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Investigation on different sowing dates affecting the development and progression of stripe rust of wheat in India

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Abstract

Stripe or yellow rust caused by *Puccinia striiformis* f. sp. *tritici* is one of the most important foliar diseases of wheat causing severe loss under favourable conditions. This disease occurs in epidemic form in cool and moist wheat growing regions. Weather factors play a major role in the incidence and severity of the crop diseases. This study is an attempt to assess the effect of different sowing dates on stripe rust of wheat disease development. The experiment was conducted on susceptible wheat variety PBW 343 grown under artificial epiphytotic conditions at Rajasthan Agricultural Research Institute, Durgapura (Jaipur) during 2020-21 and 2021-22. Significant variations in disease severities were observed among the crop planted at five different dates. The timely sown crop on 20th November was found more vulnerable to stripe rust in comparison to early and late sown crops i.e. 10th November, 30th November and 10th December.

Keywords: Epiphytotic, disease severities, *Puccinia*, sowing dates, stripe rust, weather

Introduction

Wheat (*Triticum aestivum* L.) is one of the major cereal crops of India in terms of the area of land covered, volume produced and the number of farmers engaged in its production. The production and productivity of wheat is adversely affected by numerous biotic and abiotic stresses (Agrios, 2005) [1]. Stripe rust caused by *Puccinia striiformis* f. sp. *tritici* is a major biotic factor which limits wheat production especially in the northern western plains and northern hills of India. Traditionally, stripe rust was prevalent in moist and cool seasons. But in recent years, this disease is emerging as a serious and alarming threat in warmer areas too where the disease was earlier considered less important or absent (Milus *et al.*, 2009) [5]. This is all due to emergence and movement of new aggressive strains which have capability of surviving in higher temperature in non-traditional areas (Hovmoller *et al.*, 2008). Sowing date is one among the important factors affecting the yield potential of a crop under provided set of conditions (Dhillon and Uppal, 2019) [2]. Various field crops can escape several diseases merely by the shifting the sowing time (Sud and Singh, 1984) [9]. This may happen due to change in environmental conditions congenial for disease development. Thus, under epidemics and unavailability of resistant varieties, cultural practices are the only option in managing the rust as a tool in integrated disease management. There is very little information published on the effect of different sowing dates to manage wheat stripe rust in India.

Material and Method

The experiments were laid in completely randomized design (CRD) with four replications each in cage house, during *Rabi* 2020-21 and 2021-22. The seeds of susceptible cultivar PBW 343 were sown by staggered sowing at an interval of 10 days starting from 10th November, 20th November, 30th November and end with 10th December in 25 cm earthen pots. Inoculum suspension was prepared by mixing the pathotypes (46S-119, 110S-119, 238S-119, 110S-84 and T) of PST in sterile distilled water (95ml) to which 5ml of Tween-20 was added and shaken properly for uniform mixing. Seedlings were sprayed with fine mist distilled water prior to inoculation followed by gentle rubbing of leaves between fingers to de-wax the leaf surface and to open the stomata. The twenty five days old plants from each sowing date were inoculated with mixed PST pathotypes using syringe technique.

Plants were misted again with the help of hand sprayers after inoculation and maintained in saturated moist cloth chamber for 48 hours duration. Hereafter, consistent mist-sprays (5 times per day) of water were given for providing optimum humidity in pots. The inoculation process was performed in late afternoon to draw the advantages of night-dew for creating leaf wetness conditions, a predisposition factor for rust infection. Disease severity (%) was recorded by using modified Cobb's scale (Peterson *et al.*, 1948) [6].

Results and Discussion

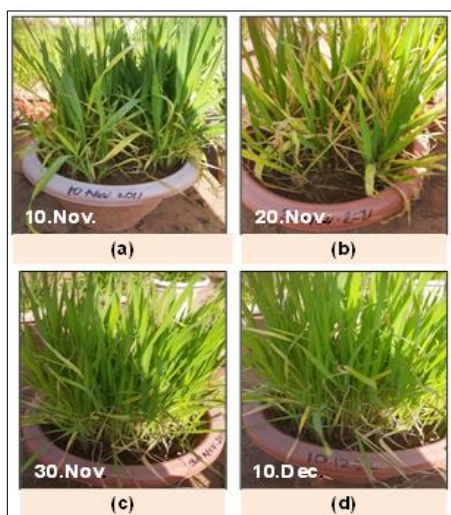


Plate 1: Effect of different dates of sowing on rust development

Results of two consecutive years and pooled have been described in Table 1. As per the data indicated, the alteration in sowing dates has a large impact on the development of this disease. The plant group sown on 20th november was

