Bangladesh J. Bot. **51**(4): 721-727, 2022 (December) DOI: https://doi.org/10.3329/bjb.v51i4.63491

EFFECTS OF SOWING DATES ON YIELD AND COLLAR ROT OF CHICKPEA (*CICER ARIETINUM* L.)

SANJU TAMANG, POLY SAHA[1*] AND SHISHIR RIZAL

Department of Plant Pathology, Bidhan Chandra Krishi Viswavidyalaya, Nadia, WB-74125, India

Keywords: Chickpea, Collar rot, Disease progression, Soil moisture, Soil temperature

Abstract

An experiment was formulated to determine the influence of soil moisture (SM) and soil temperature (ST) on the temporal and spatial distribution of collar rot in chickpea initiated by *Sclerotium rolfsii* (Sacc.), the most pervasive soil-borne pathogen, recognised as one of the major production constraints worldwide. Variety '*Anuradha'* was sown at five different dates at an interval of 7 days for the two consecutive years. Progression of disease with varying degree of changes in SM, ST along with the age of the plant were recorded. Result revealed that sowing on 26th November produced maximum seed yield. The rate of disease progression indicated, seedling at the age of 30-35 days is most vulnerable to the pathogen and the disease developed more quickly at an early stage. Despite of the fact that, disease development is dependent on ST and SM conditions, age of the plant is also strong determinant of disease initiation.

Introduction

Chickpea (*Cicer arietinum* L.) is one of the major winter legume crops grown in India and rank first in production (FAO 2021). Chickpea seeds are highly nutritious (Jukanti *et al.* 2012) and could be a suitable replacement of animal protein in a vegetarian diet (Hossain *et al.* 2010).

Chickpea production is hampered by a number of biotic and abiotic stresses (Pande *et al.* 2013). Collar rot caused by *Sclerotium rolfsii* (Sacc.) reported as the most inescapable disease rendering 54.7-95% mortality in India (Sharma and Ghosh 2017). Sustainable production of chickpea is also challenged by edaphic stresses, such as soil temperature, moisture etc. (Sharma and Pande 2013, Sinha *et al.* 2016). Contemporary studies exposed that there is a shift of paradigm in the pathogen's prevalence due to climate change and therefore hamper the yield potential (Rajlaxmi 2020, Sood *et al.* 2020). Collar rot becoming more predominant in the areas with erratic rainfall that increases soil moisture for extensive periods along with warm temperatures (Tarafdar *et al.* 2018). Moreover, having highly competitive saprophytic ability and a wide host range makes it fit to survive prolong even in dry climatic regions (Srividya *et al.* 2022).

The present study was focused to plot down the temporal and spatial distribution of the disease along with the natural changes in soil moisture and temperature under field condition obtained by sowing of the crop at different dates. Optimum date of sowing was determined for better yield with low disease incidence and the most vulnerable stage of disease initiation was also found out.

Material and Methods

The experiment was carried out at 'Jaguli farm' under the aegis of Bidhan Chandra Krishi Viswavidyalaya. The location of the farm is 22^{0}93'N latitude to 88^{0}33'E longitude at an elevation of 9.75 m above MSL and comes under new alluvial indo-gangetic zones of West Bengal, India.

*Author for correspondence: <poly.saha@gmail.com>. [1]College of Agriculture, Extended Campus of BCKV, Burdwan, West Bengal-713101, India.

Chickpea variety *Anuradha* showing moderately susceptible reaction against collar rot was sown at 5 different dates at an interval of 7 days *i.e* 26th November, 3rd, 10th, 17th and 24th December of the year 2018-19 and 2019-20 under natural epiphytotic conditions.

The soil of the farm was sandy loam in texture with the pH 7.2. The plot size was 5×6 m^2 with a spacing of 30×10 cm. Design of the experiment was RBD with 4 replications. Proper agronomic practices were followed, and good crop hygiene was maintained.

