Biological Forum – An International Journal **16(6): 148-151(2024)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Management of Wilt and Root Rot Diseases of Chickpea (*Cicer arietinum* L.) through Seed Treatment in Semi-Arid Regions of Rajasthan

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(Received: 11 March 2024; Revised: 18 April 2024; Accepted: 16 May 2024; Published: 15 June 2024)
(Published by Research Trend)

ABSTRACT: Chickpea (*Cicer arietinum* L.) is an important pulse crop in semi-arid regions of the Rajasthan and is a less expensive source of protein. It faces various constraints such as biotic and abiotic factors *i.e.*, soil borne fungi causing damping off, root rots, wilt and collar rot. An on farm trial (OFT) was conducted by Krishi Vigyan Kendra, Dausa during 2016-17 and 2017-18 in different villages of Dausa district of Rajasthan. During the crop season of 2015-16, a preliminary survey was conducted in Bandikui, Dausa, Lalsot, Lawan and Sikrai blocks of Dausa. The maximum disease incidence 13.7 per cent was observed in Bandikui block followed by Dausa (11.3%) while lowest disease incidence was observed in Lalsot block (5.2). Most of the farmers do not practice proper seed treatment as per the recommendations. Bio-formulation of *Trichoderma viride* was used as inoculants in seed treatment. Seeds were treated with *Trichoderma viride* @ 2.5g/kg seed and Thiram @ 2.5g/kg + Carbendazim 1.0 g/kg seed. The disease incidence in this technology was 1.78 and 2.4 per cent as observed in 2016-17 and 2017-18 respectively. The disease incidence in farmers practice was 15.6 and 16.4 per cent in 2016-17 and 2017-18 respectively. The grain yield in 2016-17 in tested technology was 18.29 q/ha in comparison with farmers practice which was 14.9 q/ha experiencing 22.75 per cent increase in grain yield. In 2017-18 the grain yield was 17.89 and 12.85 q/ha in technology tested and farmers practice respectively. The increase in yield was 39.22 per cent.

Keywords: On farm trial (OFT), Farmer's practice, Soil borne, root rot, wilt, biocontrol, seed treatment.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is an important pulse cropwhich is less expensive source of protein cultivated in arid and semi-arid regions of the world. Among pulses, chickpea is preferred to food legume because of its multiple uses across the world (Mohanty and Satyasai 2015). Chickpea is known as a complete protein (22%) source because it contains all nine essential amino acids, which are building blocks that help in our bodies function properly. Chickpea is also an excellent source of non-animal protein. Chickpea also contains crude fiber (8%), potassium, B vitamins, iron, magnesium, and selenium, these all supports heart health. Fiber helps to decrease the risk of heart disease by lowering cholesterol levels in the blood, chickpea contains no cholesterol (Singh *et al.*, 2005).

During 2021-22 chickpea production of India was 13.75 million tonnes from an acreage of 10.91 million ha with a productivity of 12.6 q/ha (Directorate of Economics & Statistics, Ministry of Agriculture & Farmer welfare, GOI, 2022-23). The major chickpea growing states of India are Madhya Pradesh, Uttar Pradesh, Rajasthan, Maharashtra and Andhra Pradesh. During 2021-2022 area under chickpea cultivation in Rajasthan was 20.41 lakh hectare. Bikaner district leads in chickpea grown area with a share of 13%, followed by Churu (9%), Jhunjhunu (9%), Hanumangarh (8%), Shri Ganganagar (8%), Jaipur (8%), Jaisalmer (5%), Sikar (5%), Ajmer (5%), and other remaining districts (30%) (Rajasthan Krishi, Directorate of Agriculture, GOR, 2023).

However, area and yield of chickpea does not expand incredibly as compared to other crops, it includes various constraints such as biotic and abiotic factors *i.e.* soil borne diseases like damping off, root rots, wilt and collar rot are cosmopolitan. Wilt and root rot are the common and frequently occurring diseases of chickpea and causes significantly losses in yield (Kaur and Mukhopadhyay 1992; Haware *et al*., 1996). Wilt caused by *Fusarium oxysporum* Schlecht. Emend Snyd. & Hans. f. sp. *ciceri* (Padwick) is considered to be the primary cause of disease in chickpea which is wide spread and observed from almost all chickpea growing areas of the world and havecauses devastating losses in grain yield (Halila and Harrabi 1987). The important disease of chickpea is root rot caused by *Rhizoctonia bataticola* (Taub) Butler [*Macrophomina phaseolina* (Tassi) Goid] alone is capable of causing root rot (Singh, 2005), but its occurrence with *Fusarium oxysporum* has been observed quite frequently (Andrabi

et al., 2011). Root rot and wilt are more prevalent in sandy loam soils with low moisture and high temperature. Nowaday's disease management is more focused on biological control. In the past, a lot of work has been carried out on the antagonistic nature of *Trichoderma* sp. (Papavizas, 1985; Howell, 2003; Ram *et al.,* 2016). Blakeman and Fokkema (1982) reported that *Trichoderma* species are the well-known antagonists, particularly against soil borne pathogens. Hence the present investigation was under taken using *Trichoderma* as biocontrol agent as seed treatment against root rot and wilt diseases of chickpea.

