Funding MPIC

POTATO (*Solanum tuberosum* L.'Pike' and 'FL1879')
Fusarium dry rot*; Fusarium sambucinum*

W. W. Kirk, R. L Schafer and D. Berry
Department of Plant Pathology
Michigan State University
East Lansing, MI 48824

Timing of application of seed treatments, for control of fusarium dry rot in potatoes, 2002.

Potato seed cvs. Pike and FL1879 was prepared for planting by cutting and inoculating with *Fusarium sambucinum* (dry rot) and treating with fungicidal seed treatments 2, 5 and 10days before planting (DBP). A treatment with no inoculation was included at each of the cutting dates. Potatoes free from dry rot were selected for the trials. Cut seed was inoculated with an aggressive isolate of *F. sambucinum* which was grown on potato-dextrose agar for 14 days. Conidia were harvested from the plates and concentration, determined by hemacytometer was adjusted to 3.4 x 10^3 conidia/fl.oz.. The seed pieces (160/treatment) were sprayed with 4 fl.oz. of the pathogen suspension, for a final dosage of about 0.03 fl.oz applied per tuber. Dust formulations of seed treatments were measured and added to cut seed pieces in a Gustafson revolving drum seed treater and mixed for two minutes to ensure even spread of the fungicide. In a second trial, potato seed cv. Pike was prepared for planting by cutting and inoculating with *Fusarium sambucinum* (dry rot) and treating with fungicidal seed treatments 2DBP. Fungicides applied as pre-planting potato seed liquid treatments were applied in water suspension at a rate of 0.02pt/cwt onto the exposed seed tuber surfaces, with the entire seed surface being coated in the seed treater. Foliar applications were applied with an ATV rear-mounted R&D spray boom delivering 25 gal/A (80 p.s.i.) and using three XR11003VS nozzles per row. Seed was planted at the Michigan State University Montcalm Potato Research Farm, Edmore, MI on 15 May into single-row by 30-ft plots (ca. 9-in. between plants to give a target population of 40 plants at 34-in. row spacing) replicated four times in a randomized complete block design. Fertilizer was drilled into plots before planting, formulated according to results of soil tests. Additional nitrogen (final N 28 lb/A) was applied to the growing crop with irrigation 45 DAP (days after planting). Bravo WS 6SC was applied at 1.5 pt/A on a seven-day interval (eight applications), starting after the canopy was about 50% closed. A permanent irrigation system was established prior to the commencement of fungicide sprays and the fields were maintained at soil moisture capacity throughout the season by frequent (minimum 5 day) irrigations. Weeds were controlled by hilling and with Dual 8E at 2 pt/A 10 DAP, Basagran at 2 pt/A 20 and 40 DAP and Poast at 1.5 pt/A 58 DAP. Insects were controlled with Admire 2F at 1.25 pt/A at planting, Sevin 80S at 1.25 lb/A 31 and 55 DAP, Thiodan 3 EC at 2.33 pt/A 65 and 87 DAP and Pounce 3.2EC at 8 fl. oz/A 48 DAP. For both trials, samples from each treatment (n = 25) were incubated at 50°F (95% RH) in controlled environment chambers for 14 days and the total number of healthy and dry rot affected sprouts was calculated in addition to the development of dry rot on the seed piece measured as percent decay. Three way analysis of variance was run for all combinations of treatments common to the two varieties, i.e. variety, presence of seed treatment, timing of treatment and presence of inoculum. Treatments were compared using two way ANOVA. Emergence was rated as the cumulative number of plants breaking the soil surface or fully emerged after planting. The rate of emergence was estimated as the area under the plant emergence curve (max=100) from the day of planting until 22 days after planting. The rate of canopy development was measured as the RAUCDC, relative area under the canopy development curve, calculated from day of planting to a key reference point taken as 58 DAP (about 100% canopy closure), (max = 100). Vines were killed with Reglone 2EC (1 pt/A on 5 Sep). Plots (40-ft row) were harvested on 9 Oct and individual treatments were weighed and graded.