Soil temperature and soil moisture were recorded using soil thermometer (Maxtech white pen-type soil thermometer Model name/ Number: DT-9) and moisture meter (Lutron digital soil moisture meter, Model name/ Number: PMS 714), respectively. Data on weather parameters like temperature, humidity and total rainfall were collected from the Department of Agrometeorology, BCKV, Mohanpur. Yield data was also recorded plot wise then averaged and converted into quintal/ha.

The onset time was monitored as the appearance of first symptoms and disease incidence was recorded replication wise across all the treatments. For the auto infectious nature of the disease, disease incidence and severity were directly proportional to each other. Per cent infection was recorded from the initiation of the diseases up to 45 DAS at every 5 DI and computed by the formula given by Kranz (1988).

The data were analysed using MS Excel. Per cent disease incidence was subjected to arcsine transformation (Gomez and Gomez 1984). Transformed data were analysed through MS Excel and ANOVA was developed. The level of significance and interaction effects were evaluated and graph plotted for the progression of the disease incidence in respect to both soil temperature and soil moisture condition.

Results and Discussion

Incidence of collar rot of chickpea was found to vary significantly with each different dates of sowing in the year 2018-19 except sowing dates on 17th and 24th December (Table 1). Lowest disease severity was observed on 17th December (4.73) followed by 24th December (4. 91) and their differences were statistically at par. Significant highest disease severity was observed on 3rd December (17.74) followed by 10th December (15.38) and 26th November (10.14) and their differences were statistically significant (Table 1).

In 2019-20, maximum disease severity was observed in 3rd December (18.39) followed by 10th December (17.04). All the other treatments were significantly different among themselves. Minimum disease severity was recorded on 24th December (10.38) followed by 17th December (11.34) and 26th November (14.34) and their differences were statistically significant (Table 1). Two years pooled mean showed maximum disease severity (18.06) on 3rd December followed by 10th December (16.21) and their difference was statistically significant (Table 1).

Sowing of chickpea on 26th November is better as it produced maximum seed yield. Yield decreases gradually with the next dates of sowing though the collar rot severity scored on 26th November was not the minimum. Soil temperature persisted throughout the experimental period was 19.4-15^{0}C and showed gradual decrease of temperature from 26th November to 24th December.

Singh *et al.* (2011) observed that 30th November sowing was appropriate in terms of growth and yield in north western part of India. Torkaman *et al.* (2018) obtained the highest yield on 20th November sowing. Similarly, Varoglu and Kazim (2018) showed that sowing period has an impact on yield and seed yield decrease with late sowings and this result also in corroboration of the present findings.

Table 1. Disease severity of collar rot of chickpea at different dates of sowing and its corresponding yield.

Treatment dates	Disease severity			Yield (q/ha)		
	2018-19	2019-20	Mean	2018-19	2019-20	Mean
26th Nov	10.14 (18.57)	14.34a (22.25)	12.24 (20.48)	8.85a (17.30)	7.92 (16.34)	8.38 (16.83)
3rd Dec	17.74 (24.91)	18.39a (25.39)	18.06 (25.15)	7.89ab (16.31)	6.05a (14.24)	6.97a (15.31)
10th Dec	15.38 (23.09)	17.04 (24.38)	16.21 (23.74)	6.74b (15.05)	5.85a (13.99)	6.29a (14.53)
17th Dec	4.73a (12.56)	11.34 (19.68)	8.04 a (16.47)	3.29c (10.45)	3.15b (10.23)	3.22b (10.34)
24th Dec	4.91a (12.80)	10.38 (18.79)	7.64a (16.05)	2.53c (9.15)	2.75b (9.55)	2.64b (9.35)
SEm(±)	1.23	0.75	0.41	0.60	0.47	0.27
CD (0.05)	1.45	2.05	1.19	1.17	1.17	0.79
CV%	8.88	9.31	9.27	13.01	14.86	13.87

Figure in the parenthesis represents the angular transformed value and the same English letter followed by mean are not significantly differ from each other.

