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Management of ear bug (*Leptocorisa acuta* Thunberg) infesting rice by host plant nutrients supplied through organic and inorganic sources with emphasis on use of neem and karanj cake

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Abstract
Rice (*Oryza sativa* L.), is the most important crop of Jharkhand. Ear bug (*Leptocorisa acuta* Thunberg) is an important sucking insect pest which suck-out the milky juice of developing grains causing them degradation in quantity and quanlity. Efforts were made to generate the information on the efficacy of neem and karanj cake used alone and in combination with other organic and inorganic sources of plant nutrients for management of ear bug infesting rice (var. Pusa Basmati-1). The overall results revealed that neem cake (NC)@ 2.5t/ha proved to be the most effective with the minimum incidence of ear bug 9EB) viz.2.02 EB/10hills and karanj cake (KC)@ 2,5t/ha remained almost at par resulting in the lower incidence of the pest viz.2.63 EB/10hills which, in turn, realized grains yield also almost in the similar trends with 41.50 and 38.60q/ha, respectively. It was worthy to note that the highest incidence of the pest 25.09 EB/10 hills was found when the rice plants received the Sole use of N@ 80kg/ha through urea resulting in the substaintially lower yield of grains(22.40 q/ha).It was found that neem and karanj cake @ 0.5 and 1.0t/ha kept as separate treatment(s) supplemented with the rest quantity of N,P,K as per fulfillment of RDF (Recommended dose of fertilizer) through inorganic sources could also be able to be superior over the rice plants receiving N,P,K through the other organic and inorganic sources, which ultimately suffered with significantly lesser incidence of ear bug resulting in considerably higher yields of grains as well. Based on the overall findings of the field studies it may be concluded that neem and karanj cake, separately, used as organic manure @ 0.5,1.0 and 2.5t/ha proved to be significantly effective in reducing the incidence of ear bug resulting in the substantial enhancement of yields of grains of rice.
As such, the lower dose of neem and karanj cake @0.5 and 1.0 t/ha can be used as a part and parcel in the conventional method of rice cultivation and the higher dose of the same @ 2.5t/ha can be used in the organic mode of rice production successfully to manage the pest problem without harming the environment.

Keywords: Rice, ear bug, neem and karanj cake, grains

Introduction
Rice (*Oryza sativa* L.) is the most important food crop of Jharkhand. It is grown in an area of about 18 lakh hectares in wet season. More than half of a dozen of major prevailing insect pests are found to attack rice crop in its different growing stages. Ear bug (*Leptocorisa acuta* Thunberg) is one of them. It is also known as gundhi bug which emits a characteristic offensive odour in the infested fields that can be very easily recognized as a signal of presence of this insect pest species in rice fields. The nymphs and adults suckout the milky juice from developing milky grains causing brown spots and results in damaging the quality of grains in addition to make hindrances in filling of grains. The affected ears may be devoid of grains. As such, the pest is responsible of causing loss in yield varing from 10 to 25 percent depending upon the variation in the intensity of pest attack as per the degree of congeniality the weather conditions.(Prasad and Prasad, 2006; Krishnaiah *et.al.* 2008). The pest can be controlled by use of recommended chemical insecticides, but chemical insecticides have various after and ill effects viz. eradication of natural enemies of the pest species, secondary pest outbreak, pest resurgence, ecological imbalance, residue in the crop produce, soil and water and other environmental hazards. Proper host plant nutrition maintained through use of organic and inorganic sources with more emphasis on use of neem and karanj cake as organic manure in combinations with other organic and inorganic sources of plant nutrients can be of great use in management of major insect pests of rice in general with particular reference to era bug (Prasad *et al*. 2004, Prasad and Prasad, 2012). But, information on these aspect of IPM is almost lacking in general with particular reference to rice. Hence, the present field study was undertaken to fulfil this novel objectives.

Materials and methods

A field experiment was conducted in the rice research farm of Birsa Agricultural University, Ranchi in wet season for two consecutive years, 2012 and 2013 with rice variety, Pusa Basmati-1 in plot size of 5x4 square metre. The experiment was executed in the randomized block design with 13 treatments and 4 replications (Table - 1). Date of seed sowing of rice (var. Pusa Basmati-1) was made on 2nd July and date of transplanting was 26th July during both the years, 2012 and 2013. Harvesting was made on 28 and 30th of November during 2012 and 2013, respectively. The treatment details are given in Table-1. The treatments comprised of certain organic manures viz. FYM(Farm yard manure), green manure in the form of dhaincha (*Sesbania rostrata* L.), vermi-compost, neem and karanj cake and R D F (recommended dose of chemical fertilizers) in the form of their sole and separate use and also in the form of their balanced combinations (Table-1).

