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EFFICACY OF DIFFERENT CHEMICALS FOR THE MANAGEMENT OF BACTERIAL LEAF BLIGHT OF RICE (*ORYZA SATIVA* L.) AT VARIOUS LOCATIONS OF ADAPTIVE RESEARCH ZONE SHEIKHUPURA

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A B S T R A C T

Rice (*Oryza sativa* L.), is one of the most important staple food and a life line for thousands of millions of people for their daily requirements especially in Asia and Africa but it's production is threatened by several abiotic and biotic stresses. One of the most devastating diseases for low yield of rice is Bacterial Leaf Blight (BLB) caused by *Xanthomonas oryzae* pv *oryzae* which appears at tillering and booting stage and touches its peak at flowering stage as plant grows. To manage this menace, efficacy of three fungicides (Trifloxystrobin + Tubeconazol, copper oxychloride and Bordeux mixture) were tested as foliar spray for their effect on BLB at various locations (farm and farmer fields) of district Sheikhupura during kharif season 2014. The experiment was laid out in randomized complete block design (RCBD) with three replications. Pre and post treatment observations were taken in percentages damage by the disease BLB. Number of filled grains tillers, plant height (cm), grains per spike, thousand grain weight (g) and yield (kgha^{-1}) were recorded at harvesting. Among the test chemicals, copper oxychloride and Trifloxystrobin + Tubeconazole were remained statistically at par. Maximum 63, 50, 73% (cumulative of three locations) decrease over control was observed in copper oxychloride treated plot followed by 44, 41, 70% (three locations) decrease over control from Trifloxystrobin + Tubeconazole. The highest paddy yield at three locations among the test treatments was recorded in copper oxychloride treated plot (4766.7, 3016.0 & 4650.0 kgha^{-1}) followed by Trifloxystrobin + Tubeconazole yielding 4483.0, 2860.0 & 4596.0 kgha^{-1} against 4036 , 2386.7 & 4283.0 kg ha^{-1} paddy yield in the control at three locations. It is depicted from the results that application of copper based fungicides significantly reduced the impact of disease in rice crop as compared to untreated one. Among the tested chemicals, the use of copper oxychloride played important role from all chemicals for the management of holistic BLB disease of rice.

Keywords: Chemicals, locations, BLB, yield, rice

INTRODUCTION

Rice (*Oryza sativa* L.) is the most important staple and leading cereal crops in the world. According to FAO (FAO, 2016) global rice production in 2016 was 749.7 million metric tonnes, thereby making it the most produced cereal crop like wheat (735.02 million metric tonnes) and maize (959.14 million metric tonnes). Pakistan is fifth largest rice exporter in the world but the average yield potential per unit area of Basmati rice cultivars is far behind as compare to world average production and very low from many neighboring countries. In Pakistan, the rice was grown on an area of 2891 thousand hectares in 2015 and its production was 7005 thousand metric tons (Anonymous, 2015) which was much less than average production per unit area for advanced countries.

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The reason for low yield of rice crop is due to the devastating diseases like bacterial leaf blight (Khan *et al.,* 2008). It was recorded first time in Pakistan on rice by Mew and Majid (1977) and later on Ahmad and Majid (1980) reported it on rice at Rice Research Institute, Kala Shah Kaku and farmer's field. Reddy (1989) and Adhikari *et al.,* (1994) depicted that BLB can cause damage the crop on large scale and can cause 30 to 50% yield loss to rice production. This disease is constantly present all over Pakistan and maximum incidence was reported in Punjab (Akhtar *et al.,* 2007).

Most of the Pakistani cultivars have the varied resistance or tolerance against *Xanthomonas oryzae* pv *oryzae*. Moreover, no effective control measures have been established so far to control the disease; however copper based fungicides and antibiotics have been widely tested for its control. Effectiveness of some fungicides and antibiotics for the control of BLB in rice has already been tested by many research workers. Singh *et al.,* (1980) applied antibiotics and fungicides in the field for control of BLB of rice caused by *Xanthomonas oryzae*. Chaudhry *et al.,* (2011) tested Copperoxychloride 50% @1.25kg/ha, Oxytetracycline @0.75L/ha and Streptomycin @0.50kg/ha alone and also in combination with each other were tested and compared with untreated plot at research farm and farmer's field, respectively. Thus, the present research work was planned to test and evaluate the efficacy of different chemicals for the management of BLB at different locations under ecological zone of Sheikhupura.

