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Climatic factors and transplanting times influenced on bacterial leaf blight in transplanted rice

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Abstract

The two fine varieties Basmatti Super and Basmatti 515 of rice (*Oryzae sativa* L.) were tested in field condition to investigate the co-relation of different transplanting times, temperature (^{o}C); relative humidity (%); rain fall (mm) and disease incidence (%) on bacterial leaf blight of rice crop at Adaptive Research Farm, Gujranwala during Kharif 2010-2012. Rice nursery was transplanted manually at 1st July, 15th July and 30th July each year. Significantly highest yield was recorded in B-515 i.e. T-2 (3860 kgha^{-1}) transplanted at 1st July followed by T-4 15th July (3400 kgha^{-1}) & T-5 i.e. B. Super 3880 kgha^{-1} for 30th July each year. Disease symptoms was detected on leaves at booting stage and was recorded (0-30%); (0-35%) & (0-40%) at a maximum temperature ranges (33.25 ^{o}C -29.92 ^{o}C); (37.60 ^{o}C -32.29 ^{o}C) & (32.69 ^{o}C -28.83 ^{o}C), minimum temperature ranges (28.89 ^{o}C – 21.51 ^{o}C); (29.00 ^{o}C -13.78 ^{o}C) and (24.94 ^{o}C -15.01 ^{o}C) with rain fall ranges (0-10.03 mm); (0-9.43 mm) and (0-10.76 mm); relative humidity ranges (47%-78%); (54.43%-69%) and (84.86%-96.57%) respectively during 2010-2012. Significantly highest economic return in B.515 was recorded by T-2 (Rs. 48593 ha^{-1}) with CBR 1:1.39 followed by B.515 i.e. T-4 (Rs. 27895 ha^{-1}) with CBR 1:1.22. However maximum economic return was recorded in T-5 (B.Super) producing net benefit Rs. 49493 having CBR 1:1.40 followed by T-3 (Basmati Super) Rs.46793 producing CBR 1:1.37. It was concluded that basmati 515 was transplanted at 1st week of July gave maximum yield with CBR (1:1.39). However basmati super was transplanted at 15th – 30th July gave significantly highest yield and economic return.

Keywords: Basmatti Super; Basmatti 515; Transplanting dates; Disease incidence (%); RH (%), Temperature (^{o}C); Adaptive Research Zone Gujranwala.

Introduction

Rice (*Oryza sativa* L.) is the main staple food after wheat; export item in the world along with Pakistan which is a primary source of energy and protein. The current global population is 6.4 billion which is expected to reach 7.5 billion by 2020 and 9 billion by 2050. Most of the population increase occured in developing countries (Asia and Africa) where rice is a staple food. It is cultivated in 154 millionha^{-1} with annual production of 600 million tones and average productivity of 3.9 tha^{-1} (Sheikh et al. 2011). Basmati fetches premium price in international market because of its distinct aroma, good characteristic and high yielding and recent years the importance of sustainable agriculture grown up to become one of the most important issue in agriculture. Diseases of rice are major threat to the rice grower, however it is important to find out alternate control measures against disease development; increasing yield and improves product quality (Batish et al. 2007). On the other hand the weather and soil conditions (temperature, air & humidity) influence the seasonal development and geo graphical distribution of plant diseases (Jones, 1924).

Beside all diseases of rice Bacterial leaf blight (*Xanthomonas Oryzae*) has become one of the most serious threat to paddy growers in India and field losses estimated up to 6-60 % (Sheikh et al. 2011). Basmati rice was affected by diseases with subject to temperature fluctuations (5°C–35°C) in Kashmir valley. Huge doses of nitrogen fertilizer affected the disease development in paddy crop (Chaudary et al. 2009). The weather is an important factor in the variability of disease development when there is no fluctuation of relative humidity (%) and temperature (°C) (Asai et al. 1967). Severe disease affected to plant causing serious yield losses, when the climatic conditions favorable to the pathogen (Munoz, 2008). Therefore the study have been planned to evaluate the co-relation of environmental factors with disease incidence (%) in two varieties of fine rice at Adaptive Research Farm, Gujranwala-Punjab, Pakistan..