Observations on pest incidence

The observation on the incidence of ear bug was recorded by net sweep method by employing in the insect collecting hand net. The net sweeping was used on 10 randomly selected 10 hills (plants) of rice in each treatment and replication and expressed in terms of number of ear bug (EB) per 10 hills. As such, the observations on ear bug were recorded twice, first at the early milking stage and 2nd at the peak milking stage of rice during the both the years of experimentations, viz. 2010 and 2013. The mean of the data recorded at early and peak milking stage of rice were calculated ultimately, the data obtained from the respective years were pooled together. The pooled data of two years experiment were subjected to the statistical analysis after suitable transformation. Grains yield were recorded after harvesting at the maturity of the crop during both of the years. Yield data of two years were also pooled together further for their prepared suitable stastistical analysis for their documentation and interpretation.

Mathematical procedure of recording observations for their proper interpretations. Gundhi bug/Ear bug (EB)

Incidence of EB = Total no. of EB /10 hills
i.e., total no. of EB / 5Net sweeping

Table 1: Effect of organic and inorganic sources of plant nutrients on the incidence of gundhi bug /ear head bug infesting rice (Pusa Basmati – 1) (Based on pooled mean of experimental results of 2012 and 2013)

S. No.	Treatment combinations	No.of ear head bug/10 hills at		Overall Mean	Yield of grains(q/ha)
	Treatments and doses	D1	D2		
T_1	Use of 100% RDF: NPK(80:40:20)kg/ha	21.25(4.66)	25.00(5.05)	23.13(4.86)	35.65
T_2	Use of FYM @10t/ha	10.08(3.25)	13.00(3.67)	11.54(3.46)	28.70
T_3	Use of Green manure (GM)@ 10t/ha	7.35(2.80)	11.00(3.39)	9.18(3.09)	26.56
T_4	GM+50%RDF,N as top dressing in two splits	17.63(4.26)	22.00(4.74)	19.82(4.5)	31.80
T_5	Vermi compost,VC@ 2.5t/ha	8.14(2.94)	10.25(3.28)	9.19(3.11)	27.60
T_6	Karanj cake,KC@2.5t/ha	2.08(1.61)	3.17(1.92)	2.63(1.77)	38.60
T_7	Neem cake,NC@2.5t/ha	1.99(1.58)	2.05(1.59)	2.02(1.59)	41.50
T_8	KC@0.5t/ha+NPK(40:40:20kg/ha)i.e., rest quantity of N comes through inorganic sources	5.22(2.39)	6.88(2.72)	6.05(2.55)	34.20
T_9	KC@1.0t/ha+NPK(40:40:20kg/ha)i.e., rest quantity of N comes through inorganic sources	3.74(2.06)	4.56(2.25)	4.15(2.16)	36.60
T10	NC@0.5t/ha+NPK(53:40:20kg/ha)i.e., rest quantity of N comes through inorganic sources	4.65(2.27)	5.78(2.51)	5.22(2.39)	35.90
T11	NC@.1.0t/ha+NPK(26:40:20kg/ha)i.e., rest quantity of N comes through inorganic sources	3.06(1.89)	4.15(2.16)	3.61(2.03)	37.40
T12	$N_{80}P_0K_O$Nitrogen=80kgP_0K_0Kg/ha) through inorganic sources	26.33(5.61)	23.85(5.77)	25.09(5.69)	22.40
T13	No use of manures and fertilizers (i.e., untreated control)	6.75(2.69)	10.52(3.32)	8.64(3.00)	8.95
SEm±		(0.24)	(0.32)	(0.32)	(1.28)
CD (P=0.05)		(0.69)	(0.94)	(0.82)	(3.82)
CV (%)		(12.60)	(9.72)	(11.16)	(13.72)

Figures under the parentheses are square root transformed values

DAT -Days after Transplanting; GM –Green manure; FYM – Farm yard manure; KC-Karanj cake; NC –Neem cake;
RDF – Recommended dose of fertilizer through inorganic sources (i.e., N:P:K: 80:40:20Kg/ha). D1→ early milking stage; D2 → late milking stage at 10 days interval

Results and discussion

Ear head bug (*Leptocorisa acuta* Thunberg)

The experimental results (Table-13) revealed that incidence of ear head bug (*Leptocorisa acuta* Thunberg) recorded at the initiation of milking stage (D1) and at advancement of milking stage of rice crop (Var. Pusa Basmati-1). It was found that number of ear bug/10 hills was comparatively lesser at the initiation milking stage as compared to that of peak period of milking stage of rice.

