EVALUATION OF ALTERNATIVE CARRIERS FOR POTATO SEED TREATMENT FUNGICIDES

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Introduction

Potato seed treatment product formulations typically include a blend of red alder (*Alnus rubra*) or Douglas fir (*Pseudotsuga menziesii*) bark, talc, and zeolite as the diluent materials or carrier. Physical properties of these materials provide acceptable adherence to moist surfaces of cut seed while avoiding coagulating or clumping, which can plug application equipment. As expected, costs of these ingredients vary depending on availability and proximity to supplies. Actual relative composition of these materials in commercial seed treatment products is proprietary information and unavailable.

Alternative diluent materials are being evaluated to reduce costs and or take advantage of materials that might otherwise be waste products with little or no value. One such product that is abundantly available in the mid-west region is sunflower (*Helianthus annuus*) hulls, a byproduct of the seed oil production process. Alternative wood flours, such as western juniper (*Juniperus occidentalis*) are also of interest as the availability of red alder fluctuates due to its association with riparian and wetland habitats (Rykbost et al. 2005). Although products using juniper flour performed satisfactorily, difficulty in grinding flour from this species led to an interest in looking at alternative species.

Trials were established at the Klamath Experiment Station (KES), Malheur Experiment Station (MES), and Central Oregon Agricultural Research Center (COARC) in 2005 to evaluate seed treatment products formulated with maple (*Acer* spp.) flour and sunflower hulls in various ratios as diluent for fungicide dusts. Three locations were included to expose the formulations to a range of soil and climatic conditions with potentially different disease pressures.

Materials and Methods

Six experimental formulations based on maple wood flour and sunflower hulls (obtained from Sigco-Sun Co., Breckenridge, MN) were compared with standard products at each experimental site. At KES, the standard seed treatment fungicide product was Tops® MZ (thiophanate methyl-mancozeb, Gustafson). At COARC, Evolve® (thiophanate-methyl-mancozeb-cymoxonil, Gustafson) and Tops (thiophanate-methyl, Gustafson) served as standards. The MES standard product evaluated was Tops MZ Gaucho® (thiophanate methyl-mancozeb, Gustafson, and imidacloprid, Bayer CropScience LP).

Each experimental formulation included talc at 43.9 percent, zeolite at 24.3 percent, and Dithane® (mancozeb, Dow AgroSciences) at 7.45 percent by weight. Experimental formulations evaluated also included: F1) maple flour at 24.3 percent; F2) maple flour at 18.2 percent and sunflower hulls at 6.1 percent; F3) maple flour at 12.2 percent and sunflower hulls at 12.2 percent; F4) maple flour at 6.1 percent and sunflower hulls at 18.2 percent; F5) sunflower hulls at 24.3 percent; and F6) maple flour at 17.8 percent, sunflower hulls at 5.9 percent, and GS-48 (8-20-20 plus plant growth regulator at 1 oz per cwt of cut seed) at 1 percent.

KES

The seed lot used at KES was Oregon class G III 'Russet Norkotah' (Colorado strain 8). Tubers were sorted to obtain 50 tubers of approximately 8 oz for each of 7 treatments. A range of 7-1/2 to 8-1/2 oz/tuber was allowed. On May 17, each batch of 50 tubers was hand-cut into 4 seed pieces per tuber. The total weight of cut seed pieces was determined. Seed treatment materials were preweighed into Styrofoam cups at 60 g (0.5 lb/cwt) for approximately 25 lb of cut seed. Seed pieces for each batch were slowly transferred from one clean and dry 5-gal plastic bucket to a second bucket while seed treatment dust was sprinkled onto the seed during the transfer.

Approximately one-half of the product was applied during each of two transfers between buckets. After all product was applied, the seed was again poured from one to another bucket for complete mixing. The cut and treated seed was then transferred to mesh onion bags for storage under suberization conditions (55°F at 90-95 percent relative humidity). Onion bags were held over the second bucket during this transfer to collect any seed treatment dust lost during this transfer. Both buckets were wiped down with clean paper towels to accumulate any remaining product, which was then poured back to the Styrofoam cups and weighed. Cups of residue product were heated in a microwave oven for 1 minute to remove any moisture that might have adhered to the product. Dried residue samples were again weighed.

The experimental site was planted to orchardgrass in 2002, managed for hay production through 2004, and was last used for potato production in 1999. Telone™ II (Dichloropropene, Dow Agro Sciences LLC) was shanked in at 20 gal/acre on April 14 to control nematodes and related diseases. The experiment was arranged in a randomized complete block design with 6 replications of single-row, 30-hill plots. Seed was planted on May 26 with a 2-row, assisted-feed planter at 10-inch seed spacing in 32-inch rows. Fertilizer was applied in bands on both sides of rows at 160 lb nitrogen (N), 80 lb phosphate (P_2O_5), 80 lb potash (K_2O), and 140 lb sulfur (S)/acre at planting. The insecticide Admire® 2R (imidacloprid, Bayer Crop Sciences) and the fungicide Quadris® (azoxystrobin, Syngenta Crop Protection, Inc.) were applied in-furrow at planting at 0.17 and 0.10 lb ai/acre, respectively.

