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Seasonal Incidence and Management of Cabbage White Butterfly, *Pieris brassicae* (Linnaeus) (Lepidoptera: Pieridae) on Cabbage Crop

Sonika Sharma*, Hafeez Ahmad, Suheel Ahmad Ganai, Devinder Sharma, Thanlass Norboo, Nadeya Khaliq and Mahesh Kumar

Block No. 6, Division of Entomology, FoA, Main Campus, SKUAST-J, Chatha, Jammu-180 009, J&K, India
**Corresponding author*

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A B S T R A C T

Experiments conducted on the seasonal incidence of *Pieris brassicae* L. during 2014-2015 and 2015- 2016 at the University Farm of Sher-e-Kashmir University of Agricultural Sciences and Technology- Jammu revealed that *P. brassicae* were first observed in the 43rd standard week (1.33 larvae plant^{-1}) and lowest population of 0.12 larvae per plant during the 15th standard week. The *P. brassicae* population was maximum (5.74 larvae plant^{-1}) in 7th standard week, respectively. The maximum and minimum temperature showed significant negative correlation with r values (r = - 0.545** and r = - 0.631**), while relative humidity (morning) had a positive and highly significant effect with r value (r = 0.622**) impact on larval population. Whereas relative humidity (evening) and rainfall had no significant effect with r value (r = 0.162 and r = - 0.205) on the larval population. Regression studies revealed that the weather factors had 45.30 per cent contribution towards larval population. The relative efficacy of insect growth regulators against the cabbage white butterfly, *P. brassicae* showed that fenvalerate had higher efficacy against *P. brassicae* in reducing pest population. Mean population of *P. brassicae* after two sprays revealed that fenvalerate 0.004% was effective and superior. The next best were lufenuron 0.006% and novaluran 0.100% which were at par. chlorfenapyr 0.150% was found to be least effective against *P. xylostella.*

Introduction

The cabbage white butterfly, *Pieris brassicae* (Linnaeus) (Lepidoptera: Pieridae), is a serious pest of cauliflower and cabbage in our region (Shankar *et al.*, 2016) as well as world (Hasan, 2008). A single larva can consume about 74 to 80 cm^2 leaf area (Younas *et al.*, 2004). In cruciferous vegetables, this pest alone causes 40 per cent yield loss annually in India (Hasan and Ansari, 2010). As a result of feeding, the plants either fail to form compact cabbage heads or produce deformed heads (Uddin *et al.*, 2007). The severity of the incidence of insect pests is greatly influenced by the prevailing climatic conditions (Meena *et al.*, 2013). At present, the information regarding the influence of weather parameters on the incidence of this pest and bioefficacy of insect growth regulators under field condition for their comparative efficacy against *Pieris brassicae* is very less. Therefore, keeping in view the economic importance of the crop and the magnitude of the damage caused by the insect, the present study has been proposed.

Materials and Methods

The experiment was conducted at University Farm SKUAST-Jammu, Main Campus Chatha, and Jammu during 2014-15 and 2015-16. Cabbage (Variety Pride of India) were sown in raised nursery beds in lines with 7cm distance and 1cm deep, which were covered with a mixture of soil and well decomposed farmyard manure. The bed was covered with paddy straw which was removed after germination of seeds. The seedlings were ready for transplanting after 30 days and were transplanted in plot size of 4×3 m^2 with row to row and plant to plant distance of 60 and 45 cm. respectively. Observations on the seasonal incidence of *P. brassicae* were recorded on 10 randomly selected plants. The experiment was laid out in randomized block design (RBD) with four replications. For the *P. brassicae* management, a trial was laid out in the randomized block design with four replications. Five insecticidal formulations including control were tested as given below. Observations on the *P. brassicae* population from the selected plants were recorded before and after 1, 3, 7 and 15 days of spray. Data thus obtained were analysed statistically and the efficacy of the insecticides were worked out.

