Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2020; 8(1): 1158-1164

Received: 10-11-2019
Accepted: 12-12-2019

KY Bhure
Department of Entomology,
N.M. College of Agriculture,
Navsari Agricultural University,
Navsari, Gujarat, India

HV Pandya
Department of Entomology,
N.M. College of Agriculture,
Navsari Agricultural University,
Navsari, Gujarat, India

BV Naikwadi
Department of Entomology,
N.M. College of Agriculture,
Navsari Agricultural University,
Navsari, Gujarat, India

Corresponding Author:
KY Bhure
Department of Entomology,
N.M. College of Agriculture,
Navsari Agricultural University,
Navsari, Gujarat, India

Relative bio-efficacy of different insecticides against major insect pests infesting cabbage under field condition

KY Bhure, HV Pandya and BV Naikwadi

Abstract
The efficacy of different insecticides against major insect pests of cabbage, out of five newer insecticides tested, imidacloprid (0.005%) was found to be the most effective against cabbage aphid, while novaluron (0.007%), emamectin benzoate (0.0015%), deltamethrin (0.00125%) and profenophos (0.05%) were significantly superior against lepidopteron leaf feeding insect pests of cabbage. Novaluron recorded the highest yield of cabbage heads (4938 kg/ha) among all the treatments followed by emamectin benzoate (4629 kg/ha), imidacloprid (4320 kg/ha), profenophos (4320 kg/ha) and deltamethrin (3703 kg/ha). However, the highest cost benefit ratio of (1:17.88) was obtained in the treatment of imidacloprid followed by profenophos, novaluron, and deltamethrin and emamectin benzoate in the order of merit.

Keywords: Bio-efficacy, cabbage, major pests, insecticide

Introduction
Cabbage (*Brassica oleracea* var. capitata Linnaeus) is most important cole crop origin from Cyprus and Mediterranean region. In addition to several minerals such as P, K, Ca and Fe, cabbage also contains high percentage of vitamin A, B and C. Due to availability of large amount of vitamin and mineral there is a good scope for hiking vegetable production to meet domestic demand to top foreign exchange in the world market. In India, cabbage grown mainly in the state of Gujarat, Uttar Pradesh, Orissa, Bihar, West Bengal, Assam, Maharashtra and Karnataka (Anon., 2010) [2]. Cabbage crop is cultivated in almost all the districts of Gujarat includes Mehsana, Kheda, Baroda, Gandhinagar, Anand, Surat and Valsad districts. In Gujarat, this crop is cultivated in about 28.2 (000" HA) area with 553.6 (000" MT) production and 19.6 MT per hectare productivity (Anon., 2010) [2].

Even if the crop has got huge domestic requirement, a number of limiting factors have been attributed for low productivity. It is attacked by the various important insect pests viz., diamond back moth, *Plutella xylostella* (Linnaeus), cabbage butterfly, *Pieris brassicae* (Linnaeus), cabbage aphid, *Brevicoryne brassicae* (Linnaeus), leaf webber, *Crocidolornia binotalis* (Zeller), cabbage cutworm, *Spodoptera litura* (Fabricius), painted bug, *Bagrada cruciferarwn* (Kirkaldy), head eating caterpillar, *Helicoverpa armigera* (Hubner) and mustard sawfly, *Athalica proxima* (Klug). Among them, the chief constraint in the production of cabbage is damage caused by pest complex right from germination till harvesting stage (Sachan and Srivastava, 1972) [9]. Among them, Cabbage aphid, diamond back moth, *P. xylostella*, Head eating caterpillar, *H. armigera*, cabbage cutworm, *S. litura* are the major insect pests of cabbage found in Gujarat.

Under south Gujarat conditions where intensive cultivation of cruciferous crops is most common practice, diamond back moth (DBM) infestation to cabbage head was reported to the peak activity found in month of January (Mala, 2006) [8]. The diamond back moth, *P. xylostella* alone is capable of reducing cabbage yield up to 100 per cent (Sachan and Srivastava, 1972) [9]. The cabbage aphid colonies are found on tender shoots and excessive desapping the cell sap of the plant from seedling stage to maturity by the large colonies of insects and infestation ranged from 30 to 100 per cent during different months of the year and also cabbage cutworm and head eating caterpillar damages leaves and heads of cabbage. Younger seedlings are the most susceptible to the attack of these insect pests. The caterpillar in initial stage mine the leaves, later on feed on the surface and bore into the heads of the cabbage.

The estimated loss of cabbage yield due to the cabbage head borer, *H. armigera* was 31.5 per cent in Gujarat (Borad *et al*., 1991) [5].

