Biological Forum – An International Journal **15(5a): 305-311(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of Date of Transplanting and Nitrogen Levels on Incidence of Major Insect-Pests of Rice

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(Received: 03 April 2023; Revised: 28 April 2023; Accepted: 01 May 2023; Published: 15 May 2023)
(Published by Research Trend)

ABSTRACT: A field experiment was carried out to evaluate the effect of date of transplanting and nitrogen levels on incidence of major insect-pests of rice during *kharif*, 2017 to 2019. In order to achieve an effective and sustainable control of the rice pest, a management strategy integrating the use of resistant cultivar, appropriate planting date, and appropriate nitrogen levels must be developed. Therefore, the present study is undertaken on rice variety GR – 11 to study the influence of two main cultural practices *viz.*, date of transplanting and nitrogen fertilizer on the insect-pest incidence and severity. The rice seedlings transplanted on 2nd and 4th week of July with application of nitrogen at 80 kg N/ ha and 100 kg N/ ha recorded minimum insect-pests incidence as compared to rice seedlings transplanted during 2nd week of August and application of nitrogenous fertilizer at 120 kg/ ha. The rice seedlings transplanted in the second and fourth weeks, as well as the plots fertilized with 100 kg N/ha and 80 kg N/ha, produced the highest grain as well straw yield.

Keywords: Rice, nitrogen level. transplanting date, hoppers, dead heart, leaf folder etc.

INTRODUCTION

Rice plays an important role in food as well as livelihood security for almost every household. To feed this estimated 1.6 billion population of India by 2050 calls for stepping up the current production of 106 MT of milled rice to 140 MT (FAO, 2015). A system of intensification is a methodology adopted in various ecosystems and deal with the sustainable best management practices of what farmers have within their available resources which offers the best alternative to increase the productivity of crops with minimum cost. Insect pests are the major limiting factors in production of rice. Therefore, to improve pest management and increase the sustainability of agriculture, it is necessary to take an integrated system approach of management. Insect pest management is the key input in sustainable crop production. It is a multidisciplinary eco-friendly approach for pest management, that is practical, economical, effective and protective to both public health and environment (Morya and Kumar 2021).

In India, nitrogen fertiliser is a crucial component of the rice-growing process. However, using too much nitrogen can increase insect and pest populations, cause plant lodging, and reduce yield. Conversely, using too little nitrogen can also reduce yield, so using nitrogen fertiliser wisely is essential for getting a better crop.

Beside nutritional factor transplanting date is an important factor, which affects tremendously the grain yield of transplanted rice. Chowdhury *et al.* (2000) reported that grain and straw yields gradually decreased after 10 August plantation. Transplanting of rice between 15 July and 20 August is the optimum time for transplanting of aman rice especially incase of photosensitive rice varieties (Islam, 1986). There is a need to find out the suitable date of transplanting for rice, which may help the crop in escaping from the attack of insect pests. Considering these facts, the present experiment was carried out to show the effect of transplanting dates of rice and nitrogen levels on incidence of pests and diseases

METHODOLOGY

The field experiment was conducted to assess effect of transplanting dates and nitrogen levels on incidence of major insect-pests of rice during *Kharif* season of three consecutive years from 2017 to 2019 at College of Agriculture, Anand Agricultural University, Vaso, Dist. Kheda (Gujarat). The experiment was laid out in Split Plot Design with three replications. There were three dates of transplanting *viz.*, 2nd week of July (D_1), 4th week of July (D_2) and 2nd week of August(D_3) and three

levels of nitrogen *viz*.,80 (N_1), 100 (N_2) and 120(N_3) kg N/ha. For the purpose, thirty-day old seedlings of rice variety GR-11 was transplanted in 2nd week of July, 4th week of July and 2nd week of August with a spacing of 20 × 15 cm having plot size 5.4 × 3.6 m. All the recommended agronomical practices were followed whenever required and the plot was kept free from chemical spray.

