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Integrated Management of Cabbage Aphid (*Brevicoryne brassicae* L.)

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ABSTRACT

The present investigation entitled "Integrated Management of Cabbage Aphid (*Brevicoryne brassicae* L.)" was carried out at Department of Entomology as well as field of Vegetable Research and Demonstration Block, College of Horticulture, VCSG Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Garhwal during 2022. Seasonal incidence of Cabbage aphid (*Brevicoryne brassicae*) revealed that the maximum numbers of aphid, (784.05 nymphs/plants and 506.32 adults/plants) were recorded during 23rd SMW viz., 2nd week of June. Correlation studies indicated that aphid population exhibited highly significant positive correlation with maximum temperature and minimum temperature and significant negative correlation with morning and evening relative humidity. While rainfall showed non-significant positive correlation with aphid population. Efficacy of different treatments (Cultural practices (Weeding) + Yellow sticky trap), (Garlic extract + Red pepper extract), (Onion extract + Yellow sticky trap), (Neem leaf extract + Cow urine), (Thiamethoxam 25 WG + *Beauveria bassiana*), (L-cyhalothrin 5 EC + *Beauveria bassiana*) and (Biological control + Mechanical control) were evaluated by two sprays at 3, 5 and 7 days interval against aphid (*B. brassicae*) during year 2022. After 1st and 2nd application highest reduction in aphid population (77.37 and 93.57) and maximum yield (5.85 kg/plot and 541.66 q/ha) over pre treatment was recorded in L-cyhalothrin 5 EC incorporated with *Beauveria bassiana*.

Keywords Integrated management, *Brevicoryne brassicae, Beauveria bassiana,* Cabbage aphid.

INTRODUCTION

Cabbage (*Brassica oleracea* var. *capitata*) is the major vegetable growing throughout the globe that belongs to the Cruciferae and genus Brassica. Cabbages are extremely nourishing food supply and contain a high quantity of minerals and vitamins like A, B_1, B_2 and C (Hasan and Solaiman 2012). It's low in calories and noteworthy with its high content levels of calcium, iron, iodine, potassium, sulfur, phosphorus and ascorbic acid.

India is the second largest producer of cabbage with in the world, accounting for 16.55 % of the globe

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area and 12.79 % of the world production. Country wise, it mature in a vicinity of 397000 hectare with an annual production of 9207 MT and productivity of 22.6 t/ha, ranking second to cabbage in area however topping in production among cole crops (Department of Agriculture and Farmers Welfare, 2020). In Uttarakhand, Cabbage matures in summer (high hills) and winter (low-mid hills) and occupies a vicinity of 6568.25 hectare with a production of 69233.68 tonnes (Department of Agriculture and Farmers Welfare, 2020).

Cabbage aphid, *Brevicoryne brassicae* is known to be the most abundant and destructive species of aphididae on canola crop during the flowering and podding stage. Cabbage aphids are gray-green in color, but they usually appear grey or white due to a dusty, waxy secretion covering their bodies. Earlier instars of cabbage aphid nymphs may be devoid of this waxy coating and appear brighter green. Adults and nymphs have dark heads and short cornicles and can only be found on brassicas. In India, (Khan *et al.* 2015) reported a 80% yield loss on cabbage due to diamond back moth while cabbage aphid played an important role in decreasing the yield ranging from 50 to 80 % Khan and Munir (1986), Ellis and Singh (1993).

Also, there is a growing concern about environmental pollution and its adverse effects on the health of humans and animals due to indiscriminate use of synthetic chemicals (pesticides) in cabbage production. So, there is a need to find different strategies to manage the insect pests other than applying synthetic chemicals. Every strategy used to control insect pest must be ecologically safe and satisfy the growers. The methods used to control the insect pests in sustainable agriculture without harming the nature are considered as the most important component.