MATERIALS AND METHODS

The present study was carried out at three locations viz. Adaptive Research Farm Sheikhupura and two farmer fields under ecological zone of Sheikhupura, Punjab, Pakistan during kharif season 2014. The experiment was conducted under randomized complete block design (RCBD) and treatments were tested in triplicate on rice cultivar basmati super. The experiment contained four treatments including control at all the three locations.

Nitrogen (N, 140 kg ha^{-1}), Phosphorus (P_2O_5, 80 kg ha^{-1}) and Potash (K_2O, 62 kg ha^{-1}) were applied in the form of urea, diammonium phosphate and sulfate of potash, respectively. Hundred percent of P, K and one third of N was applied before transplanting, while the remaining two third of N was top dressed in two equal splits at 30 & 60 days after transplanting. Irrigation was applied as and when needed.

All the treatments were applied on appearance of disease at the following rates:

T_1 = Trifloxystrobin + Tubeconazol @ 160 g ha^{-1}

T_2 = Copper oxycholoride @ 1235g ha^{-1}

T_3 = Bordeux mixture 2.5 :2.5 :250 ha^{-1} (2.5 kg copper sulphate+ 2.5kg quick lime+ 250 L water)

T_4 = Control (no application)

A fine rice variety Super Basmati was transplanted in the last week of July by maintaining the rows spacing i.e. 22.5cm and 66.66m^2 plot size was maintained at all locations. All other agronomic practices were kept uniform at all locations.

At each location rice fields were surveyed and visually observed the presence of BLB symptoms which appeared in the patches. Incidence of disease was recorded by following the schematic diagram (Table 1) showing the percentage of plants infected in the field according to following formula given by Chaudhary (1996). For calculating incidence of disease, plants were observed at ten points along a diagonal transect. Points were selected randomly five paces apart, starting ten meter inside the field. At each point, five plants were examined for disease symptoms. Actual incidence of disease in a field was then recorded as percentage of tissue area infected out of total leaf area examined. Percent disease incidence was calculated according to following formula described by Gnanamanickam *et al.,* (1999)

Table 1: Disease severity scale for evaluation of bacterial blight of rice in the field

Disease rating	lesion size (% of leaf length)
0	0
1	>1-10 %
3	>11-30 %
5	>31-50 %
7	>51-75 %
9	>76-100 %

$$\text{Disease Index} = \frac{n(1) + n(3) + n(5) + n(7) + n(9)}{tn}$$

Where: n (1), n (3), n (5), n (7) and n (9) = Number of leaves showing severity score of 1, 3, 5, 7 and 9. tn = Total number of leaves scored

Percent disease incidence was then calculated according to following formula described by Gnanamanickam *et al.,* (1999).

$$\% \text{ Disease incidence} = \frac{\text{Affected area of leaf}}{\text{Total leaf area}} \times 100$$

The data of yield & yield attributes like plant height (cm), number of productive tillers, 1000 grain weight (g), grains per panicle and paddy yield in kg ha^{-1}were recorded. The data recorded for each trait were statistically analyzed using the analyses of variance (ANOVA) and the means were compared using least significant difference (LSD) at 5% significance level (Steel *et al.,* 1997)

RESULTS AND DISCUSSION

Disease incidence: Visual estimates were recorded before and after application of chemicals by using the IRRI scale 1996 mentioned in methodology for BLB. The location wise data is presented in Table 2. Data recorded from all the locations revealed that among the tested chemicals, copper oxychloride and trifloxystrobin + tubeconazole were remained statistically at par. Copper oxycholoride was remained most effective in minimizing disease symptoms while trifloxystrobin + tubeconazole remained at 2nd rank at all three locations as reported in table 2 & 3 and Figure 1 & 2. Maximum percent decrease over control i.e. 63, 50, 73 % (three locations data) was observed in copper oxychloride treated plot followed by 44, 41, 70% (three locations data) decrease over control recorded from the plot treated with trifloxystrobin +tubeconazole. Chaudhary *et al.,* (2011) whose results revealed that Bordeaux mixture proved more effective than copper oxychloride and antibiotics. These findings are partially agreement with our results because the bordeaux mixture is also a copper based chemical.

