	223	40	8.0	58	34	55
Alfalfa	16190	0.51	10.97	1.11	0.52	172	41	9.4	66	34	95
LSD (.04)	(2400)	(NS)	(NS)	(0.07)	(40)	(40)	(NS)	(NS)	(8)	(NS)	(NS)
N Rate											
75	12730	0.50	11.49	1.04	0.49	187	39	9.4	61	34	73
225	14240	0.50	11.18	1.05	0.50	208	42	8.0	63	34	77
LSD (.05)	(870)	(NS)	(.17)	(NS)	(NS)	(NS)	(3)	(NS)	(2)	(NS)	(NS)
Nematicide											
Check	13080	0.47	11.24	1.06	0.50	236	40	8.6	60	33	74
Temik	13810	0.50	11.48	1.02	0.48	213	40	8.3	64	34	89
Temik + Vorlex (Broadcast)	13450	0.54	11.41	1.04	0.48	180	43	8.2	63	36	60
Temik + Vorlex (Row)	13600	0.50	11.23	1.05	0.51	161	40	9.7	62	33	77
LSD (.05)	(NS)	(0.03)	(NS)	(NS)	(0.02)	(36)	(NS)	(NS)	(NS)	(NS)	(NS)
Previous Crop By N Rate Interaction											
Corn - 75	9130	0.50	11.95	0.96	0.46	219	38	57	57	35	42
Corn - 225	12420	0.48	11.46	0.98	0.48	226	42	59	59	33	67
Alfalfa - 75	16320	0.50	11.03	1.12	0.52	155	40	65	65	33	104
Alfalfa - 225	16060	0.51	10.90	1.11	0.51	189	42	67	67	36	86
LSD (.05)	(2060)	(NS)	(.63)	(NS)	(0.05)	(NS)	(NS)	(NS)	(3)	(3)	(NS)

Table 4. Root-lesion nematode populations in potato roots and soil as affected by previous crop, nitrogen rate, nematicide treatments and time of sampling.

Treatment	Root-lesion nemotode population density				
	100 cm^3 soil			2.0 g root	Soil & roots
	4/20/83	8/1/83	9/28/83	(8/1/83)	(8/1/83)
Previous Crop					
Corn	6.5a [1]	5.6a	20.1a	9.4a	15.0a
Alfalfa	21.7b	12.3a	40.6b	12.4a	24.8a
Nitrogen Rate					
75 lbs/A	13.4ab	11.5a	28.a b	9.5a	21.0a
225 lbs/A	14.8ab	6.4a	32.6ab	12.3a	18.7a
Nematicide					
Check	13.0ab	34.9b	86.9b	43.0b	77.9b
Temik	20.5ab	0.4a	16.8a	0.4a	0.8a
Temik + Vorlex (Broadcast)	9.6ab	0.3a	10.8a	0.2a	0.5a
Temik & Vorlex (Row)	13.3ab	0.3a	7.1a	0.2a	0.4a

[1] Any two means not followed by the same letter are significantly different according to the LSD test (P=0.05)

Table 5. Root-lesion nematode populations in potato roots and soil as affected by selected production management practices (interaction effects).

Treatment	Root-lesion nematode population density				
	100 cm^3 soil	2.0 g root		2 .0 g Roots	Soil & Roots
	4/20/83	8/1/83	9/28/83	(8/1/83)	8/1/83)
Corn - 75 N					
Check	11.0a	29.7ab	60.8c	35.7b	65.5b
Temik	9.9a	0.0a	14.7ab	0.5a	0.5a
Temik & Vorlex (Broadcast)	3.5a	0.0a	9.7ab	0.3a	0.3a
Temik & Vorlex (Row)	10.5a	0.0a	3.0a	0.2a	0.2a
Corn - 225N					
Check	4.0a	13.7ab	50.3bc	37.5b	51.2ab
Temik	2.5a	0.7a	16.3ab	0.2a	0.5a
Temik & Vorlex (Broadcast)	3.0a	0.0a	4.7a	0.5a	0.5a
Temik & Vorlex (Row)	8.0a	0.7a	1.3a	0.3a	1.0a
Alfalfa - 75 N					
Check	21.5a	60.7c	95.8d	38.8b	99.5b
Temik	23.0a	0.3a	10.7ab	0.7a	1.0a
Temik & Vorlex (Broadcast)	14.0a	0.3a	8.3ab	0.0a	0.3a
Temik & Vorlex (Row)	14.5a	0.0a	15.0ab	0.2a	0.2a
Alfalfa - 225 N					
Check	15.5a	35.0b	127.0e	60.3b	95.3b
Temik	47.0b	0.7a	25.3ab	0.2a	0.8a
Temik & Vorlex (Broadcast)	18.0a	0.7a	20.3ab	0.0a	0.7a
Temik & Vorlex (Row)	20.0a	0.3a	9.0ab	0.0a	0.3a

Table 6. Early blight ratings[1] of Atlantic following alfalfa.

Treatment	Date			
75 lb N	7/27	8/3	8/17	8/31
Check	0.5	0.7	1.2	2.1
Temik	0.4	0.4	1.1	2.0
Temix+Vorlex (Broadcast)	0.4	0.4	1.0	1.8
Temix+Vorlex (Row)	0.5	0.6	0.9	1.9
225 lb N				
Check	0.1	0.2	0.4	0.5
Temik	0.0	0.1	0.4	0.3
Temix+Vorlex (Broadcast)	0.0	0.1	0.5	0.6
Temix+Vorlex (Row)	0.0	0.0	0.3	0.4

[1] 0 = no symptoms; 1 = 1-10% coverage; 2 = 11-20%; 3 = 21-40%; 4 = over 41% coverage.

Table 7. Early blight ratings[1] of Atlantic following corn.

Treatment	Date			
75 lb N	7/27	8/3	8/17	8/31
Check	0.7	1.0	1.6	2.8
Temik	0.8	0.8	1.3	2.7
Temik+Vorlex (Broadcast)	0.6	0.8	1.0	1.9
Temik+Vorlex (Row)	0.6	0.7	0.9	2.1
225 lb N				
Check	0.1	0.4	0.7	1.3
Temik	0.0	0.3	0.6	1.4
Temik+Vorlex (Broadcast)	0.0	0.3	0.3	0.9
Temik+Vorlex (Row)	0.0	0.4	0.5	1.0

[1] 0 = no symptoms; 1 - 1-10% coverage; 2 = 11-20%; 3 = 21-40%; 4 = over 41% coverage.

INFLUENCE OF FIELD PRODUCTION TREATMENTS ON THE QUALITY OF POTATOES OUT OF EXTENDED STORAGE (MSU 1982 INTEGRATED PROJECT - STORAGE PHASE)

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INTRODUCTION

This report contains data on the effect of various field production treatments on the quality of MSU grown Atlantic, Denali, and Russet Burbank potatoes out of extended storage.

PROCEDURE

Potato Samples

For the 1982 MSU integrated project three varieties of potatoes (Atlantic, Denali, and Russet Burbank) were grown under controlled conditions at the Michigan State University Potato Research Farm at Entrican, Michigan. These potatoes were harvested with the one row MSU research plot harvester on September 23, 1982.

Treatments

All production treatments in this phase of the integrated potato project are field applied. All treatments had two crop rotation treatments. One set of treatments was performed in a corn rotation and one set of treatments was performed in an alfalfa rotation.

For the Atlantics, 225 lbs/acre of nitrogen was applied to all three Atlantic treatments. The Atlantic treatment number 7 was a check. Atlantic treatment number 8 had a field application of Temik and Atlantic treatment number 9 had a field application of Vorlex. See Table 1. For the Denali, 225 lbs/acre of nitrogen was applied to one Denali treatment. The Denali treatment also had a field application of Temik and Vorlex. See Table 1. For the Russet Burbanks there were six treatments. Three were treated with 75 lbs/acre of nitrogen and three plots were treated with 225 lbs/acre of nitrogen. See Table 2.

Table 1. Field Production Treatments for the MSU 1982 Integrated Project Atlantic (7, 8, 9) and Denali (10).

Treatment Number	Crop Rotation	Chemical Treatments
7A	Alfalfa	Check
8A	Alfalfa	Temik
9A	Alfalfa	Temik & Vorlex
7C	Corn	Check
8C	Corn	Temik
9C	Corn	Temik & Vorlex
10A	Alfalfa	Temik & Vorlex
10C	Corn	Temik & Vorlex

Table 2. Field Production Treatments for the MSU 1982 Integrated Project Russet Burbank Potatoes.

Treatment Number	Nitrogen lbs/acre	Crop Rotation	Chemical Treatments
1A	75	Alfalfa	Check
2A	75	Alfalfa	Temik
3A	75	Alfalfa	Temik & Vorlex
1C	75	Corn	Check
2C	75	Corn	Temik
3C	75	Corn	Temik & Vorlex
4A	225	Alfalfa	Check
5A	225	Alfalfa	Temik
6A	225	Alfalfa	Temik & Vorlex
4C	225	Corn	Check
5C	225	Corn	Temik
6C	225	Corn	Temik & Vorlex

Storage Environment

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

Evaluation

Weight Loss: All bagged potato samples were weighed after treatment; after two weeks suberization; and at the market quality evaluation date of June 1, 1983 (251 days in storage). Weight loss during storage is represented by a percent using the following equation:

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

Where Wi = initial weight
We = evaluation weight

Market Quality

A market quality evaluation was made after the potatoes had been in storage for 251 days. The market quality evaluation involved removing the respective bagged samples from storage, emptying the bag, and examining each individual tuber. Each examined tuber was classified as follows:

A. Marketable

B. Non-marketable

1.	0 to 5.0%	dry rot	5.	0 to 5.0%	soft rot
2.	5.1 to 10.0%	dry rot	6.	5.1 to 10.0%	soft rot
3.	10.1 to 25.0%	dry rot	7.	10.1 to 25.0%	soft rot
4.	over 25.0%	dry rot	8.	over 25.0%	soft rot

9. Other reasons (but not due to storage, such as insect damage, excess scab, etc.)

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

Marketable quality is represented by a percent and is determined by two methods:

1. By number of tubers:

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

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

2. By weight of tubers:

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

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

RESULTS AND DISCUSSION

Weight Loss

Tables 3-5 show the weight loss data for the Atlantic, Denali, and Russet Burbank potatoes, respectively for the 1982 integrated potato project.