MATERIALS AND METHODS

An on farm trial (OFT) was conducted by Krishi Vigyan Kendra, Dausa during 2016-17 and 2017-18 in different villages of Dausa district of Rajasthan. During the crop season (*Rabi* 2015-16) a preliminary survey was conducted in nearby areas of the chickpea fields *i.e*., Bandikui, Dausa, Lalsot, Lawan and Sikrai blocks of Dausa district. In each block survey was conducted in chickpea growing areas of different directions and one to three fields per village were observed for diseases incidence. An area of 1.0 × 1.0 m^2 was marked diagonally across the field at three spots on each farmers' field and percent disease incidence (PDI) was calculated by [(Number of diseased plants/total number of plants) × 100] counting the diseased to the total number plants per spot. Wilt and root rot affected chickpea plants in the field exhibit leaf yellowing and premature drying, affected plants occur in patches of irregular size and shape, distributed unevenly in the field. Disease incidence of each field was used for mean incidence of disease of each block. During the survey, personal discussions were also held with the farmers regarding occurrence and severity of the disease, agronomic practices and field history. The details of treatments under investigation are given below:

T_1 - Farmers practice (no seed treatment)

T_2 - Seed treatment with Thiram @ 2.5 g/kg + Carbendazim 50 WP 1.0 g/kg

T_3 - Seed treatment with Thiram @ 2.5 g/kg + Carbendazim 50 WP 1.0 g/kg + *Trichoderma viride* 2.5 g/kg

Seed treatment with *Trichoderma viride*

The bio-formulation of *Trichoderma viride* was used as inoculants in seed treatment in powdered form (1.0 × 10^7cfu/g). Seeds were treated with *Trichoderma viride* @ 2.5g/kg seed and Thiram @ 2.5g/kg + Carbendazim 1.0 g/kg seed and used for sowing as per package technology of agro-climatic zone IIIa of Rajasthan. Each on farm trial (OFT) was conducted in 0.4 ha and thus, 10 on farm test were conducted in each year. For the selection of village PRA techniques and for the selection of farmer, purposive sampling from frequently organized group meetings was exercised in each village. Before conducting on farm trial a list of sample farmers was prepared. During meeting respective and innovative farmers were selected for package technology intervention. Seed treatment with chemicals was applied on seed prior to bio control agent. After chemical treatment seeds of chickpea variety CSJ 515 were treated with *Trichoderma viride* formulation @ 2.5 g/kg and sowing was done in furrows in the second fortnight of November. Sowing was done at 30 cm row to row and 10 cm plant to plant distance. Observations of disease incidence were recorded after pod formation and grain yield was recorded after harvesting and threshing.

The performance of package technology was compared with farmers practice and seed treatment only in same field. For observation of disease incidence 1.0 × 1.0 m^2 area was selected and total number of plants was counted and after that diseased plants were also counted in selected area by randomly placing of quadrate at five places in on farm trial from all three treatments and disease incidence calculated.

Yield data of each treatment were recorded at maturity, all the plants from 1.0 m^2 quadrats of each treatment were cut at ground level. All the pods were threshed and the seeds were air-dried, cleaned and weighed to determine grain yield (Thangwana and Ogola 2012).

RESULTS AND DISCUSSION

The data of field surveys in five blocks showed in Table 1 revealed that root rot and wilt were pre dominant in all the fields. The maximum incidence of 13.7 per cent was observed in Bandikui block followed by Dausa (11.3%), while lowest disease incidence was observed in Lalsot block (5.2%). The overall average of the five blocks was 9.84 percent in all 56 fields observed in the season. The difference in a district of disease incidence in small area was high. In Bandikui region chickpea was cultivated only under rainfed condition and in Lalsot region farmers gave at least one irrigation in chickpea fields.

Table 1: Disease incidence of root rot and wilt on farmers' field during 2015-16.

Sr. No.	Name of block	No. of field visited	Disease incidence recorded
1.	Bandikui	11	13.7
2.	Dausa	9	11.3
3.	Lalsot	13	5.2
4.	Lawan	15	10.4
5.	Sikrai	8	8.6
	Average	**56**	**9.84**

Sharma and Pande (2013) also observed that the incidence of dry root rot is high when chickpea is under moisture deficit conditions and disease progress was optimum at higher soil temperature. Sharma *et al.* (2015) reported that the chickpea root rot gaining importance in the changed scenario of climate when growing crop is predisposed to high temperature and moisture stress. As per the disease susceptibility index

(DSI), a combination of high temperature (35°C) and low soil moisture content (60%) was found to elicit the highest disease susceptibility in chickpea (Sharath *et al.*, 2021).