Our findings are also agreed with that of Tagami and Mizukami (1962) and Hori *et al.,* (1973) who also reported that copper oxychloride and streptomycin solution completely inhibits the growth of bacterium. Gnanamanickam *et al.,* (1999) also concluded that copper compounds and Bordeaux mixture were effective against BLB and environmentally safe.

Effect of disease on yield and yield attributes: Location wise results regarding different yield parameters of rice crop were presented in table 4 & Figure 3. At crop maturity the adverse effects of disease incidence on plant height, productive tillers, grains per spike, and thousand grains weight were noted and compared with the treatments under test. It is depicted from the results that T_2 & T_3 were at par in reducing the adverse effect of disease followed by T_1 at location I. Similarly at location II, the chemicals under evaluation were at par in protecting the plant for its normal growth. While at location III, T_1 was statically different and better in promoting normal plant growth then rest of the treatments. Therefore, the use of chemicals under report at given doses is beneficial in normal growth of rice plant.

The effects of disease on fertile tillers were noted and compared with control. In all the three locations, disease has significantly reduced the number of productive tillers in the untreated plot. The results of all the locations presented in Table 4, showed that all the treatments remained significantly at par as compared with control plot. Among the tested chemicals, T_2 gave better results at all locations and maximum number of productive tillers i.e. 178, 179 & 216 (three locations data) per m^2were recorded (Table 4) as compared to untreated plot where 141, 122 & 167 (three locations data) productive tillers per m^2. Therefore, the use of chemicals may be recommended to reduce the bad impact of disease on tillering of rice crop.

It is depicted from the data presented in figure 4 that there were significant differences in paddy yield as compared to untreated plot. The maximum 4766.7, 3016.7 & 4950 kg ha^{-1}yield (three locations data)were recorded from the plot treated with T_2 (copper oxychloride) which is 18.08 , 26.39 & 8.56 % higher than that of untreated one. Location wise interaction within treatments was statistically significant at location 1 & 2 while the results at location 3rd showed that all the treatments equally effective in increasing paddy yield (Table 5). The results are accordance with that of khan *et al.,* (2005) who reported that Copper oxycholoride was effective as foliar spray against BLB and improved yield. Azhar *et al.,* (2013) reported that application of Nativo (trifloxystrobin + tubeconazole) 65WG was found highly effective in controlling BLB as it controlled incidence (9.233%) as it was up to (87.19%) against untreated plots which is partially confirmatory with our results where Nativo (trifloxystrobin + tubeconazole) also revealed promising results against BLB.

