Effect of inoculum source and Quadris™ application on the development of potato black dot

Nadav Nitzan, Tom Cummings, and Dennis Johnson
Department of Plant Pathology, Washington State University, Pullman

Introduction

Potato black dot, caused by *Colletotrichum coccodes*, is a concern in many potato areas worldwide, and may cause up to 30% yield reduction on susceptible cultivars. The relative role of inoculum sources of the pathogen, and the effect on yield is not well understood. Inoculum sources for black dot development in the field may be either one or a combination of soil-, seed-, and air-borne. A main source of inoculum is possibly infected tubers. These tubers may spread the pathogen in old, and to new production areas, and when introduced to soil the fungus may establish to become soil-borne. Similar processes may occur with infected plant debris introduced to soil at the end of each growing season. To date, no specific fungicides have been developed to control black dot, and even those that proved effective in the laboratory failed under cropping conditions in field experiments. In the present two-year field study, the contribution of seed- and soil-borne inocula to potato black dot development was examined; and the efficacy of QuadrisÔ (Syngenta) to suppress black dot incidence was tested.

Materials and Methods

Trials were conducted at the Washington State University research station near Othello, during the 2002 and 2003 growing seasons in a randomized complete block design with four repetitions. The black dot susceptible cultivars Russet Burbank (RB), and Russet Norkotah (NK) were used, with two seed-tuber generations, G1 and G3. During the 2002 trial one lot of G1/NK, and two different lots of G3/RB (RB1, and RB2) were tested. During the 2003 trial one lot of NK, and one lot of RB were tested with two seed-tuber generations G1, and G3 for each cultivar.

The initial black dot incidence on G1/NK seed-tubers was 0%, and 2% in 2002 and 2003, respectively; and 16% on G1/RB seed-tubers in 2003. Black dot incidence on G3/NK seed-tubers was 14% in 2003; and 41%, and 49% on G3/RB seed-tubers in 2002 and 2003, respectively.

The 2002 trial was planted on April 18th, vine beat on September 6th, harvested and graded on September 16th. The 2003 trial was planted on April 15th, vine beat on October 1st, harvested and graded on October 3rd. Fungicides were applied in four occasions in the following manner: in furrow at time of planting, and on June 16th, July 8th, and July 18th as foliar applications in 2002; and in furrow at time of planting, and on June 18th, July 9th, and July 23rd as foliar applications in 2003. QuadrisÔ Applications were carried out with a six nozzle CO_2 backpack boom sprayer, TXVS-18 ConeJetÒ nozzle, 40 GPA, at 30 psi.

Results and Discussion

Black dot incidence was reduced by the application of QuadrisÔ (Tables 1, and 2). Yield was increased, in the 2003 trial, by 23% for G3/NK, and by 15% and 11% for RB G1 and G3, respectively, compared to non-treated controls. QuadrisÔ application suppressed stem colonization by 60 - 80% in both NK, and RB G1 and G3 during 2002, and 2003 trials. The incidence of infected progeny tubers was also reduced by 50 – 100% on both cultivars in both trials.

Concerning the contribution of inoculum sources to disease development we observed in the 2003 trial that stem colonization was higher on G3, with 44% and 26% on NK and RB, respectively compared to the G1 controls. These results indicate that soil-borne inoculum may contribute up to 37% to disease development, whereas seed-borne may add an additional 10% as indicated by the above ground colonization of stems (Table 2). The incidence on tuber progeny was 86% higher in G1/NK compared to G3 controls, and 20% higher on G3/RB compared to G1 controls. These observations indicate that soil-borne inoculum may have a more diverse contribution, with possibly a cultivar specific response as observed from the incidence on G1/NK progeny in the 2003 trial.

Table 1: Effect of inoculum source, and Quadris application on potato black dot development - 2002 field trial [a]

Treatment [b]	Total yield (cwt/ acre)	Stem colonization (%) [c]		Infected daughter tubers (%) [d]
		Above ground	Below ground	
NK-G1, control	475	43.0 ab	13.7 a	13.7 a
NK-G1, Quadris	371	15.75 bc	0.0 b	0.0 b
RB1-G3 control	434	4.25 c	1.25 b	1.25 b
RB1-G3 Quadris	460	0.0 c	0.0 b	0.0 b
RB2-G3, control	426	49.75 a	5.0 ab	5.0 ab
RB2-G3, Quadris	477	5.25 c	2.5 b	2.5 b

Table 2: Effect of inoculum source, and Quadris application on potato black dot development - 2003 field trial [a]

Treatment	Total yield (tons/ha) [e]	Stem colonization (%)		Infected daughter tubers (%)	AUDPC [f]	Plant Height (cm) [g]
		Above ground	Below ground			
NK-G1, control	65.8 a	10.2 ab	36.7 a	8.7 a	811 c	76.3 a
NK-G3, control	41.9 b	19.7 a	35.5 a	1.25 b	1936 a	42.0 b
NK-G3, Quadris	55.0 ab	1.0 b	14.0 a	1.25 b	1725 b	51.8 b
RB-G1, control	82.0 bc	28.0 ab	36.0 a	7.5 ab	762 a	83.4 a
RB-G1, Quadris	95.7 ab	7.25 bc	5.25 b	1.0 b	568 b	84.1 a
RB-G3, control	86.3 abc	38.2 a	37.5 a	10.0 a	692 ab	86.8 a
RB-G3, Quadris	97.3 a	8.25 bc	10.5 b	0 b	601 b	80.7 a

[a] Statistical analysis was carried out using the general linear procedures (GLM), SAS software Inc.; means were separated with the t-tests (LSD), a=0.05. Different lowercase letters within a column indicate significant statistical differences

[b] NK = Norkotah Russet, RB = Russet Burbank, (RB1 = lot 1, RB2 = lot 2), G1, G3 = seed generation 1, and 3, respectively

[c] 5 cm of above ground, and 5 cm of below ground parts of the stem were cut into segments (~1cm), and were placed onto modified PDA. Incidence of infected segments was evaluated. Sample size per treatment, n = 12

[d] Stolon end of tubers were cut and placed onto modified PDA. Incidence of infected tubers was evaluated. Sample size per treatment, n = 80

[e] NK-G3 Quadris, and NK-G3 control were significantly different by single degree of freedom contrast p=0.044

[f] AUDPC = Area under disease progress curve. LSD value for NK = 156.2; LSD value for RB = 128.02

[g] Length of main stem from soil surface to highest leaf was measured 87 days after planting