Data depicted in table 2 showed that seed treatment with Thiram @ 2.5 g/kg + Carbendazim 50 WP 1.0 g/kg + *Trichoderma viride* 2.5 g/kg managed the soil borne diseases effectively. The disease incidence of 1.78 and 2.4 per cent was observed in 2016-17 and 2017-18 respectively for the tested technology. The disease incidence in farmers practice was 15.6 and 16.4 per cent in 2016-17 and 2017-18 respectively. Singh *et al.* (1998) also found that seed treatment of chickpea with bio-control agents like *T. harzianum* and *Gliocladium virens* gave excellent results against *R. solani* and *F. oxysporum* f. sp. *ciceri*. *Trichoderma* strains obtained from various sources, including NCIPM, NBAIR, NRRI and *Trichoderma* mutant from BARC were used as seed treatment and compared with chemical seed treatment. On an average *Trichoderma* mutant was the most effective followed by *T. harzianum* + Propineb @ 10g + 1.5 g/kg seed in minimizing wilt/DRR incidence (Annual Report, 2023). Rudresh *et al.* (2005) reported significantly minimized root rot and Fusarium wilt of chickpea by soil application of *Trichoderma* spp. Tiwari and Mukhopadhyay (2003) also observed that integration of *Gliocladium virens* powder and vitavax used as seed treatment provided maximum protection 81.9 per cent to the crop against chickpea root rot and collar rot pathogens in glasshouse. Khan *et al.* (2014) also reported that soil application of biocontrol agents checked 25-56 per cent and 39-67 per cent disease and increased yield by 12-28 and 8-24 per cent in the two years respectively. Manjunath *et al.* (2013) reported that the root rot incidence of chickpea was minimized (2.67%) with higher seed germination (97.60%) and seed yield (12.74 q/h) were achieved when seed treatment with *Trichoderma viride* and soil application of FYM. Andrabi *et al.* (2011) also observed that seed coating with *Trichoderma viride* resulted in minimum disease incidence (9.24%), however, it was at par with *Trichoderma virens* (9.72%). Maximum yield (10.10 q/ha) was recorded with the application of carbendazim, followed by carbendazim + mancozeb (9.77 q/ha) and *Trichoderma viride* (8.10 q/ha). Seed biopriming checked the incidence of wilt and root rot in the range of 45%-60% and increased the yield of chickpea by 10%-20% (Pandey *et al.*, 2017).

Table 2: Performance of different treatments against wilt and root rot diseases in Rabi 2016-17 & 2017-18.

Particulars	Grain yield (q/ha)				Disease Incidence	
	2016-17	Increase (%)	2017-18	Increase (%)	2016-17	2017-18
T_1 - Farmers practice	14.90	-	12.85	-	15.6	16.4
T_2 - ST with Thiram @ 2.5 g/kg + Carbendazim 50 WP 1.0 g/kg	16.53	10.93	16.35	22.75	8.7	9.6
T_3 - ST with Thiram @ 2.5 g/kg + Carbendazim 50 WP 1.0 g/kg + *Trichoderma viride* 2.5 g/kg	18.29	22.75	17.89	39.22	1.8	2.4

The grain yield in 2016-17 in tested technology was 18.29 q/ha in comparison with farmers practice (14.9 q/ha) which was 22.75 per cent increase in grain yield. In 2017-18 the grain yield was 17.89 and 12.85 q/ha in technology tested and farmers practice respectively. Chemicals thiram and carbendazim provided initial protection to the soil borne pathogens especially *F. oxysporum* f. sp. ciceri and *R. solani* till biocontrol agent established in plant rhizosphere and thereafter plants were protected by colonized population of *Trichoderma viride* in the rhizosphere of the chickpea plants. The increase in yield was 39.22 per cent. Tiwari and Mukhopadhyay (2003) reported increase in grain yield when used *Gliocladium virens* as seed treatment with CMC+ vitavax (79.7%) followed by G. virens + vitavax (64.5%) over check.

CONCLUSIONS

The root rot and wilt diseases were prevalent in all chickpea growing blocks in Dausa district of Rajasthan. The technology tested was very effective in management of soil borne diseases as integration of biological and chemical seed treatment.

Acknowledgement. The authors are grateful to ICAR-ATARI Jodhpur for providing necessary funds for conducting the package technology. Authors are also thankful to ICAR-Krishi Vigyan Kendra, Dausa 303303, SriKaran Narendra Agriculture University, Jobner, 303329, Rajasthan, India.

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How to cite this article: R.L. Meena, B.L. Jat and Akshay Chittora (2024). Management of Wilt and Root Rot Diseases of Chickpea (*Cicer arietinum* L.) through Seed Treatment in Semi-Arid Regions of Rajasthan. *Biological Forum – An International Journal, 16*(6): 148-151.