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Emergence of cuphea seeds treated with different fungicides

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ABSTRACT

Cuphea (*Cuphea viscosissima* Jacq. × *C. lanceolata f. silenoides* W.T. Aiton, Lythraceae) is an oilseed crop, with medium-chain fatty acids, being developed for the North Central United States for industrial applications in the manufacture of soaps and detergents. Seed germination and seedling emergence of cuphea is often low when compared to the commercial crops. Identification of seed treatments to optimize seedling emergence and stand establishment for cuphea are important for commercial production. The objective of this study was to determine the effect of several fungicide treatments on pure live seed emergence (PLSE) of cuphea. Pure live seed emergence is defined as total seedling emergence adjusted by the germination of the seed planted. Field experiments were conducted at Prosper, ND and Glyndon, MN, in 2005 and 2006. Previous crop rotations were soybean [*Glycine max* (L.) Merr.]/hard red spring wheat (*Triticum aestivum* L.), and soybean/hard red spring wheat/sugarbeet (*Beta vulgaris* var. *saccharifera* L.) at Prosper and Glyndon, respectively, for both years. The experimental design was a randomized complete block with six treatments and four replicates. Treatments were: no fungicide applied (check treatment), captan, mefenoxam, fludioxonil + mefenoxam, azoxystrobin, and azoxystrobin + mefenoxam. Plant stand was counted and PLSE was calculated 10 to 15 d after seeding at all locations by counting emerged seedlings in the center two-plot-rows and adjusting PLSE for germination. Greenhouse experiments were conducted with soil treatments (pasteurized and non-pasteurized) and the same fungicide seed treatments as the field experiment. Pure live seed emergence, vigor index, and percent of diseased seedlings were recorded. Plant stand and PLSE were significantly greater for the seed treatments that had mefenoxam at the Glyndon, MN, environments, in which the previous crop was sugarbeet. Soil treatment (pasteurization) increased PLSE and vigor index. All fungicide seed treatments improved PLSE and vigor index and reduced damping-off compared to the untreated check. Results suggest that seed treatments including mefenoxam would be beneficial for commercial cuphea production.

1. Introduction

Cuphea, an annual oilseed crop with medium-chain fatty acids, is being developed for the North Central United States for industrial applications in the manufacturing of soaps, detergents, cosmetics, and sunscreens (Kleiman, 1990; Brown et al., 2007). Cuphea oil could replace imports of coconut (*Cocus nucifera* L.) and palm (*Elaeis guineensis* Jacq.) oils to the United

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Fig. 1 – Cuphea 'PSR23' flowers, capsules, and seeds.

States. Cuphea has been undergoing domestication since the late 1970s (Knapp, 1993), and the development of crop production management strategies for cuphea began in 1999 (Gesch et al., 2005, 2006). Most production research studies have been conducted with cuphea germplasm 'PSR23' (Fig. 1) Cuphea PSR23 is an interspecific hybrid between *C. lanceolata* and *C. viscosissima*, and is partially non-shattering (Knapp and Crane, 2000). Progress has been made towards the successful cultivation of cuphea in the North Central United States (Sharratt and Gesch, 2002, 2004; Gesch et al., 2002a,b, 2005, 2006; Forcella et al., 2005), but a continuing problem is poor seedling establishment (Gesch et al., 2006). Low soil temperatures in the spring, limited or excess soil moisture, and pathogens in the soil may all reduce seedling emergence. Reduced plant stands were reported when cuphea was planted on 15 April in Morris, MN due to low soil temperatures (below 10 °C) (Gesch et al., 2002c). Seed germination and seedling emergence of cuphea, a new crop, are often low compared with other commercial crops where fungicide seed treatments are used. Pure live seed emergence is used to determine the effective emergence in crops to correct for differences in seed lot germination. Pure live seed emergence of canola (*Brassica napus* L.) is approximately 70% when seeded at 25 mm or less depth (Lamb and Johnson, 2004), whereas PLSE of cuphea can range between 5 and 25% at a range of seeding depths (Berti et al., 2008). Cuphea plant stands generally are poor when sugarbeet is the previous crop (personal communication, Russ Gesch), thus it is likely that pathogens causing seed rot and damping-off in sugarbeet also are affecting cuphea emergence and stand establishment.

Fungicide seed treatments such as azoxystrobin, captan, fludioxonil, and mefenoxam are registered for control of seedling blights and damping-off of many broadleaf crops in North Dakota caused by pathogens such as *Fusarium*, *Phytophthora*, *Pythium*, and *Rhizoctonia* (McMullen and Bradley, 2007). Azoxystrobin and captan have been reported to have efficacy against *Fusarium*, *Phytophthora*, *Pythium*, and *Rhizoctonia* (Hewitt, 1998; Kiewnick et al., 2001; Bartlett et al., 2002; Stump et al., 2002; Ramirez et al., 2004; Windels and Brantner, 2005; Meyer et al., 2006; Broders et al., 2007a,b). Fludioxonil has been reported to have efficacy against *Fusarium* and *Rhizoctonia* (Hewitt, 1998; Uesugi, 1998; Munkvold and O'Mara, 2002; Meyer et al., 2006; Broders et al., 2007b). Mefenoxam has efficacy only on pathogens from the Oomycete class such as *Phytophthora* and *Pythium* (Hewitt, 1998; Uesugi, 1998).

Identification of fungicide seed treatments that will optimize seedling emergence and stand establishment is critical for successful commercial cuphea production. The objective of this study was to determine the effect of five fungicide seed treatments on cuphea PLSE, plant density, and seed yield.

2. Materials and methods

2.1. Field experiment

Experiments were conducted at the Prosper, ND research site associated with the North Dakota Agricultural Experimental Station at Fargo, ND (46°58′N, 97°3′W, elevation 280 m) on a Bearden silty-clay loam (fine-silty, mixed, superactive, Frigid Aeric, Calciaquolls) in 2005, and 2006, in a producer's field near Glyndon, MN (46°48′N, 96°35′W, elevation 282 m) on a Glyndon loam (coarse-silty, mixed, superactive, Frigid Aeric, Calciaquolls) in 2005, and on a Borup loam (coarse-silty, mixed, superactive, Frigid Typic, Calciaquolls) in 2006. Previous crop rotations were soybean/wheat and soybean/wheat/sugarbeet, at Prosper and Glyndon, respectively. The experiments followed wheat and sugarbeet at Prosper and Glyndon, respectively, both years. The experimental design was a randomized complete block with six treatments and four replicates. Plots consisted of six rows spaced 0.31 m apart and 4.5 m in length. Cuphea was sown at 21 kg ha^{-1} pure live