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Effects of sowing date on severity of blight caused by *Ascochyta rabiei* (Pass.) Labr. and yield components of three chickjpea cultivars in *Tarai* area of Uttarakhand.

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ABSTRACT
Three chickpea cultivars PG 114, PG 186 and H 208 were planted on three sowing dates at N.E. Borlaug Crop Research Centre (NEBCRC), Pantnagar for Rabi season 2015-16. Severity of blight, caused by Ascochyta rabiei, was measured on a 1–9 scale (defined) on vegetative parts and on pods as percent infected. The disease severity was essentially lower on plants sown on the third dates but higher on plants sown on the two earlier dates. Yield components were measured as number of pods per plant and total yield (q/ha), where both disease severity and yield differed significantly among sowing dates and also among cultivars for each sowing date, these differences depending both on sowing date and cultivars. 20th November was found to be optimum for sowing of chickpea to avoid the pathogen infection. It shows moderate disease severity (41.56%), more number of pods per plant (43.33 nos.) and highest yield (19.34q/ha) in comparison to other dates of sowing. Among varieties PG 114 was found to be best cultivar showing minimum disease severity and higher yield in all dates of sowing in comparison to others. While, H 208 was found most susceptible to the Ascochyta blight with maximum disease severity and lowest yield in all sowing dates.
Keywords: *Field trial · Cicer arietinum · Infected pods · pods per plant · yield (q/ha)*

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INTRODUCTION

Chickpea (*Cicer arietinum* L.) belongs to family leguminaceae, commonly known as 'gram' or 'Bengal gram' or çhana' occupies a position of pride among the leguminous crops owing to its great importance both as vegetable and as pulse. In a country like, India where most of the population is primarily vegetarian chickpea has a special place in the daily diet of people due to its high protein content and manifold uses. They are rich source of protein and form an important part of vegetarian diet containing about 18-24% of protein, 38-59% carbohydrate, 3% fiber, 4.8-5.5% oil, 3% ash, 0.2% calcium, and 0.3% phosphorus. (Hulse, 1991). In spite of the evolution of improved varieties and adoption of recommended package of practices, the average production of this crop is very low in India in comparison to many other countries of the world. Among the various factors, responsible for lowering down its yield, the disease especially those cause by fungi, are considered to be the major ones. The fungus, *Ascochyta rabiei*, is the causal agent of chickpea blight and is the major biotic constraint limiting chickpea production in in Northern Indian condition (Nene, 2012). Severe attacks may result in total loss of the crop (Reddy and Singh 1990; Singh *et al.,* 1981; Singh and Reddy 1990; Solh *et al.,* 1994) and, in some years, the disease has even affected international trade (Dusunceli *et al.* 2007). Pande *et al.* (2005) recently reviewed the biology and management options of Ascochyta blight of chickpea. It is an important foliar disease of chickpea problematic in areas where cool (15-25ºC) and humid weather (>150 mm rainfall) prevails during the crop season (Pande *et al*., 2005). In India, Ascochyta blight is largely distributed in the Indo-Gangetic Plain and known to occur widely in North Western Plain Zone covering Jammu, Punjab, Haryana, Western UP and North West Rajasthan and causing a yield loss of about 50-90 percent (Grewal and Pal, 1986). Ascochyta blight of chickpea is the main reason behind yield instability of chickpea particularly in Northern Indian condition. Alteration in date of sowing is considered as one of the important strategy for blight disease management. This strategy follow the principle of avoidance

which aims to enable the host to avoid contact with the pathogen or to ensure that susceptible stage of the plant and favorable conditions for the pathogen should not coincide. Spread of the disease is favoured by cool and wet weather such as occurs in winter in the *Tarai* region of Uttarakhand. Here, in order to avoid the disease, some farmers sow chickpea as late as early March or even April but yields may then be limited by the onset of hot and dry weather before maturity. In contrast, providing that blight is controlled yields of winter sowings may be double those of spring sowings (Singh and Reddy, 1990). One aim of the current work was therefore to determine the effect of sowing dates on the severity of Ascochyta blight and yield components of three chickpea cultivars grown under *Tarai* area of Uttarakhand.

MATERIALS AND METHOD

Experimental Procedure

The Present investigations were carried out at Department of Plant Pathology, G.B. Pant University of Agriculture and Technology, Pantnagar. Field trial was carried out at N.E. Borlaug Crop Research Centre (NEBCRC) for *Rabi* season 2015-16. Topographically, Pantnagar falls in the humid-subtropical climate of North West Plain Zone (NWPZ) commonly known as Tarai at the foothills of lower Himalayas-Shivalik range. It is situated at 29^0 N latitude and 79.73^0E longitude, at an altitude of 243.8 metre above the mean sea level (MSL).