Data from all three varieties show that there is less than a 2% difference between the various field treatments. This means that the various production treatments used in the integrated project have very little if any bearing on potato weight loss during storage.

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

Table 3. Weight Loss Data from the 1982 Integrated Project Atlantic Potatoes Stored at 40°F and 95% r.h.

	Storage Duration Days			
	83		237	
Treatment Number	Wt. Loss %	WLF	Wt. Loss %	WLF
7A	4.3	.051	8.7	.037
7C	3.6	.044	8.5	.036
Avg.	3.9	.048	8.6	.036
8A	3.9	.047	9.3	.039
8C	3.8	.046	9.3	.039
Avg.	3.9	.046	9.3	.039
9A	3.8	.046	7.8	.033
9C	3.7	.045	8.9	.037
Avg.	3.8	.045	8.3	.035

Table 4. Weight Loss Data for the 1982 Integrated Project Denali Potatoes Stored at 40°F and 95% r.h.

	Storage Duration Days			
	83		237	
Treatment Number	Wt. Loss %	WLF	Wt. Loss %	WLF
10A	4.5	.055	7.2	.031
10C	3.9	.047	6.6	.028
Avg.	4.2	.051	6.9	.030

Table 5. Weight Loss Data for the 1982 Integrated Project Russet Burbank Potatoes Stored at 40°F and 95% r.h.

	Storage Duration Days			
	83		237	
Treatment Number	Wt. Loss %	WLF	Wt. Loss %	WLF
1A	3.3	.040	5.7	.024
1C	3.9	0.47	4.9	.021
Avg.	3.6	0.43	5.3	.022
2A	3.2	.039	5.4	.018
2C	4.1	.050	6.0	.025
Avg.	3.6	.044	5.7	.021
3A	3.5	.042	4.7	.020
3C	4.5	.054	6.2	.026
Avg.	4.0	.048	5.4	.023
4A	2.5	.030	4.0	0.13
4C	3.7	.035	4.7	.020
Avg.	3.1	.033	4.3	.016
5A	4.2	.051	5.8	.025
5B	4.9	.059	7.3	.031
Avg.	4.5	.055	6.5	.028
6A	3.3	.040	5.7	.024
6C	4.7	.064	6.6	.028
Avg.	4.0	.047	6.1	.026
Check Avg.	3.4	.038	4.8	0.19
Temik Avg.	4.0	.047	6.1	.026
Temik & Vorlex Avg.	4.0	.047	5.7	.021

Market Quality

The market quality data (by weight) of the Atlantic, Denali, and Russet Burbank potatoes of the integrated project are shown in Tables 6-8, respectively.

Table 6. Market Quality (by weight) of the 1982 Integrated Project Atlantic Potatoes Stored at 40°F and 95% r.h.

Treatment Number	Market Quality
7A	93
8A	88
9A	85
7C	88
8C	86
9C	76*
7-Average	92.5
8-Average	87.0
9-Average	80.5

*Unaccountable potential research error - other #9 treatments did not show this difference in market quality.

Table 7. Market Quality (by weight) of 1982 Integrated Project Denali Potatoes Stored at 40°F and 95% r.h.

Treatment Number	Market Quality
10A	89
10C	90
Avg.	89.5

Table 8. Market Quality (by weight) of 1982 Integrated Project Russet Burbank Potatoes Stored at 40°F and 95% r.h.

Treatment Number	Market Quality
1A	95
2A	97
3A	99
4A	97
5A	95
6A	98
1C	99
2C	99
3C	99
4C	98
5C	96
6C	98

CONCLUSIONS

1. The field production treatments in the 1982 integrated project using different rates of nitrogen, crop rotations, and treatments of Temik and Temik combined with Vorlex have very little affect on weight loss of potatoes out of extended storage.

2. The field production treatments in the 1982 integrated project using different rates of nitrogen, crop rotations, and treatments of Temik and Temik combined with Vorlex have very little affect on market quality of potatoes out of extended storage.

QUALITY OF STORED POTATOES DUE TO PRESTORAGE HANDLING, CHEMICAL AND MECHANICAL TREATMENTS, AND STORAGE ENVIRONMENTS (1982 INTEGRATED PROJECT)

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INTRODUCTION

The objectives of the storage phase of the 1982 MSU integrated potato research project were:

To compare the influence of prestorage mechanical and chemical treatments on the quality of Atlantic and Denali potatoes stored under various environments for extended storage periods.

To investigate the effects of various application rates of prestorage chemicals (Mertect 340F and chlorine) and types of prestorage application equipment on marketable quality of stored potatoes.

The economic value (market quality) of potatoes varies due to prestorage mechanical and chemical treatments and various storage environments. The overall objective is to try and determine the best combination of prestorage treatments and storage environments to maximize the economic value of potatoes out of storage.

This report contains the 1982 results for the prestorage chemical and mechanical treatment and storage phase for Atlantic and Denali potatoes.

PROCEDURE

Potato Samples

The 1982 integrated potatoes (Atlantic and Denali) were harvested from the Integrated plot at Michigan State University's Montcalm Potato Research Farm at Entrican, Michigan using the one row plot harvester. The potatoes were divided into two lots. Lot I was controlled mechanically bruised by rerunning the potatoes two times over a PTO operated windrower with an engine speed of 700 rpm. Lot I was designated as bruised potatoes. Lot II was taken directly off the MSU plot harvester and was designated as nonbruised.

Equipment

The MSU research conveyor was used for the controlled application of fungicides and bacteriacides. The conveyor controlled the potato volume at 12 tons/hr (about 1/6 - 1/3 the rate of the commercial bin piler). The chemicals were applied with calibrated equipment. For the Atlantics two different nozzle systems were used:

1. The standard Delavan TX-6, which is used commercially for the application at the 1 gal/ton treatment rate.
2. Micromax spinning disc controlled droplet applicator (CDA) supplied by the Micron Corp., Houston, Texas. (Denalis used only Micromax)

Chemical Treatment

Atlantic: Lot II potatoes (nonbruised and no chemicals) a check treatment. Lot I potatoes (bruised) were divided into 3 treatment lots: one check with no chemicals and two chemical treatments. See Table 9.

Denali: Lot II potatoes (nonbruised and no chemicals) were used as a check treatment. Lot I potatoes (bruised) were divided into 2 treatment lots; one check with no chemicals and one chemical treatment. See Table 10.

All chemical solutions were used at 0.42 oz/ton Mertect 340F.

Table 9. Prestorage Chemical and Mechanical Treatments of 1982 Atlantic Potatoes.

Treatment Number	Mechanical Treatment	Nozzle System	Total Solution/Ton
1	Nonbruised	Check	-
2	Bruised	Check	-
3	Bruised	Standard Delavan	1 gal
4	Bruised	Micromax	3 oz*

Table 10. Prestorage Chemical and Mechanical Treatments of 1982 Denali Potatoes.

Treatment Number	Mechanical Treatment	Nozzle System	Total Solution/Ton
1	Nonbruised	-	-
2	Bruised	-	-
3	Bruised	Micromax	3 oz*

*The 3 oz solution contained 0.42 oz Mertect 340F, 0.64 oz chlorine, and 1.94 oz water.

Storage Environment

Immediately after treatment, bagging, tagging, etc. all potatoes for this research project were placed in storage cubicles on the MSU campus. Each cubicle contains approximately 350 cubic feet (or 10 cubic meters). The potatoes were suberized for two weeks; one week at 60°F (15.6°C) and 95% r.h. and one week at 55°F (12.8°C) and 95% r.h. After suberization all potatoes were lowered 5°F/week until the desired storage environment of 40, 45, and 50°F and 95% r.h. was obtained. The relative humidity was maintained at 95% by using a hygrodynamics humidity controller with electric vaporizers in each storage cubicle. All cubicles were monitored daily to insure a stable storage environment.

Evaluation

Weight Loss: All bagged potato samples were weighed after treatment, after two weeks suberization, and at three market quality evaluation dates (83, 142, and 245 days in storage). Weight loss during storage is presented in percent loss and determined by the equation (see page 70).

Market Quality

Market quality evaluations were made after the potatoes had been in storage for 83, 142, and 245 days. Market quality evaluations involved removing the respective bagged sample from storage, emptying the bag, and examining each individual tuber. The examined tubers were classified as (see page 70).

After the potatoes were classified, the nonmarketable potatoes were counted and weighed.

Market quality is represented by a percent and is determined by two methods (see page 70).

Chip Color

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

DISCUSSION AND RESULTS

Weight Loss

The weight loss data for the 1982 Atlantic potatoes stored at 40, 45, and 50°F is shown in Tables 11-13 and for the Denali potatoes in Tables 14-16.

