Field evaluation of biological control and fungicide seed treatments for pre-emergence damping off of chickpeas

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Pre-emergence damping off of chickpeas is a disease caused by a complex of soil-borne pathogens (1). In Montana, an increasing number of growers are interested in growing chickpeas organically, especially the kabuli varieties. Montana has the greatest number of acres devoted to organic wheat production in the United States (2), and organic chickpeas have the potential to be a profitable rotation crop. A number of fungicide seed treatments for pre-emergence damping off are available (3-5), but growers cultivating chickpeas organically can not use fungicide seed treatments. Organic growers could use biologically based seed treatments, but little data exists regarding the efficacy of biocontrol seed treatments for chickpeas in Montana. However, tests of the biological seed treatment Kodiak (*Bacillus subtilis* GB03) in Colorado indicated success for this seed treatment (6). Beyond the use of biological seed treatments in organic systems, they could also be used by conventional growers for chickpeas as part of an integrated strategy for disease control.

The objective of this research was to determine which biological and conventional seed treatments would be the most useful for both conventional and organic chickpea growers. Biocontrol seed treatments were tested alone and in combination with conventional seed treatments to determine if commercially available biological control seed treatments would be effective for managing pre-emergence damping off. Furthermore, this research sought to determine if biologically based seed treatments, whether used alone, or in combination with standard fungicide seed treatments, would affect other measures of plant health, ultimately leading to increased yield over untreated seeds and seeds treated solely with standard fungicides.

Seed treatments were tested on both kabuli and desi varieties. Winter greenhouse results indicated that desi varieties were less susceptible to pre-emergence damping off than kabuli varieties. Five replicates of twelve seeds each of a desi variety (CDC-Anna) and a kabuli variety (Dylan) were planted in sterile and non-sterile field soil obtained from a chickpea field in Big Sandy, Montana. Germination of the desi and kabuli seeds in sterile field soil were 84% and 70% respectively, whereas germination of desi and kabuli seeds in non-sterile field soil were 80% and 0% respectively. Results were averaged over two repetitions of the experiment. In collusion with these results, the desi variety (CDC-Anna) was also less susceptible to pre-emergence damping off than the kabuli (Sierra) variety in field trials.

The biological seed treatments Actinovate SP (*Streptomyces lydicus* WYEC108), Kodiak (*Bacillus subtilus* GB03), Mycostop (*Streptomyces griseoviridis* K61), Subtilex (*Bacillus subtilus* MB1600), T-22 (*Trichoderma harzanium* Rifai strain KLR AG-13), and Yield Shield (*Bacillus pumilus* GB34), as well as the fungicide seed treatments Apron XL LS (metalaxyl/mefanoxam) and Maxim (fluidoxonoil) were tested in greenhouse experiments to determine which were most effective for managing pre-emergence damping off cause by *Pythium ultimum*. Kodiak, T-22, and Yield Shield were the most effective biological seed treatments for reducing pre-emergence damping off and increasing stand counts over the untreated control. Apron XL LS was the most effective fungicide treatment and the most effective seed treatment overall for reducing pre-emergence damping off caused by *Pythium ultimum* in the greenhouse.

Seed treatments were tested at three field sites near Bozeman, Huntley, and Sidney, Montana in the summer of 2007. Each biological and conventional seed treatment was tested alone, as well as in combination with one another to determine if biological and conventional seed treatments would provide additive benefits. Treatments tested were as follows: Kodiak, T-22, Yield Shield, Apron, Maxim, Apron+Kodiak, Apron+T-22, Apron+Yield Shield, Maxim+Kodiak, Maxim+T-22, and Maxim+Yield Shield. All seed treatments were applied at the manufacturer's highest recommended rates two days prior to planting.

Table 1. Seed treatments tested for management of pre-emergence damping off of chickpeas

Treatment	Active ingredient	Type	Rate
Kodiak	*Bacillus subtilis* GB03	biological control	.125 oz/cwt
T-22	*Trichoderma harzanium* Rifai strain KLR AG-13	biological control	8 oz/cwt
Yield Shield	*Bacillus pumilus* GB34	biological control	.125 oz/cwt
Apron XL LS	metalaxyl/mefanoxam	fungicide	.64 oz/cwt
Maxim	fluidoxonil	fungicide	.16 oz/cwt

Stand counts of chickpea seedlings were obtained at each of the field sites approximately three weeks after planting. Desi variety CDC-Anna had low incidence of pre-emergence damping off and few significant differences in stand count between the control and seed treatments at all three sites. For the kabuli variety Sierra, seed treatments containing Apron were most effective for reducing pre-emergence damping-off and increasing stand count. On average, at Bozeman, seed treatments containing Apron increased Sierra stand counts by 60%, at Huntley 38%, and at Sidney, where the germination period was cool and wet and disease pressure severe, 900%. Stand count for seeds treated with biological controls generally did not differ significantly from the untreated control.

Ascochyta blight was rated in plots to determine if biological controls would have any plant health effects including induced systemic resistance (7). Plots were monitored and rated for Ascochyta blight using a 1-9 scale (8) before foliar fungicide applications (Proline 480 and Quadris Opti SC) to control Ascochyta blight. Prior to applications of fungicides, disease ratings did not differ significantly from the untreated control plot at any of the locations. Ratings were taken every 7-10 days following the first fungicide application, and the overall AUDPC (area under the disease progress curve) calculated (9). Seed treatments did not consistently lower the severity of Ascochyta blight at any of the three locations. Other measures of plant health such as plant height, plant weight, seed size and yield indicated no differences between seed treatment plots and untreated control plots.

Although significant differences in stand counts for seed treatments were observed, there were few consistent significant yield differences for the desi or kabuli varieties. At Sidney, no yield data was collected for the kabuli variety Sierra, due to extremely low initial stands.

Biocontrol seed treatments were ineffective for managing pre-emergence damping-off of kabuli chickpeas in Montana. Desi chickpeas incurred low incidence of pre-emergence damping off and few significant differences in stand count were observed at any of the three locations in this study. Seed treatments containing the fungicide Apron XL LS were most effective for increasing stand count. Despite differences in stand count, there were few significant differences in seed quality or yield.

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