To record the observations on hopper population, five hills were randomly selected from each net plot area and total number of nymphs and adults was counted at weekly interval starting from 30 DAT till to harvest. In case of dead heart and white ear heads due to yellow stem borer (*Scirpophaga incertulas*), five hills were randomly selected from each net plot area. For this purpose, total tillers and dead hearts were counted at 30 and 45 days after transplanting (DAT), whereas total tillers and white ear heads were counted at 60 and 75 DAT. Per cent dead hearts and white ear heads were calculated by using following formula:

$$\text{Dead heart /White ear head (\%)} = \frac{\text{No. of dead hearts/white ear heads}}{\text{Total no. of tillers (Dead heart + healthy tillers)}} \times 100$$

Observations on leaf damage due to leaf folder, *Cnaphalocrocis medinalis* was recorded by counting total leaves and damaged leaves at 30, 45, 60 and 75 DAT on the five hills selected randomly from each net plot area. Based on this per cent leaf damage was calculated by using following formula.

$$\text{Leaf damage (\%)} = \frac{\text{No. of damaged leaves}}{\text{Total no. of leaves (damaged + healthy leaves)}} \times 100$$

Thus, the data obtained for hoppers population were analyzed by standard statistical procedure (Steel and Torrie 1980) after adopting square root transformation and damage due to stem borer and leaf folder were analyzed by using arc sine transformation, whereas, the yield data were analyzed without any transformation.

RESULTS AND DISCUSSION

A. Hoppers

According to data on the hopper population during the first year (Table 1), paddy crops transplanted during the fourth week of July had a lower hopper population (2.74 hoppers/hill) than the rest of the dates of transplanting, with the exception of paddy crops transplanted during the second week of July (D1), which had a population of 3.03 hoppers/hill. In contrast, a higher number of hoppers (3.34 hoppers/hill) were found in the crop that was transplanted during the second week of August. According to data gathered over several years, there was no discernible difference between these three transplantation dates.

The data (Table 1) on the impact of different nitrogen levels on hopper population showed that during the first year of the study, hopper populations were lower in the plots treated with 80 kg N/ha (N1) with 2.74 hoppers/hill than in the plots treated with 100 kg N/ha (N2) with 2.85 hoppers/hill than 120 kg N/ha (3.54 hoppers/hill). More or less, similar trend was observed during second and third year of experimentation. According to data on pooled over years, the paddy crop plots treated with the highest nitrogen dose, 120 kg N/ha (3.22 hoppers/hill), had the highest hopper population. However, the treatment of 80 kg N/ha produced the lowest (2.42 hoppers/hill) population of hoppers, which was followed by 100 kg N/ha (2.63 hoppers/hill).

The number of hoppers per hill was significantly smaller (2.39 hoppers/hill) in the crop transplanted during the fourth week of July with 80 kg N/ha in the first year, indicating a substantial interaction between different dates for transplanting and nitrogen doses. While, the interaction was found non-significant during second, third and pooled over years of study (Table 1).

B. Leaf damage due to leaf folder

According to data (Table 2) on leaf folder damage in the first year, the crop transplanted during the fourth week of July (6.18%) had the significantly lowest percentage of leaf damage, but it was comparable to the second week of July (6.83%).During the second year of the experiment, paddy transplanted during the second week of July (D1) recorded significantly less leaf damage by leaf folder (5.59%), while the next date of transplanting, *i.e.*, the fourth week of July (6.49%), observed with lower percent of leaf damage than last date of transplanting, i.e., the second week of August (D3), which was 9.77%. First two dates, *i.e.* the second and fourth weeks of July, remained comparable to one another in the previous year with lower percentages of leaf damage, 3.40% and 4.02%, respectively, than the final date of transplanting (7.16%). The trend in the years' worth of data was more or less identical.

Based on data from Table 2 from the first year, it can be seen that the lowest nitrogen dose, 80 kg/ha, had the lowest percentage of leaf damage from leaf folders (6.59%), compared to the other treatments. However, the plots treated with 100 and 120 kg N/ha stood next with higher per cent of leaf damage 7.19 and 8.50%, respectively. The similar trend of leaf damage was observed during second year of experiment. On the other hand, during the third year of the trial, the treatment with 80 kg N/ha was determined to be superior to the other treatments with lower percentages of leaf damage (4.05%).The mediocre dose of nitrogen *i.e.*100 kg/ha found next with lower per cent of leaf damage (4.79%). The data on pooled over years indicated that significantly lowest (5.55%) per cent of leaf damage was registered in the treatment of N_1. The treatments of next two doses of nitrogen *i.e.* 100 and 120 kg/ha (6.29 and 7.37%) registered higher per cent of leaf damage due to leaf folder.