Excessive sprouting began to occur at the 142 day storage period. Due to the excess sprouting no weight loss is presented at the 245 day evaluation period.

Table 11. Weight Loss for 1982 Atlantic Potatoes Stored at 40°F and 95% r.h.

	Storage Duration Days			
	83		142	
Treatment Number*	Wt. Loss %	WLF	Wt. Loss %	WLF
1	3.4	.041	6.4	.045
2	6.7	.081	8.7	.061
3	6.2	.075	7.4	.051
4	6.7	.080	7.8	.055

*See Table 9 for treatment description for Atlantic potatoes.

Table 12. Weight Loss for 1982 Atlantic Potatoes Stored at 45°F and 95% r.h.

	Storage Duration Days			
	83		142	
Treatment Number	Wt. Loss %	WLF	Wt. Loss %	WLF
1	4.3	.052	7.5	.052
2	6.5	.079	10.9	.077
3	5.4	.065	8.5	.060
4	5.5	.066	6.5	.046

Table 13. Weight Loss for 1982 Atlantic Potatoes Stored at 50°F and 95% r.h.

	Storage Duration Days			
	83		142	
Treatment Number	Wt. Loss %	WLF	Wt. Loss %	WLF
1	5.7	.069	8.5	.060
2	7.0	.084	11.4	.080
3	6.6	.079	9.7	.068
4	6.9	.083	9.5	.067

Table 14. Weight Loss for 1982 Denali Potatoes Stored at 40°F and 95% r.h.

	Storage Duration Days			
	83		142	
Treatment Number*	Wt. Loss %	WLF	Wt. Loss %	WLF
1	6.0	.072	6.8	.047
2	6.6	.079	7.4	.051
3	7.0	.084	8.2	.056

*See Table 10 for treatment description for Denali potatoes.

Table 15. Weight Loss for 1982 Denali Potatoes Stored at 45°F and 95% r.h.

	Storage Duration Days			
	83		142	
Treatment Number	Wt. Loss %	WLF	Wt. Loss %	WLF
1	5.4	.065	6.1	.042
2	6.3	.076	7.5	.052
3	6.6	.079	7.4	.051

Table 16. Weight Loss for 1982 Denali Potatoes Stored at 50°F and 95% r.h.

	Storage Duration Days			
	83		142	
Treatment Number	Wt. Loss %	WLF	Wt. Loss %	WLF
1	4.6	.055	8.1	.056
2	5.7	.069	9.8	.067
3	4.4	.053	8.2	.056

Market Quality

Market quality evaluations for the various storage temperatures and durations for the 1982 Atlantic potatoes are shown in Tables 17-19 and for the Denali in Tables 20-22.

No market quality data was obtained for the 50°F 245 day storage duration due to the excessive sprouting. No sprout inhibitors are used in the MSU cubicle storage.

Market quality evaluations were determined by weight and tuber numbers, however, the weight evaluations are the only ones shown in Tables 17-22.

There are many variables that influence market quality of potatoes. These variables include: the prestorage chemical concentrations used; time of application, uniformity of application, rate of flow of potatoes over bin piler, etc. The actual market quality evaluation is also a variable because it is a judgement decision that must be made on each potato.

There appears to be a trend developing over our various years of data collection on prestorage treatment. The trend appears to be that Mertect 340F for short duration storage does not show up as well as for durations over 100 days. See Tables 17 and 18. Market quality evaluations are masked in long-term storage due to the sprouting that occurs in the 50° storage environments. These trends need to be further studied and evaluated. This also shows the importance of sprout inhibitors for 50° long-term storage.

Table 17. Market Quality (by weight) of Atlantic Potatoes Stored at 40°F and 95% r.h.

Storage Duration	Treatment			
Days	1	2	3	4
83	100	76.1	75.5	84.0
142	99.6	78.4	85.8	84.3
245	94.2	65.2	68.7	64.5
Avg .	98	73.2	77.0	77.6

Table 18. Market Quality (by weight) of Atlantic Potatoes Stored at 45°F.

Storage Duration	Treatment			
Days	1	2	3	4
83	100	76.1	75.5	84.0
142	99	80.0	80.7	83.4
245	91.5	62.9	70.4	71.0
Avg.	96	80	80	83.1

Table 19. Market Quality (by weight) of Atlantic Potatoes Stored at 50°F.

Storage Duration	Treatment			
Days	1	2	3	4
83	100	89.5	87.7	87.1
142	98.5	92.7	85.3	86.6
Avg.	99	91	86.5	87

Table 20. Market Quality (by weight) of Denali Potatoes Stored at 40°F and 95% r.h.

Storage Duration	Treatment		
Days	1	2	3
83	98.4	78.4	81.1
142	97.9	84.0	80.9
245	94.5	68.9	85.5
Avg.	96.9	77.1	82.5

Table 21. Market Quality (by weight) of Denali Potatoes Stored at 45°F and 95% r.h.

Storage Duration	Treatment		
Days	1	2	3
83	93.3	90.5	90.8
142	96.5	86.5	75.9
245	85.0	65.1	83.9
Avg.	91.6	80.7	83.5

Table 22. Market Quality (by weight) of Denali Potatoes Stored at 50°F and 95% r.h.

Storage Duration	Treatment		
Days	1	2	3
83	94.8	87.3	79.9
143	94.8	80.1	78.0
Avg.	94.8	83.7	79.0

Chip Color

Tables 23-28 present the chip color data for the 1982 Atlantic and Denali potatoes. Tables 23-25 show the chip color data for Atlantic potatoes stored for 83, 142, and 245 days. Tables 26-28 show the chip color data for Denali potatoes stored for 83, 142, and 245 days. Chip data was not determined at the 50°F temperature for the 245 day storage duration due to the excessive sprouting and poor potato quality.

Table 23. Agtron Chip Color Data for 1982 Atlantic Potatoes Stored at 40°, 45°, and 50°F for 83 days.

Original Storage Temp °F	At Harvest	83 Days Storage	Reconditioning Time		
			1 Week	2 Weeks	3 Weeks
40	65+	50 - 55	55 - 65	60+	65+
45	65+	50 - 55	55 - 65	60+	65+
50	65+	50 - 55	55 - 65	60+	65+

Table 24.* Agtron Chip Color Data for 1982 Atlantic Potatoes Stored at 40°, 45°, and 50°F for 142 Days.**

Original Storage Temp °F	142 Days Storage	Reconditioning Time			
		1 Week	2 Weeks	3 Weeks	4 Weeks
40	40 - 50	40 - 50	45 - 55	45 - 55	50 - 55
45	40 - 50	40 - 50	45 - 55	50 - 55	50 - 60
50	40 - 50	40 - 50	45 - 55	50 - 55	50 - 60

*Potatoes reconditioned at 5°F/wk. Potato temperatures did not exceed 60°F.

**See Table 23 for at harvest Agtron chip color data.

Table 25.* Agtron Chip Color Data for 1982 Atlantic Potatoes Stored at 40° and 45°F for 245 Days.**

Original Storage Temp °F	245 Days Storage	Reconditioning Time			
		1 Week	2 Weeks	3 Weeks	4 Weeks
40	30 - 40	30 - 40	35 - 45	35 - 45	35 - 45
45	30 - 40	30 - 40	35 - 45	35 - 45	35 - 45

*Potatoes reconditioned at 5°F/wk. Potato temperatures did not exceed 60°F.

**See Table 23 for at harvest Agtron chip color data.

Table 26.* Agtron Chip Color Data for 1982 Denali Potatoes Stored at 40°, 45°, and 50°F for 83 days.

Temp	At Harvest	83 Days Storage	Reconditioning Time		
			1 Week	2 Weeks	3 Weeks
40	65+	40 - 50	45 - 55*	55 - 60*	60+
45	65+	45 - 54	50 - 60	60+	65+
50	65+	45 - 54	50 - 60	65+	65+

*Reconditioned at 5°F/wk. Potato temperatures do not exceed 60°F.

Table 27.* Agtron Chip Color Data for 1982 Denali Potatoes Stored at 40°, 45°, and 50°F for 142 days.

Temp	At Harvest	142 Days Storage	Reconditioning Time			
			1 Week	2 Weeks	3 Weeks	4 Weeks
40	65+	40 - 50	40 - 50	45 - 55	45 - 55	50 - 55
45	65+	45 - 54	45 - 54	50 - 60	50 - 60	50 - 60
50	65+	45 - 54	45 - 54	50 - 60	55 - 65	60+

*Reconditioned at 5°F/wk. Potato temperatures do not exceed 60°F.

Table 28.* Agtron Chip Color Data for 1982 Denali Potatoes Stored at 40° and 45°F for 245 Days.

Temp	At Harvest	245 Days Storage	Reconditioning Time			
			1 Week	2 Weeks	3 Weeks	4 Weeks
40	65+	35 - 44	35 - 44	35 - 44	35 - 44	35 - 44
45	65+	35 - 44	35 - 44	35 - 44	35 - 44	35 - 44

*Reconditioned at 5°F/wk. Potato temperatures do not exceed 60°F.

QUALITY OF STORED POTATOES DUE TO PRESTORAGE HANDLING, CHEMICAL AND MECHANICAL TREATMENTS, AND STORAGE ENVIRONMENTS (1982 MSU MONONA POTATO PHASE)

INTRODUCTION

The economic value (market quality) of potatoes varies due to prestorage mechanical and chemical treatments and various storage environments. The overall objective is to try and determine the best combination of prestorage treatments and storage environments to maximize the economic value of potatoes out of extended storage.

