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EFFECT OF FERTILIZERS ON THE INCIDENCE OF LEAF FOLDER AND BROWN PLANT HOPPER IN TRANSPLANTED *BASMATI RICE*

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Abstract

The *Rice* Leaf folder, *Cnaphalocrocis medinalis* and Brown plant hopper, *Nilaparvata lugens* are *Rice* pest which are prone to outbreaks when high level of nitrogen fertilizers are applied to *Rice*. To determine the effect of different fertilizers on the incidence of Leaf folder and Brown plant hopper on transplanted *Basmati Rice* a field experiment was conducted at the Experimental Farm School of Agriculture, in Lovely Professional University Phagwara, Punjab during *Kharif* season 2015. The experiment was comprised with 15 treatments and laid out in a Randomized complete block design with three replications. The recommended dose of fertilizer N- 43 kg ha^{-1}, P_2O_5- 30 kg ha^{-1}, K_2O-30 kg ha^{-1} and $ZnSO_4$- 25 kg ha^{-1}. The results showed that high dose of nitrogen did not affect *Rice* grain and straw yield but more impacted to the outbreak of Leaf folder and Brown plant hopper. The phosphorous and potash applications were directly correlated with control of insect pest and yield of *Rice*. The $ZnSO_4$ proved to be a better mode of fertilization for the crop at all levels of application, as it allowed nutrient blend in soil and reduced susceptibility of plants to pests. The crop with 48 kg ha^{-1} nitrogen application showed highest leaf folder damage *per* cent and brown plant hopper hill^{-1} and showed maximum plant height. Phosphorous and potash fertilizer was less promoted the plant growth than nitrogen height, number of tillers per plant**,** panicles per plant, 1000 grains weight. The grain and straw yield were recorded maximum in NPK- 48, 30, 30 kg ha^{-1}. The lowest grain and straw yield (2698, 4278 kg ha^{-1}) was recorded in control. For the less pest attack and more crop yield, we have to optimize the doses of fertilizers.

Key word: Susceptibility, Incidence, Phosphorous, Leaf folder, Brown plant hopper and Fertilizer.

Introduction

Rice is one of the leading cereal crops in the world and half of the population depends on this cereal crop for its dietary needs (Anonymous, 2006). It is the major staple food for most of Asia (Chakravarti *et al.,* 2012). It belonging to family Graminae and is self-pollinated crop. For half of world's population it serves as a source of nourishment (Davla *et al.,* 2013). India is second largest producer of *Rice* (Savary *et al.,* 2005). The one varietal group which differed itself from other dwarf varieties and gains popularities all over the world as a unique *Rice* called *Basmati Rice*. It is one of the most staple and popular cereal crops of India (Maclean *et al.,* 2002). It is also known as queen of fragrance (APEDA- Agriculture Produce Export and Development Agency). *Basmati Rice* a variety of long grain, good texture, excellent in cooking and eating qualities, sweet in taste and soft in texture. The highly aromatic *Rice* proved as a gift to whole world. The word *Basmati* derives from two Sanskrit words (*Vas*-Aroma, *Mati*-Present) from beginning. Generally pronounces as *Vasmati*, but now *Basmati*.

The world's 70% *Rice* is produced in India and the rest of it is produced in Pakistan. In Indian-Punjab, Haryana, U.P, Uttrakhand, Jammu and Kashmir are major states of *Basmati* cultivation. Now M.P, Telangana, Andhra Pradesh also started cultivation of Basmati. In India the area and production under cultivation- 27 lakh hectare and 81 lakh tonne. Among various constraint of *Rice* production, losses due to insect pests are substantial and demands more attention (Bajya *et al.,* 2010). *Rice* yield is decreased slightly at global level (Fernandez, 2005) due to increased insects and pests. *Rice* is attacked by 70 Sp. of insect pests. Out of these stem borer, Brown backed Plant hopper, Leaf folder are pests of economic importance (Barley and Butter). It has been evaluated that these pests cause damage up to 21-51% (Parkash *et al.,* 2007) which is one of major reasons for poor crop productivity in India (Krihnaiah, *et al.,* 2008). Brown plant

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hopper (*Nilaparvata lugens*) is one of pests responsible for large scale devastation to *Rice*, which accounts for yield losses as high as 60% (Srivastra *et al.,* 2009, Kumar *et al.,* 2012). It gains major pest status in Indian subcontinent, due to high fertilizer input and narrow seedling space (Singh *et al.,* 1992). The nymphs and adults of brown plant hopper suck plant sap from phloem cells, tillers become dry and turn brown. It leads to hopper burn.

