The Journal of Rural and Agricultural Research Vol. 23 No. 1, 45-48 (2023)
Received February 2023; Acceptance May 2023

Foot rot disease management in basmati rice at farmer fields

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Abstract

Foot rot is a serious disease and a yield limiting factor in the cultivation of basmati rice in Punjab. An experiment was conducted at farmer fields of Bathinda and Rupnagar districts of Punjab during Kharif *2020 to investigate the technological gaps under field conditions. Field experiments consisting of time of transplanting and various combinations of urea application + Seed and Seedling treatments alongwith untreated check were conducted at 24 sites (farmer fields). The results showed significantly lesser disease incidence (3.13%) under seed + seedling treatment + zero N, which was followed by seed + seedling treatment + 42 kg/ha N (3.71%). When only the seed was treated (and not seedling) + zero N, the disease incidence was higher (19.6%), but it was lesser than the untreated check which had 44.2% disease incidence. Early transplanting of basmati rice (second fortnight of June) recorded higher disease incidence (27%), while the disease incidence was lower (7.1%) under late transplanting (second fortnight of July). The study found that seed soaking in pesticides solution containing* Carbendazim *50 WP @ 0.2 per cent for 12 hrs followed by seedling root dip in* Carbendazim *50 WP (0.2%) for 6 hrs was effective in reducing foot rot disease incidence.*

Key words: Basmati rice, Foot rot, Seed treatment, Nitrogen, Time of transplanting

Introduction

Rice crop is affected by several diseases, among which, Bakanae caused by *Fusarium fujikuroi* is one of the most damaging diseases in Basmati rice. *Fusarium* is considered as a common soil-borne plant pathogen resulting in huge agricultural losses in the whole world (Bentley *et al*., 2006). Genus *Fusarium*, as a plant pathogen, develops about 300 phylogenetic species despite a number of these species not being seriously studied yet (Aoki *et al*., 2014). The pathogen *Fusarium fujikuroi (F. fujikuroi)* is known to be seed and soil-borne and can survive effectively on diseased crop residues. *F. fujikuroi* formed different types of infectious structures like swollen tip hyphae, infection cushion and appressoria in rice husk and seedlings. Maximum percentage of survival of pathogen is in the husk and maximum transmission of pathogen is through florets (air borne inoculum) (Sunani *et al*., 2019). Rice is an important cereal crop and grown all over the world. Rice grown in India is primarily divided into Basmati rice and Non-Basmati rice. India is the major producer and exporter of Basmati rice to the world (Jain *et al.* 2014). In recent years, the Bakanae disease has gained significant importance in non-traditional rice growing areas as well, as its incidence has increased in aromatic rice varieties in northern parts of India namely Punjab, Haryana and Uttar Pradesh. This, by and large, not only affects the grain production but also the grain quality under field conditions. The invasion by this fungal disease can cause tremendous losses to yield because it is virtually uncontrollable once it appears in the field. The typical and distinguished symptoms of the disease are elongation and rotting of rice plants. *F. fujikuroi* produces broad-spectrum secondary metabolites, pigments and mycotoxins resulting in quantitative and qualitative losses to the rice crop (Bashyal, 2018). It has been observed that many farmers try to manage the disease with improper techniques in their infected field which is a wasteful practice and leads to poor results (Singh and Ghuman, 2016). As the disease is primarily seed-borne (Webster and Gunnell, 1992), seed

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dressing represents the first way to control the spread of the disease. However, seed treatment alone fails to prevent soil-borne infection after transplanting (Bagga and Sharma, 2006). Considering the above context, an experiment was conducted at farmer fields in Bathinda and Rupnagar district of Punjab in the year 2020 to evaluate the technological gaps under field conditions. Field experiments consisting of time of transplanting and various combinations of urea application + Seed and Seedling treatments alongwith untreated check were conducted at 24 sites (farmer fields).

Materials and Methods

The experiment was conducted at farmer fields of district Bathinda (30.207° N latitude and 74.95° E longitude; 201 m above mean sea level) and Rupnagar of Punjab (30.97° N latitude and 76.53° E longitude; 260 m above mean sea level) during *Kharif* season of 2020 to study the effect of time of transplanting along with seed/seedling treatment and doses of nitrogen on the occurrence of foot rot disease. Twenty four (24) farmers' fields were selected (12 in each district) during Kharif 2020. Two experiments were designed. First experiment tested the times of transplanting in which three time slots for basmati transplanting were there- 15 June to 25 June, 1 July to 10 July and 15 July to 25 July. The area under each treatment was 400 m^2. The second experiment was formed from various combinations of seed treatment and nitrogen, as listed below:

