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EFFECTIVENESS OF BIOCONTROL BASED IPM MODULES AGAINST LIPAPHIS ERYSIMI KALTENBACH (*HEMIPTERA: APHIDIDAE*)

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Abstract: Rapessed and mustard are important oilseed crops in India. The vulnerability of the crop to mustard aphid, *Lipaphis erysimi* Kaltenbach is the main bottleneck in successful cultivation of this crop. In order to use insecticides at a minimum level, effectiveness of different Integrated Pest Management (IPM) modules were tested under field conditions. The module (NSKE +*Chrysoperla carnea*) proved most effective in reducing the aphid population in terms of socio-economic and environmental values.

Key words: *Chrysoperla carnea*, endosulfan, IPM, *Lipahis erysimi*, NSKE

INTRODUCTION

Among the various edible oilseed crops in India, rapeseed (*Brassica campestris* var. *toria*) and mustard (*Brassica juncea* Coss) are the second most important oilseed plants next to groundnut and rank first as oilseed crops of north India (Hegde 2000). One of the major factors attributed to low production is the biotic stress on rapeseed and mustard. The mustard aphid, *Lipaphis erysimi* Kaltenbach (*Hemiptera: Aphididae*) is undoubtedly the most destructive insect pest in India (Ghorpade 1981; Bakhetia *et al*. 1989;) and other tropical and sub-tropical parts of the world (Blackman and Eastop 1984). An attempt was made to restrict the recurring menace of *L. erysimi* in the crop by minimum and judicious use of biorational methods.

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MATERIALS AND METHODS

To develop a sustainable mustard aphid management programme, different IPM modules were tested along with untreated control under field conditions during winter seasons of 2001–2002 and 2002–2003 at farmer's field. Three components viz. Neem Seed Kernel Extract (NSKE) @ 5%, endosulfan @ 0.07% and *Chrysoperla carnea* (Stephens) (*Neuroptera: Chrysopidae*) (release two-days old first instar 150 000 larvae/ha) were selected to formulate different IPM modules. Of the botanical origin and easily available to the farmers neem seed kernel extract was selected. Singh *et al.* (1987) suggested that endosulfan is more suitable for IPM of *L. erysimi* on rapeseed and mustard. However, on the basis of availability and preying capacity of various bioagents, *C. carnea* was selected as one of the components (Singh *et al*. 2003, 2005).

The IPM modules studied in the experiments are given hereunder:
(1) NSKE + *C. carnea* + Endosulfan,
(2) Endosulfan + *C. carnea,*
(3) NSKE + *C. carnea,*
(4) Control (Untreated).

The first module consisted of three components. The crop was initially treated with NSKE followed by the release of *C. carnea* and application of endosulfan. The components, in different modules, were applied when the average aphid population approached the economic threshold (ET) level (25–30 aphids per 10 cm of central shoot). Under the second and third modules, only two components were applied. In the second module the crop was initially treated with endosulfan followed by the release of *C. carnea* and in the third module application of NSKE was followed by the release of *C. carnea*. There was 15-days interval between the applications of components. The aphid population was counted from top 10 cm of central shoot of the plant and 25 plants were selected randomly from each replication for further observations (100 plants per module were observed). Plot size for each module was 900 m^2 and there were four replications in randomized block design.

The effectiveness of different modules was assessed on the basis of aphid population as well as the yield obtained and least significant difference (LSD) (critical difference) at 5% level of significance was determined. The economics of different modules was also studied.