T1- Novaluron 10EC @ 0.10%
T2- Lufenuron 5 EC@ 0.006%
T3- Fenvalerate 20 ES @ 0.004%
T4- Chlorflenapyr 10 SC @ 0.15%
T5- Control

Results and Discussion

Seasonal Incidence of *P. brassicae on cabbage*

Pooled data for the both years (Table 1 and Fig. 1) revealed that larvae (1.33 larvae plant^{-1}) was observed right from 43rd standard week, when the mean maximum, minimum temperature, mean relative humidity and rainfall were 27.10 and 13.00^{o}C, 84.00 and 57.50 per cent and 7.20 mm, respectively. Larval population reached it's peaked during 7th standard week with (5.74 larvae plant^{-1}) when the mean maximum, minimum temperature, mean relative humidity and rainfall were 22.80and 10.30^{o}C, 87.00 and 49.50 per cent and 2.90 mm, respectively. The larval population declined and reached to minimum of 0.68 larvae plant^{-1} during 16th standard week. The present finding are in agreement with the findings of Sharma *et al.,* (2005) who found that the larvae first appeared on cauliflower in the first week of November, and the population peaked during the fourth week of January 2005, and remained active up to April. In the present investigation, the number of larvae per plant ranged from 0.56-12.03. Ahmad *et al., (*2007) also recorded the larvae first appeared on cabbage in 43rd standard week (8.60 larvae plant^{-1}) and the population peaked to 58.10 larvae plant^{-1} during the 50th standard week, and remained active up to 7th standard week and Sharmila *et al.,* (2015) revealed that the larvae first appeared on cabbage in first week of November (7.40 larvae plant^{-1}) and the population peaked to 23.22 larvae plant^{-1} during 3rd week of march. The number of larvae per plant ranged from 0.56-12.03 larvae plant^{-1} and remained active up to ending March.

Pooled data for both the years (Table 2) revealed that mean maximum temperature and relatively humidity (morning) had negative but highly significant effect on larval population with 'r' values (r = -0.545 and r = -0.631) and relative humidity morning had positive but highly significant effect on larval population with 'r' value (r = 0.622). On the other hand mean relative humidity had positive effect on larval population with 'r' value (r = 0.162) and mean rainfall had negative effect on larval population with 'r' value (r = -0.205). Regression studies for both the years revealed that weather factors had 61.00 and 48.30 per cent effect and pooled data had 45.30 per cent influenced on larval population.

The present finding are in finding are in conformity with Sharma *et al.,* (2005) who observed that weather parameters, significantly correlated and positively with the temperature (maximum) relative humidity (morning and evening) and rainfall. However, maximum and minimum temperature had negative effect on their population, as the correlates were highly significant and negative. However, the present findings are in contradiction with those of Khan and Talukder (2017) who found that the population of *P. brassicae* was positively correlated with maximum and minimum temperatures while negative correlation with maximum relative humidity and a strong negative correlation minimum relative humidity.

Efficacy of the insecticides revealed that all the treatments at 1, 3, 7 and 15 days after spray were superior to control (Table 3 and Fig. 2). The pooled data during 2014-15 and 2015-16 (First spray) revealed that there was no significant difference between the treatments one day before spray. The observations recorded on 1st day after spray revealed that all the treatments proved significantly superior over control. Fenvalerate 20 ES (10.13 larvae/ plant) was found to be most effective followed by lufenuron 5 EC (11.88 larvae/ plant), novaluron 10 EC (14.13larvae/ plant) were statistically at par with each other whereas chlorfenapyr 10 SC (15.38 larvae /plant) was found to be least effective. After 3days of application all the treatments proved significantly superior over control. Fenvalerate 20 ES (5.63 larvae/ plant) was found to be most effective treatment in reducing the larval population. The treatments viz., lufenuron 5 EC (7.63 larvae/ plant), novaluron 10 EC (9.38 larvae/ plant) were statistically at par with each other whereas chlorfenapyr10 SC (12.88 larvae /plant) was found to be least effective. The observations recorded on 7th day after spray revealed that all the treatments proved significantly superior over control.

