Fumigant Application Efficacy Trials in Light of Potential EPA Changes

PERSONNEL:

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Introduction:

Pre-plant center pivot fumigation with metam sodium is an effective means for controlling economically important soil borne pathogens in potato production (Triky-Dotan et al., 2007; Tsror et al., 2005). Other putative reduced air emission application methods (specifically shank and low drift drizzle boom (Smart Drop)) are receiving favorable buffer zone consideration as part of EPA-OPP's July 2008 Reregistration Eligibility Decision (RED) document (USEPA 2008). To better ascertain if product efficacy is affected by changing to reduced-emission application technologies, two pre-plant center pivot field fumigation efficacy studies were initiated in Franklin County WA; the first in the fall of 2008 followed by a more comprehensive field examination initiated in the fall of 2009.

2008-2009 Efficacy Demonstration: The goal of the 2008-2009 field-scale efficacy examination is to provide growers with efficacy information that directly compares water run to shank and low drift drizzle-boom chemigation (also marketed as Smart Drop) when using Sectagon 42® (Tessenderlo Kerley Inc.) at conventional application rates of 40 gallons per acre (GPA). For this single field 2008-2009 efficacy demonstration, pre and post fumigation soil borne pathogen soil core assays, visual plant evaluations at harvest, and harvest yield and quality determinations were evaluated at nine randomized sampling locations (3 application treatments x 3 replicate plots/treatment).

2009-2010 Efficacy Demonstration: In October 2009, we repeated randomized block Sectagon efficacy trials at 40 GPA rates. However, we also expanded the program to investigate product efficacy through harvest at lower (20 GPA) and higher (60 GPA) Sectagon 42 application rates to ascertain if there can be differences in product efficacy relative to application rate.

The over-arching objective is to provide growers and field men with tangible application practice options and information to support product efficacy for informed management decision-making. Application-based efficacy information will be important to provide growers in view of imminent buffer designation label language changes in spring 2011.

Study Overview:

2008-2009 Single Application Rate Efficacy Evaluation:

Ranger Russet potatoes were planted in April 2009 and harvested in late August 2009 from a 122 acre circle provided by Schneider Farms, Pasco WA. Pre-fumigation, post fumigation,

pre-harvest soil-borne pathogen assays, in-season plant evaluations, and harvest yield and quality of potatoes were conducted in a randomized replicated design to compare application practice treatments (Figure 1). To avoid possible field application edge effects, the nine sampling positions (+) were located equidistantly between the individual tower treatments.

