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Effect of different soil amendments and bio agents on development of dry root rot (DRR) diseases of chickpea caused by *Rhizoctonia bataticola* (*M. phaseolina*)

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Abstract

Chickpea (*Cicer arietinum* L.) is one of the important pulse crops of India. Occurrence of dry root rot (DRR) caused by *Rhizoctonia bataticola* (Taub.) Butler is emerging as a serious biotic constraint in recent years for successful and profitable cultivation of chickpea. The efficacy of various soil amendments and bio agents viz wheat straw @ 20g/kg of soil, bajra straw @ 20g/kg, mung bean straw @ 20g/kg, mustard cake @ 5g/kg, ground nut cake @ 5g/kg and farm yard manure @ 20g/kg of soil as mixture with soil and *Trichoderma viride* @ 4gm/kg seed, *T. harzianum* @ 4gm/kg seed, *T. virens* 0.5 gm/kg seed & *Bacillus subtilis* @ 6gm/kg as seed treatment respectively were evaluated against *Rhizoctonia bataticola* causing root rot in Chickpea. Study of DRR in chickpea done under both pot and field condition during years 2018-2019 and 2019-2020. Soil amendment with mustard cake amendment was found most effective in reducing the disease incidence (33.33 & 38.33%) during both years (2018-2019 & 2019-2020) of study followed by wheat straw, bajra straw and FYM. Among the bio agents *Trichoderma viride* (24.44 & 26.66%) was found most effective in minimizing DRR incidence and mean pathogen propagules g⁻¹ soil (1.16 x 10³) during both years of study.

Keywords: Bio agents, chickpea, dry root rot, organic amendments, *Rhizoctonia bataticola*

Introduction

Chickpea, *Cicer arietinum* L. is one of the most important pulse crop of India It occupies very important position in semi-arid farming system both for human nutrition and restoring the soil fertility (Singh and Sirohi, 2003) [1]. Total production of chickpea 7060.00 thousand tonnes in year 2015-16 and 43.18 per cent share in Total production of pulses (Anonymous 2019) [1]. Crop plays an important role in the economy of the state on account of low and static yield levels. In the state of Rajasthan the crop is grown mainly on the receding soil where moisture is conserved from the rain received prior to the chickpea growing season. India is the world leader in chickpea production. The chickpea crop is attacked by 172 pathogens (67 fungi, 22 viruses, 3 bacteria, 80 nematodes and mycoplasma) from all over the world (Nene *et al.* 1996) [4]. Dry root rot incited by *Rhizoctonia bataticola* (*M. phaseolina*) has been found prevalent in such chickpea growing tracts of the state that is a serious threat to the chickpea growers. However no detailed work seems to have been done on dry root rot in Rajasthan hence an attempt has been made to study the effects of soil amendments and bio-agents on dry root rot of chickpea at Jagan Nath University Chaksu, Jaipur.

Materials and Methods

Soil was amended with six different types of organic materials including four crop straw two oil cakes and farm yard manure (FYM). Straw and cakes each individually were thoroughly ground and mixed in the form of powder in pot house condition. Soil was amended 15 days earlier to sowing and then inoculated with the pathogen. The pots were irrigated at an interval of 6 days with equal amount of water i.e.400 ml/pot. The organic material used for soil amendment are wheat straw at 20g/kg of soil, bajra straw at 20g/kg, mung bean straw at 20g/kg, mustard cake at 5g/kg, ground nut cake at 5g/kg and farm yard manure at 20g/kg of

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soil. Observation on disease incidence was recorded. Pathogen population was estimated in terms of propagules (CFU) g^{-1} of soil from samples drawn from each treatment. Four replications of each treatment were maintained.