Cabbage is a highly remunerative vegetable crop and the intensive plant protection measures involving use of a number of insecticides are of most common practices. In spite of large scale and repeated applications of insecticides, the pest has been found to occur in severe form in all cabbage growing areas of Gujarat. Hence ecological studies which are basic in understanding the causes for high population of the pest and identification of long term control measures are of great importance. Seasonal abundance is one of the most important tools in pest management as they reveal the most opportune periods and vulnerable stages of the insect species. Thus, seasonal abundance studies enable us to devise an intelligent and practical manipulation of control factors for sound pest management strategy.

The management of major cabbage insect pests by using different insecticides has provided an effective but short term remedy. The major limitations of this method are high cost of cash inputs and insecticidal hazards. On the other hand, control of cabbage insect pests is difficult due to its fast development rate and high reproductive potential. To achieve satisfactory control of this noxious and destructive pest, testing and evaluation of newer insecticides is quite necessary. Efforts were therefore, made in the present investigation to evaluate the bio-efficacy of some newly developed insecticides from different groups for the control of cabbage insect pests.

Materials and Methods

Layout: The field experiments was conducted at College farm, N.M. College of Agriculture, N.A.U, Navsari during the winter season of 2012-13 for relative bio-efficacy of some insecticides against major pests infesting cabbage. Cabbage (Cultivar : Golden Acre) was raised in the plots size of 3.6 x 4.5 m^2 with the spacing of 60 x 45 cm following recommended package of practices.

Treatments: The field experiments were laid out in randomized block design (RBD) consisting of six treatments including control. By using different insecticides the treatments including Novaluron 10 EC @ 0.007%, Imidacloprid 17.8 SL @ 0.005%, Emamectin benzoate 5 WSG @ 0.0015%, Profenophos 50 EC @ 0.05%, Deltamethrin 2.8 EC @ 0.00125% and Control (Water spray). Insecticides were applied with pneumatic knapsack sprayer using spray volume @ 500 litres/ha with four replication. Each treatment schedule comprised single sprays, except treatment No. 6 which was taken as untreated control.

Observations: The incidences of major insect pests of cabbage, weekly observations were recorded throughout the crop season. Pre-treatment observations were recorded one day prior to insecticide application. Post treatment observations were recorded at 1, 3, 5, 7 and 10 days after each spray. For this purpose, ten plants per plot were selected randomly. For recording observations on different insect pests of cabbage aphid the number of nymphs and adults of aphid was recorded from 3 leaves of cabbage plant at 1, 3, 5, 7 and 10 days after spray from 10 randomly selected tagged plant. The larval population count of Diamond back moth, Cabbage cutworm and Cabbage head eating caterpillar was recorded from randomly selected 10 plants at 1, 3, 5, 7 and 10 days after spray to determine relative bio-efficacy of insecticides. Healthy and damaged cabbage (weight and number basis) were recorded separately from each replicated plot at the time of picking for calculation of yield. The net plot yield was converted into kg ha-1 for analysis and comparison.

Data analysis: The population count of sucking pests and larval population count for lepidopteron pests recorded at before treatment application and 1,3,5,7 and 10 days after application of treatment was subjected to square root (x+0.5) and square root transformations before analyzing and data subjected to analysis of variance in randomised block design.

Results

Various insecticides were tested under field condition for determining their bio-efficacy against major insect pests infesting cabbage in Rabi season during November 2012 to March 2013. The treatments were evaluated on the basis of larval population and yield of healthy cabbage.

Sucking pests

Aphid, *Brevicoryne brassicae* (Linn): Aphid, *B. brassicae* incidence recorded before the application of insecticidal treatments indicated non-significant difference suggesting uniform spread of the pest in all the experimental plots. Observations recorded at 1st day after spraying indicated that lowest (12.32 aphids/three leaves) population of aphid was found in plots treated with imidacloprid which was followed by deltamethrin (14.00 aphids/three leaves). While, treatment of novaluron recorded 16.00 aphids/three leaves followed by emamectin benzoate (17.25 aphids/three leaves) and profenophos (18.75 aphids/three leaves) which remained middle in order. However, control recorded highest population of aphids (21.47 aphids/ three leaves). The data at 3rd day after spraying recorded indicated that minimum aphid (9.75 aphids/three leaves) count was recorded in imidacloprid which was at par with deltamethrin (10.02 aphids/ three leaves). The data at 3rd With respect to aphid incidence, the treatment of novaluron recorded 12.57 aphids/three leaves followed by emamectin benzoate and profenophos which exhibited 14.00 and 17.30 aphids/ three leaves, respectively. The higher numbers of aphids were found in control (24.50 aphids/three leaves). More or less similar trend of treatment was noticed even at 5th day after spraying.