Regarding the leaf damage caused by the leaf folder, the interaction between the nitrogen dose and the transplanting date was determined to be non significant. This finding is in accordance with Wagan *et al.* (2019), who reported that lowest dose of nitrogen *i.e.* 75 kg N/ha registered with lowest infestation of rice leaf folder in Pakistan. While, Kumari and Prasad (2021) recorded lowest incidence of leaf folder and highest grain yield in early (1st July) transplanted rice in Ranchi. Rautaray *et al.* (2019) reported that rice crop transplanted on 1st July proved to be the best for lowest infestation of leaf folder in Odisha. Moreover, Sreelatha *et al.* (2022) reported that the leaf folder and gundhi bug infestation reached its highest-level during 4th week of August and 4th week of September, respectively.

C. Dead heart due to rice stem borer

The results (Table 3) on dead hearts caused by rice stem borer in the first year showed that significantly less dead hearts (3.15%) were seen in the crop transplanted during the second week of July, but it was followed by the fourth week of July (4.45%).In the second year of the study, plots transplanted during the second week of July (D1) had a lower incidence of dead hearts (3.04%) than the last date, the second week of August (D3), which had a dead heart incidence of 7.71%. While, in case of third year of study, the plots transplanted during 4th week of July recorded with lower (1.82%) per cent of dead hearts than rest of the treatments except first date of transplanting *i.e.* 2nd week of July (2.49%). The data on pooled over years indicated that the lowest dead heart was observed in the plots transplanted during 2nd week of July (2.90%), whereas, it was found at par with 4th week of July (3.29%). The late transplanting of paddy observed with higher (6.96%) incidence of dead heart due to stem borer.

Data on the percentage of dead hearts detected during the first year (Table 3) showed that the plots applied with 80 kg N/ha were determined to be superior with a lower percentage of dead hearts (3.86%). The treatment of mediocre dose of nitrogen also found effective and remained at par with lower dose of nitrogen with 4.53 per cent of dead heart in the first year. During the second year, the experiment treated with lowest dose of nitrogen recorded with lowest (3.3%) per cent of dead hearts than rest of the treatments. However, the treatment with the greatest dose, 120 kg N/ha, had a higher (6.18%) percentage of dead hearts. Whereas, the treatment of highest dose *i.e.* 120 kg N/ha found with higher (6.18%) per cent of dead heart. A more or less similar pattern to that found during the first year of investigation was seen throughout the third year of the experiment. The pooled data showed that the lowest dose of nitrogen (80 kg N/ha) registered significantly lowest (3.26%) per cent of dead heart than rest of the treatments.

Interaction effect of different date of transplanting and dose of nitrogen was found significant with respect to dead heart due to rice stem borer by recording lower (2.18%) per cent of dead heart in crop transplanted during 2nd week of July with 80 kg N/ha in the first year. However, the interaction was found non-significant during second, third and pooled over years of study (Table 3).

Prasad (2020) reported that early (1st July) or timely (15th July) transplanting of rice seedling that minimize the incidence of major insect pests prevalent in the area *viz*., YSB, hispa, leaf folder, case worm and GLH etc. except gundhi bug and provide maximum crop in Jharkhand. Also, Sreelatha *et al.* (2022) reported that the yellow stem borer incidence was started from 2nd week of July and the pest population reached its highest level during the 4th week of September.