As a result, in the national context, the development of an integrated pest management (IPM) package for vegetables with pesticide residues at or below allowable levels is required. While a great deal of work has been carried out on IPM of cabbage in India Krishnaiah *et al.* (1981), Krishnamoorthy and Kumar (2001) and abroad (Finch 1993), all of these deal with control of either a particular insect or disease. There is no single package for the integrated control of insects and diseases together while ensuring low pesticide residues in cabbage at harvest. The present study is thus aimed at development of an IPM package for cabbage with safe pesticide residue level.

MATERIALS AND METHODS

The present investigations entitle "Integrated Management of Cabbage Aphid (*Brevicoryne brassicae* L.)" was conducted in the Department of Plant Pathology Laboratory, Vegetable Research and Demonstration Block, Department of Vegetable Science, College of Horticulture, VCSG UUHF, Bharsar (Pauri Garhwal), Uttarakhand during March 2022. The details of experimental material used and procedure are described here under.

Field preparation and sowing

Field was prepared thoroughly by two ploughing with power tiller followed by two cross tilling and it was levelled with the help of leveller then divided into 24 plots having irrigation channels, path and distance to mark different replications as well as plots as shown in layout. Farm Yard Manure (FYM) was applied as per the recommended of package of practices.

Experiment 1. To study about the seasonal incidence of Cabbage aphid (Brevicoryne brassicae L.)

The experiment for the studies of seasonal incidence of aphids was conducted on Cabbage (*Brassica oleracea* var. *capitata*). The crops were grown under timely and late sown conditions with recommended package of practices.

Experiment 2. To evaluate the efficacy of different integrated methods for management of Cabbage aphid (Brevicoryne brassicae L.)

1) Cultural and mechanical practices

Weeding in the field was done in 15 days interval. Yellow sticky traps were placed in the plots to control the aphid population.

2) Method of plant extract preparation

Collection of different plant extracts was done from

the nearby places. Extract was prepared by crushing the leaves and bulbs separately. The crushed material was separated through muslin cloth and was filtered by filter paper. The obtained filtered liquid was used as botanicals.

3) Method of application of plant extracts

First spray application was given on the appearance of the pest and subsequently 2 sprays to be given at 3, 5 and 7 days interval using manually operated garden hand sprayer with duromist nozzle. Extract of respective plant material was made by grinding the sufficient quantity of leaves/seeds using grinder.

4) Preparation of insecticidal spray solution

The insecticidal spray solutions of desired concentration as per treatments was prepared at the site of experiment just before the start of spraying operations. There were two treatments and each treatment have three replications. Two sprays were given at an interval of 15 days.

5) Entomophagous fungi spray

The entomophagous fungi conidia were sprayed on the plant directly after spraying of insecticides. Two sprays were given at interval of 15 days.

6) Method of recording observations

Cabbage aphid population was recorded visually during early morning hours from five randomly selected plants from each plot before first spray and 3rd, 5th and 7th days after first and second spray applications.

RESULTS AND DISCUSSION

The data presented in (Table 1) revealed that the incidence of the cabbage aphid appeared on the crop from 11th standard meteorological week (third week of March) to 26th SMW (First week of July). The population started increasing rapidly from 19th SMW with the rise in temperature. The population was found to be 328.65 nymphs/plant and 278.79 adult/plant respectively. The aphid population reached to the peak point with 784.05 nymph/plant and 506.32 adults/plant on 23rd SMW (second week of June) whereas the lowest population was 9.36 nymphs/plant during 11th SMW (third week of March), 19.48 adults/plant during 12th Standard week (fourth week of March).

Table 1. Seasonal incidence of cabbage aphid (*Brevicoryne brassicae* L.), during (March to July) 2022.