Fenvalerate 20 ES (2.50 larvae/ plant) was found to be most effective treatment in reducing the larval population. The treatments viz., lufenuron 5 EC (4.38 larvae/ plant), novaluron 10 EC (6.38 larvae/ plant) were statistically at par with each other whereas chlorfenapyr10 SC (9.50 larvae /plant) was found to be least effective. On 15thday after spray revealed that all the treatments proved significantly superior over control. Fenvalerate 20 ES (3.00 larvae/ plant) was found to be most effective treatment in reducing the larval population. The treatments viz., lufenuron 5 EC (5.75 larvae/ plant), novaluron 10 EC (7.13 larvae/ plant) were statistically at par with each other whereas chlorfenapyr10 SC (10.50 larvae /plant) was found to be least effective.

Second spray revealed (Table 3 and Fig. 2) that there was no significant difference between the treatments one day before spray. The observations recorded on 1st day after spray revealed that all the treatments proved significantly superior over control. Fenvalerate 20 ES (5.25 larvae/ plant) was found to be most effective treatment in reducing the larval population. The treatments viz., lufenuron 5 EC (8.88 larvae/ plant), novaluron 10 EC (9.75 larvae/ plant) were statistically at par with each other whereas chlorfenapyr10 SC (12.50 larvae /plant) was found to be least effective. After 3rdday after of application, all the treatments proved significantly superior over control.

Table.1 Seasonal incidence of *P. brassicae* on cabbage (pooled)

Standard week	*Larval population / plant	Metrological Parameters				
		Temperature (^{o}C)		Relative Humidity (%)		Rainfall (mm)
		Maximum	Minimum	Morning	Evening	
43	1.33	27.10	13.00	84.00	57.50	7.20
44	1.55	26.80	12.70	89.00	64.00	1.50
45	2.12	26.10	8.40	88.00	65.00	0.40
46	2.64	24.70	7.30	88.50	45.50	0.00
47	3.36	24.80	8.10	90.00	43.50	0.00
48	3.67	24.90	6.00	91.00	44.00	0.00
49	3.53	19.80	5.40	93.00	50.00	0.00
50	3.03	12.90	5.10	95.50	73.00	14.20
51	2.91	15.80	3.30	93.50	59.50	0.00
52	2.58	19.70	4.70	91.00	49.50	0.00
1	2.52	11.80	5.80	93.50	72.00	0.90
2	3.44	14.70	6.00	86.50	54.00	0.45
3	4.27	18.80	6.50	93.00	70.50	0.80
4	5.40	17.00	4.60	95.00	64.50	0.00
5	5.56	18.80	6.00	93.00	62.00	9.15
6	5.70	21.40	6.40	87.50	47.00	1.40
7	5.74	22.60	10.30	87.00	49.50	2.90
8	5.37	22.80	12.40	87.50	60.00	31.65
9	4.51	19.50	9.70	87.00	62.00	58.30
10	3.51	20.60	9.70	86.00	57.50	14.45
11	2.59	22.60	10.10	88.50	66.00	86.70
12	1.70	29.10	13.50	82.00	49.50	0.10
13	0.61	26.10	15.50	84.10	59.80	49.80
14	0.24	25.00	15.10	79.50	53.50	56.70
15	0.68	31.40	16.80	75.45	39.60	0.80
16	0.680.12	32.10	17.80	77.00	48.00	30.00
Range	**0.12-5.74**	**11.80-32.10**	**3.30-17.80**	**75.45-95.50**	**39.6-73.00**	**0.00-86.70**
Mean	**3.03**	**22.19**	**9.24**	**87.93**	**56.42**	**14.13**
S.Em(±)	1.71	5.23	4.12	5.26	9.35	**23.56**

Table.2 Correlation coefficients and regression model between mean larval population of *P. brassicae* and abiotic factors

	X_1	X_2	X_3	X_4	X_5	Regression Model
Y1	-0.545**	-0.631**	0.622**	0.162	-0.205	$Y= -10.148 – 0.097X_1 + 0.018X_2 + 0.213X_3 - 0.064X_4 + 0.06X_5$ ($R^2 = 0.453$)