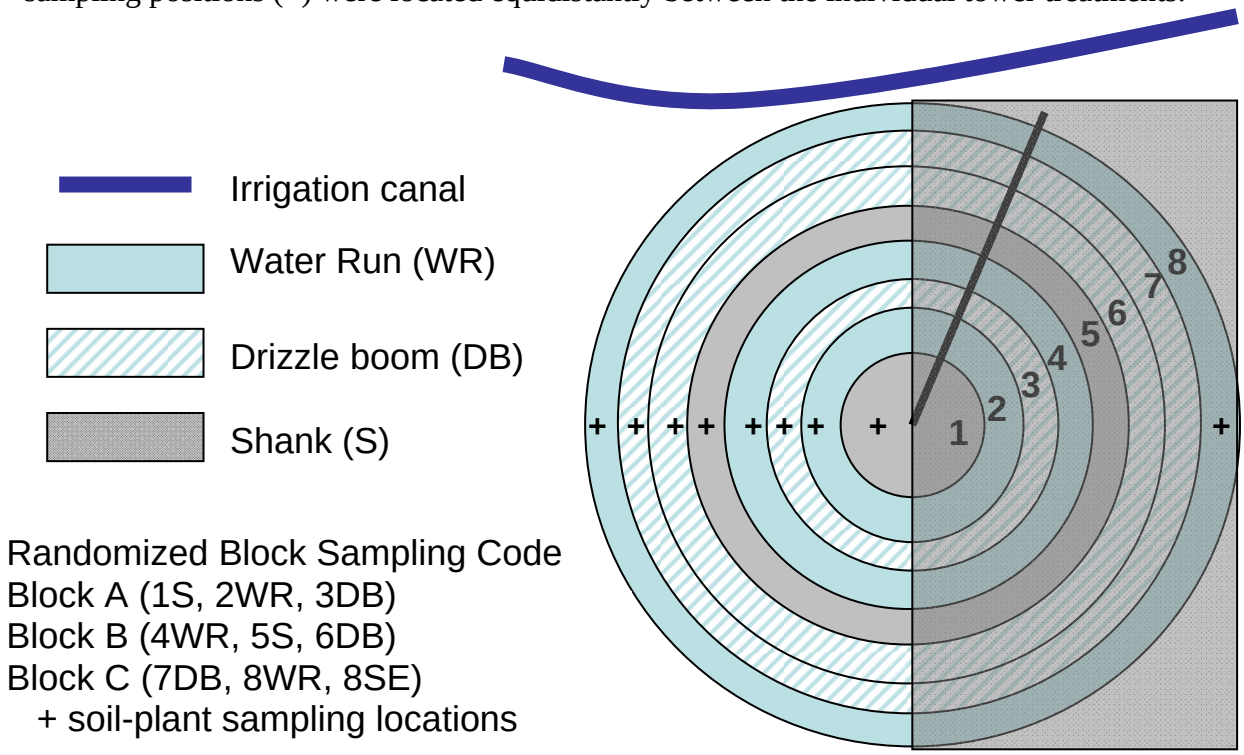

Figure 1: 2008-2009 Field Efficacy Layout

Soil borne pathogen soil assays: Before field fumigation in the fall 2008 and just before planting in 2009, soil cores were taken and segregated into two soil depths (0-12 and 12-24 inches) then composited from each of the treatment plots pre and post fumigation. The composited soil core samples (9 treatment plots x 2 depths) were assayed for *Verticillium dahliae*, *Pythium* spp., and *Fusarium* by OSU HAREC.

Visual plant evaluations: Field visual examinations were conducted in late August 2009 to document foliage symptoms just before harvest. Stems (15-17) were pulled from the ground within center of each of the nine replicated treatments and assayed for *Colletotrichum coccodes* and *Verticillium dahliae*. Stems were air dried in 48^{o}F storage held at 90% relative humidity and evaluated by WSU Plant Pathology for sclerotia incidence and severity of *Colletotrichum coccodes* and *Verticillium dahliae*.

Yield and grade assessments: Tubers were harvested in mid-August 2009 from 40 foot row sections at the nine treatment plot locations and transported to OSU HAREC where yield and grade assessments were conducted.

2009-2010 Multiple Application Rate Efficacy Evaluation:

In October 2009, a 148 acre eight tower circle with corner catchment (courtesy of Schneider Farms) was used for the second-year application based efficacy demonstration (Figure 2). *Ranger Russet potatoes were planted in April 2010.*

