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MANAGEMENT OF LITCHI FRUIT BORER AND LITCHI MITE USING BIO-RATIONAL APPROACHES UNDER SUBTROPICS OF BIHAR

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KEYWORDS

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ABSTRACT

Field trial was conducted consecutively for two years at research farm of National Research Centre on Litchi, Mushahari, Muzaffarpur, Bihar to develop the eco sustainable bio-rational approaches for managing the litchi fruit borer and litchi mite which are the major pests of litchi causing economical loss to the growers. Studies revealed that Trichogramma chilonis cards @50000 eggs/ha in combination with Nimbicidine 0.5% (12.65% borer infestation) or Kamdhenu Keet Niyantrak 5% (12.30% borer infestation) were found equally effective in managing the fruit borer infestation which were closely followed by Kamdhenu Keet Niyantrak 5% (14.35% borer infestation). Highest infestation of borer was recorded in control (43.52%). Further, highest reduction in fruit borer infestation over control (70.29%) was recorded in Trichogramma cards @ 50000 eggs /ha with Kamdhenu Keet Niyantrak 5.0% which was closely followed by Trichogramma cards @ 50000 eggs /ha with Nimbicidne 0.5% (69.34%) and Kamdhenu Keet Niyantrak 5.0% (65.00%). In case of litchi mite, two years study revealed that reduction over initial infestation ranged from 47.67 to 98.0%. Highest reduction of mite over initial observation (98.0%) was obtained with Pruning of affected twigs in June + Pruning in October followed by spraying of Profenofos 0.05% which was closely followed by pruning of affected twigs in June + Pruning in October (96.33%) and pruning of affected twigs in June + Pruning in October + Dicofol 0.05% spray (95.67).

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INTRODUCTION

Litchi (*Litchi chinensis* Sonn) is an important subtropical evergreen fruit crop belongs to family Sapindaceae. It is known as queen of the fruit due to its attractive deep pink/red colours and flavoured juicy aril. It has high nutritive value and refreshing taste. Litchi is consumed as fresh fruit, pulp and various processed products like squash, RTS, wine etc (Singh *et al.,* 2012). Litchi appears to be native of the area, near Southern province of China and northern Vietnam from where it was introduced into India during the 18th century in the North East region (Tripura) and over the period of time to eastern states and percolated in the northern states (Rai *et al.,* 2000). In India litchi is being grown in an area of 82700 ha with a total production of 580 000 ton annually NHB (2013).

The major litchi growing countries are China, India, Brazil, Malaysia, Thailand,Vietnam, Myanmar, Mauritius, South Africa, Australia, New Zealand, Madagascar and Taiwan. It is now an important commercial fruit crop in India due to its export potentiality. Cultivation of litchi is widely spread in eastern India which provides livelihood opportunities to millions of people in the region. It is commercially grown in Bihar, Uttarakhand, West Bengal and Jharkhand (Rai and Kumar, 2004). Due to its high economic returns and ever increasing demand in the domestic markets, the crop is also gaining momentum in Punjab, Himachal Pradesh, Assam, Tripura, and Orissa. Considering the importance of this fruit crop in the region, efforts are made to provide technological support through research and promoting production, post-harvest management and marketing. The litchi growers are facing serious problem of many insects pests like fruit borer, litchi mite, shoot borer, bark borer, leaf minor, leaf webber etc, and as such the production is reduced drastically with marketability (Kumar *et al.,* 2011). Fruit borer (Acrocercops cramerella or Conopomorpha cramerella) is a major pest of litchi as it has several generations' right from initial stage to maturity (Kumar *et al.,* 2011). Kumar and Kumar (2007) also reported 24-32% infestation of litchi fruit borer at harvest stage in Bihar condition showing needs for systematic management of fruit borer. Litchi mite is another threat to litchi growers as both nymphs and adults damage the leaves, inflorescence and young developing fruits (Kumar and Kumar, 2010). Neem products are not only effective against the crop pest but also ecologically safe and free from residual problems (Alexander *et al.,* 2012).Therefore, keeping in view the importance of litchi fruit borer and litchi mite field trials were conducted to validate the different bio rational approaches against these important pests.