Weeds were adequately controlled with Dual II Magnum® (metolachlor, Syngenta Crop Protection, Inc.) and Prowl® 3.3 EC Herbicide (pendimethalin, BASF Ag Products) applied with a ground sprayer at 1.75 pt/acre, each on June 7, and Matrix® (Rimsulfuron, Dupont) applied via chemigation at 1.5 oz/acre on July 21. Dual and Prowl were incorporated immediately following application with a rolling cultivator in two passes. Approximately 20 inches of irrigation was applied during the growing season with solid-set sprinklers arranged in a 40- by 48-ft pattern.

Plant stands were monitored on June 21, June 27, July 5, and July 12. Fungicides were applied aerially on July 10 (Quadris), August 15 (Dithane F-45 [Ethylene bisdithiocarbamate, Dow AgroSciences]), and September 10 (Bravo® Ultrex [mancozeb, Syngenta Crop Protection, Inc.]) at labeled rates. Insecticide Asana® XL (Esfenvalerate, Dupont) was applied aerially on August 20 for control of loopers. Vines were desiccated with Reglone® Desiccant (diquat dibromide, Syngenta Crop Protection, Inc.) applied with a ground sprayer at 1.5 pt/acre on September 7. Tubers were harvested with a one-row, digger-bagger on October 3. All tubers were saved and graded on October 24. Grades included USDA No. 1s, 4-8 oz, 8-12 oz, and over 12 oz, Bs (<4 oz), U.S. No.2s, and culls. Data were statistically analyzed with SAS® for Linear Models, Fourth Edition (SAS Institute Inc.) software. Least significant differences (LSD) were tested based on Student's t at the 5 percent probability level.

COARC

Certified Russet Norkotah seed was sorted into 6- to 8-oz tubers and cut into 4 pieces per tuber on May 9. One hundred thirty-two seedpieces (32 per replicate) were weighed and placed into a clean, dry bucket. Treatment materials were weighed and about 400 g of material added to each respective bucket. Seed pieces and treatment material were mixed and transferred several times between two buckets. Seed pieces were allowed to air-dry and any remaining treatment material was collected and weighed.

The experiment included four replications of single row, 32-hill plots arranged in a randomized complete block design. Seed was spaced at 9 inches in 36-inch rows. Fertilizer was banded at planting on May 25 at 151 lb N, 110 lb P_2O_5 and K_2O, and 66 lb S/acre. Admire was applied at 0.36 lbs ai/acre at planting to control insects. Eptam® 7-E (s-ethyl dipropylthiocarbamate, Gowen) and Matrix were applied at 5 pt/acre and 1.5 oz/acre, respectively, to control weeds. The experiment was irrigated with solid-set sprinklers based on AgriMet crop water use calculations. Emergence data were collected on June 22. Stem counts were taken on October 18 prior to harvest. Vines were rolled on September 14 and tubers were harvested on October 18. All tubers were graded to USDA standards in late October.

MES

Russet Norkotah seed was cut and treated on April 13. As at other locations seed was 4-cut to provide uniform cut surfaces. Seed was suberized in paper bags for 5 days at 43°F and planted on April 18. Plots of 30 hills arranged in a randomized complete block design were replicated 6 times. Seed was spaced at 9 inches in 36-inch rows. Standard cultural practices were followed for weed, pest, and disease control. Vines were senescing by the end of July and completely dead by the end of August. Tubers were harvested on October 7. All tubers were saved and graded to USDA standards in mid-October.

Results and Discussion

KES

The recovery of seed treatment dust following batch treatments was 5.1 g for Tops MZ. Residual product for experimental formulations ranged from 7.1 to 10.7 g, which represents 12-18 percent of applied product. One problem reported by growers is that seed treatment products will sometimes clump in applicator hoppers, requiring frequent cleaning for consistent application. This tendency was evaluated when the products were emptied out of Styrofoam cups. Clumping was not observed in any of the formulations.

A second complaint occasionally mentioned with use of seed treatment products when seed is suberized for several days prior to planting is a tendency for shrinking of seed pieces due to hydroscopic moisture depletion. This tendency was not observed at KES during the 9-day suberization period for any of the treatment products. Plant emergence data indicated no significant effects of treatments on rate of emergence. Mean percent emergence was 35, 81, 95, and 98 percent at 27, 33, 40, and 47 days after planting. Uniform plant vigor among the seed treatments was observed throughout the growing season.

Data documented no significant yield or grade response to differences between products or formulations evaluated (Table 1). The F6 treatment, which included a plant growth regulator, exceeded all other treatments in total yield of U.S. No.1s by 27-63 cwt/acre but this difference was not statistically significant. Overall, 2005 yields at KES were similar to yields observed in numerous studies with Russet Norkotah over more than 10 years.