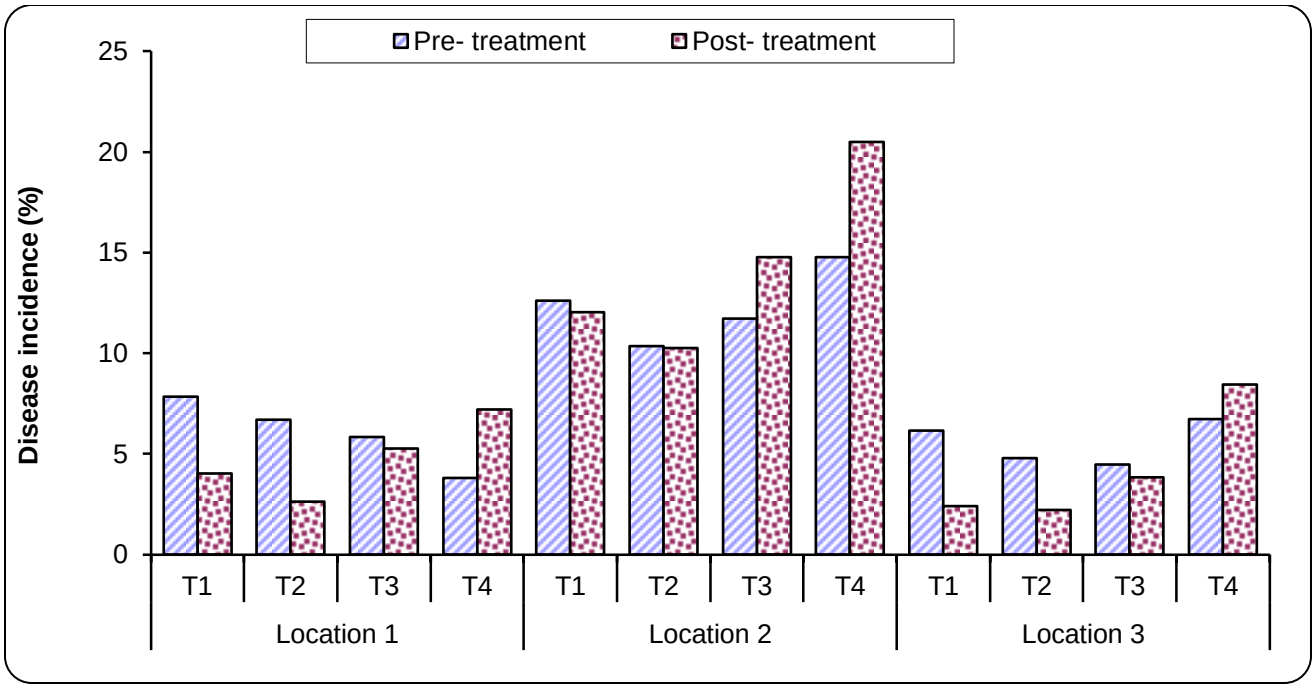


Figure 1. Graphical representation of the percent diseases incidence before & after treatment of chemicals.

T_1 = Trifloxystrobin + Tubeconazol @ 160 g ha^{-1} , T_2 = Copper oxycholoride @1235g ha^{-1}, T_3 = Bordeux mixture 2.5 :2.5 : 250 ha^{-1} (2.5 kg copper sulphate + 2.5kg quick lime+ 250 L water), T_4 = Control (no application)

Table 2: Percent Diseases Incidence Before & After Treatment of Chemicals

Treatment	DISEASE INCIDENCE PERCENTAGE					
	LOCATION 1		LOCATION 2		LOCATION 3	
	Pre-treatment	Post-Treatment	Pre-treatment	Post-Treatment	Pre-treatment	Post-Treatment
T_1	7.83A	4.03 A	12.60 AB	12.03 B	6.16 A	2.40BC
T_2	6.70A	2.63 A	10.36 B	10.26 B	4.80 B	2.20 C
T_3	5.83 A	5.26 A	11.73AB	14.76 B	4.46 B	3.83 B
T_4	3.80 A	7.20 B	14.76 A	20.50 A	6.73 A	8.46 A
LSD 5%	NS	10.67	3.19	4.63	1.36	1.44

At P = 0.05, within a column, Means having same letter are statistically similar to Fisher's Least Significant Difference (LSD) test

T_1 = Trifloxystrobin + Tubeconazol @ 160 g ha^{-1} , T_2 = Copper oxycholoride @1235g ha^{-1}, T_3 = Bordeux mixture 2.5 :2.5 : 250 ha^{-1} (2.5 kg copper sulphate + 2.5kg quick lime+ 250 L water), T_4 = Control (no application)

Table 3. Percent Efficacy of Different Chemicals against Bacterial Leaf Blight at Various Locations.

Treatments	Location.1	Location.2	Location.3
	% decrease/ control	% decrease/ Control	% decrease/ control
T_1	44 %	41%	70%
T_2	63%	50%	73 %
T_3	27%	28%	26%
T_4	--	----	---

At P = 0.05, within a column, Means having same letter are statistically similar to Fisher's Least Significant Difference (LSD) test

T_1 = Trifloxystrobin + Tubeconazol @ 160 g ha^{-1} , T_2 = Copper oxycholoride @1235g ha^{-1}, T_3 = Bordeux mixture 2.5 :2.5 : 250 ha^{-1} (2.5 kg copper sulphate + 2.5kg quick lime+ 250 L water), T_4 = Control (no application)