This report contains the data for the prestorage chemical and mechanical treatment and storage phase for the 1982 Monona potatoes.

OBJECTIVES

The objectives for the 1982 Monona potato phase of the potato storage research project were:

To determine the influence of prestorage mechanical and chemical treatments on the quality of Monona potatoes stored under various environments for extended storage periods.

To investigate various rates of prestorage chemical treatments (Mertect 340F and chlorine) and types of application equipment on quality of stored Monona potatoes.

To evaluate quality of Monona potatoes stored in commercial bulk bins compared to equivalent potatoes stored in research cubicles at MSU.

PROCEDURE

Potato Samples

The 1982 Monona potatoes were harvested from the Monona plot at Michigan State University's Montcalm Potato Research Farm, Entrican, Michigan using the one row plot harvester. The potatoes were divided into two lots, Lot I was controlled mechanically bruised by rerunning the potatoes two times over a PTO operated windrower with 700 rpm engine speed. Lot I was designated as bruised potatoes. Lot II was obtained directly off the MSU plot harvester and designated as nonbruised potatoes. Samples from Lot I and II were taken to a commercial processor (Ore-Ida, Greenville), held 48 hours and then given the bruise-free evaluation test. Lot I (bruised) potatoes were given a 65.7% bruise-free evaluation (34.3% bruised). Lot II (nonbruised) potatoes were given a 90.5% bruise-free evaluation (9.5% bruised).

Equipment

The MSU research conveyor was used for the controlled application of fungicides and bacteriacides. The conveyor controlled the potato volume at 12 tons/hr (about 1/6 - 1/3 the commercial rate). The fungicides and bacteriacides were applied with calibrated equipment. Three different application nozzles were used: 1) the standard Delavan TX-6 nozzle used commercially for the recommended 1 gallon fungicide treatment rate, 2) the Micromax, and 3) Mantis II spinning disc controlled droplet applicators. They were supplied by Micron Corp., Houston, Texas.

Chemical Treatment

The Lot II potatoes (nonbruised) were a check treatment (no chemical). Lot I potatoes (bruised) were divided into 5 treatment lots: one check (no chemical) and four different chemical treatments. See Table 29 for detailed description of the six treatments.

Table 29. Prestorage Chemical Application Treatments on 1982 Monona Potatoes.

Treatment*	Nozzle System	Total Solution/Ton
1	Check	-
2	Check	-
3	Standard Delavan	1 gal.
4	Micromax	3 oz.
5	Mantix II	3 oz.
6	Mantis II	2 oz.

*Treatments 3-5 used 0.42 oz/ton Mertect 340F, .64 oz/ton chlorine (5.25% active chlorine ingredient) plus water. Treatment 6 used .42 oz/ton of Mertect 340F, 0.64 oz chlorine, and 1.06 oz/ton water. Mertect 340F contains 42.78% active ingredients of 2-(4-Thiazolyl) Benzimidazole (TBZ).

Storage Environment

Immediately after treatment, bagging, tagging, etc. all potatoes for this research project were placed in storage cubicles on the MSU campus. Samples from all six treatments were also placed in the center of a commercial potato storage (Bin #10 Chief Chips Storage, Edmore, Michigan). The Michigan State University stored potatoes were suberized for two weeks, one week at 60°F and 95% r.h. and one week at 55°F and 95% r.h. After suberization the storage temperatures were lowered 5°F/week until the desired storage environments of 40°, 45°, 50°F and 95% r.h. were reached in the MSU cubicles and 45°F and 95% r.h. in the commercial storage. The relative humidity was maintained at 95% by using hygrodynamics humidity controller with electric vaporizers in each storage cubicle. All cubicles were monitored daily to insure a stable storage environment.

Evaluation

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

Weight Loss

All MSU stored bagged potato samples were weighed after treatment, after two weeks suberization, and at the three market quality evaluation dates (83, 142, and 245 days storage). The weight loss for the samples in the commercial storage was determined when the storage was emptied after 190 days of storage.

Market Quality

Market quality evaluations were made at three times during storage, December 22, 1982 (83 days storage), February 17, 1983 (142 days storage), and May 21, 1983 (245 days storage). The potatoes in the commercial storage were evaluated when the storage was emptied after 190 days storage. Market quality evaluations involved removal of a respective bag from storage, emptying the bag, and examining each individual tuber.

Chip Color

Chip color samples were taken at harvest, after suberization, and at each of the three evaluation dates. Potato samples were fried in vegetable oil at 365°F for 105-135 seconds. Samples that did not get a 60 or higher reading on the Agtron index were reconditioned by increasing the temperature 5°F/week until the desired chip color was reached or potato quality could no longer be maintained. Potato storage temperatures did not exceed 60°F.

DISCUSSION AND RESULTS

Weight Loss

Weight loss data for the 1982 Monona potatoes are shown in Tables 30-33. Tables 30-32 compare the weight loss between bruised and nonbruised potatoes stored in the MSU cubicles at 40, 45, and 50°F for 83, 142, and 245 days. Table 33 shows the weight loss data for the Monona potatoes stored in bin #10 Chief Chips Storage, Edmore, Michigan.

Nonbruised potatoes for all treatments have slightly less weight loss than bruised potatoes. This is expected due to the increased weight loss during suberization of the bruised potatoes. However, Tables 30-33 show that with good suberization and storage at 95% r.h. there is less than 2% weight loss difference between bruised and nonbruised potatoes even after 245 days in storage.

The weight loss factor (WLF) is an important factor for growers. The WLF is a "tool" that enables a grower to economically consider holding or selling a bin of potatoes. Extended storage normally means an increased selling price per hundredweight (cwt); however, weight loss and market quality degradation due to extended storage may dictate selling. The "WLF tool" can be used as an aid in this decision. To use the WLF multiply the days in storage times the appropriate WLF closest to the storage duration.

From the data on weight loss there is no clear correlation between the six treatments, chemical formulations, and application methods. It is shown, however, that there is less weight loss for nonbruised potatoes than bruised potatoes for a given storage duration. As storage duration increases, the amount of weight loss increases for a given controlled environment.

Table 30. Weight Loss Data for 1982 Monona Potatoes Stored in the MSU Cubicles at 40°F and 95% r.h.

	Storage Duration Days					
	83		142		245	
Treatment	%	WLF	%	WLF	%	WLF
1	5.3	.064	6.3	.044	8.5	.035
2	6.6	.080	6.4	.045	7.8	.031
3	6.4	.078	6.3	.044	10.5	.043
4	5.1	.061	6.5	.046	10.0	.041
5	5.3	.064	6.8	.048	9.7	.039
6	5.4	.065	6.6	.046	8.5	.035
Avg. Bruised	5.8	.070	6.5	.046	9.3	.038

Table 31. Weight Loss Data for 1982 Monona Potatoes Stored in the MSU Cubicles at 45°F and 95% r.h.

	Storage Duration Days					
	83		142		245	
Treatment	%	WLF	%	WLF	%	WLF
1	6.2	.075	7.2	.051	11.8	.048
2	6.7	.081	8.9	.063	14.2	.058
3	5.0	.061	7.6	.054	13.7	.056
4	5.0	.060	7.0	.050	13.0	.053
5	5.4	.065	7.0	.050	11.8	.048
6	5.8	.070	7.8	.055	14.1	.058
Avg. Bruised	5.6	.067	7.7	.054	13.4	.055

Table 32.* Weight Loss Data for 1982 Monona Potatoes Stored in the MSU Cubicles at 50°F and 95% r.h.

	Storage Duration Days			
	83		142	
Treatment	%	WLF	%	WLF
1	5.1	.061	7.4	.052
2	6.3	.076	8.4	.059
3	5.1	.062	6.7	.047
4	4.5	.055	7.1	.050
5	5.3	.064	7.1	.050
6	5.7	.068	8.6	.061
Avg. Bruised	5.4	.065	7.6	.053

*Since no sprout inhibitors were used there was excessive sprouting at the 245 day storage duration and thus no weight loss data was calculated for the 50°F Monona potatoes.

Table 33. Weight Loss Data for 1982 Monona Potatoes Stored in the Chief Chips Storage, Edmore, Michigan at 45°F and 95% r.h. for 190 Days.

Treatment	%	WLF
1	5.0	.026
2	4.8	.025
3	6.2	.033
4	5.3	.028
5	5.3	.078
6	5.9	.031
Avg. Bruised	5.5	.029

Market Quality and Deposition

Market quality and deposition for the 1982 Monona potatoes are shown in Tables 34-37. Tables 34-36 compare market quality, deposition, treatments, and storage duration for the 1982 Monona potatoes stored in the MSU cubicles. Table 37 compares market quality, deposition, treatments, and storage duration for the 1982 Monona potatoes stored in the center of a commercial potato storage (bin #10, Chief Chips).

Table 37 shows that there is a difference in market quality between the nontreated and nonbruised checks (73% to 93%), however, the prestorage chemical treatments appear to be less effective on improvement of market quality than in previous years.

The Micromax showed a 11% improvement in market quality over the bruised nontreated check (75% to 84%). The other three prestorage treatments show very little variation, however, the average prestorage chemical treatments show a gain in market quality over equivalently bruised nontreated potatoes.

As stated previously in this report, there are problems in most any research and repeatings (replications) are essential--during the year and various years. During 1982 MSU cubicle storage we evidenced cubicle temperature failure during suberization and twice during the storage duration temperatures were found during the daily checks to be off 5°F or more. Murphy's Law says that anything that can fail will fail.

