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RESEARCH ARTICLE

Evaluation of *Chrysoperla scelestes* as a Bio-Control Component Against Pest Faunal Complex in Barley.

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ABSTRACT

The Chrysopids, popularly known as green lacewings are of considerable economic importance because of their role in natural control of many insect pests. In the study Chrysoperla scelestes was used as a bio-control component against pest faunal complex in barley. Experiment was set and percentage reduction in aphid population was calculated. The data indicate that pest infestation could be managed or checked at reasonable low population density.
Key words: *Chrysoperla scelestes, Bio-control component, Pest faunal complex*

INTRODUCTION

The Chrysopids, popularly known as green lacewings or golden eyes are of considerable economic importance because of their role in natural control of many insect pests in different crops. Quaintance and Brues (1905) reported that the larvae of lacewings were among the important predators of bollworms in cotton. Lefroy (1909) reported them as voracious feeders of aphids. Several other workers have also reported the usefulness of chrysopids in natural control of certain insect pests of cotton, vegetables, tobacco, cucurbits, fruit orchards, cereals and even in forest trees (van den Bosch and Stern, 1962). The chrysopids generally feed on aphids, cicadellids, psyllids, coccids, aleurodids, thrips, mites and eggs and larvae of lepidopterans (Richards and Davies 1979; Rao and Satyanarayana, 1984; Boussienguet, 1986).

Ba-Angood *et al*., (1985) reported that the major enemies of aphids *(*mainly *Schizaphis graminum, Rhopalosiphum maidis and R.padi)* on wheat in surveys in the Yemen Democratic Republic in 1975-80 were the predator *H. variegata, C. vicina, C. propinquavicina and Chrysoperla sp*. The predators were most abundant in January- February, and were believed to have played part in controlling aphids in the later stages of crop development. In trials with five sowing dates in 1975-76 and 1976-77, aphids were relatively few in crops sown on 15 October and 1st November , reached a maximum abundance in crops sown on 1st December, and were lower in numbers in crops sown later (15 December) From trials with four insecticides in sprays, a single application of malathion at 700 or dimethoate at 500 ml/ha before mid- January was recommended for chemical control. Similarly Or and Gerling (1985) have reported that the nymphs of *B.tabaci,* Genn. constitute the suitable food for *C. carnea.*

Voronen *et al*., (1986) presented a review of the biological methods in intergrated plant protection. Particular aspects referred to in this review of the current position with regard to biological methods in intergrated control of insects in the USSR include the establishment and testing of criteria for the effectiveness of natural enemies, the successful utilization of naturally occurring control agents, especially those of pests of grain and pulse crops such as the granulosis virus of the grey grain moth *Apame aanceps* in the northern part of the Kazakh, SSR: the importance of knowledge of economic thresholds for successful use of such pathogens, microbiological preparations and seasonal colonization projects in the control of tomato, cabbage and lucerne pests: studies and tests leading to the establishment of success regimes for control of the colorado potato beetle *(Leptinotarsa decemlineata)* using predatory bugs *(Perillus bioculatus* and *Podisus maculiventris)* and the aphid lion *(Chrysoperla carnea);* and the urgent need to develop effective rearing methods for these predators.

(Herold and Stengel (1994) drew the attention on serious damage caused by thrips in an area of Alsace, France. Surveys were undertaken in 1992-93 of the species and numbers responsible (natural enemies) and prospects for control with insecticides and resistant varieties were investigated. Eleven species of thrips were taken (some of them fortuitous on this crop), of which *T. tabaci* and *T. angusticeps* were the most important. In six varieties of cabbage, no particular variation in pest sensitivity was detected. Among four commercial insecticides tested, none gave significant control of thrips. *C. carnea* was one of the chief predators of thrips recorded on the crop.

Messina *et al*., (1995) stressed that host plant affects the predator- prey interaction of Russian wheat aphid and its predator *C. carnea*. Kabissa *et al*., (1996) explored prospects of manipulating chrysopids for biological control of *H. armigera* and *A. gossypii.*

The above mentioned facts prompted the development of an integrated control schedule against the pest faunal complex in the barley using *Chrysoperla scelertes* as a bio-control component.

