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RESEARCH PAPER

In vivo management of seed borne pathogens in chickpea

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Abstract: A field experiment was carried out to study the effect of seed treatment with different fungicides on seed mycoflora at National Seed Project, UAS Raichur during *rabi* 2020-21. The experiment was laid out in a Randomized Block Design (RBD) with eleven treatments replicated thrice. The results revealed that, among the various fungicides used in the present study, seeds treated with *Trichoderma asperillum* @ 5 g kg^{-1} seed recorded significantly lowest seedling mortality (1.34%) at 20 DAS, wilt at flowering (2.10%), at pod setting (2.05%), at maturity (2.12%) and the total wilt of 7.61 percent. Further, this treatment was able to record the highest field emergence (97.1%), number of pods per plant (50.10), seed yield per plant (13.94 g) and seed yield (2667 kg^{-1} ha) compared to control (86.4%, 41.92, 10.86 g and 2226 kg, respectively).

Key words: Chickpea, Fungicides, Seed borne pathogens, Seed yield, Management, Wilt

Introduction

Chickpea (*Cicer arietinum* L.) a member of the family *Fabaceae* and sub family *Faboideae*. Among the pulses it is the third most important pulse crop in the world after bean (*Phaseolus vulgaris* L.) and field pea (*Pisum sativus* L.). It is popularly cultivated in sub-tropical and semi-arid to warm temperate regions under dry season. India is the largest producer of chickpea contributing to over 65 per cent of the world production occupying an area of 9.69 million hectares with a production of 11.91 million tonnes and with 1142 kg/ha productivity (Anon, 2021).

There are more than 50 pathogens known to attack chickpea; of which about 40 are of economic important. Many factors are involved in reducing chickpea yield and seed quality but a combination of susceptibility to pathogenic fungi, environmental condition that favour disease development and field deterioration of seed are the most important ones. Moreover, chickpea seeds are rich in protein and therefore get infected easily by several field and storage fungi; which not only affect seed quality but also emergence in the field. This crop is affected by many diseases, among them *fusarium wilt* (*Fusarium oxysporum* f. sp. *ciceri*), collar rot (*Sclerotium rolfsii*) and dry root rot (*Rhizoctonia bataticola*) mainly affect the crop growth and seed yield. *Fusarium wilt* epidemics can devastate the crop and can cause up to 100 percent loss in highly infested fields and under favourable conditions. Dry root rot is more dominant when the crop is exposed to moisture stress conditions. It can contribute to 50 – 100 per cent yield loss under favourable conditions (Gupta and sharma, 2015). Collar rot of chickpea caused by *Sclerotium rolfsii* may damage up to 30 percent of the chickpea productions (Shirsole *et al.,* 2018). Management of these seed borne diseases can be reasonably achieved through seed treatment with systemic, non-systemic fungicides and biological agents. Seed treatment plays an important role in protecting the seeds and seedlings from seed and soil borne diseases affecting seedling emergence and its growth.

Fungicides are chemical compounds or biocontrol agents used to kill parasitic fungi or their spores. Fungicides based on their translocation mode in plant, can either be contact, translaminar or systemic. A systemic fungicide is the one which is taken up by a plant and is then translocated within the plant system, it can there by protect the plant from infections and restrict or control further growth of existing fungal infection. Contact fungicides don’t enter the plant, but controls the fungi when it comes in contact with the fungi when it is applied. While, the translaminar fungicides redistribute the fungicide from the upper sprayed leaf surface to the lower unsprayed surface. Agriculture relies on the growth of seeds. They are the first stage in the lifecycle of a crop and if seeds fail to germinate, crops fail. Seeds face a lot of challenges from diseases to pests to environmental stresses. While seeds can overcome these on their own, the chances of success can be improved with seed enhancement. Seed treatment is one of the most effective ways to support the growth of seeds and reduce the challenges that they face.

Material and methods

The field experiment was conducted at National Seed Project, Seed Unit, University of Agricultural Sciences, Raichur during *rabi* 2021. The experiment was laid out in a Randomized Block Design (RBD) with eleven treatments *viz.*, T_1- Thifluzamide 24% SC (0.5 ml /kg), T_2- Carbendezim 50WP (2 g/kg), T_3- Thiram 75% WS (2 g/kg), T_4- Hexaconazole 5% + Captan 70% WP (2g/kg), T_5- Thiophanate Methyl 45%+ Pyraclostrobin 5% FS (2 ml/kg), T_6- Penflufen 13.28% w/w + Trifloxystrobin 13.28% w/w (1ml/kg), T_7- Mancozeb 50% + Carbendazim 25% WS (2 g/kg), T_8- Mancozeb 75% WP (2g/kg),T_9-Mancozeb 63% + Carbendazim 12% WP (2g/kg), T_{10}- *Trichoderma asperillum* (5g/kg) and T_{11}- Control replicated thrice. For each treatment one kilogram of seed was taken in a small rotary seed treater to which a little quantity of jagary solution was sprinkled in a rotating drum. Then the different fungicides as per the treatment and dosage

