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Screening of Biopesticides against Insect Pests of Cauliflower

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Abstract: A field study was carried out during 2015 at the experimental farm of Agriculture Research Institute, (ARI) Tandojam. The efficacy of different bio-pesticides was examined against insect pests of cauliflower. The study was conducted on field experimental design with seventh treatments and three replications. The observations were recorded on Pre- and post-treatments. The cauliflower was infesting by three insect pests including thrips, whitefly and diamondback moth. The results exposed against thrips the highest efficacy of chemical control (confidor) (82.82%), followed by Neem extract (78.42%), Tobacco extract (72.33%), Tooh extract (69.51%), Akk extract (65.55%) and lowest for Dhatura extract (58.97%). Against whitefly, chemical control (confidor) confirmed the highest efficacy (95.75%) followed by Tooh extract (83.81%) and least efficacy for Dhatura extract (78.14%). The results against Diamondback moth population on cauliflower denoted that chemical control (match) has the highest efficacy (98.88%), followed by Neem extract (97.23%), Tobacco extract (95.39%), Tooh extract (92.19%), Dhatura (89.79%) and least efficacy was resulted by Akk extract (80.98%).

Keywords: Cauliflower, Screening, Bio-pesticides, Diamondback moth and Thrips

1. INTRODUCTION

Cauliflower, *Brassica oleracea* L. belongs to the family Cruciferae, it reproduces by seed that is an annual plant. Naturally, the white curd of abandoned floral meristems is eaten, although the stalk and green leaves and surrounding thick are used in vegetable potage or discarded. This floral plant is known as cabbage, which normally produces only leafy greens for eating and flower an acknowledgment of its unusual place among a family of food plants (Barbara, 1996). There are different cultivar groups of *Brassica oleracea* and they includes cabbage, broccoli, brussels sprouts, kale, and collard greens. This floral plant can be roasted, steamed, fried, boiled, or eaten raw. Further, this is microwaving or steaming for better preserves anticancer amalgams than boiling. Cauliflower is low in fat, carbs but rich in dietary fiber, water, folate, and vitamin-C, antibacterial and very rich in nutritional density. It may be beneficial to human health (Kirsh *et al.,* 2007; USDA, 2011) and contains some phytochemicals, combined in the cabbage family. Cauliflower plan is damaged by a number of insect pests such as root maggots, aphids, harlequin bugs, cutworms, flea beetles, loopers and cabbage worms. In the most developing countries to control these insect pests, the Synthetic insecticides are widely used. In the last few years the use of globally bio-pesticides, such as plant extracts broadly increased. The feeding and oviposition deterrence, growth disruption, repellency, reduced fitness, and sterility are collectively the diverse biological activities of bio-pesticides (plant extracts) (Schmutterer, 1990). Nzanza and Mashela, (2012) confirmed the Bio-pesticides are natural and usual control of crop insect pests and these obviously occurring substances control pests through non-toxic mechanisms (Bardin *et al.,* 2008); while synthetic pesticides may adversely affect the organisms which includes birds, beneficial insects and mammals (Knott, 1998).

However, for achieving high effective results from bio-pesticides, the users need to know about practices of managing pests (Adalbert *et al.,* 2013). Among insect pests, bollworms, aphids, fruit borers, jassids, whitefly, leaf hopper, thrips, diamond back moth found to be infest safflower and it has been proved that botanical pesticides effectively control these insect pests. Waghmare *et al.,* (2006) found bio-pesticides being effective against diamondback moth in cabbage, while Hemchandra and Singh (2006) and Shukla and Kumar (2006) also reported the effect of some indigenous plant products against diamondback moth. Krishna Kumar *et al.,* (1983) reported 52% loss in marketable yield of cabbage due to the attack of *P. xylostella*. The farmers use various synthetic pesticides to reduce the damage by this pest, but with limited success. Therefore, considering the importance of this pest in red cabbage cultivation *vis-à-vis* the ill-effects of using synthetic chemicals, an attempt was made to find out the seed extracts from the bio-efficacy of Kochila, *Strychnos nuxvomica* (Loganeaceae) and Yam bean, *Pachyrrizus erosus* (Papilionaceae) by means of petroleum ether as solvent and an entomopathogenic fungus eg., *Beauveria bassiana,* against important on diamondback moth, *P. xylostella* (Vishwakarma *et al.,* 2009).