observed to be highly susceptible to the infection with minimum latent period (7 days), incubation period (9 days) and the highest per cent of rust severities (85.12, 89.30 and 87.21) in both years individually and pooled. While, the plants sown on 10th december showed maximum latent and incubation period of 13 and 18 days, respectively with the lowest per cent rust severities (21.14, 23.34 and 22.24) in individual and pooled years followed by plants sown on 30th november that took latent period of 10 days and 12 days for incubation with 53.57, 57.21 and 55.39 per cent rust disease severities and plants with sowing date 10th november which showed latent and incubation period of 8 and 10 days, respectively with 62.27, 60.19 and 61.23 per cent rust severities in the individual and pooled years (Plate 1). The differences in per cent disease severities of plants with different sowing dates were statistically significant from each other (Fig. 1). It was also observed that high relative humidity (70-80%), optimum temperature 25 °C to 30 °C accompanied by rains prevailed during the growth of crop from 8th Nov. to 17th Dec., were favourable for disease development during both seasons. Singh *et al.* (2012) [7] reported that the severity of stripe rust caused by *Puccinia striiformis* on wheat did not significantly vary between the early sowing date (S1; 24 October-10 November) and midseason sowing date (S2; 11 November-2 December), whereas the variation in yield reduction due to stripe rust was significant (9-22 and 32-82% for S1 and S2, respectively). Stripe rust is traditionally important for wheat grown in cooler environments due to the lower temperatures requirement for optimum development of pathogen (Singh *et al.* 2002) [8]. Fender (2004) [3] reported that the disease severity of cereal rust was the highest in early-planted crop and suggested that delay of autumn planting date might provide a useful cultural control measure for rust pathogen.

Table 1: Efficacy of alteration in sowing dates for the management of *Puccinia striiformis* f. sp. *tritici* in terms of yield of wheat

S. no.	Date of Sowing	Date of Inoculation	Latent Period (days)	Incubation Period (days)	Percent disease severity*		
					2021	2022	Pooled
1	10-Nov	05-Dec	8	10	62.27 (52.11)	60.19 (50.90)	61.23 (51.49)
2	20-Nov	15-Dec	7	9	85.12 (67.34)	89.30 (71.25)	87.21 (69.16)
3	30-Nov	25-Dec	10	12	53.57 (47.07)	57.21 (49.15)	55.39 (48.10)
4	10-Dec	05-Jan	13	18	21.14 (27.26)	23.34 (28.86)	22.24 (28.09)
	S Em±				1.42	1.39	1.12
	CD at 5%				4.28	4.19	3.38
	CV				5.86	5.56	4.55

*Mean of four replications. Figures in parentheses are arcsine √ per cent angular transformed value

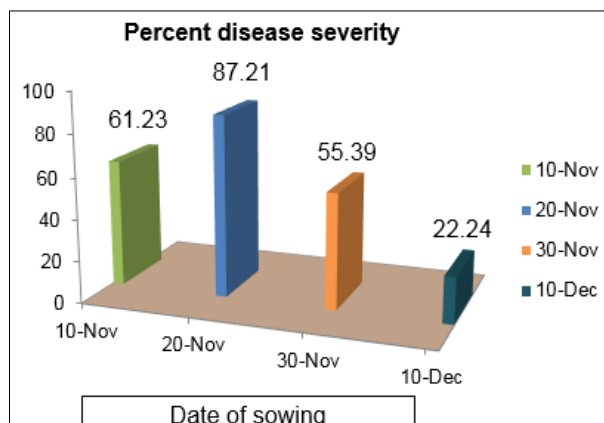


Fig 1: Per cent disease severity of *Puccinia striiformis* f. sp. *tritici* on different sowing dates

Conclusion

The minimum rust severity was observed in early (30 Oct.), late (30 Nov.) and very late (10 Dec.) sown crop while, highest rust severity was observed in timely sown crop (20 Nov.). In late and very late sown crops (30 Nov. and 10 Dec.) less infection was observed as compared to three early sown dates (30 Oct, 10 Nov and 20 Nov.). Maximum disease severity was recorded in timely sown crop on 10th - 20th November with 61.23 - 87.21 per cent rust severity while, minimum per cent rust severity (22.24) was observed in late sown crop on 10th December. Thus, it is recommended that wheat crop may be sown before 20th November to escape losses due to stripe rust disease.

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