The experiment was conducted during *Rabi* season 2015-2016 in a Factorial Randomized Block Design (FRBD) with three replications. The size of each plot was 4.0 × 1.2 m^2 with a row to row spacing of 30 cm and plant to plant 10 cm. H 208, a highly susceptible variety along with 2 commercial varieties PG 114 and PG 186 were sown at three different dates starting from November 5 to December 5 at fortnight interval. A uniform fertilizer dose (N_{20} P_{40} K_{50} Kg/ha) was applied in each plot. Indoxacarb 0.0075 percent in 750 L of water per hectare was sprayed twice on the crop at fifteen days interval to prevent crop damage from gram pod borer and other foliage insects.

Observation on severity of Ascochyta blight was recorded at fifteen days interval starting from first disease appearance till the maturity of crop using 1-9 rating scale for each sowing dates. Number of pods per plant and Grain yield (kg/ha) were also estimated for each plot.

Experimental details:

No. of cultivars	:	3 (2 commercial adopted varieties PG 114 and PG 186 and 1 susceptible check H 208)
Date of sowing	:	3 (Early, Optimum, Late)
Design	:	FRBD with 3 replication
Row length	:	4 m
No. of rows	:	4 for each cultivar 30 cm apart, No. of seeds/plot 200

Disease evaluation

Plants selected for disease assessment were the 10 at the centre of the second and third rows (5 from each row) of each of the sub-plots. Disease severity on vegetative parts of the plants was assessed at 9–20 day intervals after detection of the first symptoms, using a 1-9 scale given by Pandey *et al.*, 2009. (Table 1). Where 1 denotes no disease and 9 denotes a dead plant. But in ambiguous cases it was sometimes necessary to use the % of broken branches as an additional criterion.

Percent disease index (PDI) was calculated by using following formula described by McKiney (1923).

$$PDI = \frac{\text{Sum of all disease ratings}}{\text{Total number of plants observed x maximum rating value}} \times 100$$

Yield components

Plants selected for yield components were also the 10 at the centre of the second and third rows of each sub-plot (i.e., the same plants as those used for disease evaluation) effectively from an area.

Table 1: The description of the rating scale used in the present study.

Rating	Description	Reaction
1	No infection on any part of the plant.	Asymptomatic (A)
2	Minute lesions on lower leaves, flower and pods covered under dense canopy, usually not visible.	Resistant (R)
3	Lesions on less than 5% of the leaves, flowers and pods covered and dense plant canopy.	
4	Lesions and some fungal growth (conidiospores and conidia) can be seen on up to 15%	Moderately

	of the leaves, flowers and pods and branches covered under dense plant canopy.	Resistant (MR)
5	Lesions and slight fungal growth on up to 25% of the leaves, flowers, pods, stems and branches covered under dense plant canopy.	
6	Lesions and fungal growth on up to 40% of the leaves, flowers, pods, stems branches and defoliation, 25% of the plants killed.	Susceptible (S)
7	Large lesions and good fungal growth on up to 60% of the leaves, flowers, pods, stems branches, defoliation common, drying of branches and 50% of the plants killed.	
8	Large Lesions and profuse fungal growth on up to 80% of the leaves, flowers, pods, stems, branches, defoliation, drying of branches and 75% of the plants killed.	Highly susceptible (HS)
9	Large lesions and very profuse fungal growth on up to 100% of the flowers, pods, stems branches, almost complete defoliation, drying of plants and 100% of the plants killed.	

The data obtained in the field experiments were analyzed statistically by Factorial Randomized Block Design (FRBD) using STPR programme (GBPUA&T statistical software), and MS Excel. Data recorded were compared by the means of critical differences at five per cent level of significance in field condition.

RESULT AND DISCUSSION

The result presented in Table 2, Fig. 1 & 2 indicates that different sowing dates showed marked differences in disease severity percentage. The disease severity was significantly higher in the 5th November sowing followed by crop sown on 20th November and 5th December. The disease severity was decreased slowly when sowing was delayed and minimum disease was observed in the 5th December sown crop. In early sown plots, very dense plant canopy was observed due to excessive vegetative growth of the plants; this caused increased humidity and relatively lowers temperature in the plant population which favors the disease development. In addition to this, diseases like collar rot, Sclerotinia blight, and grey mould were also recorded in high proportions. So there was high disease severity in early sowing crop, whereas the crop sown on 20th November and 5th December showed comparatively low disease severity.

The disease severity differences between the varieties were highly significant. The disease severity was significantly lowest in the variety PG 114 followed by PG 186, whereas the maximum disease severity was observed in the variety H 208. The interaction between sowing dates and varieties was significant, the variety PG114 showed significantly less disease severity in comparison to other two varieties on all dates of sowing; whereas the maximum disease was observed in the variety H 208 on all sowing dates. The disease severity was differed significantly within all the varieties which were tested on all the sowing dates

In case of pod formation, the number of pods per plant was maximum in the variety PG 114 followed by PG 186 and the least number of pods per plant was recorded in H 208 on all sowing dates (Table 4.7). Similarly, total yield was highest in PG 114 followed by PG 186 and H 208. Lowest yield was observed in the variety H 208 in all sowing dates as presented in Table 4.7. The interaction between sowing dates and varieties in order to yield were highly significant, the yield of three varieties were highest on 20th November sown crop as compared to other sowing dates. The lowest number of pods per plant and yield was observed on 5th December sown crop in all three varieties.