S. No.	Treatments
1	Seed treatment + N0
2	Seed treatment + N1
3	Seed treatment + N2
4	Seedling treatment + N0
5	Seedling treatment + N1
6	Seedling treatment + N2
7	Seed + Seedling treatment + N0
8	Seed + Seedling treatment + N1
9	Seed + Seedling treatment + N2
10	Untreated Control + N1

The seed treatment was done with solution of Carbendazim 50 WP @ 0.2 per cent + Streptocycline 0.01 per cent in water and soaked for 12 hours. The seedling treatment was done by dipping seedling roots in solution of Carbendazim 50 WP (0.2%) for 6 hours before transplanting. Both seed and seedling were treated with fungicide solution under seed + seedling treatment. No nitrogen was applied under N0 treatment, 90 kg urea per ha was applied under N1 and 135 kg per ha urea was applied under N2. Area under each treatment was 400 m^2. In each plot, observations were recorded for the incidence of foot rot disease symptoms from 3 random spots of 2m × 2m area. Disease incidence was observed at 70 and 100 days after transplanting of Basmati rice. The per cent disease incidence was calculated using the following formula:

$$\text{Per cent disease Incidence} = \frac{\text{No. of plants infected}}{\text{No. of plants examined}} \times 100$$

The grain yield was taken from whole of the plot and converted into q ha^{-1}.

Statistical analysis

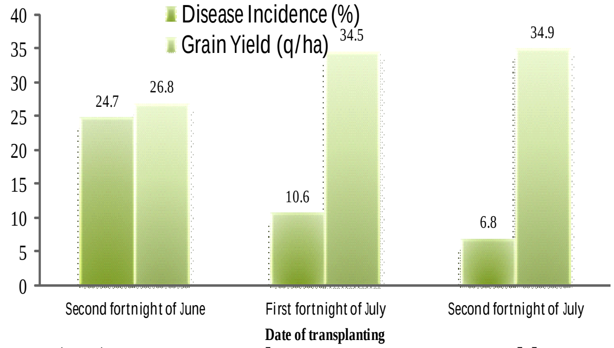
All experiments were carried out following completely randomized design. Means for treatment effects were separated to predict the cause and effect relationship of various treatments. After analysis of variance with CPCS1 software (Cheema and Singh 1990) critical difference (CD) was calculated at a significance of p = 0.05.

Results and Discussion

Effect of date of transplanting:

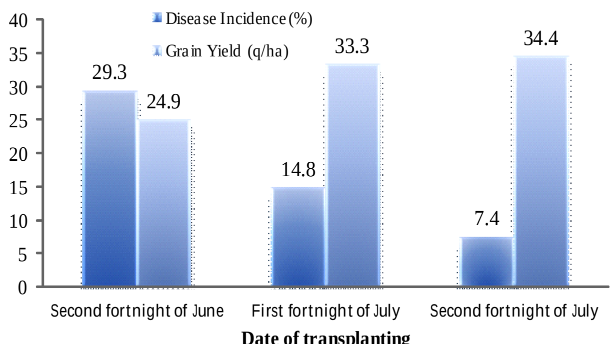
Basmati rice is recommended to be transplanted in the month of July for its quality production (Anonymous, 2020). However, depending upon rainfall, canal water availability, electricity for pumping tube well water and crop rotation, farmers change the transplanting dates accordingly. At late tillering stage (70 DAT) the data on per cent disease incidence indicated significant effect of transplanting dates on disease incidence (Figure 1 and Figure 2). The data established that advancement of transplant date in each fortnight period had significantly increased the incidence of foot rot disease. Basmati transplanted during second fortnight of July showed lower disease incidence valued at 6.8% at Rupnagar and 7.4% at Bathinda, which was significantly lower than early transplanted crop during second fortnight of June (24.7% and 29.3% at Rupnagar and Bathinda respectively). This variation in incidence may be due to effect of different environmental factors like temperature and RH on growth of the fungus. The above results were also supported by the yield data. It is obvious from the above findings that transplanting of Basmati rice before first week of July may lead to greater yield loss due to the higher disease attack.

Bal and Biswas (2018) also reported that the maximum air temperature (Tmax) was highest



C.D. (5%) Disease incidence: 9.90 Grain yield: 1.36

Figure 1: Effect of date of transplanting on disease incidence and grain yield of basmati at Rupnagar



C.D. (5%) Disease incidence: 9.64 Grain yield: 2.62

Figure 2: Effect of date of transplanting on disease incidence and grain yield of basmati at Bathinda

