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Population dynamics of rice hispa *Dicladispa armigera* (Olivier) in Barak Valley of Assam and effectiveness of bio-pesticides for its management

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ABSTRACT

Population dynamics of Dicladispa armigera (Olivier) was studied in two sites of Barak valley of Assam, viz., Dargakona and Katigarah in three seasons (Amon, Boro, Aus) for two years (2003-2005). Maximum population was recorded on Ranjit variety (15.2 ± 2.31 nos. / 5 sweeps) on 1st week of October, 04 followed by 12.2 ± 1.67 nos. / 5 sweeps, on 3rd week of September, 04 during Amon seasons in Katigarah. Kala birane variety showed maximum population (4.4 ± 0.32 nos. / 5 sweeps) on 1st week of September, 03. Whereas Dargakona witnessed maximum population (6.4 ± 0.14 nos. / 5 sweeps) on Ranjit Variety during the 3rd week of October, 04 followed by 1st week of October, 04 where population was recorded to be 5.8 ± 0.14 nos. / 5 sweeps. Bio-effectiveness was studied for two years with two bio-pesticides viz. Calpaste and Larvocel where Larvocel (0.1%) afforded maximum (86.38%) mortality of insect-pests after seven days of application during second year. All the treatments proved to be significant (p<0.05) over control (water spray). Toxicity persisted upto ten days after application.

Key words: *Population dynamics, rice hispa, bio-pesticides, tolerance characteristics, Cachar*

Rice, is the main staple food in Assam, India, grown on about 70% of the total cultivated land (3.64 million ha.) in the state (Anonymous, 2003). Rice is mostly grown on the low-lying deltas of the Brahmaputra and Barak rivers. But its yield is greatly affected every year by various insect pests (Barwal *et. al*., 1994; Dutta and Hazarika, 1994). Among the various insect pests of paddy, Rice hispa, *Dicladispa armigera* (Olivier) (Coleoptera : Chrysomelidae) causes extensive damage to the vegetative stage of the plant resulting 35-65 percent loss in yield throughout Assam (Rajek *et. al*., 1986; Hazarika and Dutta, 1991). The pest is endemic in Cachar and Karimganj districts of Barak Valley, Assam. 'Aus' crop does not suffer much, but late transplanted 'Aman' and 'Boro' paddy seriously damaged by the pest, reaching upto 100% crop loss in certain cases (Das, 1980; Islam *et. al*., 2004).

In the development of pest management strategies a detailed knowledge of the influence of abiotic factors on the pest insects is essential. Weather and climatic conditions are known to significantly affect the population dynamics of insect pests (Kennedy and Storer, 2000). Knowledge of abiotic conditions, such as temperature, day length, rainfall and relative humidity can be used as important components in forecasting and predicting the severity of insect pest population (Milford and Dugdale, 1990).

Information on the seasonal incidence and management of the pest in this valley is very limited. Considering the importance of this pest of rice an attempt has been made to study the population dynamics and management of the pest.

MATERIALS AND METHODS

Two sites viz., Dargakona and Katigarah were selected for the study during three crop seasons viz., Amon, Boro and Aus for two years during 2003-05. Population dynamics was studied fortnightly by sweeping method. Five random sweeping were done from each site and each variety of rice from 0.5 ha. of crop field. For the study of population dynamics two varieties viz., Ranjit and Kala birane were selected during Amon season, Basful and BR-19 during Boro season and Krishna and Bahadur varieties during Aus season. Multiple correlation ('F'-test) was employed to correlate abiotic factors (Temperature, Relative humidity and Rainfall) with population fluctuation on various varieties of rice during different seasons.