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2. MATERIALS AND METHODS

The field experiment was conducted against insect pests of cauliflower during the year 2015 on the screening of biopesticides (plant extracts) and check the effect of chemical control (confidor/ match). The field trail was designed in Randomized Complete Block Design with sub-plot size of 3mx3 ($9m^2$) in three replications. A plan of work of this study was designed to observe the sowing dates and methods. The planting rate of 5.0 kg ha^{-1} was applied as it was recommended; whereas plant to plant distance of 15 cm and row to row distance of 60 cm was maintained.

The seed of Thori-78, variety of cauliflower was used throughout the experiment.

The extracts of the following ordinary plants were used to investigate their efficacy against this floral plant insect pests. The following seven treatments were used as below:

T1 Chemical control (confidor/match)
T2 Neem (*Azadirachta indica)*
T3 Akk (*Calotropis procera* Alton. F.)
T4 Tooh (*Citrullus colocynthus* Schrad. L.)
T5 Datura (*Datura stramonium*)
T6 Tobacco (*Nicotiana tabacum*)
T7 Control (untreated)

3. PREPARATION OF EXTRACT

The preparation of plant extract for this study, 10 kg leaves each of Neem (*Azadirachta indica*), Tobacco (*Nicotiana tabacum*), Tooh (*Citrullus colocyanthus* Schrad. L.), Akk (*Calotropis procera* Alton. F.) and Datura (*Datura stramonium*) were gathered and administered for getting the extract. Different treatments stock weight was ten kg boiled in ten liters of water. Separately, the leaves of each plant species were taken and filtered through muslin cloth. When water remained 5 liters of stock solution to spray. The knapsack hand sprayer was used on crop after preparing the extracts. The efficacy was observed after 24, 48, 72, 96 hours 1 week and 2 weeks of spray and control treatment was compared with other treatments. Recommended pesticides for cauliflower were sprayed, such as chemical control (confider/match) @ 250 ml / acre (0.56ml/plot) and bio pesticide 5liter/Acre (12ml/plot). The collected data was statistical analyzed and using the analysis of variance to check the significance effect (efficacies against these insect pests) of different treatments and the comparison of means test namely the LSD (Least Significance Difference test) was used.

4. RESULTS

The effects of different treatments were examine and observed the efficacy of different bio-pesticides on cauliflower crop. This crop was infested by three insect pests were including thrips, whitefly and diamondback moth and The data observed on these insect pests of pre- and after-treatments and also insect count was recorded.

5. THRIPS

First spray

Statistically, the differences in thrips population on cauliflower plantation were non-significant for pre-treatment. The effect of biopesticides **(Table-1)** indicated that in cauliflower plantation sprayed with Chemical control (cofidor), the thrips population reduced from 12.47/leaf to 2.14/leaf after two weeks of spray indicating the highest efficacy of 82.82%; while the crop sprayed with the bio pesticide Neem extract ranked 2nd, where pre-treatment thrips population of 12.33/leaf decreased to 2.66/leaf after 2 weeks of spray showing efficacy of 78.42 percent. The crop sprayed with tobacco extract ranked 3rd, where pre-treatment thrips population of 12.13/leaf decreased to 3.36/leaf after 2 weeks of spray showing efficacy of 72.33%. The cauliflower plantation treated with tooh ranked 4th, where pre-treatment thrips population of 12.67/leaf decreased to 3.86/leaf after 2 weeks of spray showing efficacy of 69.51%. The Akk extract ranked 5th, where pre-treatment thrips population of 12.22/leaf decreased to 4.21/leaf after 2 weeks of spray showing efficacy of 65.55%. Similarly, the spraying of Dhatura extract ranked 6th, where pre-treatment thrips population of 12.13/leaf decreased to 4.98/leaf after 2 weeks of spray with lowest efficacy of 58.97%. According to the efficacy the treatments ranking was neem extract, chemical control, tobacco extract, tooh extract, akk extract and dhatura extract.