The data presented at 7th day after spraying, imidacloprid (6.35 aphids/three leaves) recorded lower number of aphid, followed by deltamethrin (7.25 aphids/ three leaves). The next effective treatment was novaluron (10.62 aphids/three leaves) which was also at par with emamectin benzoate (11.17 aphids/three leaves). Profenophos (14.23 aphids/three leaves) found middle in order. More or less similar trend of treatment was noticed even at 10th day after spraying. Pooled data over periods (Table 1 and Fig. 1) indicated that the treatment differences were significant. Pooled data pertaining to the aphid population recorded at different intervals revealed that minimum aphid count (8.31 aphids/ three leaves) were recorded in the plots treated with imidacloprid and deltamethrin (9.37 aphids/three leaves). These two treatments registered significantly less population of the pest in comparison to other treatments evaluated. Novaluron, emamectin benzoate and profenophos (12.17, 13.12 and 15.95 aphids/ three leaves, respectively) were moderately effective treatments against aphids on cabbage. From efficacy point of view, the treatment of profenophos (15.95 aphids/three

leaves) was less effective against the pest (Table 1).

Larval Population

Cabbage head eating caterpillar, *Helicoverpa armigera* Hub: The differences in larval population of cabbage head eating caterpillar recorded before spraying was found to be non-significant among different treatments, which indicated that the infestation of *H. armigera* was homogenous. The perusal of data (Table-2) recorded on first day after spraying indicated that deltamethrin (2.99 larvae/plant) was found to be the highly effective treatment and was at par with profenophos (3.47 larvae/plant). While, treatment of emamectin benzoate recorded 3.86 larvae/plant which was at par with novaluron (4.16 larvae/plant). The higher number of cabbage head eating caterpillar was recorded in control (5.42 larvae/plant). Cabbage head eating caterpillar population recorded at 3rd day after spraying revealed that its minimum (2.84 larvae/plant) numbers were found in plots sprayed with deltamethrin which was at par with profenophos (3.17 larvae/plant). While, treatment of emamectin benzoate recorded 3.35 larvae/ plant which was at par with treatment of novaluron (3.55 larvae/plant) followed by imidacloprid (3.72 larvae/plant). The higher number of cabbage head eating caterpillar was recorded in control (5.14 larvae/plant). More or less similar trend of treatment was noticed even at 5th day after spraying (Table 2).

The data presented at 7th day after spraying deltamethrin (2.51 larvae/plant) recorded lower number of larvae which was followed by profenophos (2.80 larvae/ plant). The next effective treatments were emamectin benzoate which recorded 2.93 larvae/plant and followed by novaluron (3.08 larvae/plant) followed by imidacloprid (3.13 larvae/plant). More or less similar trend of treatment effect was observed when the observations were recorded at 10 days after spraying (DAS). Pooled data over periods (Table-2 and Fig-2) indicated that all the treatments were significantly superior over control. However, lower numbers of larvae were observed in deltamethrin (2.91 larvae/plant) which was at par with profenophos (3.24 larvae/ plant). The next effective treatments were emamectin benzoate, novaluron and imidacloprid (3.44, 3.63 and 3.76 larvae/plant) and proved mediocre in their effectiveness against *H. armigera* infesting cabbage (Table 2).

Cabbage cut worm, *Spodoptera litura* Fab: The difference in larval population of *S. litura* recorded before spraying was found to be non-significant among different treatments, which indicated that the population of *S. litura* was homogenous. Observations recorded at 1st day after spraying indicated that lowest (4.16 larvae/plant) larval population of cabbage cutworm was found in plots treated with deltamethrin followed by profenophos (4.66 larvae/plant), while treatment of emamectin benzoate recorded 5.06 larvae/plant which was at par with treatment of novaluron (5.36 larvae/plant) followed by imidacloprid (5.68 larvae/plant) remained middle in order. The data recorded at 3rd days after spraying indicated that minimum (3.35 larvae/plant) larval counts were recorded in deltamethrin which was at par with profenophos (3.84 larvae/ plant). With respect to cabbage cutworm incidence, the treatment of emamectin benzoate recorded 4.26 larvae/plant which was at par with novaluron (4.57 larvae/plant) and followed by imidacloprid (4.92 larvae/plant). More or less similar trend of treatment was noticed even at 5th day after spraying (Table 3).

The data presented at 7th day after spraying, deltamethrin (2.96 larvae/plant) recorded lower number of larvae followed by profenophos (3.28 larvae/plant). The next effective treatment was emamectin benzoate with 3.49 larvae/ plant which was at par with novaluron (3.68 larvae/plant) followed by imidacloprid (3.84 larvae/plant). Maximum number of larvae was found in control (5.06 larvae/plant). More or less similar trend of treatment was noticed even at 10th day after spraying (Table 3). Pooled data (Table-3 and Fig-3) pertaining to the larval population recorded at different intervals revealed that minimum larval counts (3.56 larvae/plant) were recorded in the plots treated with deltamethrin followed by profenophos (3.99 larvae/plant). These two treatments registered significantly less larval population of the pest in comparison to other treatments evaluated. Emamectin benzoate, novaluron and imidacloprid (4.30, 4.56 and 4.81 larvae/ plant, respectively) were next in order of their effectiveness and categorized as moderately effective treatments against cabbage cutworm on cabbage. From efficacy point of view, the treatment of imidacloprid (4.81 larvae/ plant) was less effective against the pest.