MATERIALS AND METHODS

Present studies were conducted at experimental farm of National Research Center on Litchi, Muzaffarpur, Bihar during 2010-2011 situated between latitude and longitude of 26º5′87″N and 85º26′64″ E, respectively at altitude of 210m asl. Separate experiments were laid out in RBD design with three replications to evaluate the efficacy of various bio-rational approaches to manage litchi fruit borer and litchi mite. Eight treatments for litchi fruit borer and twelve treatments including

control for litchi mite were undertaken. Horticultural practices were performed as per recommended package of practices for litchi cv. Shahi under the trials (Rai *et al.,* 2000). In case of fruit borer trial, each treatment was applied two times at premature stage (lentil size fruit) and at peak growth of fruit development (before colour break) and observation were recorded on the basis of damaged fruit at early stage as well as harvesting stage. To observe the borer infestation at early stage the fallen fruits were collected from each treatments and cut with the help of sharp knife. For recording observation at maturity 100 fruits from each treatment and each replicates were plucked randomly and the peduncle was opened and presence of larval or their excreta was considered as infested fruits. In case of litchi mite trial, pruning was done as per treatment details and spraying was done in the month of June and October. Observation was recorded on the basis of % initial infestation before imposing of treatments and % reduction over initial infestation after treatments.

RESULTS AND DISCUSSION

Litchi fruit borer (*Conopomorpha cramerella*); Lepidoptera: Gracillariidae

The data clearly showed that all the treatments significantly reduced the fruit borer infestation done by litchi fruit borer. During 2010, least borer infestation (5.3%) was observed both in T_2 (Trichogramma cards @50000 eggs/ha + Nimbicidine 0.5%) and T_6 (Kamdhenu Keet Niyantrak 5%) followed by T_4 (6.7%) at early stage of observation (Table 1). Whereas at harvest stage, treatment T_4 ((Trichogramma cards @50000 eggs/ha + Kamdhenu Keet Niyantrak 5%) showed the lowest (3.3%) fruit borer infestation which was closely followed by T_2 (4.7%). Cumulative infestation of early and harvest stage revealed that both the treatments T_2 and T_4 were found most effective (10%) against fruit borer management. Similarly in 2011, lowest borer infestation was observed at all the stages of observations i.e. early stage, harvest stage and their combined values in T_4 (9.3, 5.3 & 14.6%, respectively) closely followed by T_2 (10.0, 5.3 & 15.3%, respectively) and T_6 (10.7, 7.3 & 18.0%, respectively). Pooled data of both the years also revealed that T_2 was the most effective treatment as recorded only 7.65% borer infestation closely followed by T_4 and T_6 (8.0%) whereas, highest borer infestation (24.35%) was noticed in control at early stage of observation. However at harvest stage, lowest borer infestation (4.30%) was recorded in T_4 followed by T_2 (5.0%), T_6 (6.30%) and highest (19.30%) in control. Overall infestation of both the stages also exhibited that the minimum damage (12.3%) in litchi fruit was observed in T_4 followed by T_2 (12.65%) and T_6 (14.35%). The highest (4.352%) fruit damage due to litchi fruit borer was figured in control (Table 1).

