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Influence of Fungicides and Soil Moisture on Black Dot (*Colletotrichum coccodes*) Tuber Blemish

Rob Wilson, Center Director/Farm Advisor; Darrin Culp, Superintendent of Agriculture; Kevin Nicholson Staff Research Associate. University of California Intermountain Research & Extension Center; 2816 Havlina Rd. Tulelake, CA. 96134 Phone: 530/667-2719 Fax: 530/667-5265 Email: rgwilson@ucdavis.edu

Introduction

Black dot fungal structures (sclerotia) on harvested tubers are a consistent problem for fresh market potato producers throughout California. Tubers infected with black dot tuber blemish have a rash like appearance that is especially evident on washed red and yellow skin potatoes making them unmarketable. Black dot infection on below ground stems and stolons occurs within weeks of sprouting. Fungicides are effective at suppressing black dot during the growing season, but fungicides have not been shown to reduce tuber blemish.

Cultural management and harvest timing impact black dot on daughter tubers. IREC research in 2021 and 2022 showed harvesting potatoes earlier in the season when vines were >50% green greatly reduced tuber blemish. The studies also showed reducing the amount of time tubers remain in the soil after vine-kill can reduce tuber blemish. Unfortunately, early vine-kill and harvest has negative outcomes such as reduced tuber size and poor skin-set. In 2024, a fungicide trial and irrigation trial were established at IREC to evaluate the effect of fungicides and soil moisture on black dot tuber blemish.

Site Information

- **Soil type-** mucky silty clay loam-6% OM
- **Irrigation –** solid-set sprinklers
- **Potato Spacing-** 36 inch rows with 10 inch seed spacing
- **Design-** Randomized complete block with 4 blocks (reps)
- **Planting and Harvest Dates:** May 20, 2024 and September 13, 2024

Study Methods

Studies were conducted in a field at the IREC with a history of natural black dot infection. Soil samples collected in March 2024 confirmed the presence of black dot in the field using real time q-PCR tests. A yellow skinned potato variety, Constance, was used in both studies. Irrigation plots were 36ft by 42ft arranged in a randomized complete block design with 3 replications. Fungicides plots were 12ft by 20 ft arranged in a randomized complete block design with 4 replications. Potatoes were grown using normal conventional management practices. Vines were killed at 50% green on August 16th 88 days after planting. Vines were killed using Reglone and rolling. Potatoes were harvested 28 days after vine kill. Tubers were harvested from the center row in each plot.

Irrometer watermark sensors were buried at 6-inch and 10-inch depths to record soil moisture in both studies. Irrigation was scheduled using soil moisture and evapotranspiration. Irrigation scheduling for the fungicide trial focused on keeping soil moisture readings between 10 and 30 centibars from early bulking to harvest. Irrigation scheduling for the irrigation trial keep soil moisture between 0 and 20 centibars from early tuber bulking until potato harvest in the wet treatment. Soil moisture was kept between 20 and 40 centibars in the dry treatment.

Fungicides were not applied in the irrigation trial except for treating the seed with fludioxonil (Maxim) to prevent early season stand loss. Seed used in the fungicide trial was treated with fludioxonil (Maxim) and azoxystroblin (Dynasty). The fungicide trial evaluated eight fungicide treatments with an untreated control (Table 1). All treatments included a fungicide applied in-furrow and foliar applied fungicides at 20 gallons per acre. Foliar fungicides were applied every 14 days starting at the 6-inch rosette stage and ending at vine-kill. Foliar fungicides were broadcast applied with a CO_2 backpack sprayer with a nonionic surfactant at 0.25% v/v. **Several fungicide treatments exceeded the maximum labelled rate. The research team decided on this approach to keep mode of action separate between treatments and assure fungicides were applied throughout the growing season**.

Trt #	Fungicide Treatment
1	**Untreated**
2	**Quadris** (azoxystroblin- group 11) trt- **Quadris**- 0.8 fl oz/1000ft of row in-furrow & **Quadris** at 12 fl oz/A foliar
3	**Evito** (fluoxastrobin group 11) trt- **Evito**- 0.24 fl oz/1000 ft of row in-furrow & **Evito** 3.8 fl oz/A foliar
4	**Headline SC** (pyraclostrobin group 11) trt- **Headline** 0.8 fl oz/1000 row ft in-furrow & **Headline** 9 fl oz/A foliar
5	**Fontelis** (penthiopyrad group 7) trt- **Fontellis** - 1.6 fl. oz/1000 row-ft in-furrow & **Fontelis** at 14 fl oz/A foliar
6	**Velum/Luna Tranquality** (fluopyram group 7) trt- **Velum Rise**-13 fl oz/A in-furrow & **Luna Tranquility** 11.2 fl oz/A foliar
7	**Velum/Revus Top** (mandipropamid + difenoconazole group 3 and 40)trt- **Velum Rise**- 13 fl oz/A in-furrow & **Revus top** 7 fl oz/A foliar
8	**Velum/Provysol** (mefentrifluconazole group 3) trt- **Velum Rise** 13 fl oz/A in-furrow & **Provysol** 5 fl oz/A foliar
9	**Velum/Miravis Prime** (pydiflumetofen + fludioxonil group 7 & 12) trt- **Velum Rise** 13 fl oz/A in-furrow & **Miravis Prime** 11.4 fl oz/A foliar

Data included tuber yield, tuber size, and the incidence and severity of black dot on daughter tubers. Tuber yield and size was determined by running all potatoes from each plot across an automated grade-line. Twenty-five tubers were randomly pulled from the gradeline from each plot and then stored for 60 days after harvest. The 25 tubers were washed and polished to remove all soil for the tuber surface. Black dot incidence and severity was determined by visually evaluating percent coverage of black dot tuber blemish on all tubers.