Dust formulations of four antagonistic bio agents were tried against dry root rot of chickpea pathogen, in the form of seed treatment. Six replications (6 pots) of each bio agent treatment were maintained. Before applying bio agents on the surface of the seeds, seeds were moistened with 5 per cent gum solution applied at 10 ml kg^{-1} of seed. Fifteen surface sterilized seeds of chickpea variety ICC -4951 were sown in each of the 5 earthen pots (30 cm. Diameter) under each treatment. The pots were surface sterilized with 2 per cent formalin solution and after 24 hours filled with inoculums mixed soil at 10 per cent w/w. The inoculums of *Rhizoctonia bataticola* was multiplied on sand maize meal soil medium 1:10 (Semenuk, 1944) [8]. Each pot containing 7 kg of soil was inoculated with inoculums at 700 g per pot. The pots were filled with inoculated soil in the same proportion using most virulent pathogen of *R. bataticola*. The detail of the bio agents used are *Trichoderma viride* at 4g/kg seed *Trichoderma harzianum* at 4g/kg, *Trichoderma virens* at 0.5 g/kg and *Bacillus subtilis* at 6 g/ kg seeds. Observations for occurrence of the disease were commenced after 15 days of sowing and continued up to 75 days. Mycelia population per gram of soil were assessed. The observations on root rot incidence prior to harvest were recorded at one month interval and done statistically analyzed and also taken chickpea yield data. Root rot incidence (%) in each treatment was calculated using following formula.

Root rot incidence (%) = $\frac{\text{Number of diseased plant} \times 100}{\text{Total number of plants observed}}$

Results and Discussion

Soil was amended with four crop straws, two oil cakes and farm yard manure. It is evident in the data presented in table-1 that all the amendments provided significant reduction in disease incidence except chickpea and mung bean straws. Mustard cake amendment was found most effective in reducing the disease during both years of testing. The incidence was noted to be 33.33 and 38.33 per cent as compared to 56.66 and 59.99 per cent in control (un amended soil) during 2018-19 and 2019-20, respectively. This treatment was followed by wheat straw, bajra straw and FYM, which were statically at par with each other in efficacy. (Table-1) Pathogen population was recorded to be minimum (1.10×10^3 propagules g^{-1} soil) when soil was amended with mustard cake followed by wheat straw with population 1.30×10^3 propagules g^{-1} of soil.

Four bio agents were evaluated as seed inoculants in pots for their efficacy against dry root rot. All bio agents were found significantly superior in minimizing the disease over control. *Trichoderma viride* was found most effective, exhibiting the lowest disease incidence of 24.44 and 26.66 per cent as against 52.22 and 55.51 per cent in check during 2018-19 and 2019-20, respectively. This was closely followed by *Trichoderma harzianum* attaining root rot incidence of 32.21 and 33.33 per cent in both the years of testing. *T. harzianum* was significantly at par with that of *T. Viride*, in efficacy. Pathogen population was the least in *T. Viride*, (1.16×10^3 propagules g^{-1} of soil) followed by *T. harzianum* having

population of 1.32×10^3 propagules g^{-1} soil (Table-2).

Effect on certain organic substrates applied in to soil was observed on disease development. All the soil amendments significantly reduced the occurrence of root rot incidence of chickpea except mung bean and chickpea straw. Mustard cake amendment was found to be most effective in reducing the disease followed by wheat straw, bajra straw and farm yard manure. The least number of pathogen propagules were recorded when soil was amended with mustard cake followed by wheat straw Snyder *et al.* (1959) [13]. Davey and Papavizas (1960) [2] reported that *R. bataticola* root rot of beans was suppressed substantially by soil amendment with mature barley straw, wheat straw and by mature crops of soybean, maize and oats. Ratnoo and Bhatnagar (1993) [7] reported a reduction in disease incidence of cowpea (*M. phaseolina*) by wheat straw amendment. While Sharma *et al.* (1995) [9] recorded a reduction in population density of *M. phaseolina* by mustard cake and cauliflower residues. Hundekar *et al.* (1998) [3] found neem cake, cotton cake, groundnut cake and safflower cake effective in reducing disease intensity of sorghum stalk rot induced by *M. phaseolina*. They also observed that wheat straw and paddy straw could reduce the disease to some extent. The effect organic amendments on the activity of pathogenic fungi could be attributed to CO₂ accumulation and non availability of nitrogen. Volatile compounds present in oil cakes and increase of saprophytic mycoflora which are inhibitory to the pathogen in amended soil (Stover, 1962) [12]. In the present studies, significant reduction in disease due to soil amendments with mustard cake and wheat straw, are in accordance with the earlier findings of Snyder *et al.* (1959) [13], Dave and Papavizas (1960) [2] and Sharma *et al.* (1995) [9]. Effectiveness of these amendments may be due to no availability of nitrogen or increase in saprophytic mycoflora which might have inhibited the activity of pathogen (Stover, 1962) [12]. However enhanced susceptibility due to amendments with chickpea and mung bean straws could be attributed to increase availability of nitrogen to the pathogen (Singh *et al.* 1981) [10].