Table 34. Market Quality and Deposition for 1982 Monona Potatoes Stored in the MSU Cubicles at 40°F and 95% r.h.

Storage Duration Days	Evaluation Dates in 1982/83	Treatment* 1	2	3	4	5	6
83	12/20	99.2	91.7	92.6	93.1	95.0	94.1
142	2/17	98.7	90.3	89.3	91.1	91.7	93.4
245	5/31	97.1	93.1	87.4	86.5	90.2	90.9
Deposition ppm		-	-	1.90	6.73	10.67	2.95

*See Table 29 for a detailed description of treatments.

Table 35. Market Quality and Deposition for 1982 Monona Potatoes Stored in the MSU Cubicles at 45°F and 95% r.h.

Storage Duration Days	Evaluation Dates in 1982/83	Treatment* 1	2	3	4	5	6
83	12/20	99.8	96.5	99.3	98.0	96.4	94.1
142	2/17	97.9	93.1	89.9	88.3	91.1	93.4
245	5/31	96.5	86.1	82.4	80.1	84.0	90.9
Deposition ppm		-	-	1.90	6.73	10.67	2.95

*See Table 29 for a detailed description of treatments.

Table 36. Market Quality and Deposition for 1982 Monona Potatoes Stored in the MSU Cubicles at 50°F and 95% r.h.

Storage Duration Days	Evaluation Dates in 1982/83	Treatment* 1	2	3	4	5	6
83	12/20	99.1	93.2	96.6	98.6	97.3	96.9
142	2/17	97.8	89.6	87.6	87.2	93.2	92.4
Deposition ppm		-	-	1.90	6.73	10.67	2.95

*See Table 29 for a detailed description of treatments.

Table 37. Market Quality for 1982 Monona Potatoes Stored at 45°F and 95% r.h. for 190 Days in the Center of Bin #10, Chief Chips Commercial Potato Storage, Edmore, Michigan.

Treatment Number*	Market Quality % Good by Weight	Deposition ppm Going into Storage
1	93.0	-
2	73.2	-
3	76.3	1.90
4	84.3	6.73
5	74.7	10.67
6	73.1	2.95

*See Table 29 for detailed description of treatments.

Chip Color

Tables 38-40 show the Agtron chip color data for the 1982 Monona potatoes stored in the MSU cubicles. Table 41 shows the chip color data for the MSU potatoes stored in the center of bin #10, Chief Chips Storage, Edmore, Michigan

The 1982 data on Agtron chip color appears to indicate that Monona potatoes stored at 40, 45, and 50°F will recondition to an acceptable Agtron color better than Atlantic or Denali.

Table 38. Agtron chip color data for 1982 Monona potatoes stored in the MSU cubicles for 83 days and reconditioned at an increasing temperature of 5°F/Week.*

		Reconditioning Time		
	At Evaluation	1 Week	2 Weeks	3 Weeks
40°	50 - 55	55 - 64	60+	60+
45°	50 - 55	55 - 64	60+	65+
50°	50 - 55	60+	60+	65+

*Agtron chip color at harvest was 65+.

Table 39. Agtron Chip Color Data for 1982 Monona Potatoes Stored in the MSU Cubicles for 142 days and reconditioned at an increasing temperature of 5°F/week.

		Reconditioning Time				
	At Evaluation	1 Week	2 Weeks	3 Weeks	4 Weeks	5 Weeks
40°	50 - 55	50 - 55	55 - 64	55 - 64	55 - 64	60+
45°	50 - 55	50 - 55	55 - 64	55 - 64	55 - 64	60+
50°	50 - 55	50 - 55	55 - 64	55 - 64	55 - 64	60+

*Agtron chip color at harvest was 65+.

Table 40. Agtron Chip Color Data for 1982 Monona Potatoes Stored in the MSU Cubicles for 245 days and reconditioned at increasing temperature of 5°F/week.*

40°	50 - 55	50 - 55	55 - 64	55 - 64	55 - 64
45°	50 - 55	50 - 55	55 - 64	55 - 64	55 - 64
50°**	50 - 55	Poor potato quality			

*Agtron chip color at harvest was 65+.
**Poor potato quality due to excessive sprouting. For this reason no further chip data was obtained.

Table 41. Chip Color Data for 1982 Monona Potatoes Stored in the Center of the Chief Chips Commercial Potato Storage (Bin #10) for 190 days and reconditioned at increasing temperatures of 5°F/week.

Storage Temperature	At Harvest	At 190 Days Storage	1 Week Recondition
45°F	65+	55 - 64	60+

CONCLUSIONS

1. There is an interaction among these storage related factors; bruised and nonbruised potatoes, storage duration, market quality, and TBZ deposition.

2. The various chemical formulations used on these Monona potatoes showed no evidence of affecting weight loss on equivalently treated and stored potatoes.

3. The out-of-storage market quality of bruised potatoes was lower than the market quality of nonbruised potatoes under equivalent storage conditions.

4. Deposition is influenced by application equipment, however, above a certain level market quality is not improved.

CONTROLLED DROPLET APPLICATION OF MERTECT 340F IN A COMMERCIAL POTATO STORAGE
(Lennard & Sons, Samaria, MI)

INTRODUCTION

During October 7 to 11, 1982 fungicide/bacteriacides (Mertect 340F and chlorine) were applied by controlled droplet application (CDA equipment) to Denali potatoes going into a commercial potato storage at Wayne Lennard and Sons, Samaria, Michigan. One entire storage bin (approximately 12,000 cwt) was treated.

PROCEDURE

Equipment

A Mantis II CDA nozzle was mounted on the Lennard bin piler over a cleaning bed just after the sorting table. The pump used for the CDA system was a high-speed centrifugal pump. Both the pump and the nozzle were supplied by the Micron Corp., Houston, Texas. The equipment was calibrated for a 45 ton/hr bulk trunk unloading rate and a chemical solution was applied with the CDA equipment at a rate of 3 oz per ton.

Chemical Solution

A 3 oz/ton solution rate was used on the project. The 3 oz solution contained 0.42 oz of Mertect 340F, 0.64 oz chlorine (5.25% active ingredient), and 1.94 oz water.

Potato Samples

Forty-three potato samples (approximately 25 lbs each) were obtained from two field truck loads during the first day of filling the storage. Seven samples were sent to Merck, Inc. for a TBZ deposition analysis. Twenty-four samples (nine nontreated check samples and 15 treated samples) were bagged, tagged, and placed into the middle of the potato pile at the west, east, and center locations of the storage. Twelve samples, 3 checks and 9 treated, were tagged, weighed, and placed into three MSU storage cubicles. The MSU cubicle stored potatoes were suberized at 60°F and 95% r.h. for 10 days and then the temperature was reduced 5°F/wk until the desired pulp temperatures of 40°, 45°, and 50°F and 95% r.h. were reached.

EVALUATION

Residue

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

Weight Loss

All bagged potato samples were weighed after treatment; after two weeks suberization; at the market quality evaluation date (239 days in storage). Weight loss during storage is represented by a percent using the following equation (see page 70).

Market Quality

A market quality evaluation was made at 239 days in storage. Market quality evaluation involved removal of a respective bag from storage, emptying the bag, and examining each individual tuber. Examined tubers were classified (see page 70).

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

Marketable quality is represented by a percent and is determined by two methods (see page 70).

RESULTS AND DISCUSSION

Weight Loss

Weight loss data for the Lennard Denali potatoes stored at Michigan State University is shown in Tables 42-44. The potatoes were stored at 40°, 45°, and 50°F and 95% r.h. Weight loss data was not taken after 132 days in storage due to excessive sprouting. (Potatoes stored in MSU cubicles cannot be gased for sprout inhibition). Note in these three tables that 45°F shows slightly less weight loss than the 40° and 50° storage temperature.

Table 42. Weight Loss Data for 1982 MSU Stored Lennard Denali Potatoes at 40°F and 95% r.h.

	Storage Duration Days			
	73		132	
Treatment	Wt. Loss %	WLF	Wt. Loss %	WLF
Non-treated	7.0	.096	8.1	.061
Treated	7.5	.099	8.3	.063

Table 43. Weight Loss Data for 1982 MSU Stored Lennard Denali Potatoes at 45°F and 95% r.h.

	Storage Duration Days			
	73		132	
Treatment	Wt. Loss %	WLF	Wt. Loss %	WLF
Non-treated	6.1	.083	7.1	.054
Treated	7.6	.099	8.0	.060

Table 44. Weight Loss Data for 1982 MSU Stored Lennard Denali Potatoes at 50°F and 95% r.h.

	Storage Duration Days			
	73		132	
Treatment	Wt. Loss %	WLF	Wt. Loss %	WLF
Non-treated	6.9	.095	9.4	.071
Treated	7.5	.098	8.9	.067

Market Quality

Tables 45 and 46 present the market quality data for the commercial storage and the MSU stored Lennard Denali potatoes, respectively.

Table 45. Market Quality Data for the 1982 Commercially Stored Lennard Grown Denali Potatoes. Potatoes were Stored for 245 Days at 50°F.

Treatment	Market Quality
East check*	86.9
treated**	89.0
Center check	77.9
treated	89.9
West check	84.3
treated	83.4
Check average	83.0
Treated average	87.4

*Check potato samples were collected at the end of the bin piler (no chemical treatment).

**Treated potatoes were collected the same as the check potatoes, however, these potatoes were treated at a chemical solution calibration rate of 3 oz/ton.