Diamond back moth, *Plutella xylostella* Linn.: The differences in population of diamond back moth, *P. xylostella* recorded before spraying was found to be non- significant among different treatments which indicated that the infestation of diamond back moth was homogenous.

The data on diamond back moth at 1st day after spraying indicated that the lowest mean larval population was recorded in novaluron (4.97 larvae/plant) and it was at par with emamectin benzoate (5.35 larvae/plant) followed by profenophos which recorded 6.98 larvae/plant however, it was at par with deltamethrin and imidacloprid (7.01 and 7.17 larvae/plant, respectively). The maximum larval population was recorded in control (7.88 larvae/ plant), respectively. The data recorded in Table 4 at, 3rd day after spraying indicated that novaluron recorded the lowest mean larval population of diamond back moth (3.85 larvae/plant) and it was at par with emamectin benzoate (4.10 larvae/plant). The next effective treatment was profenophos (6.08 larvae/plant) however, it was at par with deltamethrin and imidacloprid (6.32 and 6.50 larvae/plant, respectively). More or less similar trend of treatment was noticed even at 5th days after spraying.

The recorded data revealed that at 7th day after spraying, novaluron (3.14 larvae/plant) recorded lowest mean larval population of diamond back moth which was at par with emamectin benzoate (3.27 larvae/plant). The next effective treatment was profenophos which recorded 5.26 larvae/plant followed by deltamethrin and imidacloprid (5.77 and 6.35 larvae/plant, respectively). More or less similar trend of treatment was observed when the observations were repeated at 10 DAS. Pooled data over periods (Table 4 and Fig. 4) indicated that the treatment differences were significant. However, the minimum number of diamond back moth larvae was recorded in novaluron (3.60 larvae/plant) but was at par with emamectin benzoate (3.82 larvae/plant), and were significantly superior over rest of treatments. The next effective treatment was profenophos (5.71 larvae/plant) followed by treatment deltamethrin and imidacloprid (6.09 and 6.48 larvae/plant, respectively).

Discussion

Sucking pests

Aphid, *Brevicoryne brassicae* (Linn.): The superiority of imidacloprid against cabbage aphid was revealed in present study. In past, Borad *et al.* (1991) [5] found that deltamethrin 0.0015 per cent was effective in reducing the aphid population on cabbage up to one week of application. Aslam and Ahmad (2002)[3] reported that the imidacloprid 200 SL @ 100 ml ha^{-1} gave significantly better (94% mortality) control of *B. brassicae* after three days of application. Akbar et al. (2010)[1] reported that imidacloprid 25 WP @ 80 grams/ acres showed highest effectiveness followed by profenophos 50 EC after different hours of spraying.

Larval populations

Cabbage head eating caterpillar, *Helicoverpa armigera* Hub: The higher number of cabbage head eating caterpillar was recorded in control (4.96 larvae/ plant). In past, insecticide deltamethrin 0.0015 per cent proved effective and significantly reduced the damage done by *H. armigera* (Borad *et al.* (1991) [5]. Govindan *et al.* (2012) [7] reported that the treatment of emamectin benzoate 5 SG at 11 and 13 g a.i. ha^{-1} against *H. armigera* was highly effective with 10.7 and 10.2 per cent reduction, respectively.

Cabbage cut worm, *Spodoptera litura* Fab: In past, the treatment of combination product (triazophos 35% EC + deltamethrin 1%) @ 400 to 800 mg/ liter gave hundred per cent mortality of *S. litura* under field condition (Divakar and Sujith, 1999) [6]. As per report of Sreekanth *et al.* (2000) [10], profenophos @ 0.05 per cent and deltamethrin @ 0.075 per cent against *S. litura* on cabbage proved their superiority by imparting 100 and 93.33 per cent mortality, respectively. Novaluron 10 EC showed lowest incidence of *S. litura* during Rabi season (Bhushan *et al*., 2010) [4].

Diamond back moth, *Plutella xylostella* Linn: In past, Suganya *et al.* (2005) [11] conducted a field trial against *P. xylostella* and found that emamectin benzoate (Proclaim 5 SG) at 10 g a.i. /ha and 8.75 g a.i. /ha were found more effective against *P. xylostella*. Similarly, Wavare *et al.* (2008) [12] studied efficacy of novaluron 10 EC against *P. xylostella* and reported that higher concentration of novaluron 0.01 per cent recorded larval mortality ranging between 72.00 to 100.00 per cent.

Table 1: Effect of different insecticides on the mean population of *B. brassicae* on cabbage during 2012-13 at Navsari.