Two years comparative study on the progression of the collar rot disease showed that in the year 2018-19 there was a rise in soil moisture at 51 meteorological weeks when the precipitation was received and the disease incidence reached maximum at 51 week and continue to proceed up to 52 weeks. In the rest of the weeks the soil moisture remained more or less static but, at that time disease progression in the field coincide with the vulnerable juvenile stage of the plant. After that when the crop was above 40 days old, no further increase in the disease incidence was noticed though soil moisture was at optimum (Fig. 1). In the year 2019-20 trend of disease progression was similar. This year also, rainfall received for 52 week and 1 standard meteorological week. Following the effect of plant age, presence of soil moisture and the combine effect of soil moisture and soil temperature influence the rate of progression of the disease under field condition. Here, the plateau approached at 45 DAP but did not flatten completely (Fig. 1).

The nature of spread of the collar rot disease severity at 3rd December of sowing over two experimental years depicted that disease initiation started nearly at the same time i.e. age of the plant lied between 7-14 days and from then the disease increase gradually up to 5 weeks after planting. The disease increased exponentially following precipitation and reached at peak during 1 meteorological week when the plant age calculated was 35 days. After that, the graph flattened. In 2019-20, steep increase of the disease was observed along with precipitation and juvenile stage of the crop was also detected susceptible. After that, when the soil moisture go down for the next 3 weeks the disease remain constant without further progression in the population but pathogen continue to grow with in the plants (Fig. 2).

In both the year at 10th December of sowing exponential rate of disease development was observed in between 51 to 52 weeks after that gradual disease progression was noticed up to 35 DAP *i.e* 2nd meteorological week. Within this period soil moisture data were found higher than the rest of the weeks and soil temperature data noted 17.2 and 20.9^{0}C. From the next week onward no further progression of the disease in the field was recorded (Fig. 3).

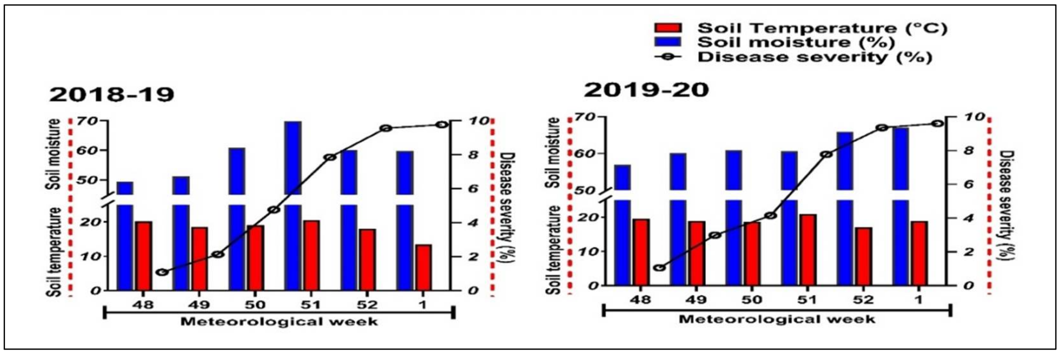

Fig. 1. Progression of collar rot disease in chickpea at 26th November sowing.

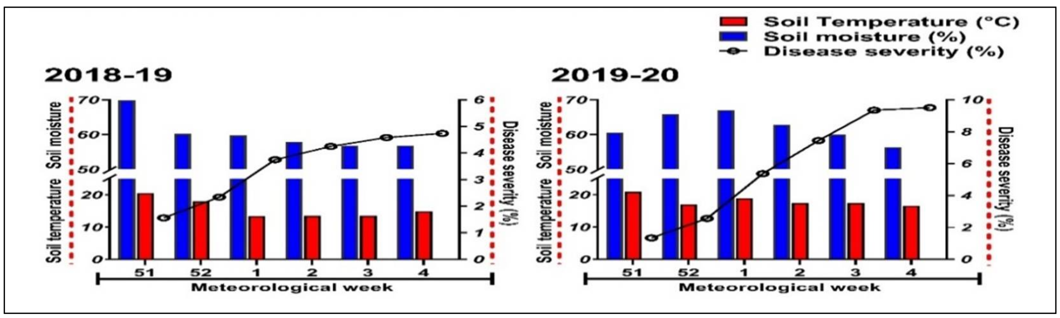

Fig. 2. Progression of collar rot disease in chickpea at 3rd December sowing.