Table 46. Market Quality Data for the 1982 Lennard Grown Denali Potatoes Stored in the MSU Cubicles for 245 Days.

Treatment	Market Quality
40° check	78.9
40° treated	92.6
45° check	89.0
45° treated	86.1
50° check	67.5
50° treated	84.8
Check average	74.5
Treated average	87.8

Residue

Table 47 shows the TBZ residue for the 1982 Denali potatoes commercially grown and treated at Wayne Lennard and Sons.

Table 47. TBZ Residue Analysis Results for the 1982 Lennard Farms Commercially Treated Denali Potatoes.

Treated Samples*	Residue**
1	3.1 - 3.32
2	5.08 - 5.15
3	3.62 - 3.87
4	6.94 - 7.86
5	6.98 - 7.64
6	9.07 - 9.62
Avg.	5.79 - 6.24

*Treated samples were collected from the end of the bin piler during the unloading of two field trucks. The chemical solution application rate was calibrated for a 3 oz/ton application rate and a 45 ton/hour unloading rate.

**Parts per million.

CORN HYBRIDS, PLANT POPULATIONS, AND IRRIGATION

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

Performance data for 59 commercial corn hybrids evaluated in 1983 with and without irrigation are presented in Table 1 along with two and three year averages for those tested in 1982 and 1981.

One inch of water was applied through a sprinkler system on each of 7 dates (July 5, 12, 18, 27, August 9, 19, 29) for a total of 7 inches of irrigation. Rainfall was: April = 3.47", May = 4.46", June = 1.9", July = 2.44", August = 2.21", September = 5.34", October = 3.26".

Irrigated yields averaged 85.0 bushels more than nonirrigated - 151.4 vs. 66.4, an increase of 128%. Hybrids ranged from 95.7 to 194.7 with irrigation and 36.5 to 90.5 without irrigation. Hybrids significantly better than average yield (arranged in order of increasing grain moisture content at harvest) are listed below. Fifteen of the 21 hybrids were in the highest yielding group for both irrigated and nonirrigated plots.

Irrigated	Not Irrigated
Pioneer 3901	Pioneer 3901
Funk 29097	Funk 29097
Great Lakes 82351	Great Lakes 82351
DeKalb-Pfizer EX-2120	Pioneer 3744
Pioneer 3744	DeKalb-Pfizer DK-484
Super Crost 1940	Pioneer 3747
DeKalb-Pfizer DK-484	King K4422
King K4422	Golden Harvest H-2480
Dairyland DX1003	Dairyland DX1003
Funk G-4342	Stauffer Seeds S5340
DeKalb-Pfizer T1000	Great Lakes GL-522
Stauffer Seeds S5340	Dairyland DX1006
Great Lakes GL-522	P-A-G SX239
Dairyland DX1006	Stauffer Seeds S5650
P-A-G SX239	Andersons PSX105
Stauffer Seeds S5650	MFI 1812
Andersons PSX105	Stauffer Seeds S5266
MFI 1812	
Stauffer Seeds S5260	

The correlation of irrigated with nonirrigated yields was highly significant, .722, indicating that hybrids tended to respond alike in both situations. During the 16-year period, 1968-1983, the correlations have ranged between .7 and .9 except for 1976 when it was .490. All correlations have been highly significant.

Average, highest and lowest yields for corn hybrids irrigated and not irrigated for the 16-year period, 1968-1983, are given in Table 2. The average yielding hybrids have yielded 47 more bushels when irrigated. The highest yielding hybrids have responded with 60 bushels added yield while the lowest yielding hybrids have given only 31 bushels added yield when irrigated. These results demonstrate the importance of choosing high yielding hybrids to maximize returns from irrigation with little, if any, additional cost.

Stalk lodging was equal for both situations -- 9.1% for irrigation and 8.9% without irrigation. In most (but not all) of the previous years, there was less lodging on the irrigated plots. Generally, stressed weaker plants on nonirrigated plots have been more susceptible to lodging.

Plant Population X Hybrids

Five adapted hybrids at four plant populations irrigated and not irrigated have been grown in each of 16 years, 1968-1983, Table 3. Over the 16-year period, a harvest plant population of 23,310 has given the highest average yield (166 bushels per acre) when irrigated while 19,340 has given the highest yield (108 bushels) without irrigation. The 19,340 population irrigated has given the highest yield in 12 out of 16 years (1973, 1979, 1981 and 1983 being the exceptions). The irrigated yields in 1983 were 154, 170, 179 and 182 for harvest populations of 15,270, 19,340, 23,310 and 27,470, respectively. The 16-year average increase due to irrigation is 66 bushels per acre at the 23,310 population. Nonirrigated yields were 69, 74, 66 and 52 for the same four populations in 1983.

Stalk lodging has increased with plant population. In 1983, there was 3-4 times more lodging at 27,470 than there was at 15,270. Moisture content of grain at harvest has averaged 1-2% higher for the two higher populations.

TABLE 1 NORTH CENTRAL MICHIGAN **ZONE 3**

Montcalm County Trial - Irrigated vs. Not Irrigated

ONE, TWO, THREE YEAR AVERAGES - 1983, 1982, 1981

HYBRID	% MOISTURE			BUSHELS PER ACRE						% STALK LODGING					
	1983	2	3	1983		2 Years		3 Years		1983		2 Years		3 Years	
(BRAND-VARIETY)		YR	YR	Irrig	Not	Irrig	Not	Irrig	Not	Irrig	Not	Irr	Not	Irr	Not
FUNK 0008X	22.6	--	--	97.5	38.9	--	--	--	--	23.8	10.9	--	--	--	--
PAYCO SX431	23.4	23	--	102.6	45.3	108	69	--	--	9.5	9.3	8	10	--	--
GREAT LAKES GL-381	23.5	--	--	109.8	43.0	--	--	--	--	11.7	13.7	--	--	--	--
MFI 1492	23.8	--	--	121.3	46.4	--	--	--	--	9.4	16.3	--	--	--	--
DEKALB-PFIZER T891	23.9	--	--	95.7	36.5	--	--	--	--	10.1	19.4	--	--	--	--
PAYCO SX599	24.0	23	--	112.3	47.3	114	69	--	--	5.1	9.9	3	10	--	--
P-A-G SX155	24.3	--	--	110.5	39.5	--	--	--	--	4.0	18.8	--	--	--	--
DAIRYLAND DX1094	24.3	23	--	124.6	59.3	134	82	--	--	6.1	8.9	4	8	--	--
DIARYLAND DX1091	24.3	--	--	117.5	55.8	--	--	--	--	4.8	6.1	--	--	--	--
MCKENZIE 858	24.4	--	--	120.9	41.3	--	--	--	--	12.7	10.8	--	--	--	--
ANDERSONS PSX93	24.4	--	--	140.9	46.7	--	--	--	--	5.9	6.0	--	--	--	--
STANTON SX1090	24.4	22	--	129.3	54.5	133	82	--	--	2.2	5.0	1	6	--	--
RUPP XR1490	24.7	--	--	121.4	64.1	--	--	--	--	8.1	7 4	--	--	--	--
SUPER CROST 1542	24.9	--	--	101.2	47.7	--	--	--	--	11.4	7.8	--	--	--	--
GREAT LAKES GL-422	25.0	23	23	146.0	66.7	154	95	144	95	5.8	8.2	6	9	5	8
PIONEER X7064	25.0	--	--	142.5	61.9	--	--	--	--	7.0	5.2	--	--	--	--
*+PIONEER 3901	25.1	24	23	170.6	75.7	167	100	154	99	6.9	13.7	5	10	4	7
GARNO S-90	25.4	23	23	143.9	61.9	154	94	143	94	7.9	7.9	6	10	5	8
STANTON SX1095	25.4	24	--	158.0	63.3	162	95	--	--	5.6	9.4	4	12	--	--
*+FUNK 29097	25.5	--	--	176.0	75.5	--	--	--	--	11.0	10.4	--	--	--	--
DAIRYLAND DX1096	25.5	24	23	143.6	63.5	150	90	141	94	3.0	8.5	5	9	7	11
PAYCO SX620	25.5	--	--	152.0	60.5	--	--	--	--	10.1	12.5	--	--	--	--
DEKALB-PFIZER XL-8	25.7	24	--	130.4	50.5	132	78	--	--	8.1	6.7	6	6	--	--
GREAT LAKES 81237	26.0	--	--	160.8	65.5	--	--	--	--	4.5	5.8	--	--	--	--
*+GREAT LAKES 82351	26.2	--	--	170.2	76.8	--	--	--	--	4.4	5.7	--	--	--	--
* DEKALB-PFIZER EX-2120	26.6	25	--	168.8	62.4	157	93	--	--	7.5	21.2	4	15	--	--
DAIRYLAND DX1093	26.6	--	--	132.7	55.2	--	--	--	--	10.9	8.0	--	--	--	--
STANTON SX10100	26.9	26	--	150.6	65.1	148	93	--	--	17.2	9.0	13	11	--	--
JACQUES JX97	27.1	24	--	149.1	63.2	150	87	--	--	12.5	4.5	8	9	--	--
*+PIONEER 3744	27.1	25	25	184.7	90.5	172	108	158	108	5.8	1.5	4	5	3	5
* SUPER CROST 1940	27.5	--	--	167.4	70.0	--	--	--	--	7.8	5.6	--	--	--	--
MCKENZIE 411	27.5	--	--	164.9	64.4	--	--	--	--	6.0	4.4	--	--	--	--
DEKALB-PFIZER T950	27.7	26	25	164.6	66.3	148	84	130	79	7.5	8.7	6	10	6	8
MFI 1776	27.7	--	--	157.6	70.9	--	--	--	--	11.4	8.7	--	--	--	--
*+DEKALB-PFIZER DK-484	27.8	--	--	194.7	83.2	--	--	--	--	11.4	8.4	--	--	--	--
WOLVERINE W166	27.9	--	--	141.9	62.9	--	--	--	--	22.6	11.3	--	--	--	--
+PIONEER 3747	28.1	--	--	157.5	75.9	--	--	--	--	8.8	5.9	--	--	--	--
*+KING K4422	28.1	--	--	182.8	82.6	--	--	--	--	6.4	3.7	--	--	--	--
KING K4423	28.1	--	--	164.6	69.2	--	--	--	--	6.2	6.7	--	--	--	--
+GOLDEN HARVEST H-2480	28.2	--	--	164.0	74.3	--	--	--	--	9.8	13.2	--	--	--	--