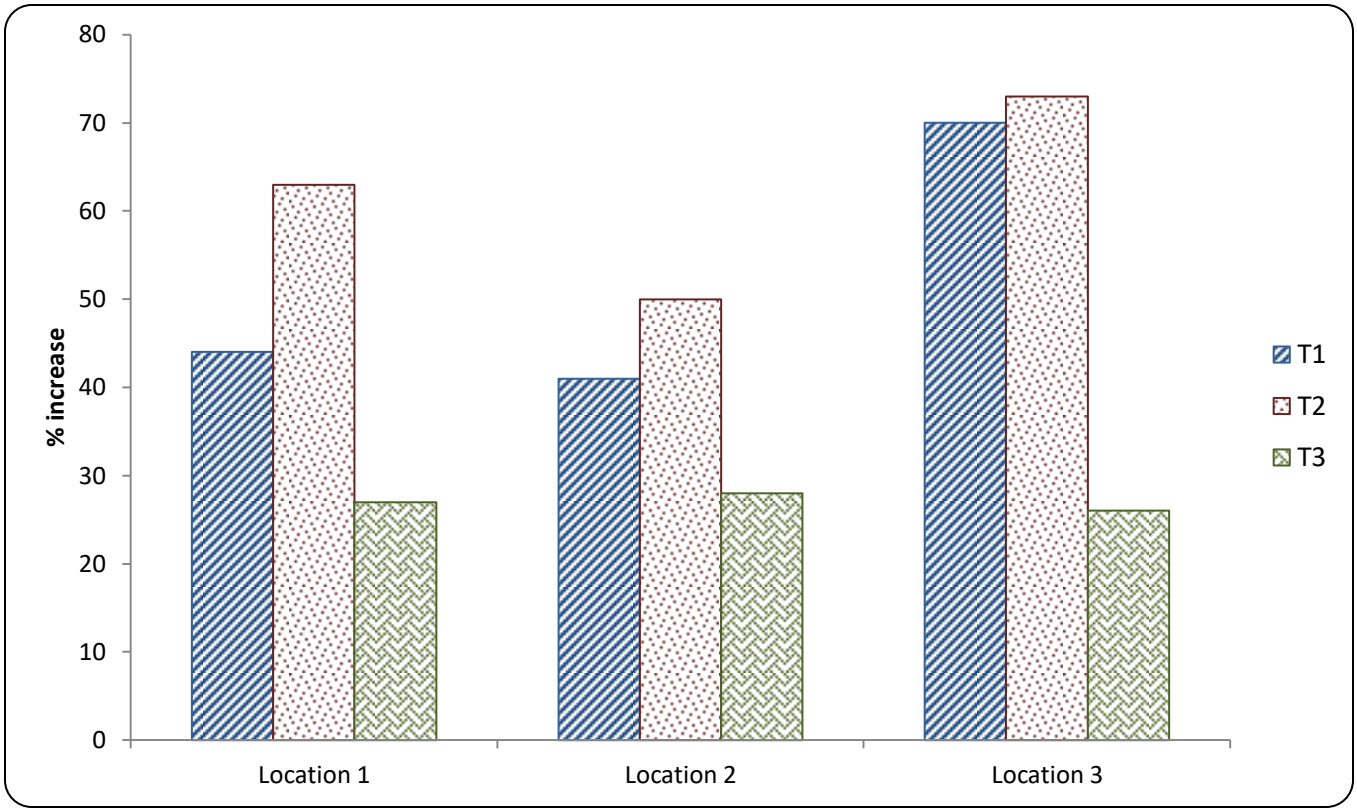


Figure 2. Graphical representation of thepercent efficacy of different chemicals against bacterial leaf blight at various locations.

T_1 = Trifloxystrobin + Tubeconazol @ 160 g ha^{-1} , T_2 = Copper oxycholoride @1235g ha^{-1}, T_3 = Bordeux mixture 2.5 :2.5 : 250 ha^{-1} (2.5 kg copper sulphate + 2.5kg quick lime + 250 L water), T_4 = Control (no application)

Table 4. Effect of Disease Incidence on Different Yield Parameters of Rice Crop at Various Locations.

