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Munna Yadav
Department of Agricultural Entomology, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

Rabindra Prasad
Department of Agricultural Entomology, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

Pradeep Kumar
Department of Agricultural Entomology, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

Chitrangda Pandey
Department of Agricultural Entomology, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

D Prasad
Department of Agricultural Entomology, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

Praveen Kumar
SMS, Plant Protection, Holy Cross KVK Hazaribag, Jharkhand, India

Correspondence
Munna Yadav
Department of Agricultural Entomology, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

Effect of date of transplanting on the incidence of green leaf hopper (GLH), *Nephotettix virescens* (Distant) & *N. nigropictus* (Stal) in rice field, Jharkhand

Munna Yadav, Rabindra Prasad, Pradeep Kumar, Chitrangda Pandey, D Prasad and Praveen Kumar

Abstract
Rice is the staple food for the Asian subcontinent. Green leafhoppers are the most common leafhoppers in rice field and are primarily critical because they spread viral disease tungro as well as they prefer rice plants that have been fertilized with large amount of nitrogen. Field trials on the subject of the effect of date of transplanting on the incidence of green leaf hopper (GLH) in rice field carried out during *Kharif* seasons 2016 and 2017 at research farm BAU, Kanke, Ranchi, Jharkhand. In order to be evaluated three date of transplanting (01 July, 21 July & 12 August, 20 days interval) in randomized block design and it replicate ten times with one common variety (Sahbhagi). We observed 1st time GLH incidence in our research plots 20 DAT, 30 DAT & 40 DAT respective at late planting, normal planting, and early planting in rice field. The incidences of GLH were recorded at 40, 60 and 80 DAT as well as noticed that lower incidence of the pest were started at 40 DAT and thereafter the pest intensity began to widen gradually with the advancement of crops age. It was remarkable to mention the outcome of shifting in dates of transplanting of rice were significant indication of pest population, during first date (1st July) of transplanting were recorded lower intensity of pest attack with respective to all the observation (40, 60 & 80 DAT). As such the intensity of the pest attack were observed to be in ascending order of early planting (1st July) < normal planting (21st July) < delayed planting (12th August) findings of the pest population GLH/10 hills, at the respective planting dates, early planting most effective than both normal & delay planting, normal date of transplanting was at par, while delay planting was on par, but overall mean population only early planting was most effective (p = 0.05), when the rice plants were transplanted at the respective planting dates in the year 2016 & 2017 studies.

Keywords: green leaf hopper, *Nephotettix virescens*, rice field

Introduction
Rice is the staple food for the Asian subcontinent. It provides 27 per cent of dietary energy and 20 per cent of dietary protein in the developing country. Food grain production analysis shows the requirement of 46 lakh tonnes of food grains for a population of 26 million against the current production of 22 lakh tones. Total food grain productivity 0.93 million tonnes in current scenario while desirable productivity is 1.73 million tonnes in the state of Jharkhand. Rice was covers around 16.93796 lakh hectare areas out of total cultivable area of 38.00 lakh hectares with net sown area of 25.75 lakh hectares, the production and productivity are 5614.931thousand tone and 3315 kg per hectare respectively in the state of Jharkhand (Anonymous, 2015-16) [8].

As the area under cultivation is gradually being decreased and demand for enhanced production is increasing, emphasis is being given towards intensification through higher inputs and cropping intensity. Such efforts in turn increase pest intensities (Hegde *et al.* 1996) [11] and losses caused by pests remains an important constraints for achieving higher paddy yields.

Green leafhoppers are the most common leafhoppers in rice fields and are primarily critical because they spread the viral disease tungro. Both nymphs and adults feed by extracting plant sap with their needle-shaped mouthparts. Both the nymphs and adults feed on the dorsal surface of the leaf blades rather than the ventral surface. They prefer to feed on the lateral leaves rather than the leaf sheaths and the middle leaves. Green leafhoppers are common in rainfed and irrigated wetland environments. They are not prevalent in upland rice. They also prefer rice plants that have been fertilized with large amount of nitrogen.