D. White ear head

The crop transplanted during the second week of July (D1) registered a lower (9.37%) percentage of white ear head than the other treatments during the first year of the experiment, according to the data (Table 4) on white ear head caused by the rice stem borer. However, it was found at par with next date of transplanting (D_2) with 10.40 per cent of damage. In second year of study, paddy crop transplanted in 2nd week of July observed with significantly the lowest (7.91%) per cent of white ear head than D_2 (8.86%) and D_3 (14.05%). The third year showed that the plots that were transplanted during the second week of August had considerably more white ear heads (12.70%) than the other treatments. The treatment of D1 (6.11%) and D2 (6.41%) both had lower percentages of white ear heads, but they were found at par with each other.

The data on effect of nitrogen level on white ear head (Table 4) in the first year indicated that the treatment of lowest and mediocre dose of nitrogen *i.e.* 80 and 100 kg/ha found superior over the highest dose of nitrogen *i.e.*120 kg/ha (12.84%) with 9.66 and 10.49 per cent of white ear head, respectively. The white ear head caused by the rice stem borer showed about the same trend throughout the second year of the study. During the third year of the experiment, the 80 kg N/ha treatment considerably reduced the percentage of white ear heads (6.59%) compared to the 100 kg N/ha (8.56%) and 120 kg N/ha (9.52%) treatments. Similar trend was observed in case of pooled over years as it was observed during third year.

Interaction effect of different date of transplanting and dose of nitrogen was found significant with respect to white ear head due to rice stem borer by recording lower (8.11%) per cent of white ear head in crop transplanted during 2nd week of July with 80 kg N/ha in the first year. While, the interaction was found non-significant during second, third and pooled over years of study.

E. Grain yield

The maximum grain output was substantially higher in paddy transplanted in the fourth week of July (2985 kg/ha) than in the other treatments during the first year (2017), according to yield data (Table 5) obtained for both the individual year and the pooled years. However, the crop transplanted during 2nd week of July (D_1) registered 2812 kg/ha grain yield. The plot that was transplanted during the second week of July (D1) produced a greater (3041 kg/ha) grain yield during the second year (2018), and it was discovered to be on par

with the plot that was transplanted during the fourth week of July, which produced 2884 kg/ha of grain. Furthermore, the data from the third year showed that the treatment of paddy transplanted during the fourth week of July had a higher grain yield (3342 kg/ha), which was comparable to the previous date of transplanting, which was the second week of July (3120 kg/ha). The pooled data over the years showed that significantly the highest grain yield 3070 kg/ha and 2991 kg/ha was recorded from the plots transplanted during 4th week of July (D_2) and 2nd week of July (D_1), respectively and were significantly superior over the paddy transplanted during 2nd week of August (2235 kg/ha).

There was no significant effect of different level of nitrogen on grain yield as the data were non-significant (Table 5) during second and third year. However, the data on pooled over years indicated that the crop transplanted during 4th week of July (D_2) registered higher (2994 kg/ha) grain yield over rest of the treatments except D_1 (2725 kg/ha). Interaction effect of different date of transplanting and dose of nitrogen was found non-significant with respect to grain yield.

Islam *et al.* (2008) reported that application of 100 kg N/ha registered highest yield of rice as compared to other doses in Bangladesh. However, Chopra and Chopra (2004) found that lowest dose of nitrogen *i.e.* 60 kg N/ha recorded highest yield of rice in Meerut. While, Pasha and Reddy (2018) reported that application of higher nitrogen *i.e.* 120 N/ha registered highest yield of rice than 0 kg N/ha in Telangana. Whereas, Singh *et al.* (2000) recorded higher yield in timely (7 July) transplanted field of rice in Bihar. Rautaray *et al.* (2019) reported that rice crop transplanted on 1st July proved to be the best obtaining maximum grain yield (42.37 Qt/ha) and the lowest yield in late planted crop in Odisha.

F. Straw yield

Data on straw yield for the first year (Table 5) showed that paddy transplanted during the fourth week of July had a greater straw yield (4365 kg/ha) than paddy transplanted during the second week of August (3642 kg/ha). However, during the second year, crop transplanted during the second week of July observed with greater (4722 kg/ha) and it was discovered at par with the next date of transplanting, *i.e.*, the fourth week of July (4572 kg/ha).While the crop transplanted during the fourth week of July (D2) produced higher straw yields than the crop transplanted during the second week of July (D1), which produced yields of 4783 and 4555 kg/ha, respectively, over the course of the third year as well as pooled data on straw yield. There was no significant effect of different level of nitrogen on straw yield as the data were non-significant (Table 5). Interaction effect of different date of transplanting and dose of nitrogen was found non-significant with respect to straw yield.