	Treatments	Plant height (cm)	No. of fertile tillers m^{-2}	Grains/panicle	1000 grain weight (g)
Location 1	T_1	98.67 BC	167.67 AB	96.67 B	22.26 B
	T_2	102.67 A	178.67 A	110.33 A	22.32 B
	T_3	101.33 AB	158.67 AB	88.00 C	23.34 A
	T_4	96.33 C	141.67 C	81.00 D	21.06 C
	LSD 5%	2.72	32.82	6.88	0.63
Location 2	T_1	99.33 AB	173.00 AB	85.33 B	19.00 BC
	T_2	103.53 A	179.33 A	94.33 A	20.06 AB
	T_3	103.40 A	162.00 B	72.33 C	20.23 A
	T_4	94.67 B	122.67 C	68.00 C	18.30 C
	LSD 5%	3.58	15.5	9.70	3.58
Location 3	T_1	105.67 A	203.67 AB	97.00 B	22.00 A
	T_2	100.00 B	216.67 A	119.00 A	21.66 AB
	T_3	100.67 B	190.00 B	88.00 B	20.33 B
	T_4	98.53 B	167.33 C	75.33 C	20.33 B
	LSD 5%	4.78	16.02	6.89	1.09

At P = 0.05, within a column, Means having same letter are statistically similar to Fisher's Least Significant Difference (LSD) test

T_1 = Trifloxystrobin + Tubeconazol @ 160 g ha^{-1} , T_2 = Copper oxycholoride @1235g ha^{-1}, T_3 = Bordeux mixture 2.5 :2.5 : 250 ha^{-1} (2.5 kg copper sulphate + 2.5kg quick lime+ 250 L water), T_4 = Control (no application)