**Correlation is significant at 0.01 level
*Correlation is significant at 0.05 level

Where,

Y= Mean larval population of *P. brassicae*
X_1= Maximum temperature (°C)
X_2= Minimum temperature (°C)
X_3= Mean relative humidity morning (%)
X_4= Mean relative humidity evening (%)
X_5=Rainfall (mm)

Table.3 Efficacy of insecticides against *P. brassicae*, population on cabbage (pooled)

Treatments	Concentration (%)	Larval population of *Pieris brassicae* /plant									
		First spray					Second spray				
		1DBS	1DAS	3DAS	7DAS	15DAS	1DBS	1DAS	3DAS	7DAS	15DAS
Novaluron 10 EC	0.10%	16.50 (0.41)	14.13 (0.38)	9.38 (0.43)	6.38 (0.59)	7.13 (0.55)	15.88 (0.43)	9.75 (0.32)	5.88 (0.38)	2.50 (0.20)	3.50 (0.35)
Lufenuron 5 EC	0.006%	16.88 (0.43)	11.88 (0.55)	7.63 (0.32)	4.38 (0.43)	5.75 (0.60)	16.00 (0.35)	8.88 (0.43)	4.63 (0.13)	1.75 (0.32)	2.50 (0.74)
Fenvalerate 20 ES	0.004%	16.25 (0.25)	10.13 (0.55)	5.63 (0.83)	2.50 (0.46)	3.00 (0.55)	15.13 (0.43)	5.25 (0.32)	1.88 (0.38)	0.38 (0.24)	1.00 (0.20)
Chlorflenapyr 10 SC	0.15%	16.88 (0.38)	15.38 (0.24)	12.88 (0.72)	9.50 (1.40)	10.50 (0.84)	16.25 (0.60)	12.50 (0.20)	8.38 (0.24)	5.75 (0.14)	6.75 (0.14)
Control	-	16.25 (0.75)	16.00 (1.43)	17.00 (2.23)	18.13 (2.01)	20.75 (0.52)	16.38 (0.52)	17.75 (0.77)	18.75 (0.14)	19.00 (0.20)	18.75 (1.23)
CD ($p \leq 0.05$)	-	**NS**	**2.63**	**3.92**	**4.02**	**1.67**	**NS**	**1.47**	**0.88**	**0.70**	**1.82**
SE(m)	-	**0.44**	**0.84**	**1.26**	**1.29**	**0.54**	**0.49**	**0.47**	**0.29**	**0.23**	**0.58**

*DBS – Days before Spray,*DAS – Days after Spray, Figures in parenthesis are square √x+0.5 transformed values

Fig.1 Seasonal incidence of larval population of *P. brassicae* on Cabbage (pooled)