Treatments	Before spray	Aphids per three leaf after spraying					Pooled data
		1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	
Novaluron 10 EC	20.37 (4.46) *	15.99 (3.96)abc	12.57 (3.51)bc	11.80 (3.41)bcd	10.62 (3.24)bcd	9.87 (3.11)bcd	12.17 (3.46)bcd
Imidacloprid 17.8 SL	25.12 (4.92)	12.32 (3.48)c	9.75 (3.09)c	7.22 (2.63)d	6.35 (2.46)d	5.92 (2.36)d	8.31 (2.84)d
Emamectin benzoate 5	19.75 (4.44)	17.25 (4.14)abc	14.00 (3.73)bc	12.62 (3.54)bc	11.17 (3.34)bc	10.55 (3.24)bc	13.12 (3.61)bc
Profenophos 50 EC	21.80 (4.60)	18.75 (4.28)ab	17.30 (4.11)b	15.80 (3.92)b	14.22 (3.68)b	13.67 (3.61)b	15.95 (3.93)b
Deltamethrin 2.8 EC	23.00 (4.76)	14.00 (3.72)bc	10.02 (3.12)c	8.65 (2.89)cd	7.25 (2.63)cd	6.95 (2.57)cd	9.37 (3.02)cd
Control (Water spray)	18.00 (4.22)	21.47 (4.60)a	24.50 (4.89)a	25.02 (4.95)a	26.00 (5.05)a	26.62 (5.11)a	24.72 (4.93)a
C.D. at 5%	NS	0.68	0.67	0.79	0.86	0.88	0.74
C.V. %	12.48	11.06	12.04	14.75	16.69	17.33	13.41

* Figures in parenthesis are square root transformed values
NS- Non significant. DAS = Days after spraying

Table 2: Effect of different insecticides on the larval population of *H. armigera* on cabbage during 2012-13 at Navsari

Treatments	Before spray	Aphids per three leaf after spraying					Pooled data
		1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	
Novaluron 10 EC	6.35 (2.48)	4.16 (2.01)bc	3.55 (1.86)b	3.45 (1.84)	3.08 (1.74)	3.91 (1.96)	3.63 (1.89)b
Imidacloprid 17.8 SL	5.17 2.25)	4.49 (2.09)b	3.72 (1.90)b	3.52 (1.86)	3.13 (1.76)	3.97 (1.98)	3.76 (1.92)b
Emamectin benzoate 5	5.77 (2.39)	3.86 (1.93)bc	3.35 (1.81)b	3.30 (1.80)	2.93 (1.70)	3.75 (1.92)	3.44 (1.84)b
Profenophos 50 EC	5.36 (2.26)	3.47 (1.83)cd	3.17 (1.77)b	3.18 (1.77)	2.80 (1.66)	3.61 (1.89)	3.24 (1.79)b
Deltamethrin 2.8 EC	5.30 (2.24)	2.99 (1.71)d	2.84 (1.67)b	2.91 (1.69)	2.51 (1.55)	3.32 (1.80)	2.91 (1.69)b
Control (Water spray)	5.60 (2.34)	5.42 (2.30)a	5.14 (2.22)a	4.60 (2.09)	4.86 (2.17)	4.79 (2.14)	4.96 (2.19)a
C.D. at 5%	NS	0.17	0.24	NS	NS	NS	0.26
C.V. %	15.32	5.44	8.68	11.37	14.44	9.25	9.12

Table 3: Effect of different insecticides on the larval population of *S. litura* on cabbage during 2012-13 at Navsari

Treatments	Before spray	Aphids per three leaf after spraying					Pooled data
		1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	
Novaluron 10 EC	7.48 (2.69)	5.36 (2.29)b	4.57 (2.10)bc	4.22 (2.02)b	3.68 (1.89)b	4.97 (2.21)	4.56 (2.11)bc
Imidacloprid 17.8 SL	6.39 (2.50)	5.68 (2.36)b	4.92 (2.19)b	4.53 (2.10)b	3.84 (1.93)b	5.08 (2.23)	4.81 (2.17)b
Emamectin benzoate 5	6.95 (2.63)	5.06 (2.22)bc	4.26 (2.03)cd	3.92 (1.94)bc	3.49 (1.85)b	4.80 (2.17)	4.30 (2.05)bc
Profenophos 50 EC	6.52 (2.50)	4.66 (2.13)cd	3.84 (1.93)de	3.53 (1.84)cd	3.28 (1.79)b	4.61 (2.13)	3.99 (1.97)cd
Deltamethrin 2.8 EC	6.49 (2.49)	4.16 (2.02)d	3.35 (1.80)e	3.05 (1.72)d	2.96 (1.70)b	4.29 (2.06)	3.56 (1.87)d
Control (Water spray)	6.79 (2.58)	6.57 (2.54)a	6.58 (2.54)a	6.66 (2.56)a	5.09 (2.21)a	5.97 (2.40)	6.17 (2.45)a
C.D. at 5%	NS	0.13	0.15	0.17	0.24	NS	0.16
C.V. %	13.54	4.02	4.89	5.50	8.45	6.65	5.16