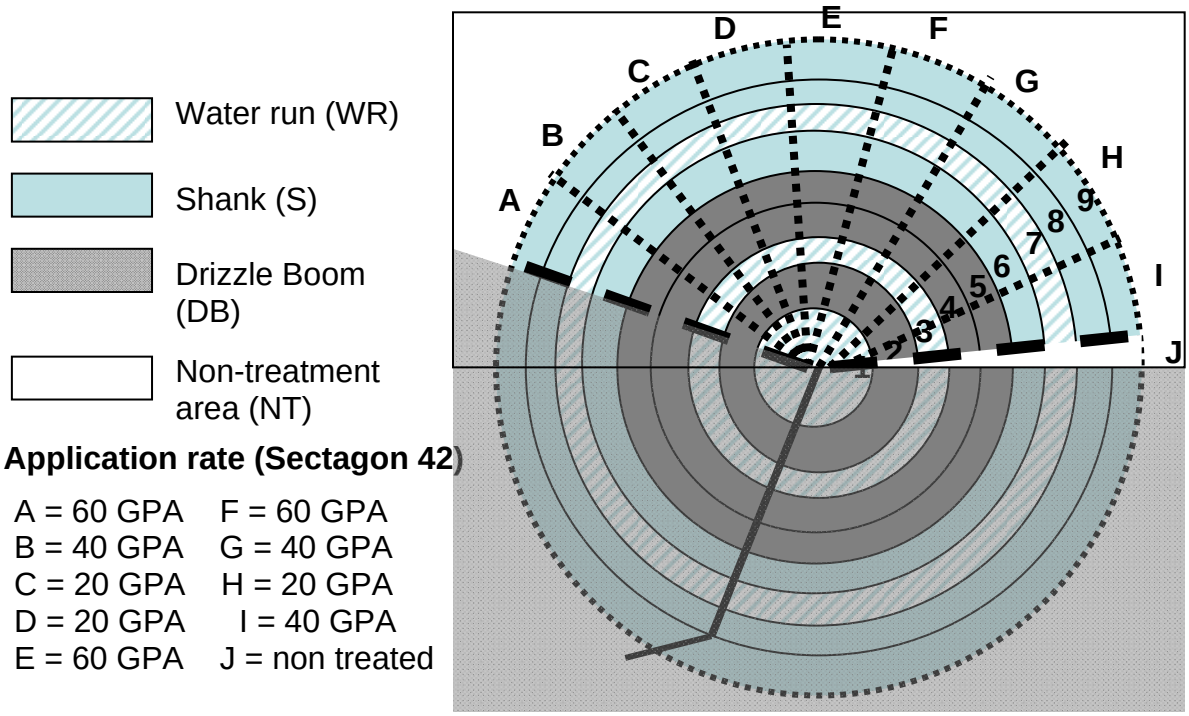

Figure 2: 2009-2010 Field Efficacy Layout

As in the 2008-2009 field study, this second year work was developed to compare water run to shank and to drizzle-boom when using Sectagon 42 at regional application rates of 40 GPA. This program has been expanded to also investigate product efficacy through harvest at lower (20 GPA) and higher (60 GPA) application rates. The three application rates were randomly assigned (in triplicate) among the nine ca. 12^{o} wedge sections within the test field. A tenth wedge (J) was set aside as an untreated control (Figure 2). The field study was developed in a manner similar to the 2008-2009 randomized block study. To avoid edge effects, the ninety GPS positions (81 application rate-practice treatment plots and 9 untreated control plots) were equidistantly positioned between treatment tower rows and application rate sections.

Set-up, field conditioning, and applications: For the water run application, low elevation drop nozzles (ca. 5ft from ground level) were retrofitted by Windflow Fertilizer Inc. (WFI) to tower rows 1, 3, and 7. The drizzle boom assembly was positioned at tower rows 2, 4, and 5. Towers rows 6, 8, and the corner catcher (row 9) were capped off for subsequent Sectagon 42 ground application by tractor-drawn shank injection. Enough water was applied to bring the entire field test sections to ca. 70-80% moisture content before conducting the fumigation treatments. The drizzle boom-water run center pivot chemigation was completed by WFI one-day before conducting the shank application. During the center pivot application, line pressure was carefully monitored for sections "A" through "I" (Figure 2) to assure even Sectagon 42 application rate coverage at either 20, 40, or 60 GPA. Figure 3 shows center pivot water run-drizzle boom operations during the fumigation period.

Figure 3: Sectagon 42 Center Pivot Application

Shortly after completion of the field center pivot chemigation, tractor drawn shank injections at 20, 40, and 60 GPA were performed by Crop Production Services to a depth of ca. 9 inches within tower rows 6, 8 and 9 (catchment area) according to the "A" to" I" section rates in Figure 2.

Soil borne pathogen soil assays: Pre-fumigation (October 2009) and post-fumigation soil cores (March 2010) were taken and segregated into two soil depths (0-12 and 12-24 inches) then composited from each of the ninety treatment plots by OSU HAREC and WSU staff. The composited soil core samples were transported OSU HAREC and are awaiting determination.

