Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2021; 9(6): 184-189

Received: 13-09-2021
Accepted: 15-10-2021

Swati Kharayat
Department of Animal Sciences Central University of Himachal Pradesh, Dharamashala, Himachal Pradesh, India

Usha Kumari
Department of Animal Sciences Central University of Himachal Pradesh, Dharamashala, Himachal Pradesh, India

Corresponding Author:
Swati Kharayat
Department of Animal Sciences Central University of Himachal Pradesh, Dharamashala, Himachal Pradesh, India

Studies on different pests infesting cabbage and their management from two districts of Himachal Pradesh

Swati Kharayat and Usha Kumari

Abstract
In Himachal Pradesh, cabbage productivity is about 32.77 MT/HA. Decrease in productivity mainly occurs due to pest infestation. A survey was conducted in cabbage cultivating areas of Kangra and Kullu districts of Himachal Pradesh during March-May, 2019. The main objective was to identify the pests and the management practices prevalent in these areas. *Brevicoryne brassicae*, *Pieris brassicae*, *Plutella xylostella* and *Trichoplusia ni* were observed to cause great damage to cabbage in Himachal Pradesh. *P. brassicae* was reported by 40% of the farmers as major pest in Kangra valley whereas 43% of the farmers from Kullu valley reported *P. xylostella* as serious pest. It was observed that around 60% of the farmers relied on chemical control for pest management. However, other pest management practices like use of pheromone traps, predators, botanicals and microorganisms were also prevalent. But the percentage of farmers using these practices was very low in both the districts.

Keywords: cabbage pests, insecticides, pest management, botanicals

1. Introduction
Cabbage (*Brassica oleracea* var. *capitata*) belonging to family Cruciferae is a cole crop which grows under cold climatic conditions. Cultivation of crop commences from October and usually ends in March. The crop is also grown as an off-season vegetable in the later months thus, accounting for higher market value.

In India, area and production of cabbage and other *Brassica* vegetables is 0.39 million hectares and 8.80 million tonnes respectively (FAO, 2017) [1]. In Himachal Pradesh cabbage is mainly grown in an area of 4.99 ('000 hectare) with a production of 163.37 ('000MT) giving productivity of 32.77 MT/HA (Anonymous, 2017) [2].

Cabbage is attacked by almost 42 different species of insects in various parts of world (Bonnemaison, 1965) [3]. Pests of cabbage include cutworms, cabbage semilooper, diamondback moth, head borer, leaf webber, cabbage butterfly and cabbage aphid. They decrease overall yield and market value of cabbage. Maximum pest infestation occurs during the vegetative stage. To reduce loses occurring due to pest's infestation various cultural, mechanical and chemical methods have been used. Cultural control involves measures to be taken during pre-sowing, transplanting/seed sowing stage, vegetative and head stage. Mechanical control involves killing the insects or preventing their damage to crop by handpicking of eggs, use of sticky traps and pheromone trap.

Chemical control involves use of insecticides to control pest population. It is being predominantly used due to its effectiveness, complete suppression of pest and early results. Insecticide formulation varies with the target pest. Insecticides with active ingredients such as chlorpyrifos, profenofos, cypermethrin are used against cabbage butterfly; imidacloprid against cabbage aphid; malathion, eldrin and indoxocarb against diamondback moth; emamectin benzoate against cabbage semilooper. Different active ingredients are used in alternation so as to prevent development of resistance in diamondback moth (Riley and Sparks, 2017) [4]. An increased use of broad spectrum insecticides has lead to resistance in insects leading to incidences of pest resurgence and secondary pest outbreak due to effect on non-target insects.

Ongley in 1996 stated that chemical pesticides tend to persist in soil surface, water bodies as well as in ground water for long period thus imposing serious health threats for humans [5]. So, in order to increase the yield and decrease the harmful effects an integrated approach called as Integrated Pest Management is used.

This approach utilizes all the suitable techniques and methods in a compatible manner to maintain the pest population at levels below those causing economic injury. It is a combination of cultural, mechanical and biological methods of control with chemical control to be used only as the last option.

Keeping in view the importance of this study it was considered desirable to identify various pests of cabbage and the management practices that were being used by the farmers in Kangra and Kullu districts of Himachal Pradesh.

2. Materials and Methods

The present investigations were conducted in two districts, Kangra and Kullu of Himachal Pradesh. The studies were conducted from March to May, 2019.