MATERIAL & METHOD

BIOEFFICACY OF RELEASE DOSES OF *C. SCELESTES* FOR THE CONTROL OF BARLEY APHID:

Since the barley aphid has very high reproductive potential flourishing within three to four weeks to a high population density. The infestation grading levels were tentatively fixed as per the criteria given below:

GRADE I : Aphid population at zero level.
GRADE II : Aphid population 1- 20 per plant usually confined to central whorl.
GRADE III : Aphid population in sporadic patches on central whorl leaves and stems (200 to 300 adults/plant).
GRADE IV : Heavy infestation of aphids on the entire plant,
GRADE V : Plant wilted due to very heavy infestation of aphids.

PREDATORY POTENTIAL UNDER SIMULATED FIELD CONDITIONS:

The barley variety Rajkiran was sown in earthen pots in the month of November and were kept under field condition to get the natural infestation of barley aphids.

The potted plants having grade II and III level of infestation were selected for the studies. Two releases of *Chrysoperla* larvae (two days old) at the rate of 1, 2 and 3 larvae per plant were made for the grade II level infested plants. Similar releases were also made for grade III level infested plants. Both these experiments were replicated ten times. In the controlled potted plants, no predatory larvae were released.

MANAGEMENT OF PEST INFESTATION IN CROPS:
FIELD EXPERIMENTS ON BARLEY:

A field experiment was laid out at farmer's field at Sewar. There were nine treatments including control and all the treatments were replicated three times.

The same variety of barley i.e., Rajkiran was selected for this study. The plot size was 2/3 meters with the row to row distance of 30cms. The experimental design was randomised block design. The normal recommended agronomical practices were used during the crop season. The same grading criteria as reported for pot experiments were followed. The details of the treatment selected were as under:

T_1 Two releases of *C. scelestes* larvae (two days old) @ 50,000 larvae/ha, at the time of grade Il level of infestation and the second release was made after ten days.
T_2 Two releases of *C scelestes* larvae (two days old) @ 1,00,000 larvae/ha.at the time of grade IlI level of infestation and second release after ten days.
T_3 Two sprays of endosulfan 35 EC @ 1250 ml/ha. first spray at the time of grade Il level infestation and the second after fifteen days.

T_4 Two sprays of acephate 76 S.P. @ 750 g/ha. first spray at the time of grade Ill level infestation and the second after fifteen days.

T_5 One release of *C. scelestes* larvae (two days old) @ 50,000 larvae/ha at the time of grade II level of infestation and one spray of endosulfan 35 EC@ 1250 mil/a fifteen days after the release.

T_6 One release of *C. scelestes* larvae (two days old) @ 1,00,000 larvae/ha, at the time of grade II level of infestation and one spray of endosulfan 35 EC@ 1250 m/he fifteen days after the release.

T_7 One release of *C.scelestes* larvae (two days old) @ 50,000 larvae/ha at the time of grade II level of infestation and one spray of acephate 75 S.P. @ 750 ml/ha .fifteen days after the larval release

T_8 One release of *C. scelestes* larvae (two days old) @ 1,00,000 larvae/ha at the time of grade Il level of infestation and one spray of acephate 75 S.P. @ 750 gm/ha. fifteen days after the release.

T_9 Control (Untreated Check).

CALCULATION OF PERCENT REDUCTION IN APHID POPULATION:

The percent reduction in aphid population was calculated as:

$$\text{Percent reduction} = 100\left(1 \frac{T_a \times C_b}{T_a \times C_b}\right)$$

Where,

T_a = Number of insects after treatment.

T_b = Number of insects before treatment.

C_a = Number of insects in untreated check after treatment.

C_b = Number of insects in untreated check before treatment.

RESULT DISCUSSION

The data on released of *C. scelestes* larvae during II category aphid infestaion stage (1-20 aphids/plant) on barley have been presented. The observations revealed that the treatment T_3 provide maximum protection and proved significantly superior to the other two treatments (T1-T2). The next sequence was T_2 followed by T_1.

