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Field efficacy of certain insecticides and botanicals against caseworm on Paddy under mid hill conditions of Himachal Pradesh, India

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Abstract
An experiment was conceded to study the field efficacy of certain insecticides and botanicals against caseworm on paddy in Rice and Wheat Research Centre, Malan during *kharif* 2017. Dinotefuran 20 SG (200g ha^{-1}) was found most efficacious among other formulations followed by monocrotophos 36SL (850 ml ha^{-1}) and chlorpyriphos 20 EC (1250 ml ha^{-1}) in checking rice caseworm. After botanicals, eupatorium, melia, neemazal and neem oil application proved effective while neem oil was the least effective treatment. Present discovery of the Dinotefuran 20 SG (200g ha^{-1}) and Eupatorium could aid in better management of the rice caseworm population in paddy fields.

Keywords: Synthetic insecticides, botanicals, efficacy, paddy, rice and caseworm

1. Introduction
Rice (*Oryza sativa* L.) is the most important crop and grown in 117 countries in the world, being a staple food of 2.7 billion people in Asia alone (Kumar *et al*, 2009) [4]. In India, area under rice is about 42.96 million ha with the total production of 158.7 million tonnes (Anonymous 2016) [2]. In Himachal Pradesh, rice occupies the third position in acreage after wheat and maize with 76.34 thousand ha area under its cultivation and total production of 129.88 thousand metric tonnes (Anonymous 2015) [1].

In recent years, there is a need to increase food production in order to meet the demand of rapidly increasing human population from limited land resources. This has necessitated the introduction of high yielding varieties, adoption of new agronomic practices and monoculture over a large area along with the humid environment, which is favourable for the proliferation of insect pests which have increased the population of minor pests rendering them as major pests and vice-versa (Reddy 2013) [5]. Rice caseworm is one of them, which occur sporadically on rice in India and commonly found in low lands with water stagnation in fields and poor drainage. Larvae cut the leaf blade and enclose themselves within a tubular leaf case and feed on the leaves resulting in stunting and defoliation (Srivastava *et al*. 2012) [6]. To overcome the losses and increase in yield, pesticide applications are very much important. Present study was undertaken to get the information about the field efficacy of different insecticides and botanicals against rice caseworm in an area so that proper management tactics be evolved.

2. Materials and Methods
2.1 Experimental diet
The experiment was conducted in randomized block design with three replications at Rice and Wheat Research Centre, Malan during *kharif* 2017. Seven treatments (3 insecticides and 4 Botanicals) were used in an experimental area as depicted in Table 1. The recommended rice variety, "Kasturi Basmati" was sown and transplanted in the plot size of 6 m x 4 m, with row to row and plant to plant spacing of 20 cm and 15 cm, respectively.

Table 1: List of insecticides and botanicals

Treatments	Dosage (per ha)
T_1 Dinotefuran 20 SG	200 g
T_2 Chloropyriphos 20 EC	1250 ml
T_3 Melia 5%	2500 ml
T_4 Eupatorium 5%	2500 ml
T_5 Neemazal 1% EC	1000 ml
T_6 Neemoil	2500 ml
T_7 Monocrotophos 36 WSC	850 ml
T_8 Untreated Check	-

Manual spraying using "Knapsack sprayer" was practiced; final spray volume was 500 L ha^{-1}; in control, no insecticide or botanical was sprayed

2.2 Data Recording
For recording the observations, five hills were earmarked in each plot and observations on rice caseworm incidence were recorded one day before and thereafter, seven and fifteen days of sprays.

2.3 Statistical analysis
The data were analyzed by using appropriate methods of analysis. Data for experiment planned in respective design, were subjected to analysis of variance after transformation through CPCS-1 software. Gomez and Gomez, 1984 analysed the data with standard method for experiment planned in randomized block design. The data were arc sine or square root transformed to stabilize the variances.

3. Results
One day before first spray, the per cent leaf infestation due to rice caseworm in different plots varied from 7.01 to 11.73 and the variation was found non-significant (Table 2).