2.1 Study area

In Kangra, Kot Kawal village (latitude 32.1273˚ N and longitude of 76.2798˚ E) was selected as survey site. It is located at 676 meters above sea level. The climate of the area is semi-tropical. The average rainfall is 25 cm and the average annual temperature is 21.8˚C.

In Kullu, the study was conducted in Seobagh (latitude of 31.9955˚N and longitude of 77.1399˚E), Manikaran (latitude of 32.0268˚ N and longitude of 77.3511˚ E) and Naggar (latitude 32.1140˚N and longitude of 77.1643˚E). Seobagh and Manikaran are located at 1,189 meters above sea level while, Naggar is located at 1,800 meters above sea level. The climate of the area is temperate. The average rainfall is 80 cm and the average temperature is 15.1˚C.

2.2 Survey Method

A questionnaire based study was conducted in the selected areas of two districts. From each site, 20 farmers were selected to answer the questionnaire, thus, giving a total of 80 farmers. All the farmers were interviewed for 15-20 minutes. The interview was conducted in Hindi as well as in local language. The information collected constituted of name, age of farmer, and their experience in farming. It also involved information regarding total production of cabbage, total area under cultivation of vegetables and also that of cabbage. Farmers were questioned on the knowledge of pests; production loses incurring due to pest infestation; management strategies that were being used in order to control the pest population; insecticides being used; pattern of insecticides usage and its frequency, and their source of information regarding pest management strategies.

3. Results and Discussion

The results of the study can be categorized under the headings as:

3.1 Pests of cabbage, their incidence and infestation level

Farmers interviewed had knowledge about the pests that were prevalent. Most prominent pests observed and reported in all the sites included cabbage aphid (*Brevicoryne brassicae*), cabbage butterfly (*Pieris brassicae*), diamondback moth (*Plutella xylostella),* and cabbage semilooper (*Trichoplusia ni*) (Plate 1). The pests were usually observed in the month of March in Kangra and April-May in Kullu. Diamondback moth and cabbage butterfly were observed to be the most serious pest of cabbage in Kullu (43%) and Kangra (40%) respectively. Cabbage aphids were observed in the later weeks of March and in first week of April in Kangra. In a study conducted by Pal and Singh (2012) in Gorakhpur cabbage aphids were observed in abundance during the month of March when a mean maximum temperature was observed to be 27˚ C [6]. In Kullu, cabbage aphids were observed in April and were also found to be a major pest of cabbage. The population was recorded in abundance in the month of May. Similar observations were reported by Barwal (1997) in Kullu stating it to be a major pest in vegetative as well as reproductive phase [7].

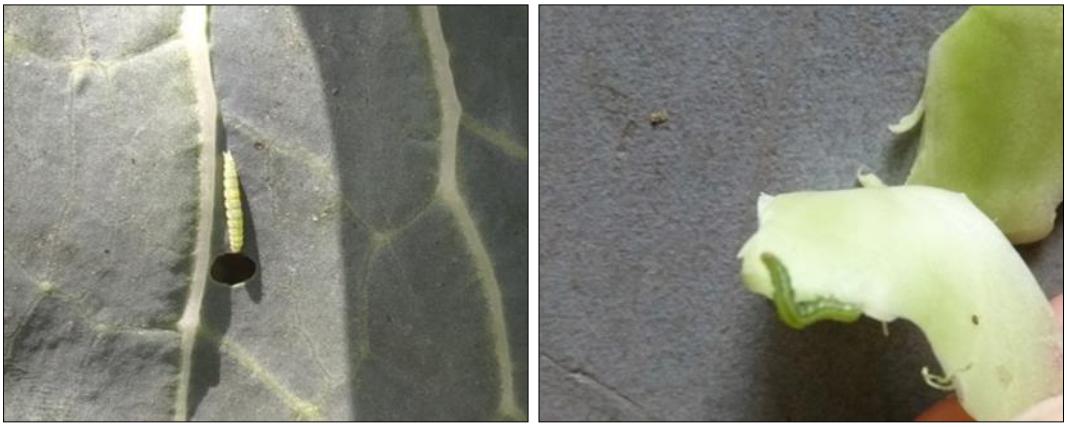
In Kangra, the eggs of cabbage butterfly were observed in the month of March. The larvae emerged in abundance in April. Egg laying was also observed in March by Gupta (1984) in a study conducted in the mid- hills of Himachal Pradesh [8]. In Kullu, eggs and young larvae were observed in last week of April. Sood (2007) also reported abundance in population of *Pieris brassicae* in last week of April and first week of May in temperate conditions of Kinnaur [9].