Effect of different bio-rational approaches on reduction of fruit borer infestation per cent over control in litchi ecosystem presented in Table 2. Data revealed that combined application of Trichogramma with Nimbicidne and Vermi wash were found most effective as compared to application alone against litchi fruit borer. During 2010, the highest reduction per cent over control (81.53) of litchi fruit borer was recorded in both the treatments T_2 and T_6 followed by T_4 (76.66) at early stage. However at harvest stage, T_4 gave the maximum reduction

Table 1: Effect of bio-rational approaches on litchi fruit borer infestation in litchi ecosystem

Treat-ment	Treatment details	2010 Early stage	2011 Harvest stage	Pooled Combined	Early stage	Harvest stage	Combined	Early stage	Harvest stage	Combined
T_1	Trichogramma cards @ 50000 eggs /ha	14.0(21.97)	9.3(17.76)	23.3(28.86)	15.3(23.03)	12.7(20.88)	28.0(31.95)	14.65	11.00	25.65
T_2	Trichogramma cards @ 50000 eggs /ha +Nimbicidine 0.5%	5.3(13.31)	4.7(12.52)	10.0(18.44)	10.0(18.44)	5.3(13.31)	15.3(23.03)	7.65	5.00	12.65
T_3	Trichogramma cards @ 50000 eggs /ha +Vermi-wash 5.0%	10.0(18.44)	7.3(15.68)	17.3(24.58)	13.3(21.39)	10.0(18.44)	23.3(28.86)	11.65	8.65	20.30
T_4	Trichogramma cards @ 50000 eggs /ha +Kamdhenu Keet Niyantrak 5.0%	6.7(15.00)	3.3(10.47)	10.0(18.44)	9.3(17.76)	5.3(13.31)	14.6(22.55)	8.00	4.30	12.30
T_5	Vermi-wash 5.0%	12.0(20.27)	10.7(19.09)	22.7(28.45)	16.0(23.58)	10.7(19.09)	26.7(31.11)	14.00	10.70	24.70
T_6	Kamdhenu Keet Niyantrak 5.0%	5.3(13.31)	5.3(13.31)	10.7(19.09)	10.7(19.09)	7.3(15.68)	18.0(25.10)	8.00	6.30	14.35
T_7	Nimbicidine 0.5%	12.0(20.27)	10.0 (18.44)	22.0(27.97)	13.3(21.39)	7.3(15.68)	20.6(27.06)	12.65	8.65	21.30
T_8	Control	28.7 (32.39)	21.3 (27.49)	50.0(45.0)	20.0(26.56)	17.3(24.58)	37.03(37.64)	24.35	19.30	43.52
	CD at 5%	5.76	2.80	2.49	2.77	2.38	2.94	-	-	-

(Values in parenthesis are inverse Sine" percentage transformation)

Table 2: Effect of different bio-rational approaches on reduction of fruit borer infestation per cent over control in litchi ecosystem

Treat-ment	Treatment details	2010 Early stage	2011 Harvest stage	Pooled Combined	Early stage	Harvest stage	Combined	Early stage	Harvest stage	Combined
T_1	Trichogramma cards @ 50000 eggs /ha	51.22	56.34	53.40	23.50	26.59	24.39	37.36	41.46	38.89
T_2	Trichogramma cards @ 50000 eggs /ha +Nimbicidne 0.5%	81.53	77.93	80.00	50.00	69.36	58.68	65.77	73.65	69.34
T_3	Trichogramma cards @ 50000 eggs /ha +Vermi-wash 5.0%	65.16	65.73	65.40	33.50	42.20	37.08	49.33	53.96	51.24
T_4	Trichogramma cards @ 50000 eggs /ha +Kamdhenu Keet Niyantrak 5.0%	76.66	84.51	80.00	53.50	69.36	60.57	65.08	76.94	70.29
T_5	Vermi-wash 5.0%	58.19	49.77	54.60	20.00	38.15	27.90	39.09	43.96	41.25
T_6	Kamdhenu Keet Niyantrak 5.0%	81.53	75.12	78.60	46.50	57.80	51.39	64.02	66.46	65.00
T_7	Nimbicidine 0.5%	58.19	53.05	56.00	33.50	57.80	44.37	45.84	55.43	50.18
T_8	Control	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