Table 1: Effect of transplanting date and different nitrogen levels on incidence of rice hoppers (Pooled over years).

Treatments	No. of hoppers/ hill							
	2017		2018		2019		Pooled	
Date of Transplanting (D)								
D_1	1.88 (3.03)		1.75 (2.56)		1.33 (1.27)		1.66 (2.26)	
D_2	1.80 (2.74)		1.82 (2.81)		1.71 (2.42)		1.78 (2.67)	
D_3	1.96 (3.34)		1.94 (3.26)		2.04 (3.66)		1.98 (3.42)	
S.Em. ±	0.02		0.02		0.02		0.10	
C. D. at 5%	0.09		0.10		0.10		NS	
C.V. (%)	10.12		11.22		12.17		11.15	
Nitrogen level (N)								
N_1	1.80 (2.74)		1.71 (2.42)		1.62 (2.12)		1.71 (2.42)	
N_2	1.83 (2.85)		1.82 (2.81)		1.67 (2.29)		1.77 (2.63)	
N_3	2.01 (3.54)		1.99 (3.46)		1.79 (2.70)		1.93 (3.22)	
S.Em. ±	0.01		0.02		0.02		0.01	
C. D. at 5%	0.04		0.06		0.06		0.03	
C.V. (%)	5.86		9.82		10.50		8.84	
Interaction (D × N)								
D_1N_1	1.79 (2.70)		1.64 (2.19)		1.26 (1.09)		1.56 (1.93)	
D_1N_2	1.84 (2.89)		1.74 (2.53)		1.32 (1.24)		1.63 (2.16)	
D_1N_3	2.02 (3.58)		1.88 (3.03)		1.41 (1.49)		1.77 (2.63)	
D_2N_1	1.70 (2.39)		1.69 (2.36)		1.63 (2.16)		1.67 (2.29)	
D_2N_2	1.73 (2.49)		1.81 (2.78)		1.67 (2.29)		1.74 (2.53)	
D_2N_3	1.97 (3.38)		1.96 (3.34)		1.82 (2.81)		1.92 (3.19)	
D_3N_1	1.89 (3.07)		1.82 (2.81)		1.96 (3.34)		1.89 (3.07)	
D_3N_2	1.94 (3.26)		1.89 (3.07)		2.03 (3.62)		1.95 (3.30)	
D_3N_3	2.05 (3.70)		2.11 (3.95)		2.13 (4.04)		2.10 (3.91)	
	S.Em. ±	C. D. at 5%	S.Em. ±	C. D. at 5%	S.Em. ±	C. D. at 5%	S.Em. ±	C. D. at 5%
Y	-	-	-	-	-	-	0.01	0.04
D × N	0.04	0.10	0.06	NS	0.06	NS	0.02	NS
D × Y	-	-	-	-	-	-	0.02	0.07
N × Y	-	-	-	-	-	-	0.02	NS
Y × D × N	-	-	-	-	-	-	0.03	NS
C.V. (%)	5.86		9.82		10.50		8.84	

Note: Figures outside the parenthesis are square root transformed values, those inside are retransformed values.

Table 2: Effect of transplanting date and different nitrogen levels on incidence of leaf folder in rice (Pooled over years).