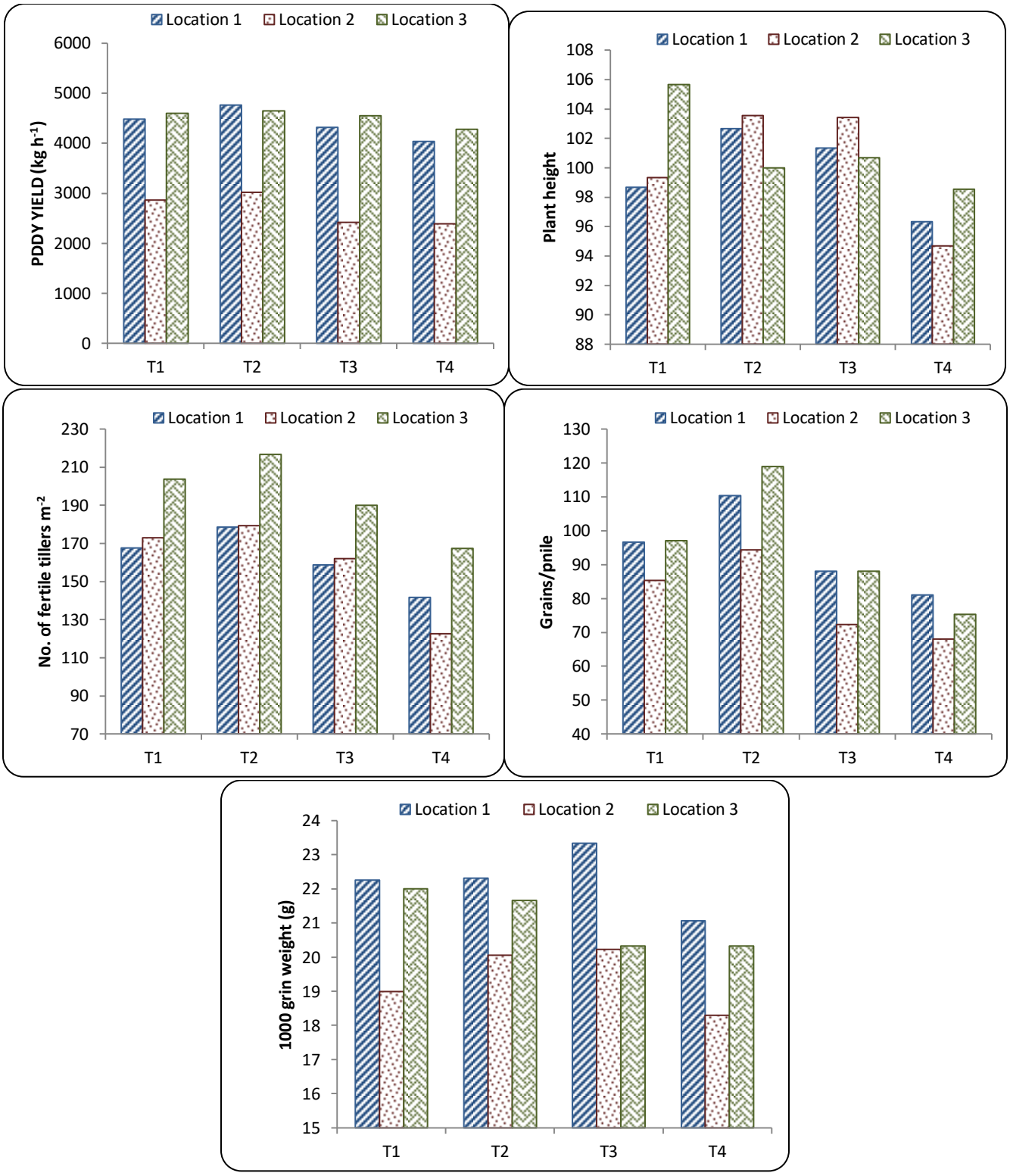


Figure 4. Graphical representation for the effect of disease incidence on different yield parameters of rice crop at various locations.

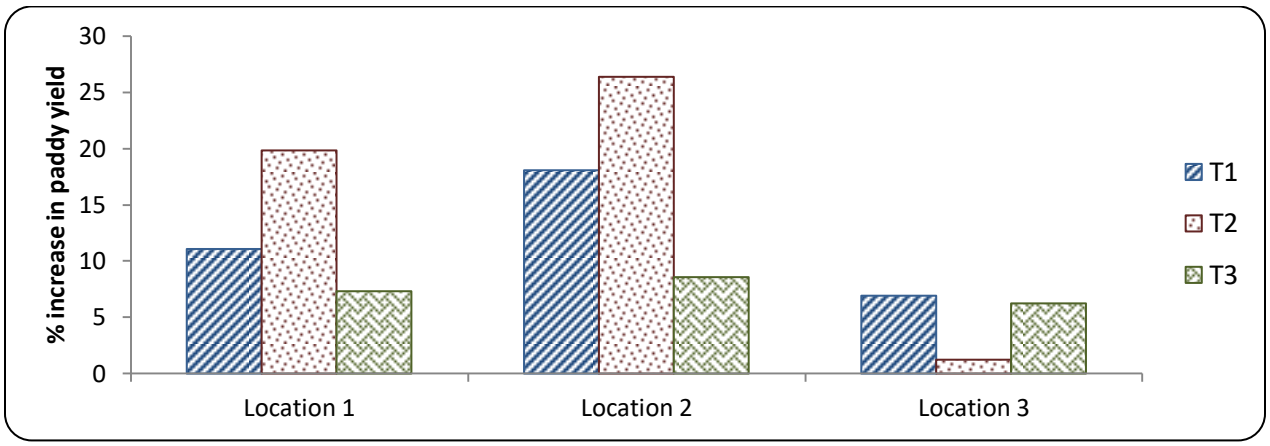
T_1 = Trifloxystrobin + Tubeconazol @ 160 g ha^{-1} , T_2 = Copper oxycholoride @1235g ha^{-1}, T_3 = Bordeux mixture 2.5 :2.5 : 250 ha^{-1} (2.5 kg copper sulphate + 2.5kg quick lime+ 250 L water), T_4 = Control (no application)

Table 5. Effect of Disease Incidence on Paddy Yield at various Locations.

Treatmen	PADDY YIELD (kg ha^{-1})					
	LOCATION 1 Yield	% increase/ Decrease	LOCATION 2 Yield	% increase/ Decrease	LOCATION3 Yield	% increase/ Decrease
T_1	4483.3B	11.06	2860.0 B	19.83	4596.7A	7.31
T_2	4766.7A	18.08	3016.7 A	26.39	4650.0A	8.56
T_3	4316.7C	6.93	2416.7 C	1.25	4550.0A	6.22
T_4	4036.7D	---	2386.7 C	-----	4283.3B	-----
LSD 5%	119.73		124.23		113.56	

* At P = 0.05, within a column, Means having same letter are statistically similar to Fisher's Least Significant Difference (LSD) test

T_1 = Trifloxystrobin + Tubeconazol @ 160 g ha^{-1} , T_2 = Copper oxycholoride @1235g ha^{-1}, T_3 = Bordeux mixture 2.5 :2.5 : 250 ha^{-1} (2.5 kg copper sulphate + 2.5kg quick lime+ 250 L water), T_4 = Control (no application)



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