Table 1. Influence of seed treatment with different fungicides on field emergence, seedling mortality, wilt and seed yield of chickpea

Treatments	Field emergence (%) (15 DAS)	Seedling mortality (%) (20DAS)	Wilt (%)at flowering (45DAS)	Wilt (% at pod setting (60DAS)	Wilt(%) at maturity (90DAS)	Total wilt (%)	Number of pods per plant at harvest	Seed yield per plant (g)	Seed yield per plant (kg)
T_1: Thifluzamide 24 % SC	92.3 (73.93)*	2.65 (9.37)*	4.03 (11.58)	5.03 (12.96)	5.19 (13.17)	16.90 (24.27)	42.87	11.21	2374
T_2 : Carbendezim 50% WP	90.3 (71.88)	1.91 (7.94)	5.84 (13.98)	4.9 (12.85)	54.35 (12.04)	17.05 (24.39)	42.98	11.08	2386
T_3 : Thiram 75% WS	93.0 (74.65)	2.41 (8.93)	5.05 (12.99)	6.54 (14.82)	4.55 (12.32)	18.55 (25.51)	43.16	12.20	2425
T_4 : Hexaconazole 5% + Captan 70% WP	91.9 (73.45)	2.25 (8.62)	6.17 (14.38)	5.82 (13.96)	5.06 (13.00)	19.29 (26.06)	42.86	11.02	2433
T_5 : Thiophanate Methyl 45% + Pyraclostrobin 5% FS	94.6 (76.50)	1.58 (7.21)	3.50 (10.78)	4.52 (12.28)	3.13 (10.19)	12.73 (20.90)	49.88	13.24	2586
T_6 : Penflufen 13.28% w/w +Trifloxystrobin 13.28%w/w	95.7 (77.99)	1.85 (7.82)	3.36 (10.56)	3.63 (10.98)	4.22 (11.85)	13.06 (21.19)	49.22	13.08	2492
T_7 : Mancozeb 50% + Carbendazim 25% WS	95.1 (77.22)	1.72 (7.54)	4.17 (11.79)	4.92 (12.82)	4.18 (11.80)	14.99 (22.78)	44.33	11.95	2522
T_8 : Mancozeb 75% WP Carbendazim 25% WS	92.6 (74.16)	1.95 (8.03)	4.91 (12.80)	5.50 (13.56)	4.94 (12.84)	17.30 (24.58)	43.12	11.45	2444
T_9 : Mancozeb 63% + Carbendazim 12% WP	94.6 (76.50)	1.64 (7.36)	3.18 (10.27)	4.47 (12.21)	3.68 (11.06)	12.97 (21.11)	48.21	12.84	2612
T_{10} : *Trichoderma asperillum* Carbendazim 12% WP	97.1 (80.21)	1.34 (6.66)	2.29 (8.70)	3.31 (10.49)	2.49 (9.08)	9.43 (17.89)	50.10	13.94	2667
T_{11} : Control	86.4 (68.39)	3.85 (11.31)	6.42 (14.67)	6.62 (14.91)	6.42 (14.68)	23.31 (28.87)	41.92	10.86	2226
Mean	93.4 (74.71)	2.10 (8.34)	4.45 (12.17)	5.03 (12.96)	4.38 (12.08)	45.33	12.08	2470	
S.Em. ±	0.93	0.03	0.08	0.07	0.07	0.64	0.17	35	
C.D. at 5 %	2.74	0.10	0.23	0.22	0.20	1.89	0.50	104	

were added. The treating drum was rotated for 3 - 5 minutes until all the seeds were uniformly coated. Then these treated seeds were sown at the spacing of 30 x 10 cm, with a seed rate of 60 kg ha^{-1}. The gross plot size of 3 × 3 m^2 was maintained for each plot and the net plot of 1.8 × 2.6 m^2 was taken for consideration for harvesting the seed yield per plot after excluding the two lines on each side from the gross plot. All the recommended agronomical practices were followed during the experimentation. Observations on wilt percentage at different stage of crop and yield parameters were recorded during the course of the experiment. The experimental data obtained was analyzed using suitable stastical tools (Sundarrajan *et al*., 1972).

