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EFFICACY OF PLANT EXTRACTS AGAINST APHID *LIPAPHIS ERYSIMI* (KALT) IN BROWN MUSTARD *BRASSICA JUNCEA* L

Kunal Kaushik[1] and Rajesh Kumar[2]*

[1]Department of Horticulture, Assam Agricultural University, Jorhat 785013, Assam, India
[2]Department of Horticulture, Sikkim University, East Sikkim 737102, Sikkim, India
*Email: rkumar@cus.ac.in (corresponding author): ORCID ID 0000-0002-9275-8518

ABSTRACT

Brown mustard is one of the widely consumed leafy vegetables in Sikkim, India. The present investigation was an effort to find out an alternative approach to control aphid incidence organically, by using locally available plant extracts with high spray efficacy on mustard aphid *Lipaphis erysimi* (kalt) in the organic state of Sikkim. The experiment included six plant extracts viz. *Schima wallichii*, *Datura stramonium*, *Athyrium filix-femina*, *Piper betle*, *Alnus nepalensis* and *Artemisia vulgaris* along with cow urine and neem oil at two concentrations. Results revealed that maximum reduction in incidence was observed with *Schima wallichii* @5%. Growth, yield and quality components were also found to be significantly superior in the treatment with *S. wallichii*.

Key words: Efficacy, brown mustard, *Brassica juncea*, *Lipaphis erysimi*, spray, plant extracts, yield, aphid, control, *Schima wallichii*, *Datura*, *Athyrium*, *Piper*, *Alnus*, *Artemisia*, Sikkim, organic

Brown mustard (*Brassica juncea* L.) commonly known as Indian mustard one of the most commonly consumed leafy green vegetable crop in Sikkim. It is a fast-growing winter vegetable, and highly susceptible to aphid infestation. The state is blessed with diverse climatic condition, results in the huge genetic diversity among different vegetable crops (Debnath et al., 2020). Aphids (Hemiptera: Aphididae) are one of the primary sucking pests of crop plants, mainly attack *Brassica* crops. Among the aphid species, *Lipaphis erysimi* (Kalt) and *Myzus persicae* (Sulz) are the most common. Aphids also act as vectors for many disease-causing viruses and pathogens and further contribute to the yield losses. In commercial fields, Brassica pests are controlled primarily through pesticide applications (Sauckeet al., 2000). It is necessary to identify some alternative biopesticide, which can control the pest in a short period. In Sikkim, farmers are facing challenges to control the pests and diseases. Also new invasive pests like *Tuta absoluta* is also being reported (Kumar et al., 2020). In organic farming system, neem oil has been found to have activity against a wide range of insect pests and show both insecticidal and fungicidal properties. Being an organic state, in Sikkim, farmers frequently use the neem oil in pest management. Besides, the farmers traditionally use some locally available crude plant extracts such as Dokhrey, wild fern, wild betel vine, Utis, Titepati etc. to control insect infestation. However, these plant extracts are not used commercially as pesticides. In this study, samples of locally available plants were collected and evaluated to determine the spray efficacy of these extracts against mustard aphid. The extracts are ecofriendly, and safe to human health. The present study highlights the potential use of ecofriendly bioproducts and their effect on growth, yield quality attributes of brown mustard.

MATERIALS AND METHODS

The experiment was carried out at the Department of Horticulture, Sikkim University, Gangtok (27.30N, 88.58E) during rabi 2020-21. Healthy and disease-free seedlings were used as planting material. The fresh leaf samples were collected from close vicinity of East District, Sikkim. These include ten plants i.e., *Ageratum conyzoides, Alnus nepalensis, Ageratina adenophora, Piper betle, Athyrium filix-femina, Musa acuminata, Lantana camara, Artemisia vulgaris, Datura stramonium* and *Schima wallichii.* The samples were cleaned, dried and made as fine powder and further subjected for qualitative preliminary phytochemical examination i.e., presence of tannins, saponins, alkaloids, flavonoids, terpenoids, glycosides, steroids and phenols, using ethanol (50%) as a solvent through standard procedure suggested by Bargah (2015) and Edeoga (2005).Aphid inoculation was done with nymphs and adults, collected from brown mustard growing region. Isolation chambers were made using insect proof net for each treatment in order to avoid entry of other insects including natural enemies, till it colonized in the crop and crossed the economic threshold level (ETL). Within a month, the plants were equally infested and crossed ETL level. The identification of aphid was carried out by sending the adult insect sample to Department of Entomology, Dr. Y S Parmar University of Horticulture & forestry, Solan, Himachal Pradesh. A total of six plant extracts i.e., *Schima wallichii, Piper betle, Alnus nepalensis, Athyrium filix-femina, Artemisia vulgaris* and *Datura stramonium* were selected for further study based upon the results obtained through preliminary phytochemical screening. There were 16 treatments replicated thrice including six plant extracts at two concentrations i.e., 5 and 10% and cow urine @ 5ml/ ℓ and 10 ml/ ℓ and neem oil @ 5ml/ ℓ and 10 ml/ ℓ. These treatments were sprayed on both sides of the leaves during the morning hours with hand sprayers. Total three sprays were given in the interval of seven days.