All the four bio agents tested were found significantly superior in reducing dry root rot incidence. *Trichoderma viride* was found most effective in inhibiting the *Rhizoctonia bataticola* population and consequently reducing the disease incidence, followed by *Trichoderma harzianum*. Parkhia and Vashnav (1986) [5] found that *T. harzianum* was effective against *R. bataticola* root rot of chickpea. A reduction in stem blight incidence of cowpea induced by *M. phaseolina* was noted by *T. viride*. While in black gram, seed treatment with *T. viride* at 4 g kg^{-1} of seed was sufficient to reduce the population of root rot pathogen and its incidence (Raghuchandra *et al.* 1995) [6]. The present studies are in conformity of the findings reported as above.

Conclusion

Soil was amended with four crop straws, two oil cakes and farm yard manure. Mustard cake amendment was found most effective in reducing the disease during both years of testing. This treatment was followed by wheat straw, bajra straw and FYM, among the bio agents *Trichoderma viride* was found most effective. This was closely followed by *Trichoderma harzianum* in reducing dry root rot incidence.

Table 1: Effect of different soil amendments on development of dry root rot of chickpea induced by *R. bataticola* (*M. phaseolina*)

Treatment	Dose g kg ⁻¹ soil	Dry root rot incidence		Mean propagules g ⁻¹ soil
		2018-19	2019-20	
Wheat straw	20	41.66 (40.14)	43.33 (41.49)	1.30 x 10 ³
Bajra straw	20	43.33 (41.14)	44.99 (42.09)	1.40 x 10 ³
Mung bean straw	20	53.33 (46.90)	56.66 (48.83)	1.54 x 10 ³
Chickpea straw	20	54.99 (47.86)	58.33 (49.80)	1.54 x 10 ³
Mustard cake	5	33.33 (35.19)	38.33 (39.18)	1.10 x 10 ³
Groundnut cake	5	48.32 (44.01)	49.99 (44.97)	1.49 x 10 ³
FYM	20	43.33 (41.14)	44.99 (42.05)	1.42 x 10 ³
Control		56.66 (48.83)	59.99 (50.78)	1.60 x 10 ³

SEm ± 1.33 1.16
 CD (P= 0.05) 3.90 3.40

*Mean of four replications (Figures in parentheses are angular transformed values)

Table 2: Effect of antagonistic bioagents applied through seeds on development of dry root rot of chickpea induced by *R. bataticola* (*M. phaseolina*)

Treatment	Dose g kg ⁻¹ soil	Dry root rot incidence		Mean propagules g ⁻¹ soil
		2018-19	2019-20	
<i>Trichoderma viride</i>	4	24.44 (29.34)	26.66 (30.75)	1.16 x 10 ³
<i>Trichoderma harzianum</i>	4	32.21 (34.57)	33.33 (35.06)	1.32 x 10 ³
<i>Trichoderma virens</i>	0.5	37.77 (37.87)	34.44 (35.79)	1.42 x 10 ³
<i>Bacillus subtilis</i>	6	39.99 (38.19)	42.21 (40.48)	1.48 x 10 ³
Control(Without treatment)	-	52.22 (46.36)	55.51 (48.20)	1.54 x 10 ³

SEm ± 1.71 2.21
 CD (P= 0.05) 5.0 6.44

*Mean of four replications (Figures in parentheses are angular transformed values)

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