The larvae of diamondback moth were considered as the most serious pest of cabbage and were observed in the month of April in Kangra and mid May in Kullu. The peak larval population was also observed to be in April by Chauhan *et al.* (1997) during a study conducted on cabbage and cauliflower in mid hills Himachal Pradesh [10].

Incidence of infestation by cabbage semilooper was reported only in one district, i.e. Kangra and was found in abundance in the month of April (Table 1).

Wingless Form of *Brevicoryne brassicae*

Larvae of *Pieris brassicae*



Larva of *Plutella xyllostella* Larva of *Trichoplusia ni*

Plate 1: Pests of Cabbage

Table 1: Pests of cabbage, their incidence and infestation level in Kullu and Kangra.

Pests of Cabbage	Number of Farmers (n=80)					Month of incidence		Infestation Level (%)	
	*1	2	3	4	Overall (%)	Kullu	Kangra	Kullu	Kangra
Cabbage Aphid (*Brevicoryne brassicae*)	7	6	7	6	26 (32)	April- May	March– April	20 (24)	6 (30)
Cabbage Butterfly (*Pieris brassicae*)	3	4	9	8	24 (30)	April- May	April	16 (26)	8 (40)
Diamondback Moth (*Plutella xylostella*)	12	10	4	4	30 (37)	May	April	26 (43)	4 (20)
Cabbage Semilooper (*Trichoplusia ni*)	0	0	0	2	2 (3)	None	April	0	2 (10)

*1 Seobagh, 2 Manikaran, 3 Naggar, 4 Kangra

3.2 Farmer's Background

During the survey, it was found that the area under cabbage cultivation was less than 800 m^2 in Kangra whereas the farm size ranged from 1600-2400 m^2 (48%) in Kullu. The median age of farmers who cultivate cabbage was 40-50 years (36%) and 30-40 years (33%) in all the sites. About 46% of the farmers had an experience of 16-25 years followed by 22% of farmers who had an experience of 26-35 years. Cabbage production of 2001-3000 Kg was reported highest by 35% of the farmers in Kangra. In Kullu, 4001-5000 Kg was reported as the highest cabbage production by 36% of the farmers. Seasonal losses of less than 10% were reported by the farmers (36%) from both the districts (Table 2).

Table 2: Comparative demography of cabbage producers in Kangra and Kullu valley.

Characteristics	Number of farmers (n=80)				Overall (%)
	*1	2	3	4	
Farm Size (m^2)					
<800	0	0	0	13	13 (18)
800-1200	2	4	2	4	12 (15)
1200-1600	3	6	5	0	14 (18)
1600-2400	12	10	14	3	39 (48)
2400-3000	3	0	0	0	03 (4)
Age (Years)					
20-30	0	2	3	2	07 (9)
30-40	8	7	10	2	27 (33)
40-50	7	6	5	10	29 (36)
50-60	4	3	2	2	13 (12)
60-70	1	2	0	4	07 (8)
Experience in production (Years)					
<15	3	2	0	2	07 (8)
16-25	10	9	8	10	37 (46)
26-35	5	5	7	4	21 (22)
36-45	2	4	4	2	12 (15)
>45	0	0	1	2	03 (4)
Production of Cabbage (Kg)					
1000-2000	1	2	0	8	11 (14)
2001-3000	2	3	5	7	17 (18)
3001-4000	2	4	3	3	12 (15)
4001-5000	7	7	8	2	24 (30)
>5000	8	4	4	0	16 (20)
Seasonal losses (%)					
<10	8	8	10	3	29 (36)
11-21	6	7	4	7	24 (30)
21-30	5	4	4	8	21 (26)

31-40	1	0	2	3	6 (7)
>40	0	1	0	3	4 (5)

*1 Seobagh, 2 Manikaran, 3 Naggar, 4 Kangra

3.3 Methods used to control the pest population in Kangra and Kullu

From the survey, it was observed that 60% of the farmers relied on insecticides to control the pest population. Interviewed farmers had knowledge about other methods that can be used as well.

In Kangra, pheromone traps and neem extracts were used in addition to insecticides whereas in Kullu, trap crops, *Bacillus thuringiensis* and natural enemies were also being used to control pest population. Pheromone traps and trap crops were observed to be used respectively by 18% and 16% of the farmers from both the districts. Natural enemies as a control were only used by 8% of the farmers. About 6% and 10% of the farmers respectively used *Bacillus thuringiensis* and neem extracts to control pest population.