A three-way ANOVA showed that the effect of timing of cutting, presence of seed treatment and variety all significantly affected sprout development, percent incidence of diseased sprouts and seed-piece decay as well as stand and canopy development, however there was no effect on final marketable yield. The timing of seed cutting and application of the seed treatment Maxim MZ significantly affected the total number of developing sprouts in both varieties (Table 1). In cv. FL1879 preparing seed 5 days before planting (DBP) resulted in significantly fewer sprouts in the absence of a Maxim MZ seed treatment but was not significantly different from the corresponding non-inoculated control. Cutting and treating 2 DBP had overall less effect on sprout development in FL1879. In Pike, only the non-inoculated control prepared 2 DBP planting had significantly fewer sprouts than any of the other treatments between which was no significant difference. The effect of timing of cutting, presence of seed treatment and variety significantly affected the percentage of sprouts with symptoms of dry rot caused by *F. Sambucinum* (dark lesions with loss of sprout viability). Non-inoculated seed had no sprouts infected and Maxim MZ had significantly fewer diseased sprouts at 2 and 5DBP planting treatments than non-treated inoculated comparisons but at 10 DBP there was no significant effect of the seed treatment in FL1879. In Pike, non-inoculated seed had no sprouts infected and Maxim MZ had significantly fewer diseased sprouts at 2, 5 and 10 DBP planting treatments than non-treated inoculated comparisons. Non-inoculated seed had no seed-piece decay and Maxim MZ had significantly less seed-piece decay at 10 DBP planting treatments than non-treated inoculated comparisons but at 2 and 5 DBP there was no significant effect of the seed treatment in FL1879. In Pike, non-inoculated seed had no seed-piece decay and Maxim MZ had significantly less seed piece decay at 2, 5 and 10 DBP planting treatments than non-treated inoculated comparisons. Final plant stand was significantly lower in non-treated inoculated comparisons 10 DBP but no other treatments differed significantly in terms of plant stand in FL1879. In Pike, final plant stand was significantly lower in non-treated inoculated comparisons 5 and 10 DBP but no other treatments differed significantly in terms of plant stand. Rate of emergence

(RAUEPC) in FL1879 was significantly lower in non-treated inoculated comparisons at 10 DBP but no other treatments differed significantly in terms of RAUEPC. In Pike, RAUEPC was significantly lower in non-treated inoculated comparisons at 5 and 10 DBP but no other treatments differed significantly. Rate of canopy closure (RAUCC) in FL1879 was significantly lower in non-treated inoculated comparisons at 5 and 10 DBP but no other treatments differed significantly in terms of RAUEPC. In Pike, RAUCC was significantly lower in non-treated inoculated comparisons at 5 and 10 DBP but no other treatments differed significantly. There was no significant difference in yield between any treatments.

The total number of developing sprouts was least in the non-inoculated non-treated control and the treatment 8 and was significantly less than all other treatments. Maxim MZ (treatment 1) had the most developing sprouts but not significantly different from the non-treated inoculated control. No other treatments were significantly different form the non-treated inoculated control. The percentage of diseased sprouts was highest in the non-treated inoculated control, Evolve and Myconate (which was also non-treated). All other treatments had significantly fewer diseased sprouts in comparison to the non-treated inoculated control. Maxim MZ had significantly less seed-piece decay in comparison to the non-treated inoculated control but no other treatments were significantly different from the non-treated inoculated control. Myconate (foliar treatment) had maximum plant stand significantly more than the non-treated non-inoculated and the non-treated inoculated controls. No other treatments had significantly different plant stands from either control. The RAUEPC of the Myconate treatment was significantly greater than all treatments except 6% Mancozeb however no other treatments were significantly different for the non-treated non-inoculated and the non-treated inoculated controls. The RAUCC of the Myconate, 6% Mancozeb and Headsup treatments was significantly greater than the non-treated non-inoculated and the non-treated inoculated controls. No other treatments were significantly different in terms of canopy development from the non-treated non-inoculated and the non-treated inoculated controls. There was no significant difference in yield between any treatments.