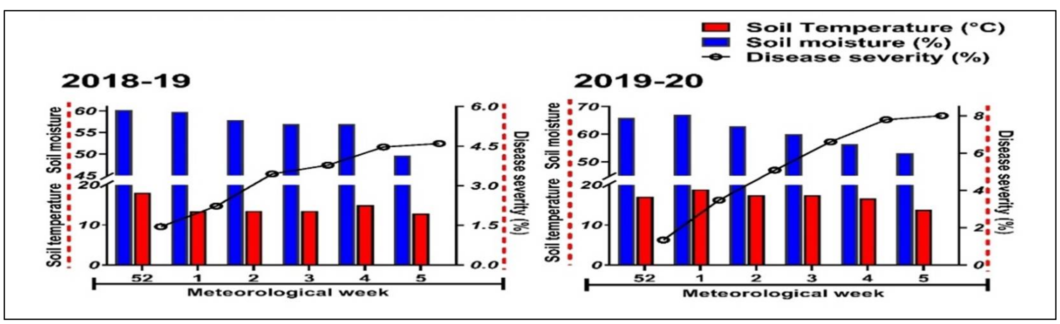

Fig. 3. Progression of collar rot disease in chickpea at 10th December sowing.

At the same date of sowing of 17th December in both the year, resemblance noted regarding the disease initiation at 51 meteorological weeks and gradually reaching the peak at 4th meteorological week with maximum number of infected plants. But variation observed in the nature of progression of the disease between the years. During 2018-19, rate of progression was slowed down from 2nd to 3rd meteorological week and again slightly increase on 4th week. Unlike, in 2019-20 more or less steep increment in the disease severity was observed from 52 to 4th meteorological week and thereafter it reached to plateau because no new infection could be possible due to non-availability of the host tissue (Fig. 4).

In the year 2018-19, a zig zag nature of disease progression had been observed at 24th December sowing. Initial establishment (at 52 meteorological week) of the disease was higher than any other dates of planting which increase gradually up.to 2nd week. Again from 2nd to 4th week the disease severity increased but rate of increment was rather slow though maximum disease incidence recorded on 4th meteorological week *i.e.* 35 DAP. After that, disease there was a gradual decrease in disease severity. On the contrary, at the same date of planting in the year 2019-20 the pattern of disease progression differs noticeably. Following precipitation received on 52 and 1st meteorological week there was an exponential increase of the collar rot disease from initiation up to 35 DAP. Thereafter, it decreased gradually in subsequent ageing of the plant (Fig. 5).

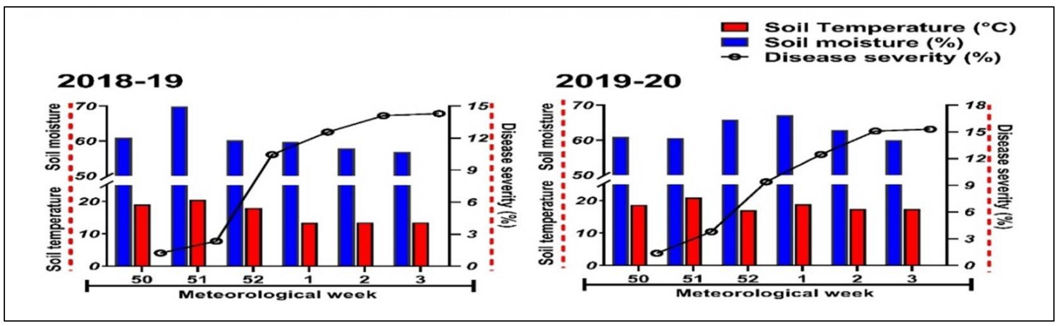

Fig. 4. Progression of collar rot disease in chickpea at 17th December sowing.