Some remarkable identification characters of insect pest and damage symptom of GLH are greenish transparent eggs are deposited in the midrib of leaf blade or sheath of rice or green grass. They are laid in batches of 10 to 15 arranged in a single row.

The nymphs are soft bodied, yellow white in colour. Gradually the colour changes to green and adults are 3-5 mm long, bright green with variable black markings, wedge shaped with a characteristic diagonal movement. Male insect has a black spot in middle of the forewings that is absent in females. The insect is active during July to September. There damage symptoms are stunted plants and reduced vigor, reduced number of productive tillers and withering or complete plant drying.

Tungro infected crops may sometimes be confused with nitrogen deficiency or iron toxicity or acid soils. To confirm the cause of the problem, check for virus infected plants in the fields, and the presence of the insect: white or pale yellow eggs inside leaf sheaths or midribs, yellow or pale green nymphs with or without black markings and pale green adults with or without black markings feeding on upper parts of the crop.

Green leafhoppers are important pests. They are vectors of viral diseases such as tungro, yellow dwarf, yellow-orange leaf, transitory yellowing, and dwarf (Anonymous, 2018, Rice Knowledge Bank) [2].

Keeping all these facts in view survey of literatures has been made to have a feed back of the issues which showed that not much information is available in Jharkhand in particular with respect to the incidence and status of GLH in rice and their effective and sustainable management operations through different date of transplanting.

Materials and Methods

Field trials were conducted during the *Kharif* seasons 2016 and 2017 at research farm of BAU, Kanke, Ranchi, Jharkhand with three treatments at three different date of transplanting (at 20 days intervals, 01 July, 21 July and 12 August) in randomized block design (RBD) & it replicates ten times with one common variety (Sahbhagi). The size of each treated plots was 15 m X 3 m =45 m^2 and all recommended agronomical practices were followed during crop period.

Periodical variation in the incidence of green leaf hopper was recorded regularly in the experimental plot (s) on a single variety of rice – Sahbhagi. Field observations were taken periodically at 20-days intervals; Observations pertaining to GLH (no. of GLH/10 hills) were made at 40, 60 and 80 DAT.

Lay out plan of field investigation during *Kharif*, 2016 and *Kharif*, 2017		
Design Treatments	:	RBD (Randomized block design) Three date of sowing and transplanting of rice, each at 20 days intervals.
Replication	:	10
Spacing (plant to plant)	:	15 cm
Spacing (row to row)	:	20 cm
Plot size	:	15 x 3 m
N:P:K Variety	:	80:40:20 (As per local recommendation) Sahbhagi

Treatments details

Time of planting

1) Early planting
2) Normal planting
3) Late planting

Sl. No.	Dates sowing	Date of transplanting	Date of harvesting
D_1	12.06.2016 & 2017	01.07.2016 & 2017	14.10.2016 & 2017
D_2	02.07.2016 & 2017	21.07.2016 & 2017	03.11.2016 & 2017
D_3	22.07.2017 & 2017	12.08.2016 & 2017	25.11.2016 & 2017

The data of results obtained from aforesaid experiments in terms of pest incidence will be compiled and tabulated in the form of mean values and their suitable transformations will be made for appropriate statistical analysis for their proper interpretation for drawing the conclusions.

The data recorded for different characteristics were subjected to statistical analysis by adopting the method of analysis of variance (ANOVA) as described by Gomez and Gomez (1984). The significance of comparison was tested. The significant difference values were computed for 5 percent probability of error. Wherever the variance ratio (F value) was found significant, critical difference (CD) values were computed for the comparison among the treatment means.