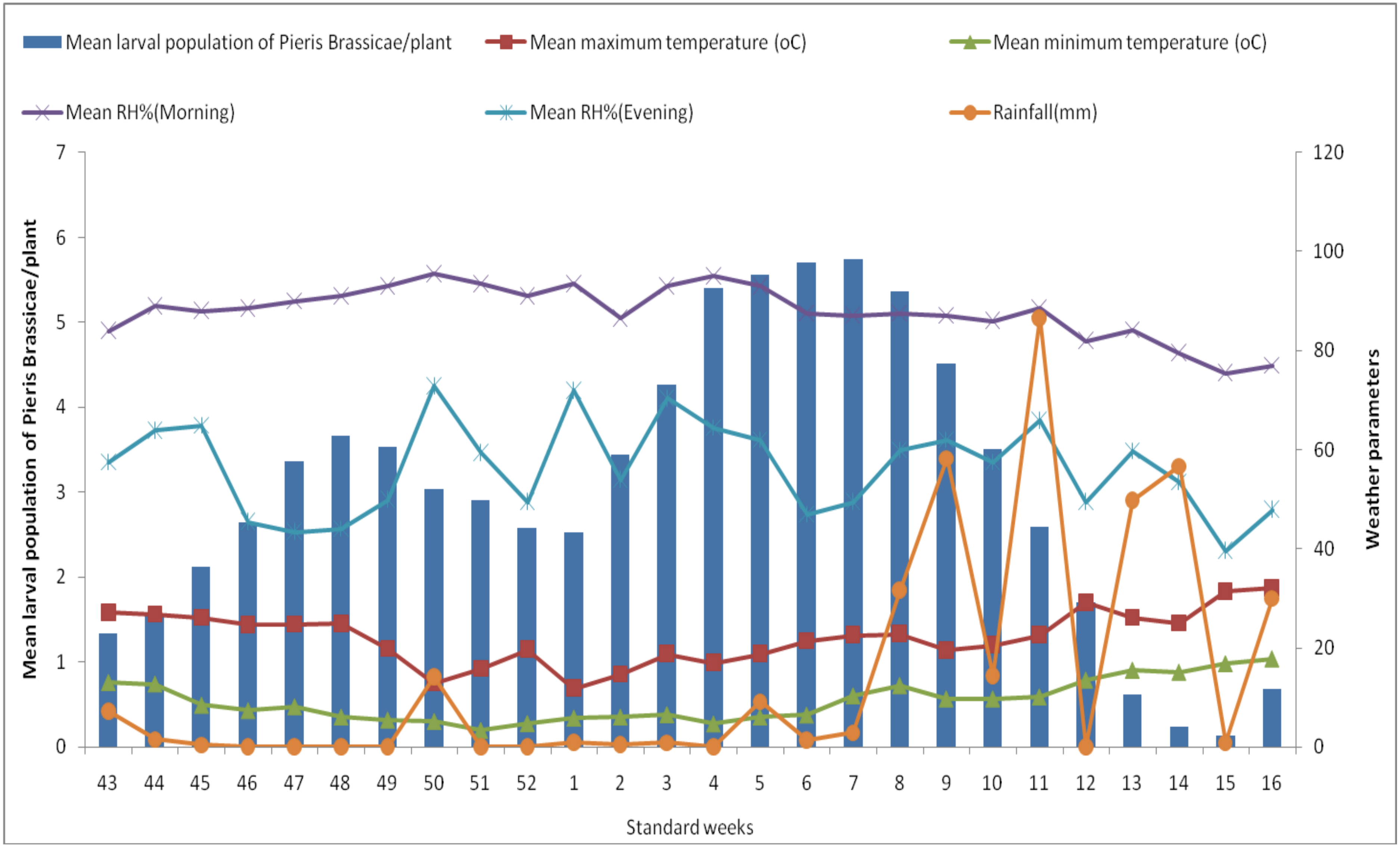
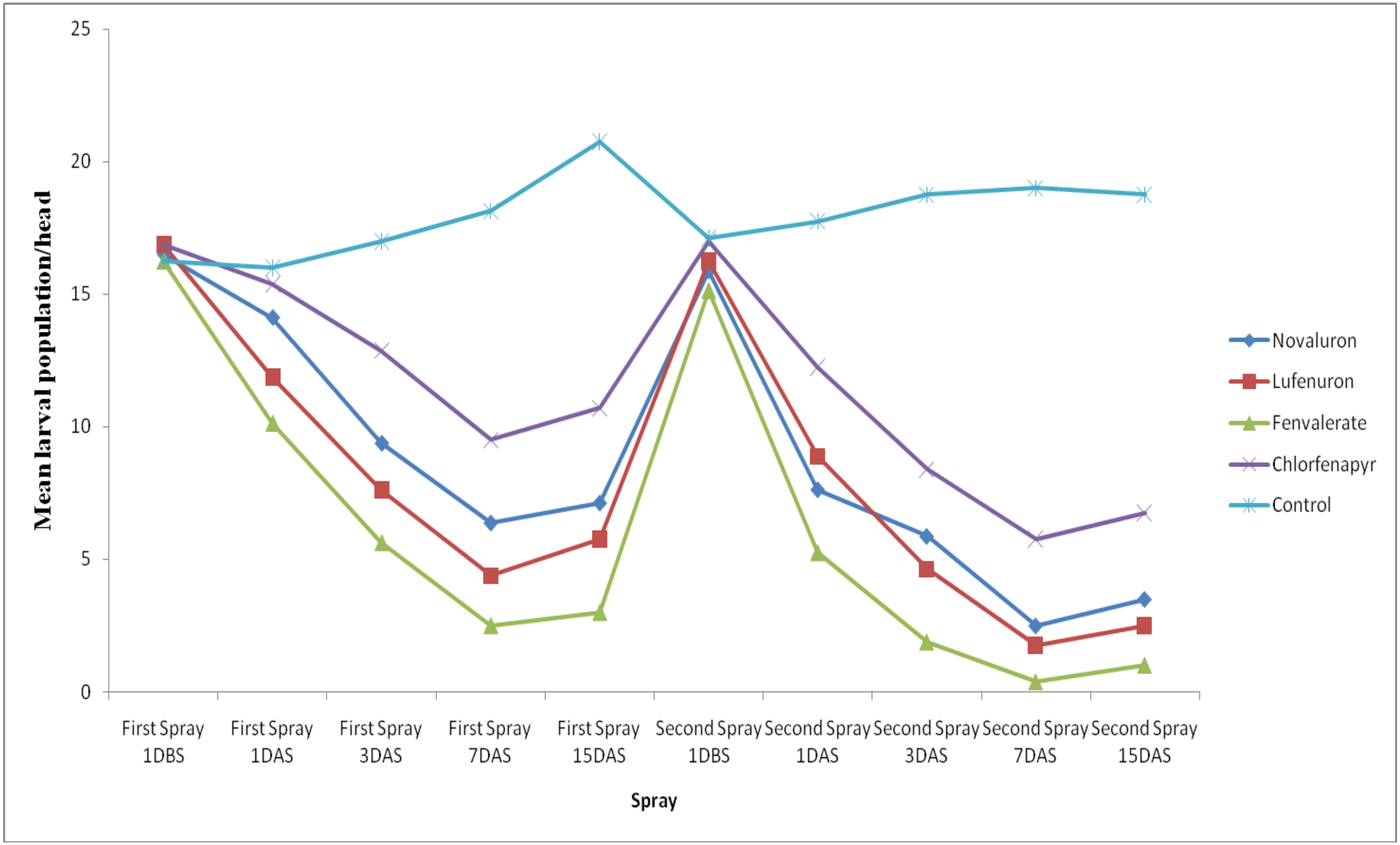