Materials and Methods

Field trials were undertaken at Adaptive Research Farm, Gujranwala during Kharif 2010-2012. The farm situated at Sialkot road, named vania wala Farm (37 °C NS) occupied 14 ha cultivated area. The treatments comprises two varieties of fine rice (B. Super and B-515) transplanted in three different planting times (1st July, 15th July and 30th July) each year in the field according to schedule to check bacterial leaf blight appearance with special reference to environmental conditions (temperature °C; relative humidity % and rainfall mm). After puddling of soil just before planking 125 kgha^{-1} DAP along with 125 kgha^{-1} SOP was broadcasted. In three transplanting times rice nursery was transplanted manually with Plant to Plant distance of 9 inches and with total plant population of 200,000 in a hectare. Pre-emergence herbicide acetachlor @ 250 mlha^{-1} was applied 5 DAT and water level was kept up to 3-5 inches; then crystalline zinc sulphate 21% was broadcasted manually @ 25 kgha^{-1} 25 DAT. Nitrogen was applied in the form of urea @ 150 kg ha^{-1} in two split doses at 30-35 DAT and 55-60 DAT in experimental field. Two split doses of Cartap monohydrate was broadcasted @ 22.5 kg ha^{-1} at 60 and 90 days after thorough pest scouting. Anyhow no fungicide was sprayed in the field against diseases. All the other agronomic and plant protection measures were kept constant to avoid any biasness. Relative humidity (%), temperature (°C) and rainfall (mm) data was recorded at 1st week of September up to harvesting on daily basis and then convert it on week basis each year by hygrometer which was affixed in field with the help of wooden stick. The experiment was repeated in the 2nd and 3rd year for result validity.

The disease incidence (%) data was recorded by disease rating scale 0-100% (Chaudary et al. 2009). The crop was harvested at maturity and paddy yield data were recorded for economic analysis. The data was also analyzed statistically using analysis of variance techniques and Duncan Multiple Range (DMR) test at 5% significance level to compare the treatments means (Steel and Torrie, 1997).

Results and Discussion

Yield kgha $^{-1}$

Table–I showed that significant effect in yield ($P<0.05$) was recorded from B-515 transplanted at 1st July (3860 kg ha^{-1}), (3820 kgha^{-1} & 3880 kgha^{-1}) and Basmati Super 15th July and 30th July respectively during kharif 2010-2012. Lowest yield 2930 kgha^{-1} was recorded by Basmati Super transplanted early at 1st July. The data of yield was recorded according to the recommendation (Kahloon et al. 2012).

Economic analysis

From the data (Table I) maximum economic return was recorded from T-2 (Rs. 48593 ha^{-1}) with CBR 1:1.39 followed by T-4 (Rs. 27895 ha-1) CBR 1.22 during three kharif seasons. However maximum economic return was recorded in T-5 producing net benefit Rs. 49493 having CBR 1:1.40 followed by T-3 i.e. Basmati Super (Rs.46793) producing CBR 1:1.37 in the field area. The economic analysis was recorded (Kahloon et al. 2012).

Correlation of Bacterial Leaf Blight with Climatic Factors

The fall in temperature at 1st week of September allowed the appearance of dew on leaves which provided optimum conditions for spreading *Xanthomonas oryzae*. First symptom was appeared in start of September after completion of tillering stage; climatic conditions favors bacterial development. The bacteria enters through physically damaged plant parts in leaf sheath causes primary infection then at favorable environmental conditions converted into secondary infection caused huge damage to the crop at different aerial parts of the plants in patches. In severe attack the whole field damaged due to this disease that cause shriveling of grain and huge loss in yield of paddy crop (Chaudary et al. 2009). *Xanthomonas oryzae* was infected the rice crop in September 2010 range between (0-20%); October (20-30%); for September 2011 (0%); and October (0-35%) and for September 2012 (0%) and for October (0-40%).

Table. I. Effect of climatic factors influenced by yield and economics of Rice

Treatments	Yield kgha^{-1}			Mean Yield (kg ha^{-1})	Total cost of production (Rsha^{-1})	Total Income Rsha^{-1}	Net Benefit (Rsha^{-1})	CBR
	2010	2011	2012					
T-1 (B Super Ist July)	2320c	3360c	3100d	2930d	125107	131850	6743	1:1.05
T-2 (B 515 Ist July)	4010a	4000a	3560ab	3860a	125107	173700	48593	1:1.39
T-3 (B Super 15th July)	4040a	3810ab	3620a	3820a	125107	171900	46793	1:1.37
T-4 (B 515 15th July)	3130b	3600bc	3470bc	3400b	125107	153000	27893	1:1.22
T-5(B Super 30th July)	3960a	4050a	3620a	3880a	125107	174600	49493	1:1.40
T-6 (B 515 30th July)	2830c	3450c	3450c	3240c	125107	145800	20693	1:1.17
LSD 0.05%	0.102	0.273	0.105					