Result and Discussions

Nymph and adult green leaf hopper (*Nephotettix virescens* Distant & *N. nigropictus* Stal) responsible for sucking cell sap of rice leaves resulting in weakness of leaves. Incidence of green leaf hopper on *Kharif* rice is observed almost throughout the crop growth right from vegetative stage to reproductive stage of the crop (Table - 01). We observed 1st time GLH incidence in our research plots 20 DAT, 30 DAT & 40 DAT respective at late planting, normal planting, and early planting in rice field. The incidences of GLH were recorded at 40, 60 and 80 DAT as well as noticed that lower incidence of the pest were started at 40 DAT and thereafter the pest intensity began to widen gradually with the advancement of crops age. It was remarkable to mention the outcome of shifting in dates of transplanting of rice were significant indication of pest population, during first date (1st July) of transplanting were recorded lower intensity of pest attack with respective to all the observation (40, 60 & 80 DAT). As such the intensity of the pest attack were observed to be in ascending order of early planting (1st July) < normal planting (21st July) < delayed planting (12th August) findings of the pest population in order to 3.02, 3.28 & 4.09 GLH/ 10 hills at 40 DAT, 4.39, 4.62 & 5.45 GLH/ 10 hills at 60 DAT, 5.52, 6.09 & 7.08 GLH/ 10 hills at 80 DAT and over all mean population of GLH are 4.31, 4.67 & 5.54 GLH/10 hills, at the respective planting dates, early planting most effective than both normal & delay planting, normal date of transplanting was at par while delay planting was on par, but overall mean population only early planting was most effective ($p = 0.05$), when the rice plants were transplanted at the respective planting dates in the year 2016 studies.

Similar result noticed in the next year 2017, As such the intensity of the pest attack were observed to be in ascending order of early planting (1st July) < normal planting (21st July) < delayed planting (12th August) findings of the pest population in order to 3.17, 3.51 & 4.27 GLH/ 10 hills at 40 DAT, 4.45, 4.73 & 5.50 GLH/ 10 hills at 60 DAT, 5.58, 6.16 & 7.17 GLH/ 10 hills at 80 DAT and over all mean population of GLH are 4.40, 4.80 & 5.65 GLH/10 hills, at the respective planting dates, early planting most effective than

both normal & delay planting, normal date of transplanting was at par while delay planting on par, but overall mean population only early planting was most effective (p = 0.05), when the rice plants were transplanted at the respective planting dates in the year 2017 studies.

Rice green leaf hopper pooled data recorded in three planting dates are presented in Table- 01 and showed the population of nymphs and adults were 3.09, 3.40 & 4.18 at 40 DAT, 4.42, 4.67 & 5.47 at 60 DAT, 5.55, 6.13 & 7.13 80 at DAT and 4.47, 4.87 & 5.73 at overall mean population of different date of observation, when the rice plants were transplanted at the respective planting dates in the year 2016 & 2017 studies.

The finding of the present field studies was found to be in accordance with the results of Prasad & Prasad (2015) [17], Kumar & Prasad (2018) and anonymous (2012, 2014 & 2016) [4, 5, 7].

Madhukar *et al.* (2014) [15], similar result was found that the rice green leaf hopper seasonal incidence results during *kharif* 2012 & 2013 revealed that the population of nymphs and adults was started from first week of September (36th SMW). Thereafter, the population was found gradually increasing with maximum population was recorded during first week of October (40th SMW). Further, the incidence showed decline infestation till harvest of the crop (43rd SMW).

Shamim *et al.* (2009) [19] from Middle Gujarat region showed that green leaf hopper attained peak population during 43rd SMW, which support the present trial results.

Litsinger (1994) [13] found similar result late planting causes high infestation against early planting within a given planting period, particularly in the dry season, reduces the risk of insect-vector disease.

Ali *et al*., (2013) [1] reported that planting date had an effect on pest incidence (p = 0.01). Planting on 1st July resulted in lower GLH incidence than on 16 July, 1st August and 16 August. There were significant differences in the pest incidence in rice field transplanted on different dates (p = 0.01). Likewise, the abundance of natural enemies was highest at early season and thereafter declined.

Table 1: Effect of date of transplanting on the incidence of green leaf hopper (GLH), *Nephotettix virescens* Distant & *N. nigropictus* Stal in 2016 &17.