RESULTS AND DISCUSSION:

2008-2009 Single Application Rate Efficacy Evaluation:

OSU-HAREC Soil borne pathogen soil assays: Below is reported colony forming units (CFU) and statistical treatment from composited soil samples for the three application treatments.

		Pythium CFU		Fusarium CFU		Verticillium CFU	
Treatment	Sample Depth	Pre	Post	Pre	Post	Pre	Post
Drizzle boom	12	62 a	45 a	2201 a	1073 a	9 a	18 a
	24	24 b	18 a	1003 b	596 a	3 b	3 a
Shanked	12	47 a	39 a	2794 a	1687 a	2 a	4 a
	24	16 a	20 a	1440 a	824 b	1 a	3 a
Water Run	12	57 a	13 a	2804 a	2295 a	5 a	13 a
	24	22 b	5 a	861 b	492 b	5 a	2 a

Values in columns within treatments followed by the same letter are not significantly different; P<0.05.

Pythium and *Fusarium* CFUs were present in pre and post fumigation in treatments and at the two depths investigated. Although there were some observed differences with depth within treatments, there were no strong significant differences observed among the treatment applications. Low observed *Verticillium* counts both pre and post fumigation makes it problematic to draw conclusions regarding differences with depth or among treatment applications.

OSU-HAREC Yield and grade assessments: Below are the yield and specific gravity for potatoes collected from the three application treatments (n=3 for each treatment).

		Yield (lbs)					
Treatment	Specific Gravity	Under 4 oz	Culls/ 2's	4-8 oz	8- 12 oz	Over 12 oz	Total Yield
Drizzle Boom	1.082	20.9	5.7	57.6	42.1	33.7	159.9
Shanked	1.084	18.8	9	49.3	39	32.9	148.8
Water Run	1.082	22	6.7	55.3	41.9	25	150.8

There were no observed significant differences ($p < 0.05$) in total yield, size, and specific gravity among the application treatments.

WSU-Plant Pathology visual plant evaluations: There was gradual increasing emergence of early die syndrome (random plant necrosis) towards the center of the pivot. The necrosis was not bounded by treatment boundaries and was measurable within the three closest tower plots to center of the pivot (Block A: 1S, 2WR, 3DB) and around the one distal plot (8 SE) on the opposite side of field (see Figure 1). Covariant analysis was used to weight data for this necrotic factor (5-15%). All treatments had increased incidence and severity of disease within these necrotic areas. Overall there was not a strong presence of disease within the treatments. There were no significant differences (P=0.05) between methods of application for the incidence and severity of sclerotia on potato stems for black dot (*C. coccodes*) or Verticillium (*V. dahliae*). Except for some necrosis proximal to center of pivot the canopy was physiologically young at harvest, which would have reduced expression of disease in stems compared to what would have been obtained later in the season, just before or at senescence.

On-going 2009-2010 Multiple Application Rate Efficacy Evaluation:

To complete this work, plant observations will be conducted as before by WSU Pathology with harvest/yield and soil assays being conducted in fall 2010 by OSU HAREC. WSU-FEQL will oversee the completion of this 2-year study with outputs in the form of an informational extension bulletin. This bulletin will address the comparative efficacy of conventional water run to reduced emission technologies to aid growers when deciding on application practice and product rate.

Acknowledgements:

This proceeding represents an on-going collaboration to provide regionally specific application-based metam sodium efficacy information. Special thanks must go to many for providing their continued *in-kind* support. Particularly, we wish to thank Ed Schneider of Schneider Farms for donating use of his land-chemigation equipment for two planting seasons, Monte Spence and his crew at WindFlow Fertilizer for retrofitting, center pivot drizzle boom operations/mult-application rate oversight, Jim Ossman and his group at Crop Production Services for their efforts in performing shank application. We also wish to express our thanks to

Jim Owens and Kurt Volker from Tessenderlo Kerley for product support and field oversight for the 2008 and 2009 field efficacy demonstrations.

References:

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