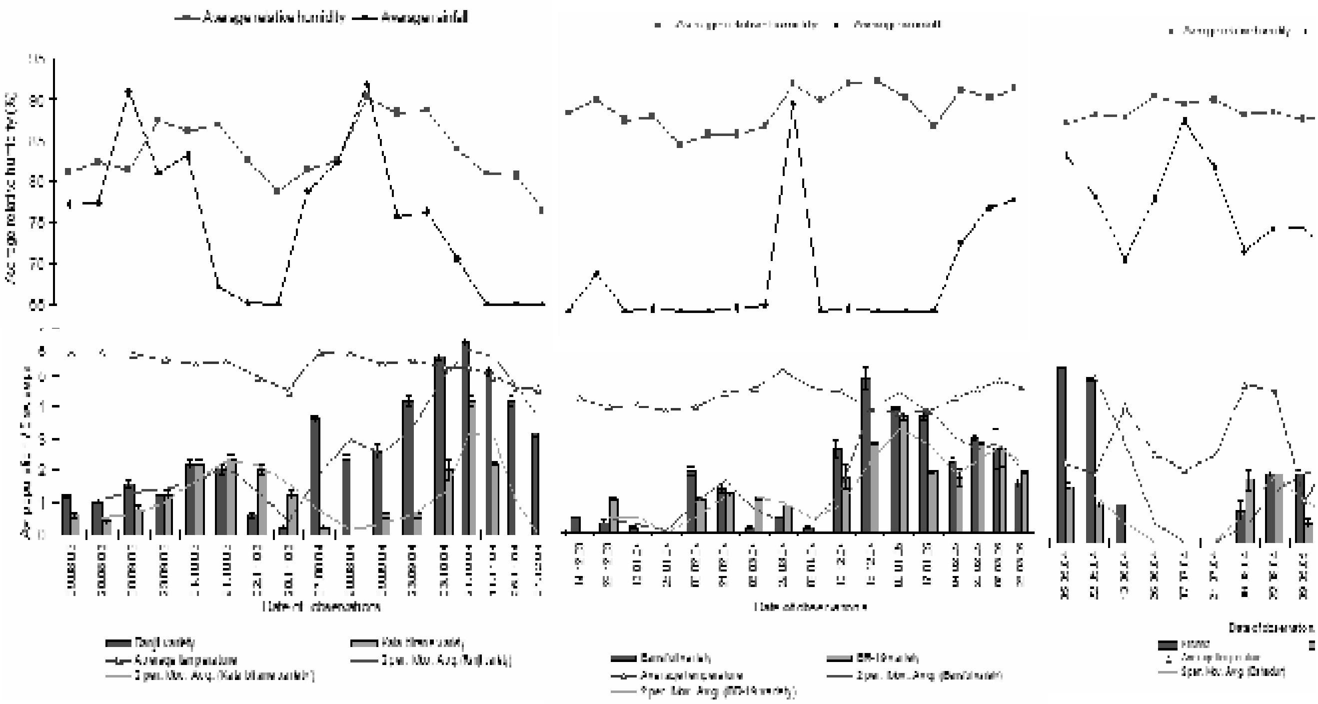
For the study of persistence of toxicity in terms of mortality of insect pest a randomized block design was followed. Two bio-pesticides (Calpaste and Larvocel) were selected with two concentrations for each treatment. Five replications were followed for each treatment. Each replication consisted of four hills (25 × 25 cm^2 area). Control (water spray) was also run against all treatments. All agronomical practices were followed for the preparation of treated as well as control plots. The percent reduction of hispa beetles were calculated following Abbott's formula (1925).

RESULTS AND DISCUSSION

Population dynamics of *D. armigera* in Dargakona during Amon seasons indicated that the maximum population was recorded on Ranjit (6.4 ± 0.14 insects in 5 sweeps) on the 3rd week of October, 04 followed by 1st week of October, 04 where population was recorded to be 5.8 ± 0.14 nos. / 5 sweeps . Maximum population of the pest on Kala birane variety (4.2 ± 0.14 insects in 5 sweeps) was also observed on the 3rd week of October, 04 followed by 2.4 ± 0.08 insects in 5 sweeps, during the same period. No population was observed on the Kala birane variety during 3rd week of August, 03 and last week of November to 1st week of December, 04. Ranjit variety showed higher pest incidence than Kala birane during both Amon seasons in Dargakona (Figure 1).