TABLE 1 NORTH CENTRAL MICHIGAN **ZONE 3**

Montcalm County Trial - Irrigated vs. Not Irrigated

ONE, TWO, THREE YEAR AVERAGES - 1983, 1982, 1981

HYBRID (BRAND-VARIETY)	% MOISTURE 1983	2 YR	3 YR	BUSHELS PER ACRE 1983 Irrig	1983 Not	2 Years Irrig	2 Years Not	3 Years Irrig	3 Years Not	% STALK LODGING 1983 Irrig	1983 Not	2 Years Irr	2 Years Not	3 Years Irr	3 Years Not
SUPER CROST 2396	28.4	26	26	166.6	69.0	163	94	152	97	16.7	12.2	11	12	9	11
FUNK 2008X	28.5	--	--	164.0	70.3	--	--	--	--	4.9	10.2	--	--	--	--
GREAT LAKES GL-466	28.5	26	25	154.5	73.0	156	96	144	92	14.3	10.5	9	8	7	9
*+DIARYLAND DX1003	28.5	25	25	185.2	81.1	169	98	154	98	10.2	6.6	6	8	6	7
* FUNK G-4342	28.6	--	--	168.8	68.5	--	--	--	--	2.1	4.5	--	--	--	--
*+STAUFFER SEEDS S5340	28.8	--	--	182.7	79.7	--	--	--	--	2.2	11.9	--	--	--	--
P-A-G SX193	28.8	--	--	129.4	63.8	--	--	--	--	18.4	11.4	--	--	--	--
* DEKALB-PFIZER T1000	28.8	27	27	169.0	68.7	168	97	153	95	11.3	4.4	8	6	7	7
GOLDEN HARVEST H-2380	28.8	25	--	163.4	72.9	161	99	--	--	10.4	8.3	8	9	--	--
*+GREAT LAKES GL-522	28.9	27	27	175.4	83.9	176	109	160	106	9.4	3.8	5	6	3	5
PAYCO SX872	29.8	--	--	150.7	64.4	--	--	--	--	9.0	8.5	--	--	--	--
*+DAIRYLAND DX1006	30.0	27	--	182.9	79.1	169	94	--	--	10.7	11.5	9	14	--	--
*+STAUFFER SEEDS S5650	30.2	28	--	187.5	87.6	171	108	--	--	8.3	2.2	4	4	--	--
*+P-A-G SX239	30.2	--	--	179.1	79.1	--	--	--	--	7.2	4.4	--	--	--	--
JACQUES JX151	30.3	27	--	164.7	71.6	157	92	--	--	14.2	11.2	10	12	--	--
*+ANDERSONS PSX105	31.0	--	--	170.2	82.9	--	--	--	--	13.0	12.9	--	--	--	--
P-A-G EXP. 111571	31.3	--	--	165.2	72.5	--	--	--	--	2.9	7.0	--	--	--	--
*+MFI 1812	31.6	--	--	172.6	75.3	--	--	--	--	6.7	11.5	--	--	--	--
*+STAUFFER SEEDS S5260	32.2	29	29	184.1	87.5	184	113	158	104	10.8	3.7	6	4	5	4
AVERAGE	27.0	25	25	151.4	66.4	154	93	149	97	9.1	8.9	6	9	6	7
RANGE	22.6 TO 32.2	22 TO 29	23 TO 29	95.7 TO 194.7	38.9 TO 90.5	108 TO 184	69 TO 113	130 TO 160	79 TO 108	2.1 TO 23.8	1.5 TO 21.2	1 TO 13	4 TO 15	3 TO 9	4 TO 11
LEAST SIGNIFICANT DIFFERENCE	1.9	1.1	0.7	14.9	7.5	9	6	7	5	--	--	--	--	--	--

* SIGNIFICANTLY BETTER THAN AVERAGE YIELD, IRRIGATED, IN 1983

\+ SIGNIFICANTLY BETTER THAN AVERAGE YIELD, NOT IRRIGATED, IN 1983

	1983	*1982*	*1981*
Planted	*May 6*	*May 6*	*May 2*
Harvested	*October 24*	*November 3*	*November 6*
Soil Type	*Montcalm - McBride sandy loam*	*Montcalm - McBride sandy loam*	*Montcalm - McBride sandy loam*
Previous crop	*Potatoes*	*Alfalfa*	*Alfalfa*
Population	*21,400*	*21,000*	*20,850*
Rows	*30"*	*30"*	*30"*
Fertilizer	*330-125-125*	*342-139-139*	*323-143-143*
Irrigation	*7 inches*	*4 inches*	*4 inches*
Soil test - pH	*5.8*	*5.6*	*5.9*
P	*417 (very high)*	*562 (very high)*	*512 (very high)*
K	*202 (medium)*	*251 (high)*	*284 (high)*

Farm Cooperator: Theron Comden, Montcalm Research Farm, Lakeview

County Extension Director: William Carpenter, Stanton (1983) James Crosby, Stanton (1982,1981)

TABLE 2. Average, highest and lowest yields for corn hybrids irrigated and not irrigated for 16 years, 1968 - 1983.

Year	No. of Hybrids Tested	AVERAGE		HIGHEST		LOWEST	
		Irrigated	Not Irrigated	Irrigated	Not Irrigated	Irrigated	Not Irrigated
1983	59	151	66	195	91	96	37
1982	82	146	113	183	139	109	83
1981	90	115	87	141	111	85	62
1980	71	126	114	167	156	74	65
1979	83	109	67	142	92	67	42
1978	73	144	88	186	112	92	61
1977	74	125	73	158	88	89	56
1976	80	156	72	183	93	120	49
1975	75	154	125	207	157	106	80
1974	76	112	103	134	122	65	58
1973	72	114	101	138	120	78	73
1972	72	157	137	206	179	99	91
1971	56	163	28	211	42	91	11
1970	64	144	103	194	128	95	70
1969	63	146	86	185	109	97	56
1968	56	136	96	182	123	92	65
AVERAGE		138	91	176	116	91	60

TABLE 3. Average yield at four plant populations irrigated and not irrigated for 16 years, 1968 - 1983.

Year	15,270		19,340		23,310		27,470	
	Irrigated	Not Irrigated	Irrigated	Not Irrigated	Irrigated	Not Irrigated	Irrigated	Not Irrigated
1983	154	69	170	74	179	66	182	52
1982	150	120	168	131	177	124	176	117
1981	122	93	132	102	130	94	119	86
1980	133	123	146	135	150	131	141	124
1979	123	77	140	87	138	83	131	78
1978	146	92	164	110	175	100	165	94
1977	141	74	152	81	160	70	150	69
1976	153	72	174	84	181	81	161	68
1975	158	136	183	164	196	151	172	146
1974	118	100	130	111	135	98	120	94
1973	108	97	134	116	128	106	108	102
1972	152	132	187	159	191	149	161	144
1971	173	37	189	35	191	20	181	11
1970	122	91	144	112	158	93	151	85
1969	126	91	158	109	173	96	148	86
1968	144	114	169	130	193	107	178	89
AVERAGE	140	96	159	108	166	100	152	94

1983 DRY BEAN VARIETY AND STRAIN EVALUATION TRIALS

J. Taylor, J. Kelly, A. Ghaderi, and M.W. Adams

Test #3220. Large Seeded Yield Trial, Montcalm - 1983.

This trial was conducted at Montcalm Research Farm to evaluate yield potential of new and standard kidney and cranberry bean varieties. The trial was highly variable with a high C.V.=21.9%. Overall the bush cranberry lines were the highest yielding entries, with entry nos. 1, 6, 4 from MSU and nos. 11 and 10 from University of Idaho showing the most potential. All these breeding lines carry BCMV resistance and the MSU lines 1, 6, 4 had a desirable larger seed size of 52-56 g/100 seeds. The UI lines tended to be smaller, with seed size equivalent to Cran-028 seed size.

The yield potential of new LRK lines from University of California and the USDA program in Washington appeared to have no yield advantage over the standard LRK varieties.

Test #3221. Preliminary DRK Bean Yield Trial, Montcalm - 1983.

Trial 3221, consisted of 49 entries of which only 25 entries were harvested including the 3 check varieties - Montcalm, Charlevoix and Isabella. The test was highly variable as indicated by the high CV value of 25.2. None of the breeding lines outyielding the standard cultivar Montcalm, but with the large LSD value of 528 pounds/acre, 17 of the lines were not significantly different from the Montcalm check. A number of lines had a significantly lower seed size than the 52 g/100 seed size of the 3 checks. Additional yield testing of 8 lines with satisfactory seed size will be required because of high variability within this particular test.