Although no significant on yield was determined in these trials, the non-treated inoculated control often had the numerically lowest yield. The use of a seed treatment effective against *Fusarium sambucinum* appears to be justified when cutting seed in advance of planting, however, cutting five DBP appears to have an effect on sprout development. This may be explained by the recovery of apical dominance in seed cut 10 DBP, in sprouts where the effect of apical dominance was removed by cutting. The effect is less easy to explain in seed cut 2DBP, in which sprout development was apparently unaffected by cutting. This effect also appears to be variety specific as it was not observed in Pike. Maxim MZ was the most effective seed treatment, significantly more effective against *F. sambucinum* than Moncoat MZ, Headsup and Mancozeb.

Table 1. Effect of timing of seed treatment application, cutting time (days before planting) and inoculation with Fusarium sambucinum on sprout health and development and potato seed-piece viability in two potato varieties.

Treatment rate/cwt (seed treatment)	Timing of seed treatment application, cutting time (days before planting) and inoculation (+)[z]		Variety	Total number of developing sprouts[y]	Diseased sprouts (%)[x]	Seed piece decay (%)[w]	Final plant stand (%)	Rate of emergence (RAUEPC)[v]	Rate of canopy closure (RAUCC)[u]	Marketable yield[t] (cwt/A)
1 Maxim MZ 0.5	10	yes	FL1879	2.24 bc[s]	30.3 cde	0.8 efg	100 a	7.9 a	39.0 a	342 a
2 None	10	yes	FL1879	2.6 a	39.7 bc	5.7 ab	87 cd	5.5 ef	31.0 de	324 a
3 None	10	no	FL1879	2.6 a	0.0 h	0.0 g	98 ab	7.4 ab	36.0 ab	340 a
4 Maxim MZ 0.5 lb	5	yes	FL1879	2.44 abc	10.3 ef	0.9 efg	91 abcd	6 de	36.0 ab	346 a
5 None	5	yes	FL1879	1.6 e	25.3 e	2.0 de	91 abcd	5.9 de	28.0 de	348 a
6 None	5	no	FL1879	1.92 de	0.0 h	0.0 g	95 abc	7.5 ab	38.0 a	368 a
7 Maxim MZ 0.5 lb	2	yes	FL1879	2.44 abc	6.7 def	1.0 efg	99 a	7.6 ab	33.0 bcd	345 a
8 None	2	yes	FL1879	2.48 abc	22.7 e	1.6 ef	94 abcd	6.5 bcde	32.0 cde	322 a
9 None	2	no	FL1879	2.12 cd	0.0 h	0.0 g	97 ab	7.3 abc	36.0 abc	379 a
10 Maxim MZ 0.5 lb	10	yes	Pike	2.4 abc	2.3 gh	0.5 fg	94 abcd	7 abcd	35.0 abc	332 a
11 None	10	yes	Pike	2.56 ab	63.0 a	5.8 ab	75 d	4.8 f	26.0 e	303 a
12 None	10	no	Pike	2.6 a	0.0 h	0.0 g	96 abc	7 abcd	35.0 abc	375 a
13 Maxim MZ 0.5 lb	5	yes	Pike	2.6 ab	4.0 gh	0.7 efg	94 abcd	7 abc	40.0 a	366 a
14 None	5	yes	Pike	2.68 a	32.3 cde	4.2 c	73 d	4.5 f	31.0 de	311 a
15 None	5	no	Pike	2.68 a	0.0 h	0.0 g	92 abcd	6.6 bcde	35.0 abc	358 a
16 Maxim MZ 0.5 lb	2	yes	Pike	2.64 a	2.7 ij	0.1 g	92 abcd	6 de	33.0 bcd	328 a
17 None	2	yes	Pike	2.4 abc	38.0 def	3.4 cd	88 bcd	6 de	31.0 cde	302 a
18 None	2	no	Pike	1.92 d	0.0 h	0.0 g	85 d	6.1 de	32.0 cd	350 a

[z] Potato seed cvs. Pike and FL1879 was prepared for planting by cutting and inoculating with *Fusarium sambucinum* (dry rot) and treating with fungicidal seed treatments 2, 5 and 10days prior to planting. A treatment with no inoculation was included at each of the cutting dates.