2nd spray

Thrips population on cauliflower after second spray of biopesticides showed non-significant variation for pre-treatment ($F=0.44$; $DF=20$; $P>0.05$) and when monitored after 24 hours of spray. The data **(Table-2)** showed that the thrips population after second spray of synthetic pesticide (chemical control) reduced from 8.22/leaf to 0.89/leaf after two weeks of spray showing the highest efficacy of 88.35%; and the crop sprayed with neem extract ranked 2nd, where the thrips population decreased from 8.00/leaf to 1.15/leaf after 2 weeks of spray showing efficacy of 78.97%. The tobacco extract ranked 3rd, where the thrips population decreased from 7.90/leaf to 1.68/leaf after two weeks of spray, showing efficacy of 82.68 %. Tooh extract ranked 4th, where thrips population decreased from 6.70/leaf to 1.60/leaf after two weeks of spray showing efficacy of 80.64 %. Akk extract ranked 5th, where the thrips population decreased from 7.82/leaf to 2.01/leaf after 2 weeks of spray showing efficacy of 79.09 %. Similarly, the spraying of Dhatura extract ranked 6th, where pre-treatment thrips population of 7.60/leaf decreased to 1.97/leaf after 2 weeks of spray with lowest efficacy of 78.97 %. According to the efficacy the treatments ranked as: synthetic pesticide (chemical control) neem extract, tobacco extract, tooh extract, akk extract and dhatura extract.

Table-1 Efficacy of various biopesticides against thrips infestation on cauliflower as compared to chemical control (Confidor) at different intervals after first spray.

Plant extracts	Pre-treatment	Post treatment observation/leaf after:						Pest Reduction /plant	Reduction %
		24hrs	48hrs	72hrs	96hrs	1week	2week		
Chemical control (confidor)	12.47	9.47	8.15	7.01	6.03	3.51	2.14	10.32	82.82
Neem extract	12.33	9.62	8.66	7.79	7.01	3.86	2.66	9.67	78.42
Akk extract	12.22	10.14	9.53	8.96	8.42	5.19	4.21	8.01	65.55
Tooh extract	12.67	10.39	9.66	8.98	8.35	4.95	3.86	8.80	69.51
Dhatura extract	12.13	10.31	9.90	9.50	9.12	5.86	4.98	7.16	58.97
Tobacco extract	12.13	9.71	8.93	8.22	7.56	4.48	3.36	8.78	72.33
Untreated	12.33	12.46	12.33	12.21	12.09	11.97	11.85	0.49	3.95
S.E.±	0.3989	0.2887	0.2250	0.1842	0.1902	0.1093	0.1298		
LSD 0.05	0.8692	0.6290	0.4903	0.4013	0.4144	0.2381	0.2813		
LSD 0.01	1.2185	0.8818	0.6873	0.5626	0.5810	0.3338	0.3943		

Table-2 Efficacy of various biopesticides against thrips infestation on cauliflower as compared to chemical control (Confidor) at different intervals after second spray.

Plant extracts	Pre-treatment	Post treatment observation/leaf after:						Pest Reduction /plant	Reduction %
		24hrs	48hrs	72hrs	96hrs	1week	2week		
Chemica lcontrol (confidor)	8.22	5.75	4.37	3.57	3.19	0.96	0.89	7.26	88.35
Neem extract	8.00	5.68	4.43	3.71	3.34	1.17	1.15	6.83	85.39
Akk extract	7.82	6.02	5.06	4.40	4.09	1.63	2.01	6.18	79.09
Tooh extract	6.70	5.09	4.18	3.60	3.33	1.30	1.60	5.40	80.64
Dhatura extract	7.60	6.08	5.23	4.70	3.81	1.60	1.97	6.00	78.97
Tobacco extract	7.90	5.85	4.68	4.02	3.70	1.37	1.68	6.53	82.68
Untreated	7.27	7.34	7.27	7.19	7.12	7.05	6.98	0.22	2.98
S.E.±	1.0981	0.8205	0.6658	0.5812	0.5438	0.2353	0.2606		
LSD 0.05	2.3825	1.7877	1.4506	1.2663	1.1848	0.5127	0.5679		
LSD 0.01	3.3541	2.5062	2.0337	1.7753	1.6610	0.7188	0.7961		

6. WHITEFLY

First spray

Whitefly population on cauliflower in response to application of biopesticides showed non-significant variation for pre-treatment insect count. The data **(Table-3)** exhibited that on the basis of efficacy against the target insect, the synthetic pesticide chemical control (confidor) 1st reducing whitefly population from 3.44/leaf to 0.17/leaf after two weeks of spray showing the highest efficacy of 95.75%; and the crop sprayed with neem extract ranked 2nd, where the whitefly population decreased from 3.53/leaf to 0.33/leaf after 2 weeks of spray showing efficacy of 91.89 %. Similarly, tobacco extract ranked 3rd by effectiveness against whitefly decreasing its population from 3.75/leaf to 0.48/leaf showing efficacy of 88.83 %. Tooh extract ranked 4th, decreasing whitefly population from 3.57/leaf to 0.66/leaf after two weeks of spray showing efficacy of 83.81 %. Akk extract ranked 5th, decreasing whitefly population from 3.84/leaf to 0.66/leaf after 2 weeks of spray showing efficacy of 84.88 %. Dhatura extract ranked 6th, causing minimum decrease in whitefly population from 3.79/leaf to 0.95/leaf after 2weeks of spray with lowest efficacy of 78.14 %. According to the efficacy the treatments ranked as: chemical control, neem extract, tobacco extract, tooh extract, akk extract and dhatura extract.

