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Short communication

Evaluation of fungicide seed treatments on flax cultivars differing in seed color

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Abstract

Fungicide seed treatments were evaluated in field trials on the flax (*Linum usitatissimum*) cultivars Omega (yellow-seeded) and York (brown-seeded) at Langdon and Carrington, ND in 2003 and 2004. Fungicide seed treatments reduced root rot severity compared to the untreated control in only one of the four environments tested, but did not have any effects on stand or yield. Root rot severity was greater in the cultivar Omega compared to York in two of the four environments tested. Yield differences between the cultivars occurred in two of the environments with Omega having greater yield than York at Langdon in 2003 and York having greater yield than Omega at Carrington in 2004. Although yellow-seeded flax cultivars have been previously reported as having reduced stand compared to brown-seeded cultivars, we did not observe these differences in the cultivars tested in this research.

Keywords: Captan; Dithane; Flax; Fludioxonil; Fungicide; Linseed; *Linum usitatissimum*; Mancozeb; Maxim; Seed color; Seed treatment; Thiram

1. Introduction

North Dakota has had the greatest flax (*Linum usitatissimum* L.) hectarage of all states in the United States of America for many years. Recently, flax production in North Dakota has experienced an increase with 32,375 ha planted in 1996 to over 360,000 ha planted in 2005 (North Dakota Agricultural Statistics Service, Fargo, ND). As flax production has increased within the state, the presence of diseases such as pasmo (*Septoria linicola*) (Halley et al., 2004), Fusarium wilt (*Fusarium oxysporum*), and root rot diseases (Bradley and Halley, personal observations) have also been observed more frequently.

The flax cultivar Omega (Miller et al., 1992) has become popular in North Dakota since its release as a yellow-seeded cultivar. In spite of its popularity, some growers in certain regions of the state have observed cultivar Omega as having some vigor problems. Many reports of lower seed germination, emergence, and vigor of yellow-seeded flax cultivars versus brown-seeded flax cultivars have been made in other flax production regions (Comstock et al., 1963; Culbertson and Kommedahl, 1956; Culbertson et al., 1960; Reitz et al., 1947; Saeidi and Rowland, 1999a,b). Yellow-seeded flax cultivars may also be more prone to cracking during threshing, which may increase their susceptibility to pathogens (Culbertson and Kommedahl, 1956; Rashid, 2003).

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Fungicide seed treatments have been investigated as a way of increasing the germination and emergence of yellow-seeded flax cultivars. Reitz et al. (1947) and Culbertson and Kommedahl (1956) reported that emergence of both yellow-seeded and brown-seeded flax cultivars were improved when seeds were treated with different fungicides. Comstock et al. (1963) reported that germination was improved more in yellow-seeded versus brown-seeded cultivars when seeds were treated with captan fungicide, but Culbertson et al. (1960) found that captan seed treatment had no effect on germination of either yellow or brown-seeded flax cultivars. In North Dakota, limited information is available on the performance of registered fungicide seed treatments on flax. The objective of this research was to evaluate the effect of fungicide seed treatments on yellow-seeded and brown-seeded flax cultivars.

2. Materials and methods

Field trials were established at Langdon and Carrington, ND in 2003 and 2004. Seeds of the flax cultivars Omega (yellow-seeded) (Miller et al., 1992) and York (brown-seeded) (Hammond et al., 2004) were either left untreated or treated with one of the following fungicide seed treatments: fludioxonil (Maxim 4 FS, Syngenta Crop Protection, Greensboro, NC) at 5 g a.i./100 kg seed; thiram (Thiram 42 S, Bayer CropScience, Research Triangle Park, NC) at 63 g a.i./100 kg seed; captan (Captan 400, Bayer CropScience) at 117 g a.i./100 kg seed; mancozeb (Dithane 75 DF, Dow AgroSciences, Indianapolis, IN) at 356 g a.i./100 kg seed. Flax seeds were treated with slurries of the fungicides with a batch lab seed treater (Seedburo Equipment Company, Chicago, IL); 1 kg of seed was treated with each fungicide approximately 2 weeks prior to planting. These fungicide seed treatments were chosen because they represent all of the fungicides currently registered for flax seed application in North Dakota (McMullen and Bradley, 2006).

Plots were planted 28 April 2003 and 2 May 2004 at Langdon, and 16 May 2003 and 10 May 2004 at Carrington at a seeding rate of 750 live seeds/m^2. Plots at Langdon were seven rows wide and 5 m long with 15 cm row spacings. Plots at Carrington were seven rows wide and 6 m long with 18 cm row spacings. Plots were arranged as a factorial in a randomized complete block design with six replications at Langdon and four replications at Carrington. Plant stand was measured 30 days after planting by counting the number of plants emerged in two 1 m sections of each plot and calculating the number of plants/m^2. Ten consecutive plants from each plot were dug from the middle row 60 days after planting and taken to the laboratory for root rot severity ratings. In the laboratory, roots were carefully washed and visually scored for incidence (% plants with root rot symptoms) and root rot severity using a 0 to 4 scale, where 0 = apparently healthy roots; 1 = dark discoloration on <25% of the roots; 2 = dark discoloration on 25–50% of the roots; 3 = dark discoloration on >50% of the roots; 4 = completely discolored roots/dead plant. After roots were scored for root rot severity, representative root samples were surface-sterilized with a 0.5% solution of NaOCl for 1 min, rinsed with sterilized distilled water, and placed on streptomycin sulfate – amended (200 mg/L) potato dextrose agar for isolation of fungal pathogens. Plots were harvested with a small plot combine and yields were calculated and adjusted to 9% moisture.

Data were analyzed using the general linear model procedure (PROC GLM) in SAS (SAS Institute, Inc., Cary, NC). Fisher's protected least significant difference test ($\alpha = 0.05$) was used to compare means.

3. Results

Due to significant ($P \leq 0.05$) environment (location-year) effects, data are presented by environment. No significant cultivar × seed treatment interactions were detected; therefore, main effects only are presented.

No significant ($P \leq 0.05$) differences occurred among seed treatments for stand or yield in any of the environments (Table 1). Significant differences among seed treatments occurred at Langdon in 2004, but not for any of the other environments. At Langdon in 2004, plots treated with mancozeb had significantly less root rot incidence than all of the other treatments, and the untreated control had significantly greater root rot severity than all of the fungicide seed treatments.

No significant ($P \leq 0.05$) differences were detected between cultivars for stand in any of the environments (Table 2). Root rot (both incidence and severity) was significantly greater on the cultivar Omega at Langdon and Carrington in 2003; no significant differences were detected between cultivars for root rot incidence or severity at Langdon and Carrington in 2004. Yield of cultivar York was significantly greater than Omega at Langdon in 2003; however, yield of cultivar Omega was significantly greater than York at Carrington in 2004. No significant yield differences were detected between cultivars at Langdon in 2004 and Carrington in 2003. Isolations made from discolored roots yielded *F. oxysporum*, *F. graminearum*, and other *Fusarium* spp.; no other known fungal pathogens were isolated.