Treatments	Leaf damage (%)							
	2017		2018		2019		Pooled	
Date of Transplanting (D)								
D_1	15.15 (6.83)		13.67 (5.59)		10.63 (3.40)		13.15 (5.18)	
D_2	15.40 (6.18)		14.76 (6.49)		11.56 (4.02)		13.91 (5.78)	
D_3	16.84 (8.39)		18.21 (9.77)		15.52 (7.16)		16.86 (8.41)	
S.Em. ±	0.12		0.15		0.35		0.53	
C. D. at 5%	0.47		0.60		1.36		2.08	
C.V. (%)	4.52		5.94		16.54		9.40	
Nitrogen level (N)								
N_1	14.88 (6.59)		14.41 (6.19)		11.61 (4.05)		13.63 (5.55)	
N_2	15.55 (7.19)		15.40 (7.05)		12.64 (4.79)		14.53 (6.29)	
N_3	16.95 (8.50)		16.83 (8.38)		13.47 (5.43)		15.75 (7.37)	
S.Em. ±	0.19		0.28		0.35		0.16	
C. D. at 5%	0.53		0.80		1.00		0.45	
C.V. (%)	7.19		10.91		16.83		11.60	
Interaction (D × N)								
D_1N_1	14.27 (6.08)		12.74 (4.86)		09.88 (2.94)		12.30 (4.54)	
D_1N_2	14.87 (6.59)		13.54 (5.48)		10.70 (3.45)		13.04 (5.09)	
D_1N_3	16.30 (7.88)		14.73 (6.47)		11.32 (3.85)		14.12 (5.95)	
D_2N_1	14.57 (6.33)		13.54 (5.48)		10.69 (3.44)		12.94 (5.01)	
D_2N_2	15.05 (6.74)		14.72 (6.46)		11.88 (4.24)		13.88 (5.75)	
D_2N_3	16.56 (8.12)		16.01 (7.61)		12.12 (4.41)		14.90 (6.61)	
D_3N_1	15.79 (7.40)		16.95 (8.50)		14.25 (6.06)		15.66 (7.29)	
D_3N_2	16.73 (8.29)		17.94 (9.49)		15.35 (7.01)		16.67 (8.23)	
D_3N_3	17.99 (9.54)		19.76 (11.43)		16.96 (8.51)		18.24 (9.80)	
	S.Em. ±	C. D. at 5%	S.Em. ±	C. D. at 5%	S.Em. ±	C. D. at 5%	S.Em. ±	C. D. at 5%
Y	-	-	-	-	-	-	0.13	0.41
D × N	0.38	NS	0.57	NS	0.71	NS	0.28	NS
D × Y	-	-	-	-	-	-	0.23	0.71
N × Y	-	-	-	-	-	-	0.28	NS
Y × D × N	-	-	-	-	-	-	0.49	NS
C.V. (%)	7.19		10.91		16.83		11.60	

Note: Figures outside the parenthesis are arcsine transformed values, those inside are retransformed values.

Table 3: Effect of transplanting date and nitrogen levels on incidence of dead heart due to rice stem borer (Pooled over years).

Treatments	Dead heart (%)							
	2017		2018		2019		Pooled	
Date of Transplanting (D)								
D_1	10.22 (3.15)		10.04 (3.04)		09.08 (2.49)		09.81 (2.90)	
D_2	12.18 (4.45)		11.35 (3.87)		07.76 (1.82)		10.45 (3.29)	
D_3	15.51 (7.15)		16.12 (7.71)		14.23 (6.04)		15.30 (6.96)	
S.Em. ±	0.30		0.70		0.78		0.36	
C. D. at 5%	1.18		2.74		3.07		1.12	
C.V. (%)	10.13		23.67		32.07		22.48	
Nitrogen level (N)								
N_1	11.33 (3.86)		10.54 (3.35)		09.27 (2.59)		10.41 (3.26)	
N_2	12.29 (4.53)		12.58 (4.74)		09.78 (2.89)		11.57 (4.02)	
N_3	14.30 (6.10)		14.39 (6.18)		12.01 (4.33)		13.58 (5.51)	
S.Em. ±	0.62		0.61		0.72		0.37	
C. D. at 5%	1.79		1.77		2.09		1.05	
C.V. (%)	20.77		20.76		29.62		23.17	
Interaction (D × N)								
D_1N_1	08.50 (2.18)		08.45 (2.16)		08.04 (1.96)		08.40 (2.13)	
D_1N_2	10.13 (3.09)		09.48 (2.71)		07.88 (1.88)		09.18 (2.55)	
D_1N_3	12.04 (4.35)		12.17 (4.44)		11.32 (3.85)		11.86 (4.22)	
D_2N_1	11.00 (3.64)		08.61 (2.24)		06.69 (1.36)		08.78 (2.33)	
D_2N_2	11.65 (4.08)		12.07 (4.37)		07.23 (1.58)		10.33 (3.22)	
D_2N_3	13.90 (5.77)		13.37 (5.35)		09.37 (2.65)		12.23 (4.49)	
D_3N_1	14.49 (6.26)		14.55 (6.31)		13.09 (5.13)		14.06 (5.90)	
D_3N_2	15.07 (6.76)		16.18 (7.76)		14.24 (6.05)		15.18 (6.86)	
D_3N_3	16.98 (8.53)		17.62 (9.16)		15.35 (7.01)		16.66 (8.22)	
	S.Em. ±	C. D. at 5%	S.Em. ±	C. D. at 5%	S.Em. ±	C. D. at 5%	S.Em. ±	C. D. at 5%
Y	-	-	-	-	-	-	0.36	1.12
D × N	0.51	1.46	0.86	NS	1.02	NS	0.65	NS
D × Y	-	-	-	-	-	-	0.63	NS
N × Y	-	-	-	-	-	-	0.65	NS
Y × D × N	-	-	-	-	-	-	1.12	NS
C.V. (%)	20.77		20.76		29.62		23.17	