over control (84.51%) followed by T_2 (77.93%) and T_6 (75.12%). Similarly, results of combined reduction of fruit borer infestation revealed that T_2 and T_4 showed highest reduction (80.0%) followed by T_6 (78.6%). During 2011, the highest reduction per cent over control (53.5) of litchi fruit borer was observed in T_4 followed by T_2 (50.0) and T6 (46.50) at early stage. The maximum reduction of borer over control (69.36%) was noticed in both T_2 and T_4 while the minimum in T_1 (26.59%) at harvest stage. Combined values of early and harvest stages on reduction of fruit borer infestation over control revealed that T_4 recorded the highest value (60.57%) followed by T_2 (56.68%) and T_6 (51.39%). Pooled data of both the years presented in Table 2 showed that the highest reduction in fruit borer infestation over control (65.77%) was recorded in T_2 which was closely followed by T_4 (65.08%) and T_6 (64.02%) however, T_1 found least effective (37.36) followed by T_5 (39.09%) at early stage of observation. Observation at harvest stage revealed that the maximum reduction in borer infestation over control (76.94%) was obtained in T_4 followed by T_2 (73.65%) and T_5 (66.46%) whereas, minimum in T_1 (41.46%) and T_5 (43.96). However, cumulative values of both stages on reduction of fruit borer infestation over control expressed similar trend as observed at harvest stage of observation.

Highest reduction of litchi fruit borer infestation with combined application of *Trichogramma* along with Nimbicidine and Kamdhenu Keet Niyantrak were found most effective as compared to application alone might be due to repellent action of the Nimbicidine and Kamdhenu Keet Niyantrak spraying subsequently parasitization by *Ttrichogramma* adults on eggs of fruit borer. The Trichogramma cards proved its effectiveness because the emergence of *Trichogramma* adults were coincides with lying of eggs by female moth during the period. Overall it can be concluded that *Trichogramma* alone is not much effective against litchi borer while in combination with Nimbicidine 0.5% or Kamdhenu Keet Niyantrak 5% proved its efficacy. Kumar and Kumar (2007) also reported control of litchi fruit borer by using *Trichogramma chilonis* @50000 eggs/ha at flowering time followed by two spray of Nimbicidine 0.5% at lentil fruit stage and colour break stage, which confirm the above findings in minimizing the damage of fruit borer. Similar trend also observed by Kumar and Kumar (2010) for minimizing the fruit borer using bio-rational approaches. Sardana *et al*. (2013) reported four release of *Trichogramma chilonis* @ 1.0 lakh/ha in combination with soil application of neem cake @ 1.5 t/ha and one spray of neem oil followed by installation of pheromone trap @15 trap/ ha was effective against minimization of fruit borer in bell paper (*Capsicum annum* L). Mandal *et al*. (2013) confirmed our findings as azadirachtin 1500 ppm could not found effective against bihar hairy caterpillar when applied alone. Sardana *et al*. (2013) also reported *Trichogramma chilonis* @ 1.0 lakh/ha in combination with Ha NPv @250 LE/ha was effective in controlling tomato fruit borer. Neem oil (0.5%) in combination with cypermethrin 25EC (0.025%) was most effective by recording lowest shoot and fruit damage in okra (Kanchan and Kumar, 2014).

The finding of present investigation holds a good promise in litchi fruit borer management and it showed that release of *Trichogramma chilonis* @ 50000 eggs/ha in combination with spraying of Nimbicidine 0.5% effectively controlled litchi fruit and shoot borer. Moreover, Kamdhenu Keet Niyantrak in combination with *T. chilonis* can also provide adequate control of litchi fruit borer. However, further studies on effect of these combinations on natural enemies need to be undertaken so that such combination can be more effectively utilized in future.