MSU BEAN PROGRAM U1111 ADVANCED LINE TESTING MONTCALM 3220 LARGE SEEDED NURSERY, MONTCALM

PLOT	ENTRY	ACC	ORIG NO	SOURCE	PEDIGREE
101	05	C70001	CRAN028		CRAN028
102	08	C81009	MVR CRAN		MVR CRAN
103	12	I82040	8922	UI	8922 UI
104	03	C81003	424	ANDY	424 • ANDY
105	14	K74002	MONT		MONT
106	07	C81008	T HORT		T HORT
107	01	C81001	422	ANDY	422 ANDY
108	10	I82038	8920	UI	8920 UI
109	04	C81004	425	ANDY	425 ANDY
110	09	I82037	07009	UI	07009 UI
111	13	K60001	CHAR		CHAR
112	06	C66001	MICRAN		
113	02	C81002	423	ANDY	423 ANDY
114	11	I82039	8921	UI	8921 UI
115	20	K77002	70688		RKLD/MEC,ISA
116	24	I82033	RY	CN	RY CN
117	28	I82027	2204	UCD	2204 UCD
118	17	K74001	MEC		MEC
119	15	I81099	SB	NL	SB NL
120	22	I81058	RKLD	CN	RKLD CN
121	18	I81103	9482	ANDY	9482 ANDY
122	26	I82029	NW126	USDA-WA	NW126 USDA-WA
123	19	K77001	70684		RKLD/MEC
124	23	I81061	SAC	SVN	SAC SVN
125	16	K66001	MAN		MAN
126	27	I82028	2602	UCD	2602 UCD
127	21	K77003	70700		RKLD/MEC
128	25	I82030	NW341	USDA-WA	NW341 USDA-WA

EXPERIMENT 3220, LARGE SEEDED YIELD TRIAL, MONTCALM - 1983

ACC. NO.	SEED* CLASS	ENT. NO.	YIELD LB/A	YIELD % CHK*	100 SEED WT.G.	DAYS TO FL.
C81001	C	1	2371	112	53.5	40
T. HORT*	C	7	2112	100	47.1	40
MICRAN	C	6	2066	98	52.5	48
C81003	C	3	2014	95	52.8	40
I82039	C	11	1999	95	43.3	40
I82038	C	10	1985	94	43.7	40
C81004	C	4	1985	94	56.5	40
I82040	C	12	1970	93	43.8	40
MANITOU	LRK	16	1879	107	53.2	47
C81009	C	8	1851	88	51.4	40
SACRAMTO	LRK	23	1840	104	51.7	40
MONTCALM*	DRK	14	1825	100	51.7	40
K77003	LRK	21	1822	103	50.2	42
I82028	LRK	27	1813	103	43.5	46
CRAN-028	C	5	1780	84	44.9	46
RED KLOUD*	LRK	22	1761	100	53.4	42
C81002	C	2	1719	81	58.7	40
K77001	LRK	19	1709	97	54.4	40
CHARL.	DRK	13	1674	92	51.4	42
I82037	C	9	1561	74	53.9	40
I82030	LRK	25	1463	83	49.6	51
MECOSTA	LRK	17	1433	81	55.8	46
S. BROWN	SB	15	1401	--	40.9	42
ISABELLA	LRK	20	1395	79	52.0	42
I82027	LRK	28	1375	78	49.6	46
I82029	LRK	26	1347	76	47.5	47
RUDDY	LRK	24	1278	73	47.3	42
I81103	LRK	18	948	54	42.8	47
MEAN (28)			1728	--	50.1	43
LSD (.05)			537	--	5.5	--
C.V.			21.9	--	7.8	--

* % CHK - yield as percent of check is shown as percent of the check variety in each commercial class (C - Cranberry; LRK - Light Red Kidney; DRK - Dark Red Kidney; SB - Swedish Brown).

PROCEDURE: Planted June 2, 1983, in 4 row plots -- 18 foot long, 20 inch row width, 4 seeds/foot of row in a randomized complete block with 4 replications. A 14 foot section of the center two rows was pulled at maturity.

LEGEND: FL. = flower

MSU BEAN PROGRAM L1234 ADVANCED LINE TESTING MONTCALM 3221 KIDNEY, ANTHRACNOSE PROGRAM, MONTCALM,

PLOT	ENTRY	ACC	ORIG NO SOURCE	PEDIGREE
101	28	K83228	79K016-1-0-0-1	C49242/2*MONT
102	18	K83218	80K001-4-0-0-1	C49242/4*MONT
103	25	K83225	79K001-4-0-0-4	C49242/3*MONT
104	08	K83208	80K001-2-0-0-2	C49242/4*MONT
105	49	K77003	70700	BKLD/MEC
106	29	K83229	79K016-1-0-0-2	C49242/2*MONT
107	12	K83212	80K001-3-0-0-1	C49242/4*MONT
108	22	K83222	79K001-4-0-0-1	C49242/3*MONT
109	07	K83207	80K001-2-0-0-1	C49242/4*MONT
110	02	K83202	79K001-1-0-0-2	C49242/3*MONT
111	33	K83233	80K001-5-0-0-2	C49242/4*MONT
112	24	K83224	79K001-4-0-0-3	C49242/3*MONT
113	05	K83205	80K001-1-0-0-1	C49242/4*MONT
114	26	K83226	79K001-4-0-0-5	C49242/3*MONT
115	47	K77001	70684	BKLD/MEC
116	19	K83219	80K001-4-0-0-2	C49242/4*MONT
117	41	K83241	80K001-6-0-0-2	C49242/4*MONT
118	30	K83230		
119	48	K77002	70688	BKLD/MEC.ISA
120	32	K83232	80K001-5-0-0-1	C49242/4*MONT
121	21	K83221	80K001-4-0-0-4	C49242/4*MONT
122	37	K83237	79K001-5-0-0-1	C49242/3*MONT
123	09	K83209	80K001-2-0-0-4	C49242/4*MONT
124	27	K83227	79K001-4-0-0-6	C49242/3*MONT
125	16	K83216	80K001-3-0-0-5	C49242/4*MONT
126	06	K83206	80K001-1-0-0-2	C49242/4*MONT
127	36	K83236	80K001-5-0-0-6	C49242/4*MONT
128	14	K83214	80K001-3-0-0-3	C49242/4*MONT
129	15	K83215	80K001-3-0-0-4	C49242/4*MONT
130	34	K83234	80K001-5-0-0-3	C49242/4*MONT
131	44	K83244	79K001-6-0-0-1	C49242/3*MONT
132	42	K83242	80K001-6-0-0-3	C49242/4*MONT
133	40	K83240	80K001-6-0-0-1	C49242/4*MONT
134	11	K83211	80K001-2-0-0-6	C49242/4*MONT
135	13	K83213	80K001-3-0-0-2	C49242/4*MONT
136	01	K83201	79K001-1-0-0-1	C49242/3*MONT
137	31	K83231	79K016-1-0-0-4	C49242/2*MONT
138	39	K83239	79K001-5-0-0-4	C49242/3*MONT
139	46	K60001	CHAR	CHAR
140	45	K74002	MONT	MONT
141	43	K83243	79K016-3-0-0-4	C49242/2*MONT
142	35	K83235	80K001-5-0-0-5	C49242/4*MONT
143	20	K83220	80K001-4-0-0-3	C49242/4*MONT
144	38	K83238	79K001-5-0-0-3	C49242/3*MONT
145	23	K83223	79K001-4-0-0-2	C49242/3*MONT
146	03	K83203	79K001-1-0-0-3	C49242/3*MONT
147	04	K83204	79K001-3-0-0-3	C49242/3*MONT
148	17	K83217	80K001-3-0-0-6	C49242/4*MONT
149	10	K83210	80K001-2-0-0-5	C49242/4*MONT

EXPERIMENT 3221, PRELIMINARY DARK RED KIDNEY BEAN YIELD TRIAL, MONTCALM - 1983

ACC. NO.	ENT. NO.	YIELD LB/A	YIELD % CHK*	100 SEED WT.G	DAYS TO FL.
MONTCALM*	45	1900	100	51.8	47
K83243	43	1825	96	52.6	46
K83207	07	1796	94	51.5	46
K83233	33	1790	94	53.9	47
N83231	31	1786	94	47.9	47
K83227	27	1706	90	50.4	46
K83222	22	1683	89	53.6	46
K83210	10	1680	88	50.0	49
K83230	30	1614	85	45.1	46
K83204	04	1598	84	47.9	49
K83215	15	1572	83	51.8	47
K83236	36	1509	79	51.3	45
K83244	44	1504	79	49.6	46
CHARL.	46	1502	79	51.6	47
K83232	32	1461	77	46.1	45
ISABELLA	48	1381	73	51.3	43
K83237	37	1379	73	45.5	47
K83223	23	1372	72	50.3	50
K83202	02	1293	68	48.5	47
K83239	39	1238	65	45.7	47
K83214	14	1203	63	50.0	49
K83213	13	1197	63	52.0	48
K83241	41	1150	61	48.9	45
K83201	01	1140	60	51.0	46
K83216	16	1128	59	44.8	46
Mean (25)		1502	80	49.8	48
LSD (.05)		528	--	3.8	--
C.V.		25.2	--	5.3	--

PROCEDURE: Planted June 2, 1983 in 4 row plots -- 18 feet long, 20 inch row width, 4 seed/foot of row, in a square lattice with 4 replications. A 14 foot section of the 2 center rows was pulled at maturity.

LEGEND: FL. = flower

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