Fig.2 Efficacy of different insecticides against *P. brassicae* (pooled)



Fenvalerate 20 ES (1.88 larvae/ plant) was found to be most effective followed by lufenuron 5 EC (4.63 larvae/ plant), novaluron 10 EC (5.88 larvae/ plant) were statistically at par with each other whereas and chlorfenapyr10 SC (8.38 larvae /plant) was found to be least effective. On 7th day after spray revealed that all the treatments proved significantly superior over control. Fenvalerate 20 ES (0.38 larvae/ plant) was found to be most effective followed by lufenuron 5 EC (1.75 larvae/ plant), novaluron 10 EC (2.50 larvae/ plant) were statistically at par with each other whereas and chlorfenapyr10 SC (5.75 larvae /plant) was found to be least effective. On 15thday after spray revealed that all the treatments proved significantly superior over control. Fenvalerate 20 ES (1.00 larvae/ plant) was found to be most effective followed by lufenuron 5 EC (2.50 larvae/ plant), novaluron 10 EC (3.50 larvae/ plant) were statistically at par with each other whereas chlorfenapyr 10 SC (6.75larvae /plant) was found to be least effective. The present investigations were in agreement with those of Thakur, (1996) and Thakur and Deka, (1997a) evaluated for control of *P. brassicae* in cabbage with eleven insecticides, Overall, fenvalerate gave virtually 100% control of *P. brassicae*, followed by deltamethrin (97.3%), cypermethrin (96.8%), malathion (96.08%) and fenitrothion (93.3%). Similarly, these findings are corroborates with those of Someya *et al.,* (2007). The present results of chlorfenapyr are in line with those of Shashi Bhushan *et al.,* (2010) who reported the effectiveness of chlorfenapyr against *S. litura* Fab.

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