Litchi mite (Aceria litchi Keifer); Eriophydae: Acarina

Litchi mite infestation on leaves at initial stage before imposing of treatments and after treatments was recorded during both the years (Table 3). The initial infestation before imposing of treatments was ranged from 30 to 58.33% and 24.0 to 67.0% during 2010 and 2011, respectively whereas in pooled analysis it ranged from 27.8 to 62.67%. The data on reduction over initial infestation during 2010 revealed that T_5 (Pruning of affected twigs in June+0.05% spray of Propenofos), T_6 (Pruning of affected twigs in June + Pruning in October followed by spraying of Dicofol 0.05%) and T_8 (Pruning of affected twigs in June + Pruning in October followed by spraying of Profenofos 0.05%) gave the cent per cent reduction in litchi mite infestation over initial observation. More are less similar trend of 2010 was also recorded in 2011. However, pooled analysis of two years revealed that reduction over initial infestation ranged from 47.67 to 98.0%. Highest reduction over initial observation (98.0%) was obtained in T_8 (Pruning of affected twigs in June + Pruning in October followed by spraying of Profenofos 0.05%) closely followed by T_2 (96.33%), T_6 (95.67), T_5 (95.0%) and lowest in control (47.67%). Pruning of affected twigs in June reduced the initial inoculums, and then subsequently pruning in October reduced the surviving population. These findings are in close confirmatory with the finding of Kumar (1992) who has also

Table 3: Effect of different bio-rational approaches in reduction of litchi mite infestation in litchi ecosystem

Treatments	Treatment details	2010 Initial infestation (%)	2011 Reduction over initial infestation (%)	Pooled Initial infestation (%)	Reduction over initial infestation (%)	Initial infestation (%)	Reduction over initial infestation (%)
T_1	Pruning of affected twigs in June	53.33 (46.93)	96.67 (81.40)	45.33 (42.33)	84.00 (66.50)	49.33	90.34
T_2	T_1 + Pruning in October	40.00 (39.20)	98.33 (85.70)	34.00 (35.67)	94.33 (76.23)	37.00	96.33
T_3	T_1 + Dicofol 0.05% spray	45.00 (42.10)	98.33 (8570)	40.00 (39.20)	85.00 (67.20)	42.50	91.67
T_4	T_1 + Dimethoate 0.05% spray	30.00 (33.17)	98.33 (85.70)	42.33 (40.60)	82.33 (65.17)	36.17	90.33
T_5	T_1 + Profenofos (Celcron) 0.05%	38.33 (38.17)	100.00 (90.00)	31.67 (34.23)	90.00 (71.57)	35.00	95.00
T_6	T_2 + Dicofol 0.05% spray	35.00 (36.23)	100.00 (90.00)	27.00 (31.30)	91.33 (72.97)	31.00	95.67
T_7	T_2 + Dimethoate 0.05% spray	50.00 (45.00)	98.33 (85.70)	39.00 (38.63)	90.67 (72.53)	44.50	49.95
T_8	T_2 + Profenofos (Celcron) 0.05%	31.67 (34.23)	100.00 (90.00)	24.00 (29.33)	96.00 (78.73)	27.80	98.00
T_9	Spraying of Dicofol 0.05%	40.00 (39.03)	96.67 (81.40)	58.67 (50.00)	72.67 (58.50)	49.36	84.67
T_{10}	Spraying of Dimethoate 0.05%	36.67 (37.10)	95.00 (77.10)	60.33 (50.97)	70.00 (56.80)	48.50	82.50
T_{11}	Spraying of Profenofos 0.05%	43.33 (41.13)	96.67 (81.40)	44.00 (41.57)	86.00 (68.03)	43.67	91.34
T_{12}	Control (no pruning, no spray)	58.33 (49.83)	48.33 (44.03)	67.00 (54.93)	47.00 (43.30)	62.67	47.67
	C D at 5%	8.36	10.38	2.11	3.74	-	-

(Values in parenthesis are inverse Sine√ percentage transformation)

reported that litchi mite infestation was reduced by using of mechanical approaches followed by spraying of Dicofol 0.05%. Aswal et al. (2013) also reported Dicofol was effective treatment in reducing red spider mite population in apple.

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