In Katigarah maximum population was recorded on Ranjit (15.2 ± 2.31 insects in 5 sweeps) on 1st week of October, 04 followed by 12.2 ± 1.67 insects in 5 sweeps, on 3rd week of September, 04 during Amon seasons. Kala birane variety showed maximum population (4.4 ± 0.32 insects in 5 sweeps) on 1st week of September, 03 followed by 4.2 ± 0.31 insects in 5 sweeps, during 1st week of September, 04. No population was observed on Kala birane during 2nd week of December, 04 (Figure 2). Multiple correlation ('F'-test) was employed to correlate the abiotic factors with

Fig. 1. Effects of abiotic factors on average population of *D. armigera* on two rice varieties in Dargakona during 2003-05



Amon Season
Ranjit variety:- 'F' : 175.5*, t-value: temp=5.19*, RH= -0.08 (NS), RF= -1.02 (NS).
Kala birane variety:- 'F' : 3.3 (NS), t-value: temp= -1.4 (NS), RH=2.7 (NS), RF= -0.3 (NS).
*Significant (p<0.001), NS= Non significant.

Boro Season
Basful variety:- 'F' : 3.73 (NS), t-value: temp= 0.12 (NS), RH=3.01**, RF= -2.02 (NS).
BR-19 variety:- 'F' : 3.04 (NS), t-value: temp= 1.03 (NS), RH=3.0**, RF= -1.92 (NS).
**Significant (p<0.01), NS= Non significant.

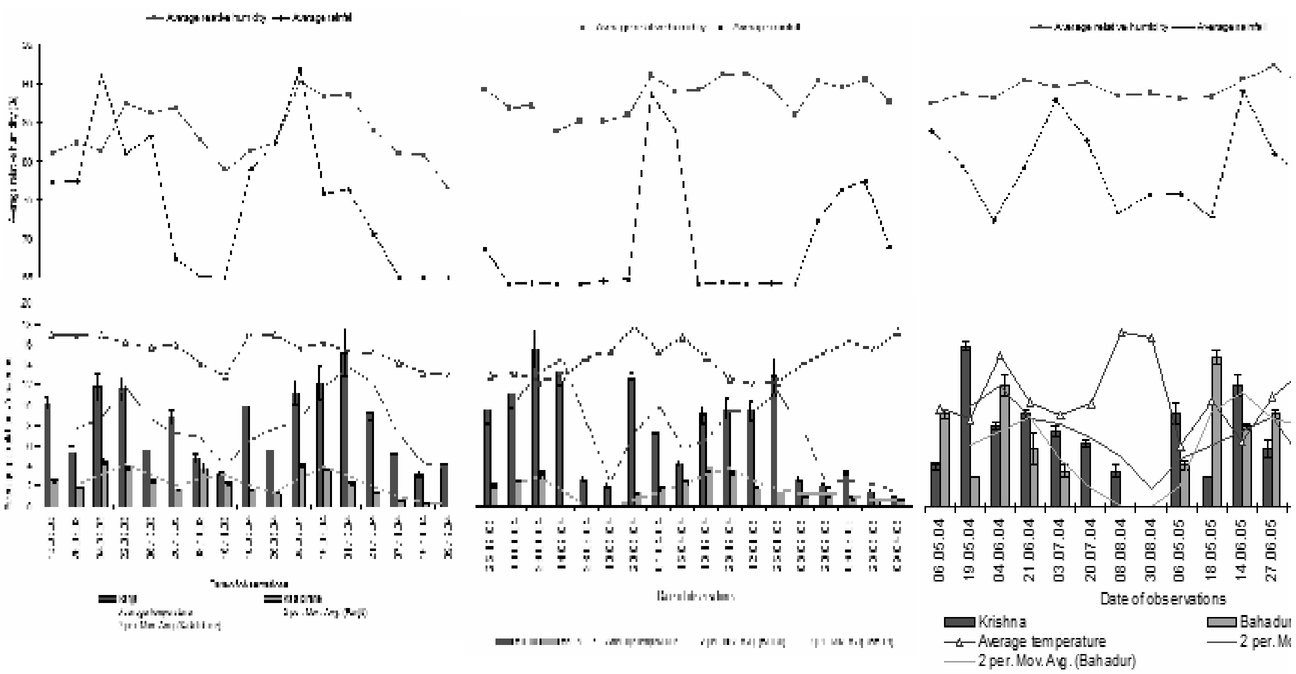
Aus Season
Krishna variety:- 'F' : 0.52 (NS), t-value: temp= -0.75 (NS), RH= -0.69 (NS), RF= 0.16 (NS).
Bahadur variety:- 'F' : 0.79 (NS), t-value: temp= 1.26 (NS), RH= -0.85 (NS), RF= 0.73 (NS).
NS= Non significant.