Second spray

Whitefly population on cauliflower in response to application of second spray of bio-pesticides showed non-significant variation for pre-treatment insect count. The data **(Table-4)** showed that on the basis of efficacy against whitefly after second spray, the synthetic pesticide chemical control (confidor) ranked 1st reducing whitefly population from 2.42/leaf to 0.38/leaf after two weeks of spray showing the highest efficacy of 86.36%; and the crop sprayed with neem extract ranked 2nd, decreasing whitefly population from 2.38/leaf to 0.72/leaf after 2 weeks of spray showing efficacy of 73.58 percent. Similarly, tobacco extract ranked 3rd by effectiveness against whitefly decreasing its population from 3.04/leaf to 0.87/leaf showing efficacy of 75.11 percent; while the Tooh extract ranked 4th, decreasing whitefly population from 2.15/leaf to 0.72/leaf after two weeks of spray showing efficacy of 70.67 percent. Akk extract ranked 5th, decreasing whitefly population from 2.49/leaf to 0.85/leaf after 2 weeks of spray showing efficacy of 70.05 percent. Dhatura extract ranked 6th, causing minimum decrease in whitefly population from 2.34/leaf to 0.89/leaf after 2 weeks of spray with lowest efficacy of 66.63 percent. After second spray to the efficacy of biopesticides against whitefly, the treatment effects were ranked and confirmed in the table.

Table-3 Efficacy of various biopesticides against whitefly infestation on cauliflower as compared to chemical control (Confidor) at different intervals after first spray.

Plant extracts	Pre-treatment	Post treatment observation/leaf after:						Pest Reduction /plant	Reduction %
		24hrs	48hrs	72hrs	96hrs	1week	2week		
Chemical Control (confidor)	3.44	2.24	1.48	0.89	0.58	0.15	0.17	3.29	95.75
Neem extract	3.53	2.37	1.63	1.06	0.95	0.29	0.33	3.24	91.89
Akk extract	3.84	2.77	2.02	1.70	1.45	0.58	0.66	3.26	84.88
Tooh extract	3.57	2.53	1.82	1.61	1.48	0.58	0.66	2.99	83.81
Dhatura extract	3.79	3.14	2.83	2.43	1.97	0.83	0.95	2.96	78.14
Tobacco extract	3.75	2.59	1.84	1.43	1.13	0.42	0.48	3.33	88.83
Untreated	3.86	3.90	3.86	3.82	3.77	3.73	3.72	0.13	3.33
S.E.±	0.3989	0.2887	0.2250	0.1842	0.1902	0.1093	0.1291		
LSD 0.05	0.8691	0.6290	0.4903	0.4013	0.4144	0.2381	0.2813		
LSD 0.01	1.2185	0.8818	0.6873	0.5626	0.5810	0.3338	0.3943		

Table-4 Efficacy of various biopesticides against whitefly infestation on cauliflower as compared to chemical control (Confidor) at different intervals after second spray.

Plant extracts	Pre-treatment	Post treatment observation/leaf after:						Pest Reduction /plant	Reduction %
		24hrs	48hrs	72hrs	96hrs	1week	2week		
Chemical Control (Confidor)	2.42	1.33	0.68	0.47	0.35	0.33	0.38	0.09	86.36
Neem extract	2.38	1.41	0.77	0.70	0.66	0.63	0.72	1.75	73.58
Akk extract	2.49	1.49	0.94	0.83	0.76	0.74	0.85	1.74	70.05
Tooh extract	2.15	1.33	0.80	0.68	0.64	0.63	0.72	1.52	70.67
Dhatura extract	2.34	1.59	1.11	0.96	0.79	0.78	0.89	1.56	66.63
Tobacco extract	3.04	1.79	1.04	0.83	0.78	0.76	0.87	2.28	75.11
Untreated	2.43	2.41	2.38	2.34	2.33	2.31	2.30	0.12	5.01
S.E.±	0.3297	0.2330	0.1804	0.1648	0.1550	0.1531	0.1720		
LSD 0.05	0.7183	0.5077	0.3931	0.3591	0.3377	0.3335	0.3747		
LSD 0.01	1.0071	0.7117	0.5511	0.5035	0.4735	0.4675	0.5253		