Month	SMW	Temperature		Relative humidity (%)		Rainfall (mm)	Cabbage aphid population	
		Maximum	Minimum	Morning	Evening		Nymph	Adult
March	11	16.56	4.15	80.54	60.51	1.09	9.36	0.00
March	12	17.67	9.60	78.65	55.76	0.66	14.76	19.48
March-April	13	18.71	10.57	74.00	52.14	0.00	54.70	32.90
April	14	20.14	11.14	69.57	60.71	0.60	120.77	92.58
April	15	20.00	11.00	71.85	44.85	1.06	150.60	106.50
April	16	20.28	11.14	71.71	45.42	0.00	378.28	256.12
April	17	19.57	11.85	70.14	46.71	0.00	309.80	206.58
April-May	18	20.14	11.57	75.85	46.57	0.00	280.40	248.89
May	19	20.42	11.28	80.00	48.42	0.00	328.65	278.79
May	20	20.57	12.14	75.42	47.71	0.00	412.34	305.24
May	21	22.28	12.28	71.28	53.14	1.06	506.80	351.64
May-June	22	25.42	16.57	71.42	43.14	0.20	731.28	476.96
June	23	26.14	18.28	65.14	43.50	0.00	784.05	506.32
June	24	26.85	15.42	73.85	46.42	4.62	568.54	362.02
June	25	22.87	14.85	70.28	46.42	8.32	428.50	274.01
June-July	26	20.85	14.57	75.20	43.00	2.33	369.47	194.10

SMW = Standard meteorological week.

Table 2. Karl pearson correlation coefficient between the aphid population and weather parameters.

Abiotic factors	Aphid population Nymph	P value	Adult	P value
Max temperature (^{0}C)	0.912**	0.0001	0.880**	0.0001
Min temperature (^{0}C)	0.864**	0.0001	0.824**	0.0001
RH % (Morning)	-0.556*	0.252	-0.505*	0.0460
RH % (Evening)	-0.674**	0.0042	-0.656**	0.0059
Rainfall (mm)	0.261^{NS}	0.3286	0.211^{NS}	0.4333

**Significant at 1% level of significance
*Significant at 5% level of significance.

Correlation coefficient studies (Table 2) between aphid *Brevicoryne brassicae* incidence and weather parameters during 2022 indicated that nymph population of aphid had highly significant positive correlation with maximum temperature (r = 0.912), minimum temperature (r = 0.864), significant negative correlation with morning and evening relative humidity (r = -0.556) and (r = -0.674) and non-significant positive correlation with rainfall (r = 0.261). The adult stage had highly significant positive correlation associated with maximum temperature (r = 0.880), minimum temperature (r = 0.824), significant negative correlation with morning and evening relative humidity (r = -0.505) and (r = -0.656) and non-significant positive correlation with rainfall (r = 0.211).

Effect of different integrated management against cabbage aphid population after 1st treatment

In (Tables 3-4) the efficacy of seven different integrated treatments were observed on the cabbage aphid population after the 1st treatment. The result of experiment shows that the minimum mean number of Cabbage aphid population was recorded in treatment T_7 (L-cyhalothrin 5EC incorporated with *Beauveria bassiana*) (34.80 aphids/plant) with per cent reduction over control of 77.37% after that T_6 (Thiamethoxam 25 WG incorporated with *Beauveria bassiana*) (63.20 aphids/plant) with the PROC of 69.22% was found effective, followed by T_4 (Onion extract + Yellow sticky trap) (111.73 aphids/plant) with the PROC of 54.96% whereas the maximum mean number of aphid population was recorded in T_8 (Biological control + Mechanical control) (180.55 aphids/plant) with the PROC of 27.22%. Similar findings were reported by Akbari *et al.* (2014).

Effect of different integrated management against cabbage aphid population after 2nd treatment.

In Table (5 and 6) L-cyhalothrin 5EC incorporated

Table 3. Effect of different integrated practices against Cabbage aphid population after 1st application.