Table 4: Effect of transplanting date and nitrogen levels on incidence of white earhead due to rice stem borer (Pooled over years).

Treatments	White earhead (%)			
	2017	2018	2019	Pooled
Date of Transplanting (D)				
D_1	17.82 (09.37)	16.33 (07.91)	14.31 (06.11)	16.16 (07.75)
D_2	18.81 (10.40)	17.32 (8.86)	14.67 (06.41)	16.93 (08.48)
D_3	21.37 (13.28)	22.01 (14.05)	20.88 (12.70)	21.42 (13.34)
S.Em.±	0.60	0.21	0.35	0.57
C. D. at 5%	2.34	0.82	1.39	2.25
C.V. (%)	13.06	4.77	9.04	9.75
Nitrogen level (N)				
N_1	18.11 (09.66)	17.20 (08.74)	14.87 (06.59)	16.73 (08.29)
N_2	18.90 (10.49)	18.23 (09.79)	17.01 (08.56)	18.05 (09.60)
N_3	21.00 (12.84)	20.22 (11.95)	17.97 (09.52)	19.73 (11.40)
S.Em. ±	0.44	0.46	0.62	0.30
C. D. at 5%	1.28	1.34	1.78	0.83
C.V. (%)	9.73	10.59	15.74	11.99
Interaction (D × N)				
D_1N_1	16.55 (08.11)	15.09 (06.78)	12.95 (05.02)	14.86 (06.58)
D_1N_2	17.65 (09.19)	15.87 (07.48)	14.61 (06.36)	16.04 (07.63)
D_1N_3	19.28(010.90)	18.03 (09.58)	15.36 (07.02)	17.56 (09.10)
D_2N_1	17.41 (08.95)	15.95 (07.55)	12.47 (04.66)	15.28 (06.95)
D_2N_2	18.36 (09.92)	16.88 (08.43)	15.31 (06.97)	16.85 (08.40)
D_2N_3	20.65 (12.44)	19.12 (10.73)	16.22 (7.80)	18.66 (10.24)
D_3N_1	20.38 (12.13)	20.57 (12.34)	19.18 (10.79)	20.04 (11.74)
D_3N_2	20.68 (12.47)	21.94 (13.96)	21.12 (12.98)	21.25 (13.14)
D_3N_3	23.06 (15.34)	23.52 (15.93)	22.34 (14.45)	22.98 (15.24)

	S.Em. ±	C. D. at 5%	S.Em. ±	C. D. at 5%	S.Em. ±	C. D. at 5%	S.Em. ±	C. D. at 5%
Y	-	-	-	-	-	-	0.24	0.74
D × N	0.36	1.05	0.65	NS	0.87	NS	0.51	NS
D × Y	-	-	-	-	-	-	0.42	1.29
N × Y	-	-	-	-	-	-	0.51	NS
Y × D × N	-	-	-	-	-	-	0.89	NS
C.V. (%)	9.73		10.59		15.74		11.99	