Leaf folder (*Cnaphalocrocis medinalis*) has accounted most of losses in paddy. Ramzan *et al.,* (1992) accounted one of major pests of paddy. The *Rice* leaf folder is a leaf feeding *Rice* pest. Out of eight species of leaf folder *Cnaphalocrocis medinalis* is important one (Shah *et al.,* 2008). The young larvae feed on leaves by scratching it and fold the leaves and secreted sticky substances. Most of the studies conclude that the incidence of Brown plant hopper and Leaf folder increases with injudicious use of fertilizers mostly with nitrogen. Excessive use of N leads to more honey dew excretion by Brown plant hopper (Karta, *et al.,* 1997). High doses of N make the tissue vulnerable to pest attack (Prasad *et al.,* 2003). The imbalance use of fertilizer leads to more vegetative growth, lower HI, plant lodging and vulnerability to insect pests in *Rice* (Bandong *et al.,* 2002).

There is a need to develop optimized management practice for nutrition management and for increasing fertilizer use efficiency in field. The increase in fertilizer use efficiency reduces the input of fertilizer. There is also a direct need to apply the alternative means of pest management in *Rice*. The most commonly fertilizer management seems to be basic and unexplored point of view in this regard. So, it is better to find out the optimum rate of fertilizers for efficiency utilization of these elements by plant for better yield. Therefore, the present investigation was put forth to evaluate the effect of different fertilizer doses on the incidence of brown plant hopper and leaf folder with the objectives:-to study the effect of fertilizers on the incidence of leaf folder and brown plant hopper and to study the effect of fertilizers on yield attributes.

Materials and methods

The field experiment was conducted during *Kharif* 2015 at Lovely Professional University, Phagwara. The experiment was laid out in a randomised block design with 15 treatments and 3 replications. The seedlings of Pusa *Basmati* 1121 was raised in a well prepared seed bed during the month June 2015 and was transplanted 30DAS into finely prepared puddle plots. One to two seedlings were transplanted per hill at a spacing of 20*10cm from row to row and plant to plant. The treatments *viz.* T_1-N-38 Kg ha^{-1}×T_2- N- 43 Kg ha^{-1}, T_3-N-48 Kg ha^{-1},T_4- P- 25 Kg ha^{-1},T_5- P- 30 Kg ha^{-1},T_6- K-25 Kg ha^{-1}, T_7-K- 30 Kg ha^{-1},T_8-N+P-43+25 Kg ha^{-1}, T_9-N+P- 48+30 Kg ha^{-1}, T_{10}-N+P+K-43+25+25 Kg ha^{-1}, T_{11}- N+P+K-48+30+30 Kg ha^{-1},T_{12}- ZnSo4-20 Kg ha^{-1}, T_{13}-ZnSo4-25 Kg ha^{-1}, T_{14}-ZnSo4-30 Kg ha^{-1}, T_{15}-control. All the recommended agronomic practices, except application of fertilizer were followed. Full dose of phosphorous and potash were applied as a basal dose through SSP and MOP. Nitrogen was supplied in form of urea at 21 and 42DAT. One month after transplanting the observations on the incidence of leaf folder and brown plant hopper were recorded at regular intervals. The observations were recorded by following method for leaf folder:

Per cent damaged leaves = No.of damaged leaves / total no. of leaves*100

The leaves which are damaged by 2/3rd portion and more than 2/3rd portion were considered as damaged leaves. The motile stages of brown plant hopper were counted on ten randomly selected hills in each treatment plot and expressed as per hill basis.

Results and discussion

Effect of fertilizers on the incidence of brown plant hopper/hill and leaf folder- The investigations on the influence of fertilizers on insect pest population conducted during 2015 revealed that the application of synthetic fertilizers at different levels affected the number of BPH hill^{-1} over control. There was a remarkable variation in BPH population at different durations. The reproductive rate of BPH increased with increase in nitrogen doses from booting to grain filling stage. The nymphs of BPH reared on those plants which was fertilized with high doses of nitrogen and produced more progeny as compared to others. The incidence of BPH was directly proportional applied doses of nitrogen and inversely proportional to phosphorous, potash and zinc doses. BPH population showed positive correlation with nitrogen levels in plants and conversely negative correlation with phosphorous, potash and zinc. Leaf folder percentage increased at different duration with increased levels of nitrogen fertilizer while decreased with increased level of P, K and Zn. It is clear from the data that application of NP (2:1), NPK (2:1:1) supported higher and moderate level of leaf folder damage. This result clearly indicated that nitrogen application promotes leaf folder incidence, while potassium restricts pest population and phosphorous has no role. The results concludes that

Table 1: Effect of fertilizers on the incidence of brown plant hopper/hill and leaf folder (%)