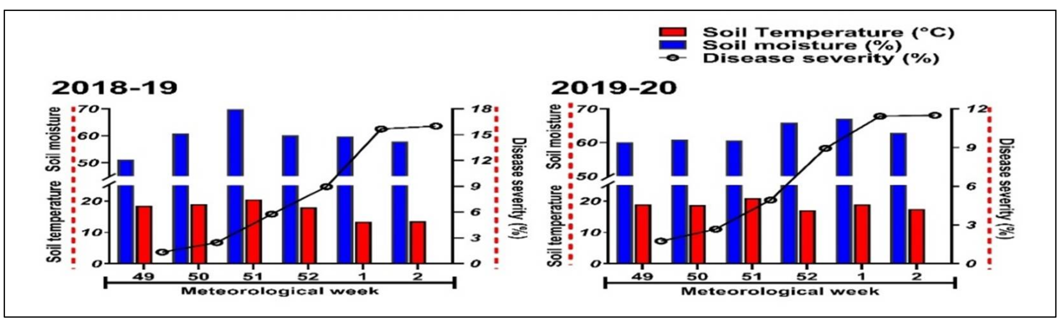

Fig. 5. Progression of collar rot disease in chickpea at 24th December sowing.

This experiment revealed the rate of progression of the disease at different dates of sowing. The seedling age up-to 30-35 days was most vulnerable to pathogen attack and the disease developed more faster at juvenile stage than the older one though, pathogen proliferation and development depend very much upon soil temperature and soil moisture condition. Following rainfall during the experimental seasons of both the years a boon in infection had been noticed and the rate of infection counted higher if the age of the plant fell below 30 days. After 35 to 40 DAP no further increase of the disease in population was noticed (Fig. 6).

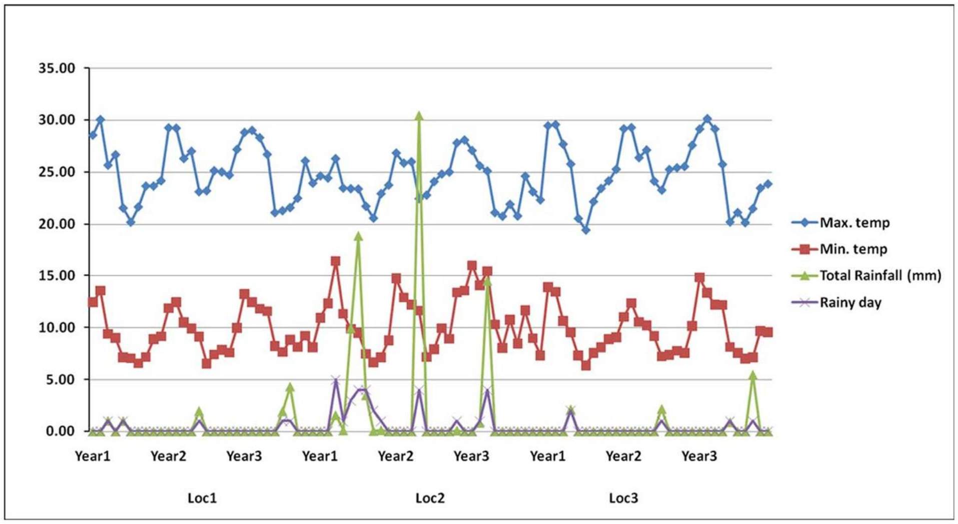

Fig. 6. Temperature, rainfall and total number of rainy days during the growing season of chickpea from 2018 to 2020.

From the current experiment, inference could be drawn that under field condition the spread of collar rot of chickpea caused by *Sclerotium rolfsii* is mainly govern by plant age, soil temperature and soil moisture and 26th November planting is the most suitable in terms of obtaining maximum yield.