[y] Total number of developing sprouts per seed piece (n = 20) after 14 days incubation at 50°F.

[x] Percentage dry rot affected sprouts per seed piece (n = 20) after 14 days incubation at 50°F.

[w] Percentage development of dry rot on the seed piece (n = 20) after 14 days incubation at 50°F.

[v] RAUEPC, relative area under the plant emergence progress curve calculated from the day of planting to full emergence at 29 days after planting (max = 100).

[u] RAUCPC, relative area under the canopy development curve calculated from day of planting to key reference point taken as 50 days after planting (about 100% canopy closure)

[t] Marketable yield, tubers greater than 2.5" in any plane (US1 grade).

[s] means followed by same letter are not significantly different at $P < 0.05$ (Fisher's LSD).

[r] Foliar application of Myconate 0.02 oz/A at 95% emergence on 5 Jun in 25 gal water/A at 60 psi.

Table 2. Effect of seed treatment and inoculation with *Fusarium sambucinum* on sprout health and development and potato seed-piece viability in potato variety Pike.

Treatment rate/cwt (seed treatment) rate/A (foliar)	Inoculation (+)[z]	Total number of developing sprouts[y]	Diseased sprouts (%)[x]	Seed piece decay (%)[w]	Final plant stand (%)	Rate of emergence (RAUEPC)[v]	Rate of canopy closure (RAUCC)[u]	Marketable yield[t] (cwt/A)
1 Maxim MZ 0.5 lb	yes	2.64 a	2.7 d	0.1 c	92 abcd	6 de	33.0 bcd	328 a
2 None	yes	2.4 abc	38.0 b	3.4 b	88 bcd	6 de	31.0 cde	302 a
3 None	no	1.92 d	0.0 d	0.0 c	85 d	6.1 de	32.0 cd	350 a
4 Evolve 0.5 lb/cwt	yes	2.24 bc	46.0 b	1.0 bc	91 abcd	6.3 cde	36.0 ab	372 a
5 Moncoat MZ 0.75 lb	yes	2.44 abc	12.0 c	1.8 bc	89 bcd	6.2 cde	34.0 abc	333 a
6 Myconate 0.02 oz[j]	yes	2.32 abc	61.3 a	5.6 ab	100 a	7.5 ab	38.0 ab	380 a
7 Headsup 3WDG 0.1 lb	yes	2.2 c	13.7 c	1.2 bc	92 abcd	6.4 cde	38.0 a	387 a
8 6% Mancozeb 1lb	yes	1.88 de	16.0 c	0.8 bc	95 abc	6.6 bcde	36.0 ab	379 a

[z] Potato seed cvs. Pike was prepared for planting by cutting and inoculating with *Fusarium sambucinum* (dry rot) and treating with fungicidal seed treatments 2 days prior to planting.

[y] Total number of developing sprouts per seed piece (n = 20) after 14 days incubation at 50°F.

[x] Percentage dry rot affected sprouts per seed piece (n = 20) after 14 days incubation at 50°F.

[w] Percentage development of dry rot on the seed piece (n = 20) after 14 days incubation at 50°F.

[v] RAUEPC, relative area under the plant emergence progress curve calculated from the day of planting to full emergence at 29 days after planting (max = 100).

[u] RAUCPC, relative area under the canopy development curve calculated from day of planting to key reference point taken as 50 days after planting (about 100% canopy closure)

[t] Marketable yield, tubers greater than 2.5" in any plane (US1 grade).

[s] means followed by same letter are not significantly different at $P < 0.05$ (Fisher's LSD).

[r] Foliar application of Myconate 0.02 oz/A at 95% emergence on 5 Jun in 25 gal water/A at 60 psi.