3.1 First spray
Seven days after first spray (DAFS), all the treatments showed significant reduction in leaf infestation as compared to untreated check (T_8), where the per cent leaf infestation increased to 18.32 from an initial of 11.73 per cent as recorded prior to first spray. Among different treatments, dinotefuran showed minimum of 5.04 per cent leaf infestation. The next better treatments in descending order were monocrotophos > chlorpyriphos > eupatorium > melia > neemazal > neem oil with per cent leaf infestation of 5.90, 6.11, 6.62, 6.89, 7.36 and 7.84, respectively. All these treatments were statistically at par with each other except dinotefuran which was at par with monocrotophos and chlorpyriphos. After fifteen days of first spray, dinotefuran continued to regain the minimum per cent leaf infestation i.e.2.26. This was followed by monocrotophos, chlorpyriphos and eupatorium treatments having a respective infestation of 3.80, 3.89, 4.65 per cent, being at par with each other. The next treatments that recorded lesser leaf infestation as compared to control were melia and neemazal, which were statistically at par among themselves and also with eupatorium followed by neem oil which differed significantly to other treatments as well as with control.

Table 2: Efficacy of insecticides and botanicals against rice caseworm during *kharif* 2017

Treatment	One day before spray	Per cent leaf infestation			
		First spray		Second spray	
		7 DAFS	15 DAFS	7DASS	15DASS
Dinotefuran20 SG	8.09	5.04 (2.46)	2.26 (1.83)	1.42 (1.57)	0.69 (1.29)
Chlorpyriphos20 EC	10.01	6.11 (2.64)	3.89 (2.21)	2.87 (1.93)	1.22 (1.46)
Melia (5.0%)	7.01	6.89 (2.80)	5.66 (2.57)	4.83 (2.41)	4.06 (2.24)
Eupatorium (5.0%)	9.55	6.62 (2.76)	4.65 (2.35)	4.00 (2.22)	3.46 (2.11)
Neemazal (1%)	10.68	7.36 (2.89)	5.88 (2.61)	5.04 (2.45)	4.76 (2.39)
Neem oil	10.09	7.84 (2.95)	6.72 (2.77)	5.15 (2.47)	5.07 (2.44)
Monocrotophos36 SL	9.97	5.90 (2.62)	3.80 (2.19)	2.61 (1.89)	1.16 (1.46)
Untreated Check	11.73	18.32 (4.37)	26.72 (5.26)	26.89 (5.32)	27.28 (5.31)
Mean		8.01 (2.93)	7.44 (2.72)	6.60 (2.53)	5.96 (1.33)

Figures in the parentheses are the square root transformed values
DAFS: Days after first spray, DASS: Days after second spray
CD (P= 0.05)
A x B x C: 0.26

3.2 Second spray
The plots treated with dinotefuran resulted in minimum leaf infestation after seven days of second spray as compared to other treatments and untreated control and the same trend was observed after fifteen days. The per cent leaf infestation after seven days of second spray was 1.42 for dinotefuran followed by 2.61, 2.87 and 4.00 for monocrotophos, chlorpyriphos and eupatorium, respectively. Monocrotophos proved to be the next promising treatment followed by chlorpyriphos. Both were statistically at par with each other. Neem oil was least effective with 5.15 per cent infested leaves but showed significant reduction over untreated control where the leaf infestation was 26.89 per cent. Botanicals were found statistically at par with each other. Fifteen days after the second spray (DASS), the overall increase in leaf infestation in untreated control (27.28%) was very small. However, there was significant reduction in leaf infestation in all the treatments over control with a minimum of 0.69 per cent infested leaves in dinotefuran. Dinotefuran, being at par with monocrotophos and chlorpyriphos, were the next best treatments. Neem oil showed maximum infested leaves (5.07%) after untreated control and was at par with neemazal.