population fluctuation. In Dargakona all the abiotic factors showed significant correlationship with population on Ranjit ($F = 175.57$, $P < 0.001$) whereas partial correlation showed significant with temperature and population (temp = 5.19, $P < 0.001$) but relative humidity and rainfall showed non-significant (RH = 0.08 and RF = 1.02, $P > 0.05$) relationship. In case of Kala birane all the abiotic factors showed non-significant correlationship with the population fluctuation ($F = 3.33$, $P > 0.05$). Partial correlation also showed non-significant (temp = 1.4, RH = 2.74 and RF = 0.30, $P>0.05$) (Figure 1). Multiple correlation showed significant correlationship with population in Katigarah during Amon season on Rangit variety ($F = 5.78$, $P < 0.02$) but partial correlation proved significant with relative humidity and population (RH = 2.44, $P<0.02$) and non-significant with temperature and rainfall (temp = 1.05, RF=0.43; $P>0.05$). All the abiotic factors showed non-significant correlationship with population on Kala birane variety in Katigarah area ($F = 3.95$, $P > 0.05$). Partial correlation also proved non-significant (Temp = -0.61, RH = 1.54, RF = 1.86, $P>0.05$) (Figure 2).

Data revealed that highest pest incidence occured in Katigarah. Preference of Katigarah may be because of water logging fields. It was also observed that the pest prefers tender and middle stage of the crop. The infestation was found in patches in the centre of the field. These affected patches present a bowl-like depression due to the stunted growth of the crop. These 'bowls' act as foci for further infestation. Infestation in the field not being uniform in all places, which creates great difficulty in the estimation of loss in yield caused by rice hispa (Khan and Murthy, 1965).

Seasonal incidence of *D. armigera* and correlation between various abiotic factors were carried out in different parts of the country by different workers. Prakasa *et al.*, (1971) mentioned that out-break of the pest was favoured by unusually high rains in July followed by low rainfall in August –September which corroborates our findings. Low rainfall with high temperature and relative humidity was observed during the month of August-September when pest incidence was found significantly higher which fovours the findings

Fig. 2. Showing the effects of abiotic factors on average population of *D. armigera* O. on two rice varieties in three seasons in Katigarah during 2003- 05.



Ranjit variety:-'F':5.78*, t-value:temp=1.05 (NS), RH= 2.44*, RF= 0.43 (NS).
Kala birane variety:- 'F' : 3.95 (NS), t-value: temp= **-0.61** (NS), RH=1.5 (NS), RF= 1.86 (NS).
*Significant ($p<0.02$), NS= Non significant.

Basful variety:- 'F':2.5(NS), t-value:temp= -1.9 (NS), RH= -0.32, RF= -0.28 (NS).
BR-19 variety:- 'F' : 2.23 (NS), t-value: temp= -0.45 (NS), RH=2.12, RF= -0.83 (NS).
NS= Non significant

Krishna variety:-'F':4.35*, t-value:temp= -2.59**, RH= 0.25 (NS), RF= -0.11 (NS).
Bahadur variety:-'F':0.51 (NS), t-value:temp= -1.21 (NS), RH= 0.27 (NS), RF= -1.03 (NS).
*Significant ($p<0.05$), **Negatively Significant ($p<0.02$), NS= Non significant

of Thakur (1979). Pest population was higher during Sali (Amon) and ahu (Aus) seasons which supports the findings of Islam *et al.*(2004). Rawat and Singh (1980) reported that during 1978, the adult population was at its peak (average 158.4 / sample) during September when the crop was in mid-tilling and flowering stage and declined progressively. Our study revealed that pest incidence varies in different study sites and on the different varieties, but peak population was recorded (2.2±1.14) on 4th October, 03 in Dargakona, 22nd September, 03 in Katigarah where population was recorded 11.6±1.13. Population was found in decreasing trend from September- November. During 2004 also same trend was observed, hence the findings corroborates to the findings of Rawat and Singh (1980). Choudhary *et al.*, (2001) reported that rice hispa started appearing as early as second fortnight of May and remain active on the crop till second week of November. Whereas, our study revealed that pest population started increasing in the second fortnight of May but population was observed less in the month of June-July and again started appearing from the month of August and remain active on the crop till second week of November. In Dargakona during 2003-04 four peaks was observed but during 2004-05 three peaks was recorded. Whereas, in Katigarah four peaks were observed during the season. The maximum population of adults was found in the month of September. In Dargakona temperature and relative humidity were found significant (Temp = 5.19, $p<0.001$; RH = 2.443, $p<0.02$) but temperature showed negatively significant (Temp = - 2.59, $p<0.02$) in Katigarah. Hence the investigation was partially in agreement with Choudhary *et al.*, (2001).