Table 4: Effect of different insecticides on the larval population of *P. xylostella* on cabbage during 2012-13 at Navsari

Treatments	Before spray	Aphids per three leaf after spraying					Pooled data
		1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	
Novaluron 10 EC	9.23 (3.01)	4.97 (2.17)c	3.85 (1.91)b	2.84 (1.66)c	3.14 (1.75)c	3.20 (1.77)c	3.60 (1.86)c
Imidacloprid 17.8 SL	7.93 (2.80)	7.17 (2.65)a	6.50 (2.51)a	5.97 (2.41)ab	6.35 (2.49)ab	6.42 (2.50)ab	6.48 (2.51)ab
Emamectin benzoate 5	8.77 (2.95)	5.35 (2.26)bc	4.10 (2.01)b	3.07 (1.73)c	3.27 (1.79)c	3.31 (1.80)c	3.82 (1.93)c
Profenophos 50 EC	8.31 (2.85)	6.98 (2.61)ab	6.08 (2.45)a	4.92 (2.20)b	5.26 (2.28)b	5.32 (2.29)b	5.71 (2.37)b
Deltamethrin 2.8 EC	7.27 (2.62)	7.01 (2.58)ab	6.32 (2.47)a	5.57 (2.33)b	5.77 (2.38)b	5.80 (2.38)b	6.09 (2.43)b
Control (Water spray)	8.02 (2.79)	7.87 (2.77)a	8.30 (2.83)a	8.25 (2.82)a	8.32 (2.84)a	8.38 (2.85)a	8.22 (2.82)a
C.D. at 5%	NS	0.39	0.42	0.42	0.39	0.39	0.38
C.V. %	12.95	10.50	11.76	12.86	11.53	11.52	10.87

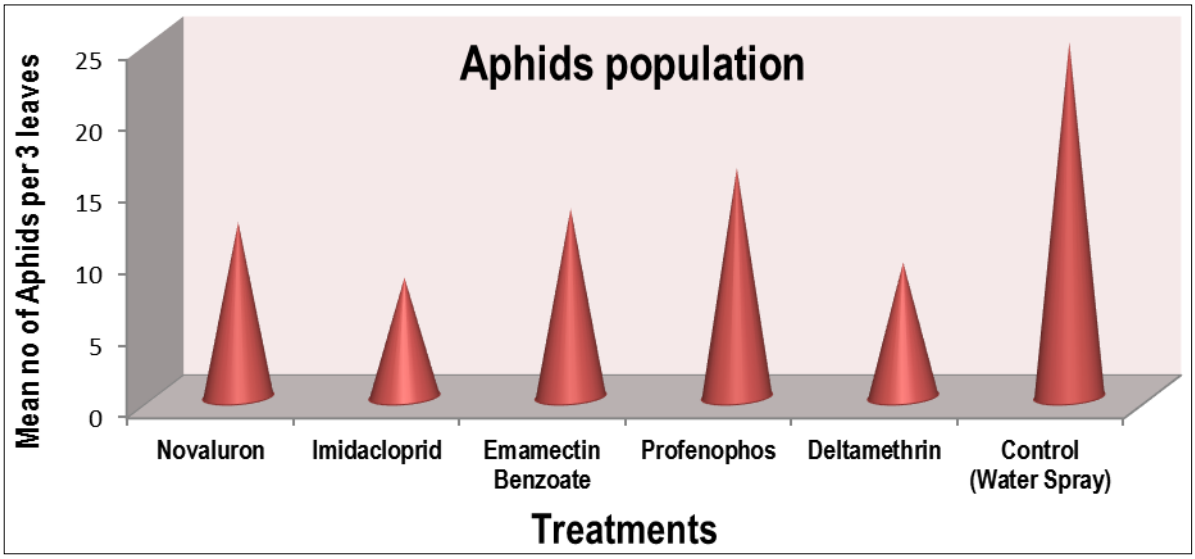

Fig 1: Effect of different insecticides on the mean population of aphid on cabbage during 2012- 13 at Navsari (pooled data)