Treatments	Concentration	Pre count	Average no. of cabbage aphid/plant After 1st application 3 DAS	5 DAS	7 DAS	Mean population of aphid
T_1 (Control)	-	218.47	229.03	236.92	248.10	238.01
T_2 (Cultural practices (Weeding) + Yellow sticky trap)	3	231.90	209.03	187.03*	159.10*	185.05
T_3 (Garlic extract + Red pepper extract)	2 %+ 2 %	248.05	211.72	171.91*	128.00*	170.54
T_4 (Onion extract + Yellow sticky trap)	5 % + 3	214.47	191.97*	149.99*	111.73*	151.23
T_5 (Neem leaf extract + Cow urine)	3% + 2 %	249.31	219.72	187.65*	142.98*	183.45
T_6 (Thiamethoxam 25 WG + *Beauveria bassiana*)	0.002 ml/L +0.5 mg/L	246.19	184.01*	108.80*	63.20*	114.35
T_7 (L-cyhalothrin 5EC + *Beauveria bassiana*)	0.003 ml/L + 0.5 mg/L	236.07	156.21*	84.02*	34.80*	91.68
T_8 (Biological control + Mechanical control)	8.90	229.00	214.64	196.56*	180.55*	197.25
SE (d)		-	9.30	15.34	15.62	-
CD (0.05)		-	20.14	33.22	33.84	-

*Significant at 5% level of significance as compared with T_1 (Control)
DAS = Days after spray.

Table 4. Per cent reduction in cabbage aphid population after 1st application.

Treatments	Concentration	Per cent reduction in aphid population /plant			
		3 DAS	5 DAS	7 DAS	Mean PROC
(Cultural practices (Weeding) + Yellow sticky trap)	3	8.73	21.05	35.87	21.88
(Garlic extract + Red pepper extract)	2% + 2 %	7.55	27.43	48.40	27.80
(Onion extract + Yellow sticky trap)	5 % + 3	16.18	36.69	54.96	35.95
(Neem leaf extract + Cow urine)	3% + 2 %	4.35	20.79	42.37	22.50
(Thiamethoxam 25 WG + *Beauveria bassiana*)	0.002 ml/L + 0.5 mg/L	19.66	40.11	69.22	43.00
(L-cyhalothrin 5EC + *Beauveria bassiana*)	0.003 ml/L + 0.5 mg/L	22.24	46.71	77.37	48.77
(Biological control + Mechanical control)	8.90	6.28	17.03	27.22	16.84

with *Beauveria bassiana* 0.003 ml/L + 0.5 mg/L was found very promising after second application, which gave minimum aphid population i.e., 28.65 aphids/plant with 87.85% reduction followed by Thiamethoxam 25 WG incorporated with *Beauveria bassiana* (35.89 aphids/plant) with the PROC of 85.32% and mimimum was seen in T_8 (Biological control + Mechanical control) (157.02 aphids/plant) with the PROC of 35.70%. Almost similar results were found by Faraji *et al.* (2016) they also observed that the combined applications of fungal isolates with L-cyhalothrin (Karate) resulted in a significantly higher mortality of Cabbage aphid.

In cabbage field during 2022 the aphid, *Brevicoryne brassicae* marked its appearance from 11th to 26th standard meteorological week (SMW) and the population of aphid ranged from 9.36 to 784.05 nymphs/plant and 19.48 to 506.32 adults/plant. The maximum population of nymph and adult form of aphid was recorded during 23rd standard week with 784.05 nymphs/plant and 506.32 adults/plant. It was observed that the rise in temperature lead to the rise in aphid population, there was a sudden increase in population of nymphs and adults when the temperature increased from 22°C to 25°C in 22nd standard week. The nymph aphid population exhibited highly significant positive correlation with maximum and minimum temperature (r = 0.912), (r = 0.864), negative correlation with morning and evening relative humidity (r = -0.556) and (r = - 0.674) also non- significant positive correlation with rainfall (r = 0.261). The adult stage had a highly significant positive correlation with maximum and minimum temperature

Table 5. Effect of different integrated practices against cabbage aphid population after 2nd application.