A perusal of data contained in Table 3 revealed that per cent leaf infestation varied from 2.35 to 6.19 in insecticide treatment, whereas in untreated check it was 24.8 which varied significantly among treatments, number of sprays and at an observational period of 7 and 15 days after treatment. Dinotefuran was the most efficacious insecticide in checking caseworm infestation, differed significantly from other treatments and resulted in the infestation level of 2.35 per cent (Table 3). Monocrotophos and chloropyriphos were the next best treatments, which were statistically at par with each

other. Eupatorium differed significantly from other treatments. Neem oil recorded maximum leaf infestation of 6.19 and was at par with neemazal.

Table 3: Interaction between per cent leaf infestation by caseworm in two sprays and different treatments

Treatment	Per cent leaf infestation		
	Spray I	Spray II	Mean
Dinotefuran20 SG	3.65 (2.14)	1.05 (1.43)	2.35 (1.78)
Chlorpyriphos20 EC	5.00 (2.42)	2.04 (1.69)	3.52 (2.05)
Melia (5.0 %)	6.27 (2.68)	4.44 (2.32)	5.35 (2.50)
Eupatorium (5.0%)	5.63 (2.55)	3.73 (2.16)	4.68 (2.35)
Neemazal (1.0%)	6.62 (2.75)	4.90 (2.42)	5.76 (2.58)
Neem oil	7.28 (2.86)	5.11 (2.45)	6.19 (2.66)
Monocrotophos36 SL	4.85 (2.40)	1.88 (1.67)	3.36 (2.04)
Untreated Check	22.52 (4.81)	27.08 (5.31)	24.80 (5.07)
Mean	7.72 (2.82)	6.27 (1.93)	

Figures in the parentheses are the square root transformed values

CD (P= 0.05)

Sprays (A) : 0.65

Treatments (C) : 0.13

C x A : 0.18

However, After first and second spray (Table 3), dinotefuran continued to be the most effective one with a minimum per cent leaf infestation of 3.65 and 1.05, respectively. Next best treatments were, monocrotophos, chlorpyriphos and eupatorium in both sprays, which were statistically at par with each other after first spray while monocrotophos and chlorpyriphos only were statistically at par after second spray and differed significantly from eupatorium. Neemazal and neem oil were statistically at par with each other in both sprays with neem oil having maximum per leaf infestation.

Table 4: Interaction between per cent leaf infestation by caseworm in different treatments and number of days after spray

Treatment	Per cent leaf infestation		
	7 DAS	15 DAS	Mean
Dinotefuran20 SG	3.23 (2.01)	1.47 (1.56)	2.35 (1.78)
Chlorpyriphos20 EC	4.49 (2.28)	2.55 (1.83)	3.52 (2.05)
Melia (5.0 %)	5.86 (2.60)	4.86 (2.40)	5.35 (2.50)
Eupatorium (5.0 %)	5.31 (2.49)	4.05 (2.23)	4.68 (2.35)
Neemazal (1.0%)	6.20 (2.67)	5.32 (2.50)	5.76 (2.58)
Neem oil	6.49 (2.71)	5.89 (2.60)	6.19 (2.66)
Monocrotophos 36 SL	4.25 (2.25)	2.48 (1.82)	3.36 (2.04)
Untreated Check	22.60 (4.84)	27.00 (5.28)	24.80 (5.07)
Mean	7.30 (2.73)	6.70 (2.52)	

Figures in the parentheses are the square root transformed values, DAS: Days after spray

CD (P= 0.05)

Days after spray (B) : 0.65

Treatments (C) : 0.13

B x C : 0.18

It was also observed that the per cent leaf infestation after the second spray (6.27) was significantly lower than per cent leaf infestation after first spray (7.72) (Table 3) therefore, showed that second spray was more efficacious in reducing per cent leaf infestation due to caseworm.

Data contained in Table 4, revealed that per cent leaf infestation after 7 days of spraying and 15 days of spraying were statistically at par and did not differ significantly.

4. Conclusion

The application of various insecticides and botanicals proved favourable in checking the rice caseworm infestation as compared to untreated control. In rice caseworm, dinotefuran showed minimum per cent leaf infestation (0.69%). Among botanicals, eupatorium was found most effective in controlling caseworm infestation. Hence, best treatments can be used in successful implementation of integrated pest management of rice.

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