DIAMONDBACK MOTH

First spray

Diamondback moth population on cauliflower as affected by bio-pesticide application suggested non-significant variation for pre-treatment insect count. The data **(Table-5)** revealed that by efficacy, the chemical control (match) ranked 1st reducing diamondback moth population from 1.27/leaf to 0.02/leaf after two weeks of spray showing the highest efficacy of 98.88; and neem extract ranked 2nd, decreasing insect population from 1.17/leaf to 0.04/leaf showing efficacy of 97.23 %; while tobacco extract ranked 3rd by efficacy against diamondback moth decreasing its population from 1.30/leaf to 0.07/leaf showing efficacy of 95.39 %. Tooh extract ranked 4th, decreasing diamondback moth population from 1.19/leaf to 0.0.11/eaf after 2 weeks of spray showing efficacy of 92.19 %, and the Akk extract ranked 5th, decreasing diamondback moth population from 1.19/leaf to 0.28/leaf after 2 weeks of spray showing efficacy of 80.98 percent; while Dhatura extract ranked 6th, causing minimum decrease in diamondback moth population from 1.11/leaf to 0.14/leaf after 2 weeks of spray with lowest efficacy of 89.79 %. According to the efficacy of biopesticides against diamondback moth after first spray, the treatments ranked as: chemical control, neem extract, tobacco extract, Tooh extract, Akk extract and dhatura extract.

Second spray

The analyses of variance for Diamondback moth population on cauliflower as affected by biopesticide application demonstrated non-significant variation for pre-treatment insect count.

The data **(Table-6)** showed that on the basis of efficacy after second spray, chemical control (match) ranked 1st reducing diamondback moth population from 0.96/leaf to 0.01/leaf after two weeks of spray showing the highest efficacy of 99.47; and neem extract ranked 2nd, decreasing insect population from 0.96/leaf to 0.04/leaf showing efficacy of 96.27 %; while tobacco extract ranked 3rd by efficacy against diamondback moth decreasing its population from 0.94/leaf to 0.04/leaf showing efficacy of 96.44 %. Tooh extract ranked 4th, decreasing diamondback moth population from 1.02/leaf to 0.10/eaf after 2 weeks of spray showing efficacy of 91.54 percent, and the Akk extract ranked 5th, decreasing diamondback moth population from 0.89/leaf to 0.25/leaf after 2 weeks of spray showing efficacy of 77.94%; while Dhatura extract ranked 6th, causing lowest decrease in diamondback moth population from 0.94/leaf to 0.35/leaf after 2 weeks of spray with lowest efficacy of 69.19 %. According to the efficacy of biopesticides against diamondback moth after second spray, the treatments ranked as chemical control, neem extract, tobacco extract, tooh extract, akk extract and dhatura extract.

Table-5 Efficacy of various biopesticides against diamondback moth infestation on cauliflower as compared to chemical control (match) at different intervals after first spray.

Plant extracts	Pre-treatment	Post treatment observation/leaf after:						Pest Reduction /plant	Reduction %
		24hrs	48hrs	72hrs	96hrs	1week	2week		
ChemicalControl (match)	1.27	1.08	0.54	0.38	0.29	0.01	0.02	1.26	98.88
Neem extract	1.17	0.78	0.43	0.39	0.36	0.03	0.04	1.14	97.23
Akk extract	1.19	1.10	0.69	0.61	0.56	0.23	0.28	0.97	80.98
Tooh extract	1.19	1.07	0.64	0.55	0.52	0.09	0.11	1.10	92.19
Dhatura extract	1.11	1.03	0.72	0.62	0.51	0.11	0.14	0.99	89.79
Tobacco extract	1.30	1.14	0.66	0.53	0.50	0.06	0.07	1.24	95.39
Untreated	1.20	1.19	1.17	1.15	1.15	1.19	1.19	0.01	1.22
S.E.±	0.0880	0.1158	0.0773	0.0713	0.0713	0.0826	0.0984		
LSD 0.05	0.1917	0.2524	0.1684	0.1554	0.1554	0.1801	0.2145		
LSD 0.01	0.2687	0.3539	0.2360	0.2179	0.2178	0.2524	0.3007		

Table-6 Efficacy of various biopesticides against diamondback moth infestation on cauliflower as compared to chemical control (match) at different intervals after second spray.