Syrphid flies are considered to control cabbage aphid as the larvae of the flies feed on cabbage aphid. Their role to suppress population of cabbage aphid on crucifers was also studied by Khan (2017) [11]. The population of flies was abundant during March in Kangra which corresponds to the population abundance of cabbage aphid. However, their use to control cabbage aphid was not prevalent. *Coccinella septumpunctatum* ïand *Diaeretella rapae* were being used as a control against cabbage aphid by 10% of the farmers in Kullu. The use of natural enemies to control cabbage aphid (*Brevicoryne brassice*) was also observed by Thakur *et al.* (1989) [12].

Pheromone traps were also being used by 35% of the farmers in Kangra and by only 13% of the farmers in Kullu. Pheromone traps were proven to be effective against diamondback moth by Chisohlm (1983) [13]. Natural larval parasitoids like *Diadegma semiclausam* was being used to control diamondback moth by very few farmers in Kullu. Prasannakumar *et al.* (2013) also reported it to be effective against diamondback moth [14]. Indian mustard was being used as a trap crop and was planted 15 days before planting cabbage by only 22% of the farmers in Kullu. Trap crop and cabbage were grown in a ratio of 1:20. The crop was favored more by diamondback moth. Use of Indian mustard as a trap crop against diamondback moth was proven to be effective by Srinivasan and Moorthy (2008) as it was favored more than cabbage for oviposition [15].

Neem extracts in the form of neem oil was used by 12% of the farmers in Kullu and 10% of the farmers in Kangra. Shiberu (2016) reported that neem seed extracts are moderately effective against cabbage aphid [16]. Prasannakumar *et al.* (2014) recorded that neem soap and neem cake in petrol extracts are most effective followed by petrol extracts of neem seed [17].

Bacillus thuringiensis was used by only 8% of the farmers to control attack of Diamondback moth in Kullu. Singh *et al.* (2015) reported that Biosap (*Bacillus thuringiensis* var. *kurstaki*) can be used to control population of Diamondback moth and resulted in less mean leaf damage[18] (Table 3).

Table 3: Methods to control the pest population in Kangra and Kullu.

Pest control Methods	Number of farmers (n=80)				
	*1	2	3	4	Overall (%)
Insecticides	9	14	10	15	48 (60)
Pheromone Trap	3	2	3	7	15 (18)
Trap crops	5	3	5	0	13 (16)
Natural Enemies	3	1	2	0	6 (8)
Bacillus thuringiensis	3	0	2	0	5 (6)
Neem extracts	4	0	3	2	9 (10)

*1 Seobagh, 2 Manikaran, 3 Naggar, 4 Kangra.

3.4 Insecticides used by farmers in Kullu and Kangra

From the survey, a total of 11 different insecticides were found to be used by the farmers (Table 4). These are Progress plus, Hamla 550, Rocket 44 EC, Nuvan, Nayak, Salmathion, Dursban, Rogor, Hotshot, Challenger, Coragen (Plate 2). Most of the products have the same active ingredient. Data showed that Progress plus, Hamla 550, Rocket 44 EC, Nayak and Nuvan were used in Kangra whereas Salmathion, Dursban, Rogor, Hotshot, Challenger were being used in Kullu. Coragen was being used in both the districts. In order to control the pest population in one cropping season usually 2-3 types of insecticides were used. They were usually sprayed at an interval of 10 to 15 days.

In Kangra, Progress plus containing a mixture of profenofos and cypermethrin was the most used product by farmers (50%) while in Kullu, Salmathion was mostly used (33%). The insecticides being used were categorized according to the classification of pesticides recommended by World Health Organisation (WHO) on the basis of hazard. Farmers usually used insecticides that were only moderately hazardous (87%). Present data showed that only one insecticide, Nuvan containing Dichlorovos as active ingredient was highly hazardous and was being used by only 6% of the farmers. Coragen containing cyantraniliprole is a safe insecticide which is unlikely to cause any harm.

The active ingredients present in these insecticides included imidacloprid, cyantraniliprole, dichlorovos, cypermethrin, profenofos, chlorpyrifos, chlorantraniliprole and malathion. Malathion was observed as the most popular followed by chlorpyrifos and cypermethrin against Cruciferae by Brar *et al.* (2018) [19]. Hotshot containing imidacloprid was observed to be effective against cabbage aphid by 19% of the farmers. Insecticide containing chlorantraniliprole as active ingredient was being used by 6% of the farmers. Chlorantraniliprole and cyantraniliprole are anthralic diamides. These are a type of bio-pesticide and unlikely to cause any harm. Shalu and Math (2018) also reported their effectiveness in controlling *Brevicoryne brassicae* and *Plutella xylostella* [20].