Table 2: Effect of varieties and date of sowing on severity of Ascochyta blight disease and grain yield in chickpea

Varieties	Disease severity (%)*			Yield Parameters*					
				No. of Pods/Plant			Total yield (q/ha)		
	Dates of sowing			Dates of sowing					
	5th Nov.	20th Nov.	5th Dec.	5th Nov.	20th Nov.	5th Dec.	5th Nov.	20th Nov.	5th Dec.
PG 186	54.89	42.93	40.93	30.33	34.67	14.67	13.89	18.75	9.65
PG 114	46.00	41.56	32.53	38.33	43.33	18.67	15.38	19.34	10.96
H 208	71.22	59.56	53.44	29.67	32.33	11.67	13.42	15.28	7.64
CD at 5%									
Dates of Sowing(D)	2.32			1.45			0.376		
Varieties(V)	2.34			1.48			0.382		
D × V	4.03			2.52			0.651		
CV	4.73			5.18			2.72		

*Mean value of three replications

The results of present investigation (Table 4.7) clearly showed that, the disease severity was distinctly low in late sown crop but yield was drastically reduced due to unfavourable environmental condition for pod formation. The variety, H 208 was found more proneness to disease in comparison to PG 114 and PG

186, at every date of sowing. The disease severity was highly affected due to climatic conditions besides different dates of sowing and varietal characters. Scanty work has been done so for on the severity of disease in relation to varieties and date of sowing. However, Weltzien et al. (1984) found that there is vast decrease in disease intensity when the crop sown lately on 15th December as compared to sown on 15th November in Allepo, Syria. Whereas, Tripathi (1985) had also observed that higher grain yield per hectare and lowest disease severity of Ascochyta blight was occurred when crop was sown on 19th November. Simillar result has been observed by Mohamed et al., 2010 in Tunisia, where disease was essentially absent on plants sown in december but present on plants sown on the two earlier dates. Sowing date delays the epiphytotic only if it is delayed beyond the beginning of the natural epiphytotic.

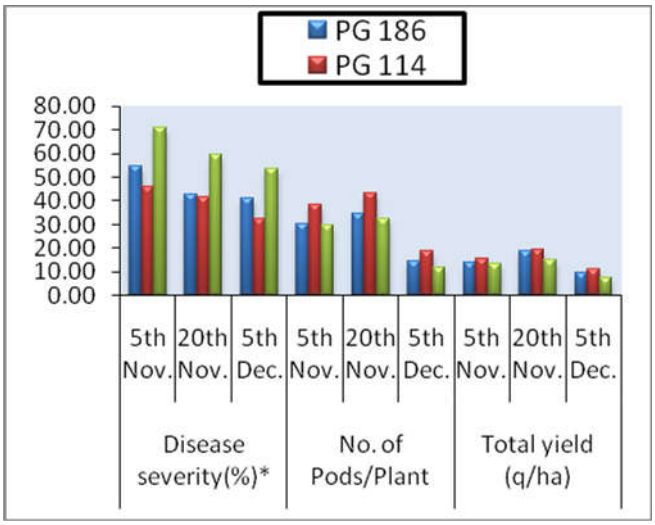

Fig 1: Effect of varieties and date of sowing on severity of Ascochyta blight disease and grain yield in chickpea

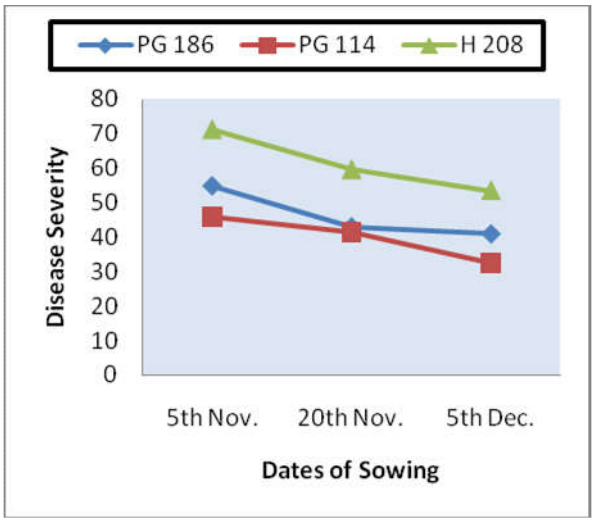

Fig 2: Disease progress curve representing Ascochyta blight development in chickpea cultivars PG 186, PG 114 and H 208

SUMMARY AND CONCLUSION

20th November was found to be optimum for sowing of chickpea to avoid the pathogen infection. It shows moderate disease severity (41.56%), more number of pods per plant (43.33 nos.) and highest yield (19.34q/ha) in comparison to other dates of sowing. Among varieties PG 114 was found to be best cultivar showing minimum disease severity and higher yield in all dates of sowing in comparison to others. While, H 208 was found most susceptible to the Ascochyta blight with maximum disease severity and lowest yield in all sowing dates.

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