(37.3±3°C) under early (10th June) transplanted crop and gradually decrease with delay in planting time and subsequently registered lowest (32.9±1.7°C) under July 10 transplanting. They also confirmed a significant positive association (r = 0.85, p<0.01) between foot rot incidence and maximum air temperature. Nyall (1999) also reported that the foot rot disease was favoured by high air temperature during initial growth stage. The study of Bal and Biswas (2018) indicated that edaphic temperature at 5 cm (34.6±2.2°C) and 20 cm (34.2±1.6°C) remained high during early transplanted environment. These gradually decreased with delay in planting and lowest temperature attained under July 10 transplanted crop. The Bakanae pathogen is a soil borne fungus and chiefly affected by soil temperature and alters its activity with fluctuation in soil temperature. It has been reported that soil temperature as high as 35°C is most conducive for foot rot development in rice (Kazempour and Elahinia, 2007). The correlation analysis also indicated high positive coefficients with 5 cm (r = 0.62) and 20 cm (r = 0.60) depth soil temperature indicating more disease incidence at higher temperature regime. The total rainfall resulted in significant negative association (r = -0.71, p<0.05) with disease incidence. The study indicated gradual increase in total rainfall under delayed planting as monsoon become active during July in this part of India. As rainfall brings down air and soil temperature, the low rainfall in early-planted basmati rice contributed to higher infection by the pathogen.

Effect of fungicide treatment on disease incidence:

The results showed that in Rupnagar district when only the seed was treated and 42 kg/ha Nitrogen was applied, the disease incidence was 21.3 %, which was significantly lesser than untreated check which had 42.5 % disease incidence. The disease incidence dropped to 3.9% under Seed + Seedling treatment + N1 (42 kg/ha N) (Table 1). The lowest disease incidence at experimental plots of Bathinda district was found in Seed + Seedling treatment + N0 (3.3%), which was 92.7% lesser than the untreated check (Table 2).

The perusal of the grain yield data revealed that in the experimental plots of Rupnagar district, basmati yield was found substantially higher than the control plots. Considering all the treated plots at Rupnagar, the basmati yield ranged between 27.3 q/ ha to 36.4 q/ ha which was 6.2 to 15.3 q/ha higher than the untreated check (Table 1). While at Bathinda district, the yield range of treated plots was from 26.3 to 38.1 q/ha which was 27% to 84% higher than the untreated check (Table 2). These results corroborate with the findings of Bal (2015) who recorded both seed and seedling treatment with fungicides proved to be better in increasing the yield in comparison to only seed

Table 1: Effect of fungicide and Nitrogen treatment on disease incidence and grain yield of Basmati Rice at Rupnagar

S. No.	Treatments	Mean Disease Incidence(%)	Mean Yield (q/ha)
1	Seed treatment + N0	18.3	28.8
2	Seed treatment + N1	21.3	34.0
3	Seed treatment + N2	22.3	27.3
4	Seedling treatment + N0	15.0	31.1
5	Seedling treatment + N1	16.3	34.1
6	Seedling treatment + N2	18.0	29.6
7	Seed + Seedling treatment + N0	2.9	33.4
8	Seed + Seedling treatment + N1	3.9	36.4
9	Seed + Seedling treatment + N2	3.9	32.6
10	Control	42.5	21.1
	C.D. (5%)	4.71	2.22

Table 2: Effect of fungicide and Nitrogen treatment on disease incidence and grain yield of Basmati Rice at Bathinda

S. No.	Treatments	Mean Disease Incidence(%)	Mean Yield (q/ha)
1	Seed treatment + N0	20.8	27.8
2	Seed treatment + N1	22.6	35.3
3	Seed treatment + N2	23.6	26.3
4	Seedling treatment + N0	17.5	29.3
5	Seedling treatment + N1	17.9	34.5
6	Seedling treatment + N2	17.5	30.5
7	Seed + Seedling treatment + N0	3.3	32.1
8	Seed + Seedling treatment + N1	3.5	38.1
9	Seed + Seedling treatment + N2	4.3	32.8
10	Control	45.8	20.7
	C.D. (5%)	3.51	1.93

treatment or only seedling treatment. Fungicidal treatment significantly reduced the foot rot, plant height, tiller no. and increased grain yield in comparison to inoculated untreated control. Sidhu and Ghuman (2018) surveyed over a sample size of 124 farmers in four blocks of Rupnagar district and observed that the disease incidence varied from 35-100 per cent (during 2014) and 5-75 per cent (during 2015) in different Basmati cultivars. This decrease in foot rot incidence in surveyed villages could be attributed to the awareness campaign regarding importance of seed and seedling treatment initiated during 2014 and continued to 2015 along with field experiments at farmer fields.

Conclusion

Foot rot disease occurred in all of the experimental plots of both districts under study. The study yielded evidence in support of seed treatment + nursery treatment as an effective method to control this disease, which along with balanced use of Nitrogen fertilizer can help manage disease and maximize the grain yield. Delaying the time of transplanting upto second fortnight of July can help reduce the disease incidence as compared to June month transplanting, while the maximum grain yield can be obtained by transplanting during first fortnight of July.

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