Results and discussion

An effective management of wilt at different stage of crop was achieved by using different fungicides and bio agents. The data presented in table 1 revealed that all the treatments were significantly superior over control in managing the wilt at different growth stages of chickpea. The seeds treated with *Trichoderma asperillum* @ 5g/ kg (T_{10}) registered significantly highest field emergence (97.1%) compared to all other treatments and (control- T_{11}, 86.4%). However, T_{10} was on par with T_5 (94.6%), T_6 (95.7%), T_7 (95.1%) and T_9 (94.6%). This might be due to seed treatment with *Trichoderma* which enabled higher field emergence by minimizing the pathogens activity present on seed surface or around it in the soil (Okoth *et al*., 2011). It could be attributed to the production of antifungal compounds and also growth regulating chytinolytic enzymes like glucanases and protease there by reducing pathogenic activity (Dubey *et al*., 2007). Further *Trichoderma* interferes with the pectolytic enzyme activity of the pathogen. These results are also in agreement with the findings of Junges *et al.* (2016), Entesari *et al*. (2013) and Yadav *et al*. (2013) who have also reported that use of *Trichoderma* and *Pseudomonas* resulted in better seedling emergence in bean, soybean and mungbean, respectively.

Among the various treatments used in the present experiment, *Trichoderma asperillum* ($T_{10,}$ @ 5 g/kg) registered the lowest seedling mortality (1.34%) followed by T_5 (Thiophanate Methyl 45%+

Pyraclostrobin 5% FS) 1.58%, T_6 (Penflufen 13.28% w/w + Trifloxystrobin 13.28% w/w) 1.64% (Table 1). However, the highest seedling morality was found in control (T_{11}-3.85%). The reduction in seedling mortality was mainly due to seed treatment with *Trichoderma asperillum* might have resulted in production of antifungal compounds and also growth regulating chytinolytic enzymes like glucanases and protease there by reducing pathogenic activity (Freeman *et al.*, 2004) which might have enabled higher field emergence by minimizing the pathogens activity present on seed the seed surface or around it in the soil.

Seed treatment with *Trichoderma asperillum* (T_{10}) @ 5 g/kg recorded the lowest wilt per cent at flowering (2.29%) followed by T_9 (3.18%), T_6 (3.36%) and lowest wilt at pod setting (3.31%) followed by T_6 (3.63%), T_9 (4.47%). While the highest wilt per cent at flowering (6.42%) and at pod setting (6.62%) was recorded in control (Table 1).

The different fungicides have significantly influenced the wilt per cent at maturity in chickpea. Among the various fungicides, *Trichoderma asperillum* @ 5 g/kg (T_{10}) registered the lowest wilt (%) at maturity (2.49 %) followed by T_5 (3.13%) and T_9 (3.68%) and lowest total wilt was observed in T_{10} (9.43 %) followed by T_5 (12.73%) and T_9 (12.97%). However, the highest wilt per cent at maturity and total wilt was found in control (T_{11}) *i.e.,* 8.42 and 23.31 per cent, respectively (Table 1). Seed treatment with *Trichoderma asperillum,* might have resulted in secretion of harmful extra-cellular compounds, like antibiotics, cell wall degrading enzymes such as gluconases, endochitinases and chitinases and against seed borne diseases (Agarwal *et al.,* 2011) and ultimately leading to reduction in wilt per cent. Similar observation were made by Andrabi *et al.* (2010) in chickpea that seed coated with *Trichoderma viride* resulted in minimum disease incidence and improved the seed yield. The effectiveness of the antimicrobial metabolites produced by *Trichoderma spp* against wide range of phytopathogens, namely, *Fusarium, Rhizoctonia solani,* and *Sclerotium rolfsii*, has been earlier reported (Kavitha and Nelson, 2013).

The results on number of pods per plant, seed yield per plant (g) and seed yield per hectare (kg) were considerably influenced by various seed treatments in chickpea. The highest number of pods per plant (50.10), seed yield per plant (13.49 g) and seed yield per hectare (2667 kg) were recorded in *Trichoderma asperillum* @ 5 g/kg (T_{10})$_{.}$ and the control (T_{11}) recorded the least number of pods per plant (41.92), seed yield per plant (10.86 g) and per hectare (2226 kg). This increase in seed yield due to *Trichoderma asperillum* seed treatment could be attributed to a considerable reduction in the total wilt percentage (9.43%) compared all other treatments and control (23.31%) thereby maintaining more healthy plant population resulting in more seed yield per plant and hectare compared to all other treatments and control (Khadse *et al.* 2015). Similar findings were also reported by Sidney and Bozemen (2007) in chickpea, Poddar *et al.* (2004) in chickpea and Fekry and Abou-El (2003) in bean.

Conclusion

Based on experimental results, among all the fungicidal and bio agents seed treatments, *Trichoderma asperillum* @ 5 g/kg and Thiophanate methyl 45%+ pyraclostrobin 5% FS @ 2 g/kg exhibited lowest seed borne mycoflora, improved the seed germination and helps in maintaining better plant population ultimately resulting in harvesting higher seed yield per ha in chickpea. Hence, chick pea seeds can be treated with either *Trichoderma asperillum* @ 5 g/kg and Thiophanate methyl 45% + pyraclostrobin 5% FS @ 2 g/kg in order to manage the seed borne pathogens in chickpea and thereby can harvest better yield in chickpea.

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