COARC

The amount of product adhered to cut seed ranged from 0.55 to 0.75 lb/cwt of cut seed for the experimental formulations. Evolve and Tops treatments were much higher at 1.27 and 1.09 lb/cwt, respectively. Emergence at Madras, Oregon 28 days after planting ranged from 91 to 100 percent with no statistical difference (Table 2). Stem counts showed a uniform canopy with treatments and standards at 2.1-2.5 stems per plant with no statistically significant differences.

High yields were observed with a high percentage of large tubers (Table 2). Excessive tuber size contributed to relatively high cullage in all treatments except F6. Total yield was significantly higher for Evolve than Tops and F6. Differences between other experimental formulations and Evolve were not significant. Total yield of U.S. No. 1s was significantly higher for the standard treatment of Evolve than for Tops but not for any of the experimental formulations. Evolve also produced high yields in the 2004 trial conducted at COARC. This suggests there may be a disease issue at this site that is being suppressed by the cymoxonil component in this product. As at the other locations, data were not obtained on disease incidence.

MES

Full, uniform emergence was observed by May 15. Stand and stem count data were not taken. Yields were much lower for Russet Norkotah at this site than at KES and COARC (Table 3). No yield differences were observed between treatments for any of the yield parameters. A much smaller size profile was observed at MES than at KES or COARC. High temperatures in this long growing season area frequently result in total U.S. No. 1 yields for Russet Norkotah being 100-200 cwt/acre lower than at KES. The yields in all grades and sizes for the standard treatment of Tops MZ Gaucho were nearly identical to trial mean yields.

Summary

Data from two sites indicated that relatively uniform amounts of product adhered to cut surfaces for the experimental formulations with greater adherence for standard products, particularly at COARC. In most treatments, approximately 0.5 lb of product/cwt of cut seed was retained on the seed. That is consistent with the experience from similar studies at KES in prior years with a range of seed treatment products. With the exception of high yields for the standard product Evolve and low yield for Tops at COARC, there were no apparent affects of seed treatment formulation on yield or grade at any location. The F6 formulation, which included a nutrient and growth regulator component, produced no significant yield responses. During a 9-day suberization period at KES excessive dehydration of seed pieces was not observed in any of the formulations. At KES and MES, emergence was uniform and there were no significant differences in yield between treatments, including standard products.

References

Rykbost, K. A., and B. A. Charlton. 2005. Evaluation of alternative carriers for potato seed treatment fungicides. Oregon State University, Agricultural Experiment Station, Special Report 1063:31-37.

Table 1. Effect of seed treatment product or formulation on performance of Russet Norkotah at the Klamath Experiment Station, Klamath Falls, OR, 2005.

	Yield U.S. No. 1s				Yield			
Treatment	4-8 oz	8-12 oz	>12 oz	Total	Bs	No. 2s	Culls	Total
	cwt/acre							
F1	76	110	193	379	19	33	22	453
F2	98	121	193	412	15	36	18	481
F3	95	124	171	390	20	32	16	458
F4	88	106	182	376	14	50	17	457
F5	91	138	165	394	15	41	15	465
F6	90	131	218	439	16	36	19	510
Tops MZ	93	123	166	382	20	47	20	469
Mean	90	122	184	396	17	39	18	470
CV (%)	17	19	24	12	33	33	57	10
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Table 2. Effect of seed treatment product or formulation on performance of Russet Norkotah at the Central Oregon Agricultural Research Center, Madras, OR, 2005.

	Yield U.S. No. 1s			Yield			Stem/	Emerg.
Treatment	4-12 oz	>12 oz	Total	Bs	Culls	Total	plant	28 DAP*
	cwt/acre							
F1	140	296	436	27	110	573	2.4	97
F2	142	335	477	19	118	614	2.1	94
F3	187	331	518	22	71	611	2.3	97
F4	194	289	483	22	116	621	2.3	91
F5	184	307	491	22	70	583	2.3	94
F6	207	283	490	26	36	552	2.5	100
Evolve	158	371	529	24	109	662	2.3	94
Tops	178	207	385	25	85	495	2.4	97
Mean	174	302	476	23	89	589	2.3	96
CV (%)	29	24	17	28	50	10	12	5
LSD (0.05)	NS	108	118	NS	65	88	NS	NS

*Days after planting.

Table 3. Effect of seed treatment product or formulation on performance of Russet Norkotah at the Malheur Experiment Station, Ontario, OR, 2005.

	Yield U.S. No. 1s				Yield			
Treatment	4-6 oz	6-12 oz	>12 oz	Total	Bs	No. 2s	Culls	Total
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F1	90	202	26	318	76	54	5	453
F2	84	219	25	328	75	63	0	466
F3	92	206	27	325	71	55	4	455
F4	85	177	24	286	71	64	1	422
F5	76	218	54	348	60	63	0	471
F6	87	201	17	305	76	66	0	447
Tops MZ G	85	205	30	320	76	64	1	461
Mean	86	204	29	319	72	61	2	454
CV (%)	57	21	68	15	19	30	338	8
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS