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# Effect of Sowing Time and Seed Treatment in Management of Collar Rot of Chickpea

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**ABSTRACT: Chickpea is a popular legume crop in Asia and Africa's semi-arid regions with modest production gains, because of several biotic and abiotic factors. Among the different diseases, collar rot of chickpea is a major limiting factor in central India. In the present investigation, three sowing dates were evaluated with four different seed treatments in three chickpea varieties for management of collar rot of chickpea. Significant effect of date of sowing along with impact of seed treatment were recorded in inhibiting the collar rot incidence. Among the different varieties minimum incidence of collar rot was recorded in JG 14 followed by JG 36 and JGK 1 in all the seed treatments and date of sowing. Further, among the different seed treatment practices, minimum collar rot incidence of 12.94%, 9.97% and 6.73% was recorded in seed treatment with *Rhizobium* + PSB @ 10 ml/kg seed during sowing in first, second fortnight of November and first fortnight of December respectively in chickpea variety JG 14. The same treatment showed the maximum effect in inhibiting the incidence of collar rot in other two studied varieties namely JG 36 and JGK 1. Among the different dates of sowing, the incidence of collar rot was recorded highest during early sowing and it kept on decreasing by delaying the sowing. The maximum mean incidence of collar rot of 18.76% was recorded with sowing during the first fortnight of November followed by sowing during second fortnight of November (14.38%) and minimum of 8.77% in sowing during first fortnight of December.**

**Keywords:** Chickpea, Date of sowing, collar rot, *Sclerotium rolfsii.*

## INTRODUCTION

Chickpea (*Cicer arietinum* L.) is one of the most important legume crops with its small (desi) and large sized (kabuli) seeds constituting the main market types. It is one of the most important pulse crops in the world with high protein content of about 25.3– 28.9% in its nutritive seeds (Mafakheri *et al.,* 2011; Kumar *et al.*, 2021). Keeping the demanding population into consideration which has been estimated 9-10 billion people by 2050, with reducing arable agricultural lands due to urbanization and water resources, the global agricultural productivity must also complement to the growing world population (Sekhon, 2014; Godfray *et al.,* 2010; Massawe *et al.,* 2016).

Collar rot is an emerging chickpea soil-borne disease that can cause 55–95 per cent mortality in seedlings when environmental circumstances are favourable, such as heavy rainfall and high soil temperatures (25–30°C) (Sharma and Ghosh 2017). Furthermore, collar rot control is difficult due to the pathogen's extensive host range, which includes at least 500 species belonging to 100 groups that are typically found in legumes, crucifers, and cucurbits (Aycock, 1966). *S. rolfsii* affects the collar region of chickpea plants and persists as mycelium in infected tissues and plant debris, as well as in the form of sclerotial structures in the soil or in conjunction with plant debris. In recent times, *S. rolfsii* has become more common in agricultural areas having high temperature coupled with abrupt rainfall resulting in increased soil moisture for prolonged periods owing to its highly competitive saprophytic survival ability. With such a diverse spectrum of natural hosts, *S. rolfsii* might potentially live in arid climates and stay in the soil for extended periods of time, even after multiple crop rotations. Controlling collar rot has been difficult due to a lack of knowledge about the components that influence its growth. Looking to the development of genomic resources in chickpea, enough data has been generated so far (Gujaria *et al*., 2011; Hiremath *et al*. 2011, 2012), However, identification of QTL for collar rot resistance is still lacking in chickpea. Therefore, development of collar rot resistance variety is still lacking and it is the need of the hour to reinvigorate the eco-friendly management tactics for management of collar rot in chickpea.

Several fungicidal seed treatments have been suggested in past for control of collar rot in chickpea. However, non-scrupulous use of fungicides has led to impose serious hazardous effect in soil rhizosphere and atmosphere. Use of biological control agents and biofertilizers have been advocated not only for management of soil borne diseases but also for better growth of the crops since ages by several workers (Srivastava *et al.*, 2009). Further, these biocontrol agents not only can successfully manage the plant diseases by antagonism or producing certain secondary metabolite (Kumar *et al.*, 2009) but also significantly contribute in plant growth promotion (Kumar *et al.*, 2019). In this way, combination of cultural practices, coupled with seed treatment may be a better alternative for management of collar rot pathogen in chickpea. Keeping this in view, present investigation was conducted to identify the combined effect of seed treatment and sowing time in management of collar rot of chickpea.

## MATERIALS AND METHODS

**Isolation of pathogen:** The symptomatic diseased samples were collected from the chickpea field and isolation of the test pathogen was conducted by tissue transfer technique. The diseased tissue (root) was cut into small bits (2-3 mm) with a sharp, sterilized blade so that each diseased tissue contained a portion of healthy tissue along with it. These bits were subjected to surface sterilization with 1% sodium hypochlorite solution under aseptic condition, followed by three rinses with distilled sterilized water to remove the remaining traces of sodium hypochlorite. The tissue pieces were blotted, dried, and later transferred aseptically to Potato Dextrose Agar (PDA) medium in sterilized Petri-plates (90mm) and incubated at 27±2ºC for seven days. The fungal colonies originating from bits were examined after seven days of incubation, then transferred on fresh medium in Petri-plates for the purification and periodic observations.

**Impact of date of sowing on collar rot.** To identify the impact of seed treatment in combination with date of sowing on incidence of collar rot of chickpea caused by *Sclerotium rolfsii*, a field experiment was conducted under natural field conditions with following details. In total three date of sowing were adopted *i.e*., first fortnight of November (09.11.2020), second fortnight of November (23.11.2020) and first fortnight of December (07.12.2020). Four seed treatments comprising of Carboxin 37.5% + Thiram 37.5%@0.2%, *Rhizobium* + PSB @ 10ml/kg seed, molybdenum @ 1 g/kg seed and *Rhizobium* + PSB (10ml/kg seed) + Molybdenum (1 g/kg seed) were applied before sowing during all three dates of sowing in three chickpea varieties namely JG 14, JG 36 and JGK 1 in split plot design (Table 1). The observations were recorded for incidence of collar rot at seedling stage of crop (two to three weeks) and percent disease incidence was calculated according to following formula:

PDI= Number of disease plants × 100/Total number of plants

Further per cent disease control was calculated in all the treatments over respective control according to Vincent (1947).

Per cent disease control = (C-T) × 100/ C

Where C= per cent disease incidence in control

T = per cent disease incidence in treatment

**Table 1: Treatment details.**

| Treatment number | Date of sowing | Treatment details |
|---|---|---|
| $T_1$ | 09.11.20 | Seed treatment with Carboxin 37.5% + Thiram 37.5% @ 2.0 g per Kg seed |
| $T_2$ | 09.11.20 | Seed treatment with *Rhizobium* + PSB @ 10 ml per Kg seed |
| $T_3$ | 09.11.20 | Seed treatment with Molybdenum @ 1.0 g per Kg seed |
| $T_4$ | 09.11.20 | Seed treatment with *Rhizobium* @ 10 ml + PSB @ 10 ml + Mo @ 1.0 g per Kg seed |
| $T_5$ | 09.11.20 | No seed treatment (Control) |
| $T_6$ | 23.11.20 | Seed treatment with Carboxin 37.5% + Thiram 37.5%@ 2.0 g per Kg seed |
| $T_7$ | 23.11.20 | Seed treatment with *Rhizobium* + PSB @ 10 ml per Kg seed |
| $T_8$ | 23.11.20 | Seed treatment with Molybdenum @ 1.0 g per Kg seed |
| $T_9$ | 23.11.20 | Seed treatment with *Rhizobium* @ 10 ml + PSB @ 10 ml + Mo @ 1.0 g per Kg seed |
| $T_{10}$ | 23.11.20 | No seed treatment (Control) |
| $T_{11}$ | 07.12.20 | Seed treatment with Carboxin 37.5% + Thiram 37.5%@ 2.0 g per Kg seed |
| $T_{12}$ | 07.12.20 | Seed treatment with *Rhizobium* + PSB @ 10 ml per Kg seed |
| $T_{13}$ | 07.12.20 | Seed treatment with Molybdenum @ 1.0 g per Kg seed |
| $T_{14}$ | 07.12.20 | Seed treatment with *Rhizobium* @ 10 ml + PSB @ 10 ml + Mo @ 1.0 g per Kg seed |
| $T_{15}$ | 07.12.20 | No seed treatment (Control) |

## RESULTS

**Pathogen identification.** The collar rot infected plants were identified in the field based on typical symptoms of slightly yellow foliage with drying of plants before death in scattered pattern. Further, presence of white mycelial growth in collar region of plants and brown colour sclerotia in soil could be observed in most of the collar rot infected chickpea seedlings. The infected plants (Fig. 1a, 1b) were collected from the field *S. rolfsii* could be isolated and confirmed as causative agent. The isolated fungus *S. rolfsii* on potato dextrose agar medium exhibited snow- white colored fluffy, compact mycelial growth with a silky lustre. The brown colored, hard sclerotia formation started after 14 days of inoculation. Sclerotia were initially white in colour and became light brown to dark brown at maturity with size ranging from 0.5 to 1.5 mm in diameter (Fig. 1b). The colony took five days to cover complete Petri plate growth of 90 mm.

**Impact of seed treatment and date of sowing on incidence of collar rot of chickpea.** Significant effect of date of sowing along with impact of seed treatment were recorded in inhibiting the collar rot incidence. Among the different date of sowing and seed treatments, the collar rot incidence ranged from 6.73% to 19.35% in JG 14. However, the control exhibited 21.18%, 15.67% and 11.21% collar rot incidence during sowing in first, second fortnight of November and first fortnight of December respectively in JG 14. The maximum collar rot incidence was recorded during sowing in first fortnight of November. Among the different seed treatment practices, minimum collar rot incidence of 12.94%, 9.97% and 6.73% was recorded in seed treatment with *Rhizobium* + PSB @ 10 ml/kg seed during sowing in first, second fortnight of November and first fortnight of December respectively in chickpea variety JG 14. This was followed by seed treatment with *Rhizobium* @ 10 ml + PSB @ 10 ml + Mo @ 1.0 g/kg seed where 13.52%, 10.11% and 7.75 % collar rot incidence could be recorded during sowing in first, second fortnight of November and first fortnight of December respectively. Among the different seed treatment, across all the sowing dates, minimum impact of application of Molybdenum as seed treatment could be recorded and only 8.64%, 1.66% and 11.69% disease control were recorded during sowing in first, second fortnight of November and first fortnight of December respectively in JG 14 (Table 2).

In JG 36 variety, the incidence of collar rot was comparatively less than the JG 14 variety and among the different date of sowing and seed treatments, the collar rot incidence ranged from 6.42% to 16.90% excluding control of each date of sowing. However, the control exhibited 18.10%, 14.11% and 7.97% collar rot incidence during sowing in first, second fortnight of November and first fortnight of December respectively in JG 36. The minimum collar rot incidence was recorded during late sowing of chickpea in first fortnight of December. Among the different seed treatment practices, maximum collar rot incidence of 16.90%, 13.58% and 7.64% was recorded in seed treatment with Molybdenum @ 1g/kg seed during sowing in first, second fortnight of November and first fortnight of December respectively which was not significantly contributing in inhibition of collar rot incidence. However, maximum effect in collar rot control was revealed in seed treatment/application of *Rhizobium* + PSB @ 10 ml/kg seed during sowing in first, second fortnight of November and first fortnight of December and respectively 38.62%, 40.04% and 19.45% disease control was recorded in comparison to relative control in chickpea variety JG 36. This was followed by seed treatment with *Rhizobium* @ 10 ml + PSB @ 10 ml + Mo @ 1.0 g/kg seed where 27.57%, 32.03% and 14.43 % collar rot control could be calculated over control during sowing in first, second fortnight of November and first fortnight of December respectively (Table 2).

While observing the collar rot incidence in JGK 1 with implementation of combination of different seed treatments and dates of sowing, results were in analogous fashion as performed in JG 14 and JG 36. Further, it was observed that least incidence of collar rot was present in all the treatments in comparison to JG 14 and JG 36, showing its more capacity to resist the collar rot incidence. In relation to, different seed treatments and date of sowing, the percent collar rot control ranged from 1.87% to 35.10% in JGK 1 in comparison to respective control. The maximum collar rot incidence was recorded in control with 17.01%, 13.37% and 7.14% incidence during sowing in first, second fortnight of November and first fortnight of December respectively in JGK 1. Among the different seed treatment practices, maximum collar rot incidence of 16.17%, 13.12% and 6.67% was recorded in seed treatment with Molybdenum @ 1g/kg seed during sowing in first, second fortnight of November and first fortnight of December respectively in JGK 1. This was followed by seed treatment with Carboxin 37.5% + Thiram 37.5%@ 2 g/kg seed where 15.36%, 12.58% and 6.48 % collar rot incidence could be recorded during sowing in first, second fortnight of November and first fortnight of December respectively (Table 2).

**Impact of sowing time on incidence of collar rot of chickpea**. The incidence of collar rot of chickpea was recorded highest during early sowing and it kept on decreasing by delaying the sowing. The maximum mean incidence of collar rot of 18.76 % was recorded with sowing during the first fortnight of November followed by sowing during second fortnight of November (14.38%). The minimum mean collar rot incidence of 8.77% was recorded under the sowing date during first fortnight of December. Among the different varieties, similar trend of collar rot incidence was recorded with respect to date of sowing. However, among different date of sowing and different varieties, maximum collar rot incidence of 21.18 % was recorded in JG 14 followed by JG 36 (18.1%) (Table 3). This signified that late sowing conditions are unfavorable for development of collar rot in chickpea.