Treatments	Concentration	Per count	Average no. of cabbage aphid/plant After 2nd application			Mean population of aphid
			3 DAS	5 DAS	7 DAS	
T_1 (Control)	-	228.47	231.40	238.09	244.50	237.99
T_2 (Cultural practices (Weeding) + Yellow sticky trap)	3	160.58	145.62*	125.63*	114.98*	128.74
T_3 (Garlic extract + Red pepper extract)	2% + 2 %	125.61	117.67*	102.30*	92.25*	104.07
T_4 (Onion extract + Yellow sticky trap)	5 % + 3	116.58	104.34*	91.08*	75.80*	90.40
T_5 (Neem leaf extract + Cow urine)	3% + 2 %	146.41	128.50*	108.38*	93.95*	110.27
T_6 (Thiamethoxam 25 WG + *Beauveria bassiana*)	0.002 ml/L + 0.5 mg/L	78.25	63.78*	45.24*	35.89*	48.30
T_7 (L-cyhalothrin 5EC + *Beauveria bassiana*)	0.003 ml/L + 0.5 mg/L	62.41	42.58*	27.65*	15.72*	28.65
T_8 (Biological control + Mechanical control)	8.90	180.68	175.37*	165.72*	157.20*	166.09
SE (d)	-	6.19	5.75	5.68	-	-
CD (0.05)	-	13.42	12.45	12.31	-	-

*Significant at 5% level of significance as compared with T_1 (control). DAS= Days after spray.

Table 6. Per cent reduction in cabbage aphid population after 2nd application.

Treatments	Concentration	Per cent reduction in aphid population/plant			Mean
		3 DAS	6 DAS	7 DAS	PROC
T_2 (Cultural practices (Weeding) + Yellow sticky trap)	3	37.07	47.23	52.97	45.75
T_3 (Garlic extract + Red pepper extract)	2% + 2 %	19.19	57.03	62.26	46.16
T_4 (Onion extract + Yellow sticky trap)	5 % + 3	54.90	61.74	68.99	61.88
T_5 (Neem leaf extract + Cow urine)	3% + 2 %	44.46	54.47	61.57	53.50
T_6 (Thiamethoxam 25 WG + *Beauveria bassiana*)	0.002 ml/L + 0.5 mg/L	50.36	80.99	85.32	72.22
T_7 (L-cyhalothrin 5EC + *Beauveria bassiana*)	0.003 ml/L + 0.5 mg/L	81.59	88.38	93.57	87.85
T_8 (Biological control + Mechanical control)	8.90	24.21	30.39	35.70	30.10

(r = 0.880) and (r = 0.824), negative correlation with morning and evening relative humidity (r = -0.505) and (r = -0.656) but non- significant positive correlation with rainfall (r = 0.211).

In case of aphid, *B. brassicae* after 1st and 2nd spray, all the treatments were found superior over control in reducing the population. Among all the treatments after 1st spray minimum number of aphid population was recorded in plots treated with L- cyhalothrin 5EC incorporated with *Beauveria bassiana* 0.003 ml/L +0.5 mg/L with 77.37% reduction followed by Thiamethoxam 25WG incorporated with *Beauveria bassiana* 0.002 ml/L + 0.5 mg/L and Onion extract + Yellow sticky trap 5 % + 3 with 69.22% and 54.96% reduction. Similarly, after 2nd spray minimum aphid population was recorded in treatment L- cyhalothrin 5EC incorporated with *Beauveria bassiana* 0.003 ml/L + 0.5 mg/L with 93.57% reduction followed by Thiamethoxam 25WG incorporated with *Beauveria bassiana* 0.002 ml/L + 0.5 mg/L and Onion extract + Yellow sticky trap 5 % + 3 with 85.32% and 68.99% reduction.

CONCLUSION

The study helped in analyzing that the high temperature and low rainfall led to the increase in, Cabbage aphid *Brevicoryne brassicae* population. The correlation between weather parameters and pest population would help farmers in tackling pest infestation in future. Among all the treatments, L-cyhalothrin 5EC incorporated with *Beauveria bassiana* 0.003 ml/L + 0.5 mg/L was found to be highly effective against *Brevicoryne brassicae* and recorded the highest yield among all the treatment. This integrated practice can be suggested to the farmers for effective management of Cabbage aphid population.

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