Figure I. Graphically representation of climatic factors, disease incidence in two varieties of paddy

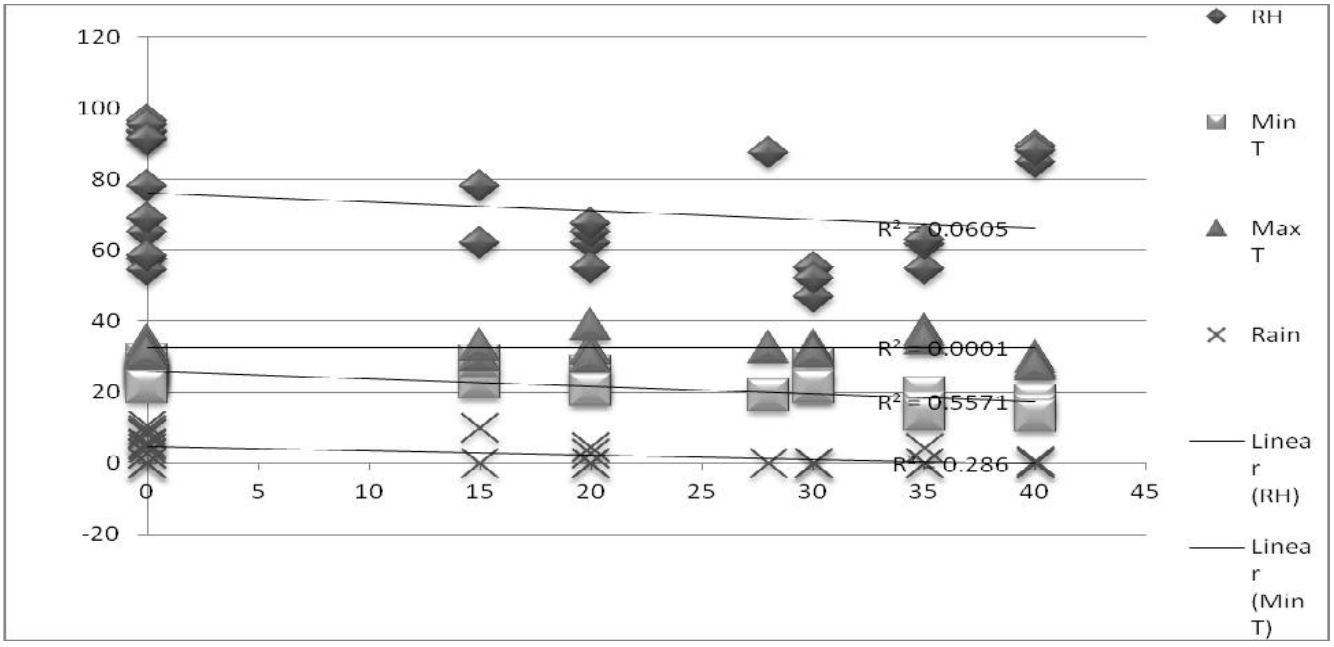

Figure-1 showed that if minimum temperature was decreased upto 28.89 – 13.46 ^{o}C and RH ranges between (62-88 %) the disease incidences increased, therefore strong direct relationship developed between increases in rain and minimum temperature. There is a strong inverse relationship with rain and disease incidence (-0.53), the relationship showed that when day temperature was high after rain splashes and minimum temperature fall down at night showed high infection of disease. Linear regression showed that maximum disease infect (0-40%) in paddy was recorded with maximum temperature (37.60^{o}C-28.89^{o}C) and minimum temperature (28.09 ^{o}C-13.46 ^{o}C) with rainfall (0– 0.76 mm) and RH (47- 96.57%). Studies showed that year to year variation of disease in crop was generally associated with weather condition (Ossai, 2004). Environmental factors (rain fall mm; intensity; relative humidity and temperature) showed significant synergistic effects on disease incidence causes variance in reduction of rice yields (Edeh et al. 2011).

Conclusion

It is concluded that basmati 515 was transplanted at 1st July – 15th July and basmati super was transplanted at 15 - 30 July gave maximum yield and maximum net benefit along with high cost benefit ratio. Be aware from air before rain splashes, the posture of bacteria initially present near the mid rib of leaf sheath on upper side just like small droplet. The disease attack spread in small patches in field at favorable environmental conditions; bacteria enter in the leaf through physical injury, drying up tip of leaf downward the collar end. Drying up of whole leaf sheath then drying up of whole plant (burning effect) and disease flare up all fields in a very short time caused huge loss to the growers.

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