Treatment	Number of GLH per 10 hills recorded at DAT											
	40 DAT			60 DAT			80 DAT			MEAN		
Date of transplanting	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled
D1 (Early planting) 01.07.2016 & 01.07.2017	8.7 (3.02)	9.6 (3.17)	9.15 (3.09)	18.8 (4.39)	19.4 (4.45)	19.1 (4.42)	30 (5.52)	30.7 (5.58)	30.35 (5.55)	19.20 (4.31)	19.9 (4.40)	19.53 (4.47)
D2 (Normal planting) 21.07.2016 & 21.07.2017	10.4 (3.28)	12 (3.51)	11.2 (3.40)	20.9 (4.62)	21.9 (4.73)	21.4 (4.67)	36.8 (6.09)	37.6 (6.16)	37.2 (6.13)	22.7 (4.67)	23.83 (4.80)	23.27 (4.87)
D3 (Delayed planting) 12.08.2016 & 12.08.2017	16.4 (4.09)	17.8 (4.27)	17.1 (4.18)	29.3 (5.45)	29.9 (5.50)	29.6 (5.47)	49.7 (7.08)	51 (7.17)	50.35 (7.13)	31.8 (5.54)	32.9 (5.65)	32.35 (5.73)
SEm. (±)	0.71 (0.09)	0.71 (0.09)	0.49 (0.07)	1.04 (0.10)	1.20 (0.12)	0.79 (0.08)	1.44 (0.12)	1.49 (0.12)	1.04 (0.08)	0.66 (0.07)	0.68 (0.07)	0.47 (0.05)
C.D. (P=0.05)	2.10 (0.28)	2.10 (0.28)	1.43 (0.19)	3.08 (0.31)	3.56 (0.35)	2.27 (0.23)	4.28 (0.35)	4.44 (0.35)	2.98 (0.24)	1.95 (0.20)	2.02 (0.20)	1.36 (0.12)
C.V. (%)	18.90 (8.70)	17.01 (8.15)		14.30 (6.85)	15.99 (7.69)		11.74 (5.94)	11.90 (5.95)		8.50 (4.28)	8.43 (4.34)	

Figure under the parentheses is square root transformed values.
DAT – Days after transplanting.

Chen *et al*., (2003) [9], also reported that the occurrence of insect pests and their natural enemies on rice is influenced by variety and date of planting. The GLH population may be due to the susceptibility of variety and weather condition. In all season there was a reduction in the incidence of GLH for early transplanting. Similar findings of reduced pests and diseases in early maturing variety and early transplanting date have been reported by Litsinger *et al.* (1987) [14]. Low incidence of pest and diseases in early planting rice is also reported by Moniperumal (1989) [16]. In early transplanted crop when the infection stage of pest and microbes are over, the inoculums would be finding a place in a late transplanting crop (Rani and Pillai, 2012) [18].

In the case of late transplanting, the surrounding crop might have completed their susceptible growth stages and the entire pest inoculums would be feeding or confining to the late transplanted crop (Rani and Pillai, 2012) [18]. This might be the reason for higher insect pests' incidence for delayed transplanting. Varying the planting time of crops works as a means of cultural control by creating asynchrony between crop phenology and insect pests phenology which can retard the colonization (Ferro, 1987) [10]. The higher population was found in the later stage of the crop. It is occurred due higher canopy developed and they induce a favorable condition of insect reproduction, growth, and development.

The present results revealed that the appropriate transplanting dates may influence green leaf hoppers from these experimental results, it may be concluded that the 1st transplanting date (1st July) can minimize green leaf hopper attack. Therefore, in Jharkhand, a thorough study on rice, the early transplanting time is very essential for building up a successful pest management system. This technology wants more research and further investigation at field level. Therefore, the present work may show a path for further and detailed research in many dimensions.

Conclusion

The intensity of the pest population GLH were shown in ascending order with early planting (1st July) < normal planting (21st July) < delayed planting (12th August).

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