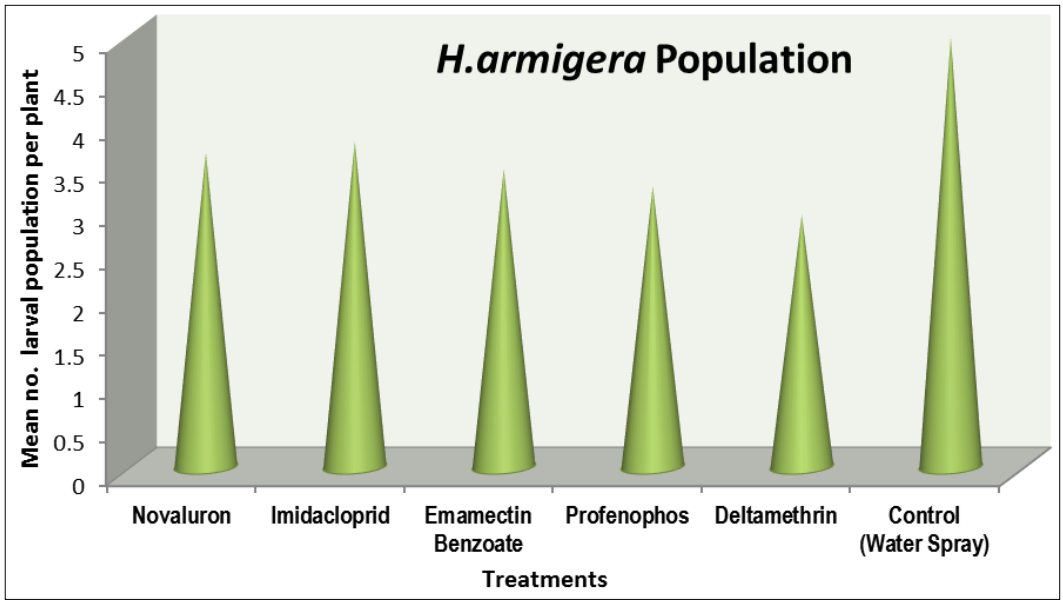

Fig 2: Effect of different insecticides on the mean larval population of *H.armigera* on cabbage during 2012- 13 at Navsari (pooled data)

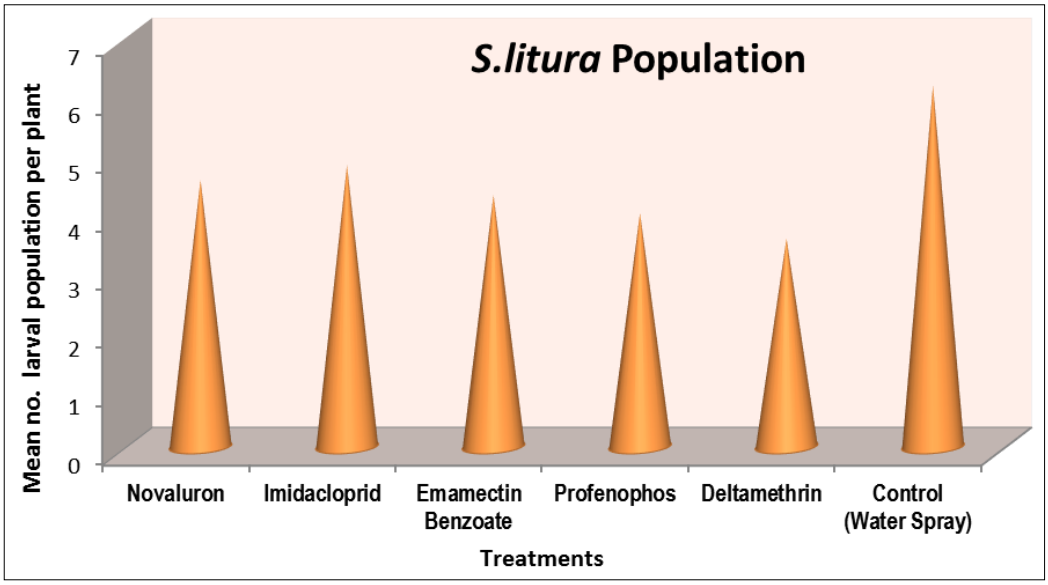

Fig 3: Effect of different insecticides on the mean larval population of *S.litura* on cabbage during 2012- 13 at Navsari (pooled data)

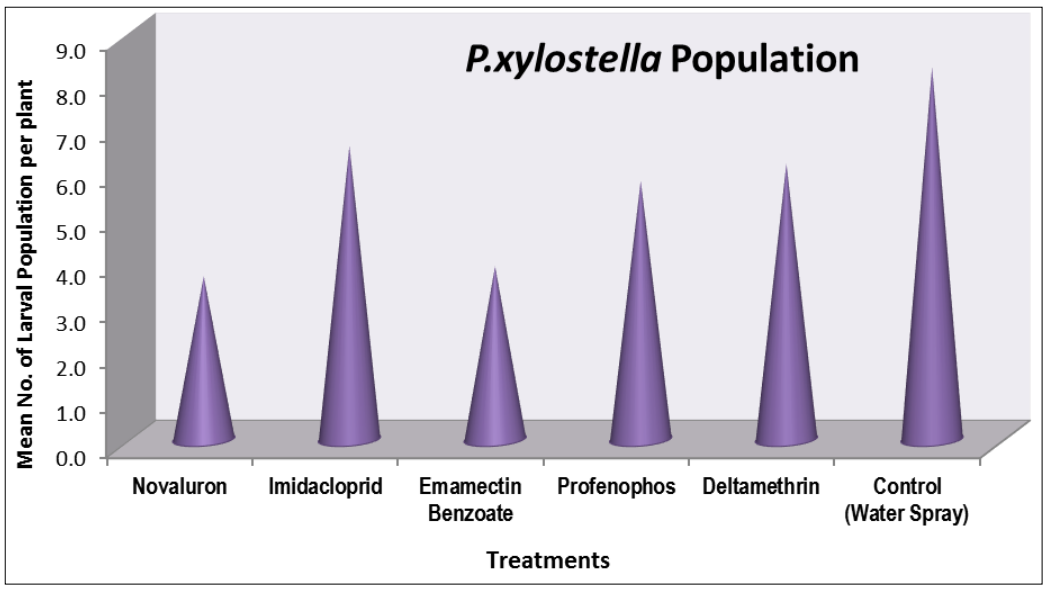

Fig 4: Effect of different insecticides on the mean larval population of *P. xylostella* on cabbage during 2012- 13 at Navsari (pooled data)

Conclusion

Our study showed that among the selected insecticide imidacloprid found to effective against sucking pests whereas, novaluron and emamectin benzoate was found effective against the lepidopteron pests of cabbage. Treatments Novaluron recorded the highest yield of cabbage heads, maximum gross realization as well as emerged most economical recording highest yield and ICBR. The information collected in this study is useful in insect pest management.

Acknowledgment

The authors are grateful to Hon'ble Chairman Dr. H. V. Pandya, Associate Professor, Navsari Agricultural University, Navsari, for his constant inspiration, valuable guidance, helpful suggestions, constructive criticism, and kind advise right selection of research work. I express my hearty sincere gratitude to the authors are grateful to the Honorable Vice Chancellor and Director of Research and Dean Faculty of Post Graduate Studies, Navsari Agricultural University, Navsari and Dean, N.M. College of Agriculture, NAU, Navsari for providing necessary facilities for conducting research work.

References:

1. Akbar MF, Haq MA, Parveen P, Yasmin N, Khan MFU. Comparative management of cabbage aphid (*Myzus persicae* (Sulzer) (Aphididae: Hemiptera) through bio- and synthetic-insecticides. Pak. Entomol. 2010; 32(1):12-17.
2. Anonymous. Indian Horticulture Data Base, 2011-2010, 138-155.
3. Aslam M, Ahmad M. Effectiveness of some insecticides against cabbage aphid, *Brevicoryne brassicae* (Linnaeus) (Aphididae: Homoptera). J. Res. Sci. 2002; 13(2):145-150.
4. Bhushan VS, Babu VR, Reddy KD, Umamaheswari T. Efficacy of certain insecticides against *Spodoptera litura* (Fab.) on potato. Karnataka J. Agric. Sci., 2010; 23(1):195-196. (Fide: A.A.U. CAB abstracts-2000-2013, ovidsp. tx. ovid. com).
5. Borad PK, Patel JR, Ratanpara HC, Shah BR. Evaluation of some insecticides for the relative efficacy against *Lipaphis erysimi* Kalt. and *Helicoverpa armigera* Hubner on cabbage. Indian Jounal Plant Protection, 1991; 19(2):191-193. (Fide: A.A.U. CAB abstracts-1990-2010, ovidsp. tx. ovid. com).
6. Divakar BJ, Sujith SK. Efficacy of a combination product (triazophos 35% EC and deltamethrin 1%) on tobacco caterpillar *Spodoptera litura* (Fab). Insect Environ. 1999; 5(1):18-19. (Fide: A.A.U. CAB abstracts-1990-2010, ovidsp. tx. ovid. com).
7. Govindan K, Gunasekaran K, Kuttalam S. Field Evaluation of Emamectin Benzoate 5 SG against Okra Fruit Borers. Madras Agric. J. 2012; 99(7-9):597-600.
8. Mala RK. Studies on biology, population dynamics and chemical control of Diamodback moth, *Plutella xylostella* Linnaneus on cabbage. Thesis submitted to the Navsari Agricultural University, Navsari, 2006, 1-80.
9. Sachan JN, Srivastava BP. Studies on the seasonal incidence of insect pest of cabbage. Indian Journal of Entomology. 1972; 34(2):123-129.
10. Sreekanth M, Babu TR, Sultan MA, Rao BN. Evaluation of certain new insecticides against lepidopteran pests of cabbage. Int. Pest Control. 2000; 42(4):134-137.
11. Suganya KS, Chandra Sekaran S, Regupapathy A, Lavanya D. Emamectin 5 SG (Proclaim) - A newer insecticide for diamondback moth *Plutella xylostella* (L.) management in cabbage. Pestology. 2005; 29(3):24-27.
12. Wavare SS, Patil RS, Jalgaonkar VN. Evaluation of novaluron (Rimon 10 EC) against diamond back moth, *Plutella xylostella* (Linnaueus). Pestology, 2008; 32(4):38-40.