Whereas in second experiment, *C. scelestes* larvae were released at III category of aphid infestation (200- 300 aphids /plant) on barley, revealed that the release of larvae at this late stage was not so effective as in II category of aphid infestation. Twenty One days after release, the treatment T_3 gave maximum reduction in pest population followed by T_2 and thereafter by T_1. All the three treatments significantly differed from each other.

The field trials data of barley using aphids predators alone, predator and insecticides in combination and spray of insecticides alone were performed. The treatment T_8 was the best both for protection (93.89%) and for production (38.40q/ha), while the least production was observed after the treatment T_1 (30.50 q/ha) with a reduction of 51.93% in aphid population.

Earlier studies made under controlled conditions by Tulisalo and Tuovinen (1975) have suggested the release of chrysopid eggs and recommended the predator-pest ratio of 1: 1.3. However, when larvae are to be used the predator prey ratio should be maintained around 1:5 (Tulisalo *et al*., 1977) Hassan (1992) achieved good control on the ratio of 1:30. Subsequently, Hassan *et al.* (1985) investigated the efficacy of predator *C.carnea* for *M. persicae* on sugarbeet in greenhouse experiments in German Federal Republic using various predator-prey ratios. Releases of early second instar larvae of *C. carnea* at predator-prey ratios of 1:5, 1: 10, 1: 20 and 1: 40 were found effective against *M. persicae* and each release completely eliminated the pest. Adequate control was obtained for five - six weeks at ratios of 1: 5, 1: 10 and for three- four weeks at ratios 1:20 and 1:40. Releases at ratios of 1: 50 and 1: 60 did not eliminate the pest but considerably reduced its abundance. Beglyarov and Ushchekov (1977) also reported satisfactory results with a ratio as low as 1:50.

Table 1: Effects of *C. scelestes* Larvae ** in Reducing the II Grade Aphid Infestation on Barley under Simulated Field Conditions

Treatments	Percent reduction in aphids population after two releases (in days)			
	3	7	14	21
T_1 = 2 releases of one larva each at an interval of 10 days.	23.25 [28.81]	38.65 [38.45]	50.80 [45.47]	90.90 [72.43]*
T_2 = 2 releases of two larva each at an interval of 10 days.	41.96 [40.38]	47.15 [43.36]	87.30 [64.09]	97.00 [80.01]
T_3 = 2 releases of three larva each at an interval of 10 days.	61.45 [51.63]	78.95 [62.67]	95.90 [78.28]	99.60 [86.53]
T_4 = Control	..	..	..	..
S Em± C D at 5%	2.038 6.422	2.18 6.88	1.43 4.52	0.996 3.139

*values in paranthesis are angular transformed values of percentage.

**The first release of C. sclestes larvae (48 hour old) was made 45 days after sowing in all treatment and the second after 10 days.

Table 1: Effects of *C. scelestes* Larvae ** in Reducing the II Grade Aphid Infestation on Barley under Simulated Field Conditions

Treatments	Percent reduction in aphids population after two releases (in days)			
	3	7	14	21
T_1 = 2 releases of one larva each at an interval of 10 days.	5.45 [13.50]	17.6 [24.08]	20.3 [26.78]	17.6 [24.84]*
T_2 = 2 releases of two larva each at an interval of 10 days.	6.45 [14.74]	24.3 [29.56]	32.8 [34.93]	39.2 [38.78]
T_3 = 2 releases of three larva each at an interval of 10 days.	19.3 [26.05]	31.3 [38.63]	38.95 [38.63]	43.45 [41.41]
T_4 = Control	..	..	..	..
S Em± C D at 5%	1.82 5.73	0.67 2.11	2.115 6.65	0.799 2.51

*values in paranthesis are angular transformed values of percentage.

**The first release of C. sclestes larvae (48 hour old) was made 45 days after sowing in all treatment and the second after 10 days.