Insecticides that were used against cabbage butterfly consisted of cypermethrin, alphamethrin, profenofos and chlorpyrifos as active ingredient. Khan and Kumar (2017) also reported cypermethrin, imidacloprid and neem oil to be

effective against *Pieris brassicae* [21]. Diamondback moth was considered as serious pest of cabbage in Kullu. Insecticides containing malathion was used against it followed by cypermethrin. Verma and Sandhu (1968) also reported 0.08% malathion to be effective against it [22]. Cypermethrin was considered to be effective after 24 hours of application by Leigwalia *et al.* (2014) [23].

Table 4: Insecticides used by farmers in Kullu and Kangra.

Name	Active Ingredient	Status by WHO	Number of farmers (n=80)				Overall (%)
			*1	2	3	4	
Progress Plus	Profenofos+ Cypermethrin	Moderately Hazardous	0	0	0	10	10 (12)
Hamla 550	Chlorpyrifos+ Cypermethrin	Moderately Hazardous	0	0	0	4	4 (5)
Rocket 44EC	Profenofos+Cypermethrin	Moderately Hazardous	0	0	0	4	4 (5)
Nuvan	Dichlorovos	Highly Hazardous	0	0	0	5	5 (6)
Nayak	Alphacypermethrin	Moderately Hazardous	0	0	0	3	3 (4)
Salmathion	Malathion	Slightly Hazardous	10	3	12	0	25 (31)
Dursban	Chlorpyrifos	Moderately Hazardous	7	8	4	0	19 (24)
Rogor	Dimethoate	Moderately Hazardous	3	0	3	0	6 (7)
Hotshot	Imidacloprid	Moderately Hazardous	4	5	6	0	15 (19)
Challenger	Cypermethrin	Moderately Hazardous	4	2	3	0	9 (11)
Coragen	Chlorantraniliprole	Unlikely to present acute hazard in normal use	3	0	0	2	5 (6)

Progress Plus Hamla 550 Rocket 44EC Nuvan Nayak

Salmathion Dursban Hot Shot Challenger

Plate 2: Insecticides being used in Himachal Pradesh

4. Conclusion

A comparison between the two districts showed that the area and production in Kullu was higher than Kangra. The crop was grown in the months of October to March in Kangra whereas in Kullu, it was also grown in the months of April and May. Pest incidences in Kangra were in 2nd week of March and in April. In Kullu, the pests were observed in 2nd week of April and in May.

Four pests of cabbage were recorded to cause damage during the survey. These were cabbage aphid (*Brevicoryne brassicae*), cabbage butterfly (*Pieris brassicae*), diamondback moth (*Plutella xylostella*) and cabbage semilooper (*Trichoplusia ni*). According to the farmers, cabbage butterfly was considered a serious pest of cabbage in Kangra valley. However, this status was occupied by diamondback moth in Kullu valley.

Insecticides were mainly used in order to control the pests in both the districts. These belonged to pyrethroids like cypermethrin, alphacypermethrin and organophosphates like chlorpyrifos, profenofos, malathion, dichlorovos and dimethoate. Other insecticides that were being used included imidacloprid, chloroantraniliprole as active ingredient. From the survey it was concluded that majority of the insecticides being used were moderately hazardous. In order to control diamondback moth insecticides were used in alteration by farmers. Besides chemical control some of the farmers also followed practices like use of pheromone traps in Kangra. In Kullu, practices like use of traps, natural enemies like *Diadegma semiclausam* and intercropping of mustard were also prevelant.

5. References

1. Food and Agriculture Organization. 2017. http://www.fao.org/faostat/en/#data/QCL

2. Anonymous. Horticulture Statistics At A Glance 2017. Ministry of Agriculture & Farmers Welfare, New Delhi, 2017, 198.
3. Bonnemaison L. Insect-pests of crucifers and their control. Annual Review of Entomology 1965;10:233-256.
4. Riley DG, Sparks AN. Insecticide resistance management for diamondback moth in cole crops. https://extension.uga.edu/publications/detail.html?number=C899&title=Insecticide%20Resistance%20Management%20for%20Diamondback%20Moth%20in%20Cole%20Crops. March 28,2017
5. Ongley ED. Control of water pollution from agriculture-FAO irrigation and drainage. 1996; 55.
6. Pal M, Singh R. Seasonal history of cabbage aphid, *Brevicoryne brassicae* (Linn.) (Homoptera :Aphididae). Journal of Aphidol 2012;25-26:69-74.
7. Barwal RN. Pest management in the temperate vegetable crops for vegetable and seed purposes. Summer School on hybrid seed production technology of vegetables. Division of vegetable crops. IARI. New Delhi 1997, 180-184.
8. Gupta PR. Bionomics of the cabbage butterfly, *Pieris brassicae* (Linn.) in mid-hills of Himachal Pradesh. Himachal Journal of Agricultural Research 1984;10(1):49-54.
9. Sood P. Effect of transplanting dates on the incidence of *Pieris brassicae* Linn. And extent of losses in cabbage under dry temperate conditions of Himachal Pradesh. Legume Research. 2007;30:297-300.
10. Chauhan U, Bhalla O, Sharma K. Biology and Seasonability of the diamondback moth, *Plutella xylostella* (L.) (Lepidoptera: Yponomeutidae) and its parasitoids on cabbage and cauliflower. Pest Management in Horticultural Ecosystems 1997;3(1):7-12.
11. Khan AA. Functional Response of four syrphid predators associated with Mealy Cabbage Aphid, *Brevicoryne brassicae* L. on cruciferous vegetables. International Journal of Current Microbiology and Applied Sciences 2017;6(7):2806-2816.
12. Thakur JN, Rawat US, Pawar AD, Sidhu SS. Natural enemy complex of cabbage aphid *Brevicoryne brassicae* L. (Hemiptera: Aphididae) in Kullu Valley, Himachal Pradesh. Journal of Biological Control 1989;3(1):69.
13. Chisohlm M, Steck W, Underhill EW, Palaniswamy P. Field trapping of diamondback moth *Plutella xylostella* using an improved four- component sex attractant blend. Journal of Chemical Ecology 1983;9(1):113-118.
14. Prasannakumar NR, Prakash C, Kumar GMS. Eco-friendly management of insect pests of cole crop. 2013; http://www.krishisewa.com/articles/disease-management/319-cole-crop-ipm.html.
15. Srinivasan K, Moorthy PN. Indian mustard as a trap crop for management of major lepidopterous pests on cabbage. Tropical Pest Management 2008;37(1):26-32.
16. Shiberu T, Negeri M. Effects of synthetic insecticides and crude botanicals extracts on cabbage aphid, *Brevicoryne brassicae* (L.) (Hemiptera: Aphididae) on cabbage. Journal of Fertilizers and Pesticides 2016;**7**(1):162.
17. Prasannakumar NR, Kumar GMS, Mukesh M. Efficacy of botanicals and synthetic insecticides on major insect pests of cabbage in Kullu valley, Himachal Pradesh. Insect Environment 2014;19(4):231-233.
18. Singh KI, Debbarma A, Singh HR. Field efficacy of certain microbial Insecticides against *Plutella xyllostella* Linnaeus and *Pieris brassicae* Linnaeus under cabbage-crop eco-system of Manipur. Journal of Biological Control 2015;29(4):194-202.
19. Brar GS, Patyal SK, Dubey JK, Singh G. Survey on pesticide use pattern and farmers perceptions in cauliflower and brinjal growing areas in three districts of Himachal Pradesh, India. International Journal of Current Microbiology and Applied Sciences 2018;7(3):2417-2423.
20. Shalu V, Math M. Management of insect pests of cabbage with a newer Anthranilic diamide insecticide, cyantraniliprole 10% OD. The Bioscan 2017;12(2):703-708.
21. Khan HH, Kumar A. Effect of certain chemicals and bio - pesticide on the 3rd instar larvae of the cabbage butterfly, *Pieris brassicae* (Linn.) (Lepidoptera: Pieridae). Journal of Entomology and Zoology Studies 2017;5(5):753-755.
22. Verma AN, Sandhu GS. Chemical control of diamondback moth, *Plutella maculipennis*. Journal of Research Punjab Agricultural University 1968;5:420-423.
23. Leigwalia MM, Munthali DC, Kwerepe BC, Obopile M. Effectiveness of cypermethrin against diamondback moth (*Plutella xyllostella* L.) eggs and larvae on cabbage under Botsawana conditions. African Journal of Agricultural Research 2014;9(51):3704-3711.