RESULTS

Among the different modules tested, module consisting of NSKE + *C. carnea* + Endosulfan proved the most effective in reducing the aphid population with an average of 13.42/plant (Table 1, 2), followed by module Endosulfan + *C. carnea* (13.96) and module NSKE + *C. carnea* (17.19). Yield data were followed the same trend as maximum 12.92 q/ha from NSKE + *C. carnea* + Endosulfan and 11.33 and 10.83 q/ha from Endosulfan + *C. carnea* and NSKE + *C. carnea* were obtained, respectively. Unlike to the first year the module (NSKE + *C. carnea* + Endosulfan) (14.26 aphids/plant) ranked second after Endosulfan + *C. carnea* (14.00 aphids/plant) in order of effectiveness against aphid population. However, maximum yield (12.42 q/ha) was obtained from NSKE

Table 1. Effect of different IPM modules on mustard aphid population during 2001–2002

IPM modules	Average* aphid population (top 10 cm of central shoot) per plant													
	December		January				February				March			Mean
	22nd	29th	5th	12th	19th	26th	2nd	9th	16th	23rd	2nd	9th	16th	
NSKE** + *C. carnea* +Endosulfan	4.75 (0.69)	9.20 (0.99)	25.55↓ (1.42)	1.60 (0.35)	4.50 (0.72)	14.00 (1.17)	36.45↓ (1.57)	40.75 (1.62)	36.45↓ (1.57)	1.10 (0.27)	0.10 (0.03)	0.00 (0.00)	0.00 (0.00)	13.42 (0.80)
Endosulfan + *C. carnea*	2.15 (0.41)	11.75 (1.10)	31.65↓ (1.51)	2.80 (0.54)	1.50 (0.28)	10.15 (1.03)	32.10↓ (1.52)	38.60 (1.60)	29.30 (1.48)	13.85 (1.16)	6.15 (0.77)	1.35 (0.28)	0.10 (0.03)	13.96 (0.90)
NSKE + *C. carnea*	1.80 (0.35)	13.30 (1.15)	29.40↓ (1.48)	4.60 (0.70)	2.50 (0.43)	22.05 (1.36)	38.20↓ (1.59)	41.85 (1.63)	34.45 (1.59)	24.05 (1.39)	8.25 (0.95)	2.30 (0.45)	0.70 (0.17)	17.19 (1.02)
Control	0.95 (0.21)	12.25 (1.12)	30.65 (1.50)	54.25 (1.74)	115.35 (2.06)	269.15 (2.43)	289.15 (2.46)	199.05 (2.30)	81.20 (1.91)	46.30 (1.67)	1.60 (0.36)	0.10 (0.03)	0.00 (0.00)	84.62 (1.37)

	LSD ($p = 0.05$)
Module	0.015
Period	0.020
Module x Period	0.053

* average of four replications
** NSKE – Neem Seed Kernel Extract
↓ application of treatments
figures in parentheses are Log (x + 1) transformed values

Table 2. Effect of different IPM modules on mustard aphid population during 2002–2003

IPM modules	Average* aphid population (top 10 cm of central shoot) per plant													
	December			January				February				March		Mean
	17th	24th	31st	7th	14th	21st	28th	4th	11th	18th	25th	4th	11th	
NSKE** + *C. carnea* +Endosulfan	3.10 (0.58)	10.45 (1.06)	30.40↓ (1.50)	2.15 (0.33)	4.75 (0.74)	12.30 (1.12)	38.55↓ (1.60)	42.70 (1.64)	38.60↓ (1.60)	2.25 (0.42)	0.10 (0.03)	0.00 (0.00)	0.00 (0.00)	14.26 (0.81)
Endosulfan + *C. carnea*	2.25 (0.48)	12.05 (1.11)	31.75↓ (1.51)	6.50 (0.69)	2.10 (0.45)	7.05 (0.89)	32.05↓ (1.52)	42.70 (1.64)	31.40 (1.51)	12.35 (1.12)	1.75 (0.40)	0.00 (0.00)	0.00 (0.00)	14.00 (0.87)
NSKE + *C. carnea*	0.35 (0.10)	14.55 (1.19)	30.45↓ (1.50)	8.40 (0.77)	4.05 (0.68)	24.40 (1.40)	35.55↓ (1.56)	45.55 (1.67)	38.30 (1.59)	20.00 (1.32)	2.40 (0.44)	0.15 (0.05)	0.00 (0.00)	17.24 (0.94)
Control	3.90 (0.65)	10.40 (1.05)	28.10 (1.46)	48.20 (1.35)	112.35 (2.05)	270.25 (2.43)	350.10 (2.55)	280.70 (2.45)	118.10 (2.08)	40.25 (1.61)	0.35 (0.10)	0.00 (0.00)	0.00 (0.00)	97.13 (1.37)