Plant extracts	**Pre-treatment**	**Post treatment observation/leaf after:**						**Pest Reduction /plant**	**Reduction %**
		24hrs	**48hrs**	**72hrs**	**96hrs**	**1week**	**2week**		
Chemical Control (match)	0.96	0.86	0.43	0.30	0.15	0.01	0.01	0.95	99.47
Neem extract	0.96	0.87	0.48	0.44	0.40	0.04	0.04	0.92	96.27
Akk extract	0.89	0.82	0.52	0.45	0.40	0.20	0.25	0.69	77.94
Tooh extract	1.02	0.96	0.57	0.49	0.48	0.09	0.10	0.93	91.54
Dhatura extract	0.94	0.90	0.63	0.54	0.47	0.29	0.35	0.65	69.19
Tobacco extract	0.94	0.87	0.51	0.40	0.40	0.03	0.04	0.90	96.44
Untreated	1.01	1.00	0.99	0.97	0.98	1.01	1.01	0.00	0.00
S.E.±	0.0880	0.0806	0.0501	0.0449	0.0401	0.0690	0.0885		
LSD 0.05	0.1917	0.1757	0.1091	0.0978	0.0874	0.1503	0.1229		
LSD 0.01	0.2688	0.2463	0.1530	0.1371	0.1225	0.2107	0.2705		

7. DISCUSSION

Recent research has proved that safe and long lasting solution of the insect pest's problem is associated with the use of natural substances for their control, because the nature has a balanced ecosystem that keeps the population of all the biological organisms within the specific limits being useful or harmful for other organisms on earth. The present study showed that against thrips the first spray of chemical control exhibited highest efficacy 82.82%, followed by neem extract 78.42%, tobacco extract 72.33%, Tooh extract 69.51%, Akk extract 65.55% and lowest for Dhatura extract 58.97%; while in the second spray, chemical control exposed highest efficacy against thrips 88.35%; followed by neem extract 85.39%, tobacco extract 82.68%, Tooh extract 80.64% and least by Dhatura extract 78.97%. Against whitefly, chemical control showed highest efficacy 95.75% as observed after 1st spray, followed neem extract 91.89%, Tooh extract 83.81% and least efficacy for Dhatura extract 78.14%; while after second spray also, chemical control showed highest efficacy 86.36%, followed by neem extract 73.58%, tobacco extract 75.11%, Tooh extract 70.67%, Akk extract 70.05% and the lowest efficacy was resulted by Dhatura extract 66.63%. Against Diamondback moth population on cauliflower the first spray results showed that chemical control (match) showed highest efficacy 98.88% against diamondback moth, followed neem extract 97.23%, tobacco extract 95.39%, Akk extract 92.19%, Dhatura 89.79% and least efficacy was resulted by Akk extract 80.98%. After second spray, chemical control showed highest efficacy 99.47%, followed by neem extract 96.27%, tobacco extract 96.44%, Tooh extract 91.54%, Akk extract 77.94% and the lowest efficacy was resulted by Dhatura extract 69.19% against diamondback moth after second spray. According to the overall efficacy of biopesticides against thrips, whitefly and diamondback moth after first and second spray. These results are further confirmed by (Lowery and Isman, 1994) and stated 50% mortality of aphids by spraying neem based biopesticide and (Kumar and Singh, 2001) testified that neem seed kernel extract was affected to insect pests regarding cost: benefit ratio.

Ahuja *et al.,* (2012) Nzanza and Mashela (2012) reported that the mixture of neem and wild garlic was

more effective to decreasing the population densities of whitefly and aphid. In conclusion, results of this research suggested a synergistic effect of fermented plant extracts of neem and wild garlic as a bio-pesticide. Gupta *et al.,* (2013) suggested combination of biopesticides and synthetic pesticides application against whitefly, thrips .

8. CONCLUSIONS

The insect pests namely: thrips, whitefly and diamondback moth on cauliflower were effectively controlled by Chemical pesticides but neem extract exposed closely related for its efficacy against the target insect pests to the chemical control. Tobacco and Tooh extracts also exhibited remarkable consequences for their efficacy against cauliflower insect pests during the both sprays. The Akk extract was also successfully reduced the insect pest infestation and the Dhatura extract was also well controlled the cauliflower insect pests. Although, the efficacy was observed lowest among all the other bio-pesticides and chemical controls. Generally, the efficacy of bio-pesticides against insect pests, after first and second spray, the treatments are ranked as: chemical control, neem extract, tobacco extract, Tooh extract, Akk extract and dhatura extract.

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