High yielding varieties of rice viz., Ranjit, BR-19, Krishna and Bahadur showed higher susceptibility to the pest than local varieties (Kala birane and Basful). Rath (2002) reported that infestation of *D. armigera* was increasing day by day in recent years due to introduction of high yielding varieties and improved agronomic practices, which is in agreement with this study.

Table 1. Bio-efficacy of bio-pesticides against *D. armigera* during 2004 –05.

Treatments	Conc. (%)	Percent reduction at days after treatment+			
		1 DATr.	5 DATr.	7 DATr.	10 DATr.
Calpaste					
2004	0.02	43.87 (41.32)bc	62.50 (52.19)a	51.02 (45.27)b	43.83 (41.32)c
	0.04	56.25 (48.58)ab	73.81 (58.31)a	66.32 (54.14)ab	50.79 (45.26)bc
2005	0.02	31.33 (33.43)d	61.29 (51.29)a	55.55 (47.48)ab	47.62 (43.63)c
	0.04	59.64 (50.38)ab	77.42 (60.57)a	66.66 (54.16)ab	49.99 (44.48)bc
Larvocel					
2004	0.05	37.50 (37.61)cd	44.44 (41.35)a	52.38 (46.09)b	38.77 (38.34)c
	0.10	51.51 (45.30)b	73.56 (58.40)a	78.16 (61.69)ab	67.03 (54.18)ab
2005	0.05	38.59 (38.38)cd	43.83 (41.32)a	77.78 (61.66)ab	54.76 (47.74)bc
	0.10	67.74 (55.74)a	56.25 (48.58)a	86.38 (67.06)a	78.57 (61.72)a
Control++ (Water spray)	0.0	11.4 (19.32)e	6.2 (13.94)b	8.4 (16.32)c	12.6 (20.52)d
CD ($p<0.05$)		9.54*	22.39*	19.66*	11.06*

* Significant ($p<0.05$), DATr. = Days after treatments. ++ Average of two years. + Based on 5 replications, each consists of 4 hills (25 cm. × 25 cm. area). Figures in the parentheses are average of transformed values = Arc sin " percentage.
In a column, means followed by a common letter are not significantly different ($p<0.05$) by DMRT.

Regarding the bio-efficacy of two bio-pesticides, Larvocel (0.10%) afforded maximum mortality (86.38%) after seventh day of application in 2nd year followed by 78.57% at tenth day post-treatment. During 1st year, maximum (78.16%) mortality was observed on seventh day of application with same concentrations. Lower concentration (0.05%) afforded the maximum mortality (77.78%) after seventh day of treatment during 2nd year whereas maximum (52.38%) was recorded during 1st year. Calpaste (0.04%) afforded maximum (77.42%) mortality on fifth day after treatment during 2nd year followed by 73.81% on same treatment period during 1st year. Lower concentrations (0.02%) showed maximum (62.50%) on fifth day after treatment during 1st year followed by 61.29% on the same period after treatment during 2nd year. Among two bio-pesticides Calpaste showed initially higher percent mortality after first day of application (Table 1.) by using 0.04% concentration whereas Larvocel afforded 86.36% mortality by using (0.10%) concentration after seventh day of application. Regarding the effectiveness of bio-pesticides among four concentrations, it indicated that all the concentrations differ significantly from each other. All the treatment proved to be significantly different from control (water spray).

Use of Calpaste showed increase and decrease of hispa population upto tenth day of application. Increase may be due to immigration of adult population from nearby rice fields. However, use of Larvocel showed decreasing trend upto tenth day of application which corroborates the finding of Hazarika and Puzari, 1997. Larvocel is a biological insecticide which posses 1.5% *Beauveria bassiana*, as fungal spore affecting for a long time.

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