Irrigation Trial Results

Black dot tuber blemish and tuber defects were similar between irrigation treatments (Table 2). Tubers per plant, tuber size, and tuber yield were also similar between irrigation treatments (Table 3). Potatoes left in the field for an additional two weeks in the dry treatment had significantly more black dot blemish (personal observation) supporting the idea that extended time in the soil after vine kill increasing black dot blemish.

Table 2. Black dot Coverage and Potato Quality for vine kill and skin set treatments at IREC in 2024.

Trt #	Treatment	Black dot blemish tuber coverage %	Incidence of black dot blemish %	Knobs	Growth cracks	Green
				Total Tuber percentages %		
1	wet soil moisture at bulking & harvest	3.50 a[1]	45 a	1.5% a	0.0% a	2.0% a
2	dry soil moisture at bulking & harvest	3.00 a	43 a	1.9% a	0.2% a	1.5% a
	p-value	0.56	0.76	0.36	0.08	0.09

[1] Means with the same letter within columns are not statistically different using the Tukey HSD mean comparison test.

Table 3. Potato stand, yield, and size for vine kill and skin set treatments at IREC in 2024.

Trt #	Treatment	Potato Stand %	Tubers/ plant #	Avg tuber size oz	Total yield CWT/A	>14 oz	10-14 oz	6-10 oz	4-6 oz	<4 oz	culls
						Tuber size class percentages					
1	wet soil moisture at bulking & harvest	93% a	9.92 a	3.03 a	310 a	0.0%	0.0% a	5.6% a	23.3% a	71.0% a	4.4% a
2	dry soil moisture at bulking & harvest	93% a	9.79 a	2.96 a	288 a	0.0%	0.1% a	4.8% a	21.2% a	66.9% a	3.8% a
	p-value	1.00	0.82	0.30	0.18	1.00	0.35	0.69	0.41	0.28	0.37

[1] Means with the same letter within columns are not statistically different using the Tukey HSD mean comparison test.

Fungicide Trial Results

The incidence and coverage of black dot tuber blemish was statistically similar across fungicides (Table 4). Quadris, Evito, and Provysol treatments had numerically lower incidence and coverage compared to the untreated control. Potato yield and size was statistically similar across fungicides (Table 5). Total yield was numerically highest in the untreated control (Table 5).

Table 4. Influence of fungicides on black dot tuber blemish on a yellow-skin fresh market potato (2024 Tulelake, CA)

Trt #	Fungicide Treatment	Coverage of tuber skin with blemish	Incidence of tuber blemish
		%	%
1	**Untreated**	3.7	52
2	**Quadris** in-furrow and foliar	2.5	36
3	**Evito** in-furrow and foliar	1.8	27
4	**Headline SC** in-furrow and foliar	3.0	43
5	**Fontelis** in-furrow and foliar	3.1	38
6	**Velum Rise** in-furrow & **Luna Tranquility** foliar	3.9	46
7	**Velum Rise** in-furrow & **Revus top** foliar	3.9	40
8	**Velum Rise** in-furrow & **Provysol** foliar	2.3	32
9	**Velum Rise** in-furrow & **Miravis Prime** foliar	3.5	43
	ANOVA p-value	0.258	0.257

25 washed and polished tubers per plot (4) were visually evaluated 60 days post-harvest

Table 5. Influence of fungicides on potato yield for a yellow-skin fresh market potato (2024 Tulelake, CA)

#	Fungicide Treatment	Tubers per plant	Ave. tuber size	10-14 oz	6-10 oz	4-6 oz	<4 oz	cull	Total
		#	oz	cwt/A					
1	**Untreated**	10.3	3.0	0	12	63	197	13	285
2	**Quadris** in-furrow and foliar	9.7	2.9	0	9	52	168	13	242
3	**Evito** in-furrow and foliar	9.0	2.9	1	9	49	177	10	245
4	**Headline SC** in-furrow and foliar	10.0	3.0	0	10	69	178	8	265
5	**Fontelis** in-furrow and foliar	10.1	2.8	0	4	47	198	11	260
6	**Velum Rise** in-furrow & **Luna Tranquility** foliar	9.4	2.9	0	6	52	189	9	256
7	**Velum Rise** in-furrow & **Revus top** foliar	9.7	3.0	0	10	67	175	6	257
8	**Velum Rise** in-furrow & **Provysol** foliar	9.2	2.9	0	9	49	181	9	248
9	**Velum Rise** in-furrow & **Miravis Prime** foliar	9.3	3.0	0	9	59	186	9	263
	ANOVA p-value	0.62	0.76	0.46	0.88	0.50	0.23	0.60	0.40

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