Note: Figures outside the parenthesis are arcsine transformed values, those inside are retransformed values

Table 5: Effect of transplanting dates and nitrogen levels on grain and straw yield of rice (Pooled over years)

Treatments	Grain yield (kg/ha)				Straw yield (kg/ha)			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Date of Transplanting (D)								
D_1	2812	3041	3120	2991	4160	4722	4783	4555
D_2	2985	2884	3342	3070	4365	4572	4982	4640
D_3	2139	2217	2350	2235	3642	3775	3865	3761
S.Em. ±	109	136	111	69	53.88	128	225	88
C.D. at 5%	427	535	437	213	212	503	881	272
C.V. (%)	12.35	15.07	11.38	12.96	3.99	8.82	14.83	10.59
Nitrogen level (N)								
N_1	2603	2691	2880	2725	4023	4380	4523	4309
N_2	2992	2900	3089	2994	4173	4602	4627	4468
N_3	2341	2550	2843	2578	3971	4086	4479	4179
S.Em. ±	156	204	124	95.10	225	194	419	171
C.D. at 5%	480	NS	NS	273	NS	NS	NS	NS
C.V. (%)	17.67	22.56	12.71	17.87	16.67	13.33	27.68	20.60
Interaction (D × N)								
D_1N_1	2641	2970	3033	2881	3928	4767	4739	4478
D_1N_2	3350	3258	3354	3320	4354	5014	4924	4764
D_1N_3	2447	2896	2974	2772	4199	4385	4685	4423
D_2N_1	2906	2923	3242	3024	4338	4575	4804	4572
D_2N_2	3321	2984	3413	3239	4469	4861	5127	4819
D_2N_3	2727	2745	3372	2948	4289	4279	5014	4528
D_3N_1	2261	2181	2365	2269	3803	3799	4026	3876
D_3N_2	2306	2459	2500	2421	3697	3932	3830	3819
D_3N_3	1848	2010	2184	2014	3425	3595	3738	3586

	S.Em. ±	CD at 5%	S.Em. ±	CD at 5%	S.Em. ±	CD at 5%	S.Em. ±	CD at 5%	S.Em. ±	CD at 5%	S.Em. ±	CD at 5%	S.Em. ±	CD at 5%	S.Em. ±	CD at 5%
Y	-	-	-	-	-	-	69	213	-	-	-	-	-	-	88	271
Y × D	-	-	-	-	-	-	120	NS	-	-	-	-	-	-	152	NS
Y × N	-	-	-	-	-	-	165	NS	-	-	-	-	-	-	297	NS
D × N	270	NS	353	NS	216	NS	165	NS	390	NS	335	NS	726	NS	297	NS
Y × D × N	-	-	-	-	-	-	285	NS	-	-	-	-	-	-	514	NS
CV (%)	17.67		22.56		12.71		17.87		16.67		13.33		27.68		18.61	

CONCLUSIONS

Rice seedlings transplanted on 2nd and 4th week of July with application of nitrogen at 80 kg N/ha and 100 kg N/ha recorded minimum insect-pests incidence as compared to rice seedlings transplanted during 2nd week of August and application of nitrogenous fertilizer at 120 kg/ ha. The rice seedlings transplanted in the second and fourth weeks, as well as the plots fertilized with 100 kg N/ha and 80 kg N/ha, produced the highest yields of grain and straw. However, the interaction effect between date of transplanting and nitrogen levels on insect-pests incidence as well as yield of grain and straw were non-significant.

Acknowledgement. We are very thankful to the Director of Research, Anand Agricultural University (AAU), Anand and Principal, College of Agriculture, AAU, Vaso (Gujarat) for their support and guidance during planning and execution of research work.

Conflict of Interest. None.

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How to cite this article: N.B. Pawar, H.C. Patel, N.B. Patel and C.J. Patel (2023). Effect of Date of Transplanting and Nitrogen Levels on Incidence of Major Insect-Pests of Rice. *Biological Forum – An International Journal, 15*(5a): 305-311.