	LSD ($p = 0.05$)
Module	0.017
Period	0.024
Module X Period	0.063

* average of four replications
** NSKE – Neem Seed Kernel Extract
↓ application of treatments
figures in parentheses are Log (x +1) transformed values

+ *C. carnea* +Endosulfan followed by Endosulfan + *C. carnea* (11.12) and NSKE + *C. carnea* (10.79) similarly to the first year (Fig. 1, 2). But there was no statistically significant difference in the yield obtained from Endosulfan + *C. carnea* and NSKE + *C. carnea* during both years of investigation.

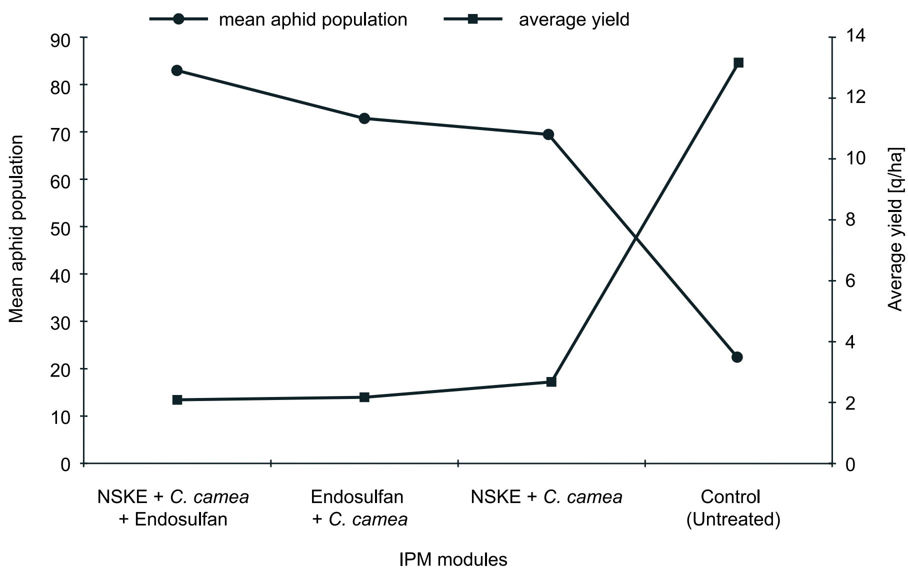

Fig 1. Average aphid population and mustard yield during 2001–2002

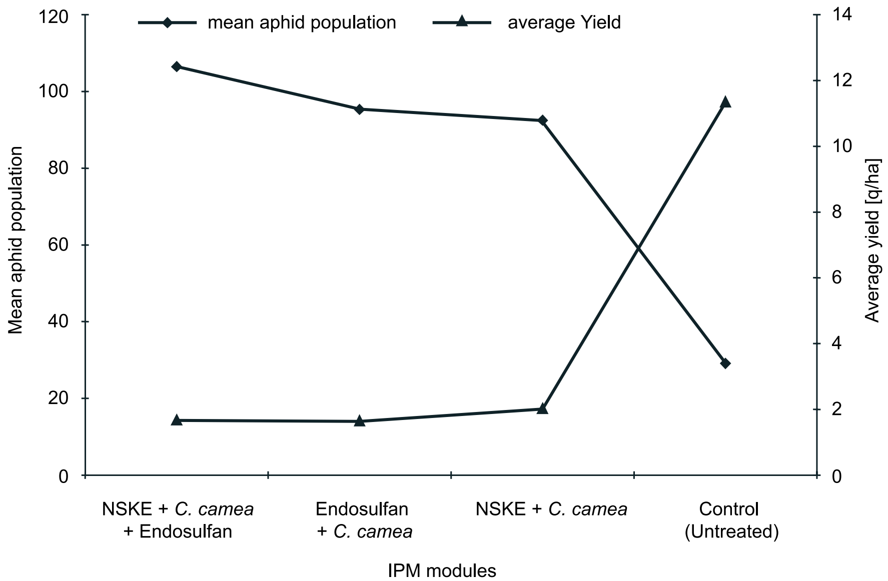

Fig 2. Average aphid population and mustard yield during 2002–2003

This might be due to minor climatic variations during the course of study; the yield data trend was unaffected. The study on economics of different modules revealed the maximum additional return over the cost from the module (NSKE + *C. carnea* + Endosulfan), however, maximum benefit over cost was obtained from Endosulfan + *C. carnea* (Table 3).

Table 3. Benefit/cost ratio of different IPM modules

IPM modules	Average seed yield [q/ha]	Additional yield over control [q/ha]	Cost of treatments [Rupees/ha]	Additional return over control [Rupees]	Additional return over cost [Rupees]	B/C ratio
NSKE** + *C. carnea* + Endosulfan	12.67	9.22	1832.40	17235.17	15402.77	9.41:1
Endosulfan + *C. carnea*	11.23	7.78	1232.40	14548.60	13316.20	11.81:1
NSKE + *C. carnea*	10.81	7.36	1230.00	13768.65	12538.65	11.19:1
Control	3.45	–	–	–	–	–

**NSKE – Neem Seed Kernel Extract

DISCUSSION

The studies on various IPM modules against mustard aphid are scanty; the reports of Devi *et al*. (2002) are in conformity with the present findings. They have reported that neem pesticide, endosulfan and phosalone could be used along with the biological control agents for the control of mustard aphid. Furthermore, their results also indicate that these combinations of treatments are not only effective in reduction of aphid population but also the population of the predatory insects is not affected to a great extent.