References

FAO Statistical Database 2021. http://wwwfaoorg/faostat/en/#data

Gomez KA and Gomez AA 1984. Statistical procedures for agricultural research. John Wiley & Sons. New York. 68 pp.

Hossain S, Ford R, McNeil D, Pittock C and Panozzo J 2010. Inheritance of seed size in chickpea (*Cicer arietinum* L.) and identification of QTL based on 100-seed weight and seed size index. Aust. J. Crop Sci. **4**: 126-135.

Hussain A, Iqbal SM, Ayub N and Zahid MA 2006. Factors affecting collar rot disease of chickpea. Pak. J. Bot. **38**(1): 211-216.

Jukanti AK, Gaur PM, Gowda CLL and Chibbar RN 2012. Nutritional quality and health benefits of chickpea (*Cicer arietinum* L.). Br. J. Nutr. **108**: 512-526.

Kranz J 1988. Measuring plant disease. *In*: Experimental techniques in plant disease epidemiology, pp. 35-50. Springer, Berlin, Heidelberg.

Pande S, Sharma M, Gaur PM, Basandrai AK, Kaur L, Hooda KS and Rathore A 2013. Bi-plot analysis of genotype × environment interactions and identification of stable sources of resistance to Ascochyta blight in chickpea (*Cicer arietinum* L). Australas. Plant Pathol. **42**(5): 561-571.

Prasad PS and Saifulla M 2012. Effect of soil moisture and temperature on population dynamics of *Fusarium udum* causing pigeonpea wilt. Biosci. Trends. **5**: 303-305.

Rajalaxmi A 2020. Analysis of total factor productivity of chickpea in major producing states in India. Indian J. Agric. Res. **54**(3): 293-300.

Sharma M and Ghosh R 2017. Heat and soil moisture stress differentially impact chickpea plant infection with fungal pathogens. *In*: Plant tolerance to individual and concurrent stresses, pp. 47-57. Springer, New Delhi.

Sharma M and Pande S 2013. Unravelling effects of temperature and soil moisture stress response on development of dry root rot [*Rhizoctonia bataticola* (Taub.)] Butler in Chickpea. Am. J. Plant Sci. **4**: 584-589.

Singh TP, Deshmukh PS and Nagar RVS 2011. Effect of sowing time of chickpea on its yield and plant growth in North Western part of India. NISCAR_CSIR, India. 31-35.

Sinha R, Gupta A and Senthil-Kumar M 2016. Understanding the impact of drought on foliar and xylem invading bacterial pathogen stress in chickpea. Frontier Plant Sci. **7**: 902.

Sood S, Singh H and Sethi D 2020. Growth performance and instability of pulses in the state of Rajasthan. Indian J. Agric. Res. **54** (5): 646-650. DOI: 10.18805/IJARe.A-5409

Srividya PV, Ahamed ML, Ramana JV and Ahammed SK 2022. Studies on diversity of *Sclerotium rolfsii* causing collar rot in chickpea using morphological and molecular markers. Legum Res. **45**(1): 82-89. DOI: 10.18805/LR-4199

Tarafdar A, Rani TS, Chandran USS, Ghosh R, Chobe DR and Sharma M 2018. Exploring combined effect of abiotic (soil moisture) and biotic (*Sclerotium rolfsii* Sacc.) stress on collar rot development in chickpea. Front. Plant Sci. **9**: 1154.

Torkaman M, Mirshekari B, Farahvash F and Yarnia M 2018. Effect of sowing date and different intercropping patterns on yield and yield components of rapeseed (*Brassica nappus* L.) and chickpea (*Cicer arietinum* L.). Legum Res. **41**(4):578-583.

Varoglu H and Kazim A 2018. Effect of sowing date on yield and quality characterstics of chickpea varieties under Mediterranean climate conditions. Legum Res. **42**(3): 360-364.

(Manuscript received on 25 September, 2022; revised on13 December, 2022)