S. no	Treatments	Brown plant hopper /hill			Leaf folder (%)		
		40 DAT	60 DAT	80 DAT	40DAT	60 DAT	80 DAT
T1	N- 38 Kg ha^{-1}	10.6	12.0	14.0	5.3	8.3	10.3
T2	N- 43 Kg ha^{-1}	12.3	14.3	16.3	8.4	12.1	15.6
T3	N-48 Kg ha^{-1}	14.6	17.3	18.6	10.1	13.9	15.8
T4	P- 25 Kg ha^{-1}	8.3	10.3	12.0	3.0	6.4	8.2
T5	P- 30 Kg ha^{-1}	6.6	8.7	10.6	2.8	6.0	8.1
T6	K- 25 Kg ha^{-1}	5.6	7.7	9.6	2.1	4.1	6.2
T7	K- 30 Kg ha^{-1}	5.0	6.7	8.6	1.8	3.4	5.9
T8	N+P- 43+25 Kg ha^{-1}	6.0	8.0	10.0	4.3	7.2	9.1
T9	N+P- 48+30 Kg ha^{-1}	7.3	9.3	11.3	4.9	7.7	10.8
T10	N+P+K-43+25+25Kgha^{1}	6.0	8.0	10.3	4.1	5.3	8.6
T11	N+P+k-48+30+30Kg ha^{1}	9.3	11.3	13.3	7.3	10.6	12.4
T12	ZnSo4- 20 Kg ha^{-1}	5.3	7.3	9.3	2.8	4.4	6.3
T13	ZnSo4-25 Kg ha^{-1}	4.6	6.6	8.6	1.6	4.0	5.9
T14	ZnSo4-30 Kg ha^{-1}	4.0	5.6	7.6	1.8	3.9	5.8
T15	Control	4.6	6.6	8.6	2.7	4.6	6.7
	$S.E_m\pm$	0.26	0.35	0.40	0.16	0.23	2.2
	CD (P=0.05)	0.85	0.99	1.06	0.21	0.80	NS
	CV (%)	6.92	6.36	5.66	3.08	7.04	1.32

Table 2: Effect of fertilizers on plant growth

S. no	Treatments	Plant height (cm)	Tillers (no.)	No.of Panicles/ plant	Filled grains /panicle	Panicle length (cm)	Panicle weight (g)
T1	N- 38 Kg ha^{-1}	142.1	31.6	40.6	87.6	20.2	2.23
T2	N- 43 Kg ha^{-1}	143.0	33.0	44.6	93.0	21.3	2.42
T3	N-48 Kg ha^{-1}	146.3	34.6	38.3	82.0	23.8	2.54
T4	P- 25 Kg ha^{-1}	141.0	29.6	38.0	82.6	22.3	2.42
T5	P- 30 Kg ha^{-1}	141.0	29.0	41.0	86.0	20.5	2.24
T6	K- 25 Kg ha^{-1}	141.0	31.0	37.6	89.0	22.4	2.37
T7	K- 30 Kg ha^{-1}	142.1	32.3	38.6	80.6	20.8	2.24
T8	N+P- 43+25 Kg ha^{-1}	142.0	32.3	41.3	79.6	22.7	2.39
T9	N+P- 48+30 Kg ha^{-1}	1436	33.3	40.3	88.3	25.3	2.73
T10	N+P+K43+25+25Kgha^{1}	144.0	34.0	41.3	83.6	23.2	2.34
T11	N+P+k48+30+30Kgha^{1}	145.0	33.3	39.0	75.3	22.6	2.38
T12	ZnSo4- 20 Kg ha^{-1}	146.3	28.7	40.3	76.3	21.0	2.23
T13	ZnSo4-25 Kg ha^{-1}	141.3	29.0	42.3	74.0	21.9	2.26
T14	ZnSo4-30 Kg ha^{-1}	141.6	28.0	40.3	80.6	21.2	2.25
T15	Control	136.8	25.3	35.6	63.6	18.5	1.50
	$S.E_m\pm$	218.0	0.43	0.57	1.5	0.37	0.74
	CD (P=0.05)	NS	1.09	1.26	2.0	1.02	0.45
	CV (%)	10.5	2.12	1.90	1.5	2.79	11.8

relation between leaf folder and nitrogen was positive while P, K, Zn was negative (table1).