Table 3: Barley of Aphid (*R. maidis*) Population on Variety Raj Kiran Together with Prevaling Abiotic Factors (1995-1996)

S.No.	Data of observation	Aphid population per tiller	Av.Relative Temperature (ºC)			Av.Relative humidity (%)		
			Max.	Min.	Mean	Morning	Evening	Mean
1.	18.12.95	0.00	24.4	3.6	14.0	85	31	58.0
2.	25.12.95	1.66	24.8	5.3	15.05	89	39	64.0
3.	01.01.96	11.33	22.4	4.8	13.6	82	35	58.5
4.	08.01.96	20.66	18.7	5.5	12.1	91	47	69.0
5.	15.01.96	98.66	20.5	5.3	12.9	89	34	61.5
6	22.01.96	108.50	24.1	4.9	14.5	77	28	52.4
7	29.01.96	165.00	24.9	6.8	15.85	90	34	62.0
8.	05.02.96	202.00	26.9	7.1	17.0	87	27	57.0
9.	12.02.96	244.00	24.5	5.5	15.0	81	23	52.0
10.	19.02.96	229.00	24.5	10.3	17.4	74	34	54.0
11.	26.02.96	192.66	24.9	10.5	17.7	76	40	58.0
12.	05.03.96	56.00	25.6	10.7	18.15	70	28	49.0
13.	12.03.96	Nil	27.6	13.7	18.65	64	25	44.5

In the present investigation, these parameters were kept in view and tentative release dose and time of application was worked out under simulated field conditions in potted-plant experiments. Since the aphids have a very high reproductive potential, the release of chrysopid egg is not advisable because the aphid predation is delayed for a week or so. With the result, the infestation level is reached to such a high density which need very high rate of predator augmentation. In addition to it, the cannibalism among the newly hatched predator larvae, predation by ants, naturally occurring enemies in nature and consequent reduction in the hatching rate of chrysopid eggs reduce the predator density leading to reduction of bioefficiency by releases of eggs. Keeping in view, the reproductive potential of the barley aphid *R. maidis*, two releases of chrysopid larvae at ten days interval at the rate of 1, 2 and 3 larvae per pot were made at grade II (1-20 aphids/ plant) and grade III (200-300 aphids plant) level of aphid infestation Thus a giving a predator-prey ratio in the three treatments somewhere around 1: 20, 1: 10 and 1: 7.3 at grade II and 1: 300, 1: 150 and 1: 100 at grade III level of infestation. A drastic reduction of 90, 97 and 99 per cent in aphid population density was recorded in potted-plant experiment at grade Il infestation level. Contrary to it, grade III level of aphid infestation 200-300 aphids / plant was characterized with a reduction in aphid population of 176, 392 and 43.45 at the respective predator-prey doses of 1: 300, 1: 150 and I: 100. These data indicate that the pest infestation could be managed or checked at reasonable low population density. The pests having higher population densities and high reproductive potential could hardly be controlled effectively by lower predator augmentation doses. It can safely be concluded that the predator-pest dose should be developed to match the reproductive potential of the pest in question with the predatory efficacy of the predator on that particular host.

The potential of the chrysopid has been established in many crop situation and field conditions (Ansari *et al*., 1992; Breene *et al*, 1992 & Pari *et al*., 1993). It has been observed that the pre - imaginal stages of *Chrysoperla* are relatively more tolerant to insecticides, and in some cases, *C. carnea* was found much more resistant to pesticides than was the pest insect (Wilkinson *et al.*, 1975). This promoted the use of parallel chrysopid and insecticidal integration combinations in India (Singh, 1986) and abroad (Hassan, 1992; Hesselein *et al.*, 1993 & Herold and Stengel, 1994).

In the present field trial on the barley crop (Variety: Rajkiran) with nine treatments, the relative bioefficacy of *C. scelestes* alone, predator in combination with relatively tolerant insecticides and the insecticides alone were tested under field conditions. The treatments having release of *C. scelestes* along with one spray of acephate fifteen days after release was quite effective and was at par with two sprays of endosulfan and acephate at the interval of three weeks after release. These observations indicate that the integration of *C. scelestes* as biocontrol agent along with the insecticides like acephate for which *C. scelestes has* tolerance, can effectively be encouraged for management of *Rhopalosiphum maidis* in barley crops.

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