The effect of cultivars and dates of sowing on disease Incidence of collar rot was quite evident in our investigations. The similar findings were recorded by Pal *et al*. (2018) where maximum Incidence of *S. rolfsii* was recorded in varietyJG-62 (46.66%) and minimum in JG-130 (31.92%). With respect to date of sowing, maximum diseases incidence was recorded in 15$^{th}$ October sowing (46.71%) and reduced thereafter. Interaction of varieties and dates of sowing revealed that JG-62 exhibited maximum disease Incidence of 51.42% in 15$^{th}$ October sowing and minimum in JG-130 (23.73%) under 1$^{st}$ November sown crop. In this way the findings of present investigation are in agreement to Pal *et al*., 2018. Further, the reduced incidence of collar rot in delayed sowing may be attributed to reduced temperature during seedling stage of crop making it unfavorable for infection of collar rot. Further seed treatment with bioagents and / or

*Rhizobium* and PSB have already been identified as potential treatment in reducing the collar rot (Singh *et al.,* 2018) and our findings are supporting it with the finding that seed treatment coupled with selection of sowing time may lead to significant reduction in collar rot of chickpea.

**Table 2: Effect of different seed treatments and sowing time on incidence of collar rot of chickpea in three different varieties.**

| Treatment No. | JG 14 | | JG 36 | | JGK 1 | |
|---|---|---|---|---|---|---|
| | Per cent disease incidence | Per cent disease control | Per cent disease incidence | Per cent disease control | Per cent disease incidence | Per cent disease control |
| $T_1$ | 17.41 | 17.8 | 16.3 | 9.94 | 15.36 | 9.7 |
| $T_2$ | 12.94 | 38.9 | 11.11 | 38.62 | 11.04 | 35.1 |
| $T_3$ | 19.35 | 8.64 | 16.9 | 6.63 | 16.17 | 4.94 |
| $T_4$ | 13.52 | 36.17 | 13.11 | 27.57 | 12.57 | 26.1 |
| $T_5$ | 21.18 | - | 18.1 | - | 17.01 | - |
| $T_6$ | 13.57 | 13.4 | 12.75 | 9.64 | 12.58 | 5.91 |
| $T_7$ | 9.97 | 36.38 | 8.46 | 40.04 | 8.36 | 37.47 |
| $T_8$ | 15.41 | 1.66 | 13.58 | 3.76 | 13.12 | 1.87 |
| $T_9$ | 10.11 | 35.48 | 9.59 | 32.03 | 9.44 | 29.39 |
| $T_{10}$ | 15.67 | - | 14.11 | - | 13.37 | - |
| $T_{11}$ | 8.57 | 23.55 | 7.44 | 6.65 | 6.48 | 9.24 |
| $T_{12}$ | 6.73 | 39.96 | 6.42 | 19.45 | 5.46 | 23.53 |
| $T_{13}$ | 9.9 | 11.69 | 7.64 | 4.14 | 6.67 | 6.58 |
| $T_{14}$ | 7.75 | 30.87 | 6.82 | 14.43 | 6.17 | 13.59 |
| $T_{15}$ | 11.21 | - | 7.97 | - | 7.14 | - |
| | CD (p=0.05): A = 1.363, B = 1.212, A × B = 2.099, C = 0.939 | | | | | |
| | SE(m): A = 0.349, B = 0.431, A × B = 0.746, C = 0.334, A×C = 0.578, B×C = 0.746 | | | | | |

Factor A = Date of Sowing, B = Seed Treatment, C = Variety

**Table 3: Effect of sowing time on incidence of collar rot.**

| Variety | Percent collar rot incidence |
|---|---|
| **First Fortnight of November 2020** | |
| JG 14 | 21.18 |
| JG 36 | 18.1 |
| JGK 1 | 17.01 |
| **Mean** | **18.76** |
| **Second Fortnight of November 2020** | |
| JG 14 | 15.67 |
| JG 36 | 14.11 |
| JGK 1 | 13.37 |
| **Mean** | **14.38** |
| **First Fortnight of December 2020** | |
| JG 14 | 11.21 |
| JG 36 | 7.97 |
| JGK 1 | 7.14 |
| **Mean** | **8.77** |


**Fig. 1.** Collar rot of chickpea a) Typical symptoms of collar rot showing white mycelial growth of fungus at collar region. B) individual plant showing yellowing of leaf in field c) Isolated pathogen *S. rolfsii* showing brown sclerotia formation.

## CONCLUSION

Overall scenario across three varieties, three date of sowing and four seed treatments revealed that late sowing during first fort night of December in combination with seed treatment with *Rhizobium* + PSB @ 10 ml/kg seed prior to sowing was recorded as best treatment for control of collar rot of chickpea irrespective of variety used.

## FUTURE SCOPE

Collar rot of chickpea is one of the major limiting factors in hampering the production and productivity of chickpea in all the chickpea growing areas of India and central India is a hot spot pocket for its occurrence. Eco-friendly seed treatment coupled with managing the sowing time with suitable variety could be utilized as a potential way for its management in sustainable manner. The identified package in the present investigation can also provide avenues for exploring more bioagents for improvement in existing practices for its management.

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