Effect of fertilizers on plant growth- Application of fertilizer increased plant height of *Rice* as compared to untreated control. Nitrogen application at levels higher than the recommended dose consistently increased the plant height which was the indication of response of *Pusa Basmati 1121*. Plant height is not a yield components especially in grain crops, but it indicted that the influence of various nutrients on plant metabolism. Plant height increased significantly and progressively with incremental levels of nitrogen up-to highest dose tried. This could be attributed to the fact that higher doses of nitrogen being constituent of enzymes and protein enhanced cell expansive various metabolic processes, like chlorophyll formation and increased plant height. The combined application of fertilizer at higher doses than recommended also showed comparable result to others. Tillers production per plant was significantly affected by levels of nitrogen at all stages. Increase in number of tillers in *Rice* crop was due to influence of different fertilizer combination. More number of tillers per hill might be due to more availability of nitrogen which played a vital role in cell division and enhanced cell expansion and various metabolic processes. The panicle length, panicle weight and number of filled grains per panicle were higher in NP-48, 30 kg ha^{-1} treated plots might be due to better N and P ratio of plant during panicle growth period. In case of single supply of nitrogen (N-48 kg ha^{-1}) and combined application of NPK at recommended rate also increased the panicle length because nitrogen is a constituent of enzymes and proteins which enhanced cell expansion and various metabolic processes which leaf to more panicles per plant and more panicle length with the application of Zinc, panicle length also increase might be due to its effect on enhancing physiological functions of crop like

Table 3: Effect of fertilizers on yield contributing characters

S. no	Treatments	1000 grain wt.(g)	Grain yield (kg/ha)	Straw yield Kg/ha	Harvest Index (%)
T1	N- 38 Kg ha^{-1}	22.0	5577.6	6713.3	45.2
T2	N- 43 Kg ha^{-1}	23.7	6022.6	7219.6	45.6
T3	N-48 Kg ha^{-1}	25.0	5933.0	7275.3	45.0
T4	P- 25 Kg ha^{-1}	23.0	4622.0	6019.3	43.4
T5	P- 30 Kg ha^{-1}	21.5	4289.0	5655.0	42.6
T6	K- 25 Kg ha^{-1}	21.3	4622.3	5783.3	44.2
T7	K- 30 Kg ha^{-1}	20.5	4799.6	6328.0	43.6
T8	N+P- 43+25 Kg ha^{-1}	22.1	4155.3	5446.6	43.3
T9	N+P- 48+30 Kg ha^{-1}	26.1	6933.3	7938.6	46.5
T10	N+P+K43+25+25Kgha^{1}	21.2	4647.3	5886.0	44.2
T11	N+P+k48+30+30Kgha^{1}	21.2	5878.6	7117.3	45.7
T12	ZnSo4- 20 Kg ha^{-1}	19.1	4889.0	6420.6	40.3
T13	ZnSo4-25 Kg ha^{-1}	20.3	4155.3	5818.6	41.4
T14	ZnSo4-30 Kg ha^{-1}	20.0	4733.6	6317.6	42.6
T15	Control	18.0	3133.6	5370.0	36.7
	S.E$_m$±	1.2	7392.5	6794.0	33.7
	CD (P=0.05)	3.3	143.8	137.92	NS
	CV (%)	0.5	1.73	1.30	13.6

photosynthesis and translocation of plant nutrients which ultimately increased the number of panicles per plant and also increased panicle length. The minimum panicle length was observed in control due to non-availability of fertilizer (table 2). The significantly maximum 1000 grain weight (26.1g) was observed in treatment NP-48, 30 kg ha^{-1} which was at par with treatment N-48 kg ha^{-1} (25g) and statistically similar to each other. All the treatments produced significantly higher grain yield over control. NP- 48, 30 kg ha^{-1} increased the grain yield significantly better than alone N, P, K and Zn. The N+P, combination produced more number of grains per panicle. the nitrogen and phosphorous combination, at higher doses lead to more dry matter accumulation due to which more straw yield was obtained. Alone N - 43Kg and 48 kg ha^{-1}, showed comparable result. Nitrogen increased the rate of photosynthesis and being a basic constituent of protoplasm and chloroplast stimulated the meristematic growth and thus increased the growth and dry matter of plants. In case of zinc straw yield was also more due to the favourable effect of zinc on the proliferation of roots and increased the up-take of plant nutrients from soil and supplied it to the aerial parts of the plant ultimately enhanced the vegetative growth of plant. In control, no fertilizer was applied. So, it gave less straw yield as compared to others. Maximum harvest index was observed in T_9 (NP-48, 30 kg ha^{-1}) which was at par with N-43 kg ha^{-1} and maximum harvest index was observed in control (table3). Nitrogen application increased the chlorophyll formation and improved photosynthesis, increased plant height, number of leaves, number of tillers per unit area leaf to production of higher dry matter.

Conclusion

It can be concluded that the crop with 48 kg ha^{-1} nitrogen application showed highest susceptibility to insect pets with highest pest incidence. Excessive use of Nitrogen fertilizers to the crop is the wastage of resources that lead serious effects on crop health in form of pest incidence. However, optimizing the fertilizers doses in relation to micronutrients is extremely essential. So, there is need of more investigation regarding this aspect.

(Words 1844)

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