Even the module (NSKE + *C. carnea*) ranked second with a B/C ratio 11.19:1 in terms of benefit over the cost but was less costly than the module (Endosulfan + *C. carnea*) as presented in Table 3. Considering the benefit over the risk and no significant difference in the yield, the module (NSKE + *C. carnea*) is appropriate in managing the aphid population as well as agroecosystem. The studies conducted by Dhaliwal *et al*. (1998) showed that neem based insecticides provide 95.77 per cent of *L. erysimi* mortality as compared to endosulfan (97.24 per cent). They have also reported that the neem formulations were safer to parasitoids. In addition, the feeding efficiency of *Coccinella septempunctata* on *L. erysimi* was more in the crop treated with neem based insecticides than treated with endosulfan. Hence, initial application of NSKE 5% followed by the release of *C. carnea* @ 150 000/ha manage effectively the mustard aphid population.

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POLISH SUMMARY

EFEKTYWNOŚĆ WZORCÓW IPM OPARTYCH NA BIOLOGICZNYM ZWALCZANIU PRZECIWKO *LIPAPHIS ERYSIMI* KALTENBACH (*HEMIPTERA: APHIDIDAE*)

Rzepa olejna (*Brassica campestris* var. *toria*) oraz gorczyca (*Brassica juncea*) są w Indiach ważnymi gatunkami roślin oleistych. Podatność drugiego z wymienionych gatunków na mszycę gorczycową *Lipaphis erysimi* jest głównym, trudnym do rozwiązania problemem w uprawie tej rośliny. W celu wykorzystywania do zwalczania tej mszycy minimalnej ilości insektycydów, badano w warunkach polowych efektywność różnych wzorców IPM. Biorąc pod uwagę kryteria socjo-ekonomiczne oraz środowiskowe stwierdzono, że najlepszą efektywność w zwalczaniu populacji mszycy *L. erysimi* zapewnia wykorzystanie wzorca (NSKE + *Chrysoperla*).