Gundhi bug incidence at initiation of milking stage of the crop

Neem cake applied as organic manure @ 2.5 t/ha was found most instrumental in reducing the minimum incidence of ear bugs (1.99bugs/10 hills) and karanj cake @ 2.5 t/ha remained at par, followed by neem cake @1.0t/ha, karanj cake@1.0t/ha in this regard. It is encouraging to note that use of neem and karanj cake, applied as organic, in terms of suppression of incidence of gundhi bug, as compared to that of application of other organic manures viz.green manure, vermi compost and FYM and green manure plus 50% RDF which in turn, is more effective than the use of N, P, K (RDF, N, P, K @ 80:40:20 KG/ha) from inorganic sources (Chemical fertilizer) and N applied @ 80kg/ha in the form of urea. As such, highest incidence of gundhi bugs (26.33 bugs/hills when nitrogen was applied @ 80kg/ha in the form of urea. Thus it is clear that balanced dose of NPK @ 80:40:20 kg per hectare (2.25 bug/10 hills) remained superior to the application of sole

nitrogen @ 80 kg /ha (26.33 bugs/ha) in reducing the incidence of the pest. In nut shell, all the organic treatments viz. Neem cake, karanj cake, green manure, vermin compost and FYM proved superiorly effective in suppressing the incidence of inorganic fertilizer. Further more in sole use nitrogen fertilizer (Urea) made the rice plant more succulent that in turn remained highly preferred by the pest (26.33 bug/10hills). Use of N, P & K in the balanced quantity (i.e., N, P, K @ 80:40:20kg/ha) made the plant healthier which is relatively less preferable by gundhi bug (21.25 bugs/10 hills). There was significantly decreased incidence of Gundhi bug (17.63 bug/10 hills) was harboured by rice plants receiving green manure plus 50% RDF as against full dose of RDF (N:P:K @ 80:40:50 kg/ha) harbouring 21.25 bugs /10 hill.

Incidence of gundhi bug at the peak period of milking stage of the crop

It was found that incidence of the pest was found to be more increased at the peak peak period of milking stage of the crop as compared to that initiation of milking in the ear and standing crop. The efficacy of different treatments, maintained almost similar trends of incidence of gundhi bug at peak period of milk formation stage as that of initiation of thee milk formation stage in ears of the crop. As such, the efficacy of the test treatments were found to be in order of : neem cake@ 2.5t/ha >karanj cake @ 2.5 t/ha > neem cake @ 1.0 t / ha > karanj cake @ 1.0 t / ha > neem cake (0.5t/ha) >karanj cake @ 0.5 t/ha vermi compost @ 2.5 t/ha >green manure (GM) @ 10 T/ha >FYM @ 10 t/ha > GM (1.0T/ha) +50% RDF >100% >N@80kg /ha (i.e., N_{80} P_0K_0) in reducing the incidence of gundhi bug.

Rice plants receiving zero quantity of N, P and K (i.e., untreated check) also harboured very low number of the bugs (10.52bug/10hill) probably on account of poor nutrient contents of the plant which have less attraction for the pest.

Overall mean incidence of gundhi bug

The overall mean incidence of gundhi bug of two observations as influenced by use of different organic manure, chemical fertilizer and their combination presented in table-13, revealed that the pest suppressing effect of the test treatments were found to follow almost similar trends to the trends of the experimental results registered in the in the first observation at the beginning of the milking stage of the crop.

As such, neem cake @ 2.5t/ha (2.02bugs/10 hills) proved to be the most effective and karanj cake @ 2.5t/ha (2.63bug/hills) remained at par in suppressing the incidence of gundhi bug infesting rice in its milking stage. Accordingly, all the three doses of neem NC@0.5,1.0 and 2.5t/ha proved highly effective against gundhi bug in the order of NC(2.5t/ha)>NC (1.0t/ha)>NC (0.5t/ha) and the respective doses of karanj cake (@2.5,1.0 &0.5t/ha) remained at par in reducing the incidence of gundhi bug.It was also found that all the test organic manures viz. neem and karanj cake (@0.5 to 2.5t/ha) FYM(@ 10t/ha) remained more capable of reducing the incidence of gundhi bug as compared to those of RDF (N:P:K @80:40:20kg/ha) GM(10t/ha)plus50% RDF and N alone @80kg/ha in the form of urea(Table-13) in the present studies.

Grain yield

The overall results reveals that the sole use of neem cake (NC)@ 2.5t/ha realized the highest yield of rice grains of 41.50 q/ha. which remained at par with that of the sole use of karanj cake (KC)@ 2.5 t/ha resulting grains yield of 38.60q/ha, followed by neem cake @ 1.0 t/ha plus rest of N,P,K @ 26,40,20 kg/ha from the chemical fertilizers(37.40q/ha),karanj cake @ 1.0 t/ha plus rest of N,P,K @ 40,20,20kg/ha from inorganic source i.e. through chemical fertilizer (36.60q/ha);neem cake @0.5t/ha+N.P.K @53,40,20 kg/ha from inorganic sources (35.90q/ha)and 100% RDF:N,P,K@80,40,20 kg/ha through chemical fertilizers realizing 35.60q/ha. The Sole use of N@80 kg/ha through urea resulted to the substantially lower yield of 22.40q/ha.

The overall results indicated that neem and karanj cake used in the varying doses of 0.5, 1.0 and 2.5t/ha proved to be significantly effective in reducing the incidence of earbug (*L. acuta*) resulting in the realization of substantially higher yield of grains of rice.Hence, the present findings. suggested that inclusion of neem and karanj cake @ 0.5,1.0 and 2.5t/ha based on the availability of the same as a part of INM could be an important component of IPM for sustainable cultivation of rice.

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