Observations were taken from five randomly selected plants in each replication. Initiation of spraying was done upon the pest population reaching economic threshold level (ETL). Pretreatment observations were taken 24 hr before spraying Post-treatment observations were recorded after 1st, 3rd, 5th and 7th days of each spray except third spray, where the observation was made at one day after spray only. The aphids were counted manually with magnifying glass and % reductions in incidence was worked out (Mvumi and Maunga, 2018). All morphological and quality attributes were recorded at the maturity of the plants. Data were recorded upon plant height (cm), leaf length (cm), leaf width (cm), number of primary branches/ plant, number of leaves/ plant, weight of leaf (g), and leaf yield/ plant (g). Ascorbic acid (mg/ 100 g) was estimated as per the method of Rangana, (1976) and moisture content (%) was recorded through hot air oven drying method. The data was recorded from five randomly selected plants under each replication and mean was worked out. The experiment was statistically laid out as pot experiment in complete randomized design (CRD) with three replications and tested for least significant difference (p=0.05).

RESULTS AND DISCUSSION

Qualitative preliminary phytochemical screening among ten plant extracts was done for the presence of phytochemicals. Compounds like phenolics, flavonoids, terpenoids, tannins and steroids were higher in *Alnus nepalensis, Piper betle, Athyrium filix-femina, Artemisia vulgaris, Datura stramonium*

Table 1. Effect of plant extracts on *L. erysimil* incidence on brown mustard

S. No.	Treatments	Aphid incidence control after 1st spray (%)				Aphid incidence control after 2nd spray (%)				Aphid incidence control after 3rd spray (%)
		1st day	3rd day	5th day	7th day	1st day	3rd day	5th day	7th day	1st day
1	T_1 (*Schima wallichii*@ 5%)	60.81	90.22	90.30	78.52	70.36	85.18	93.14	82.28	57.26
2	T_2 (*Schima wallichii*@ 10%)	45.84	54.22	71.21	62.53	38.40	46.32	77.19	60.79	38.06
3	T_3 (*Piper betle*@ 5%)	12.60	21.48	24.36	15.69	19.59	20.20	28.80	17.40	16.13
4	T_4 (*Piper betle*@ 10%)	25.35	47.55	48.41	40.43	29.29	55.57	68.24	54.48	28.06
5	T_5 (*Alnus nepalensis* @ 5%)	31.35	61.16	69.87	55.05	42.45	58.23	75.41	58.47	43.03
6	T_6 (*Alnus nepalensis* @ 10%)	20.40	42.15	67.25	63.19	24.11	40.00	66.78	64.45	21.30
7	T_7 (*Athyrium filix-femina*@ 5%)	39.35	49.22	61.86	53.61	36.19	49.50	79.52	65.89	30.13
8	T_8 (*Athyrium filix-femina*@ 10%)	28.68	45.39	59.17	53.48	28.54	50.12	75.60	63.12	21.33
9	T_9 (*Artemisia vulgaris* @ 5%)	43.08	69.08	86.09	77.58	48.20	73.26	90.60	81.44	54.26
10	T_{10} (*Artemisia vulgaris* @ 10%)	27.96	53.23	78.42	68.49	32.38	58.42	72.48	67.22	38.18
11	T_{11} (*Datura stramonium* @ 5%)	42.37	58.35	75.45	69.57	45.63	61.28	70.62	60.45	35.11
12	T_{12} (*Datura stramonium* @ 10%)	39.41	53.55	67.36	57.51	42.36	56.31	66.33	54.37	20.66
13	T_{13} (Neem oil @ 5%)	45.13	60.37	73.60	63.24	43.31	61.20	81.22	72.41	48.11
14	T_{14} (Neem oil @ 10%)	40.06	53.32	71.65	58.56	34.52	56.56	76.51	58.31	43.59
15	T_{15} (Cow urine @ 5%)	NA	NA	NA	NA	NA	NA	NA	NA	NA
16	T_{16} (Cow urine @ 10%)	NA	NA	NA	NA	NA	NA	NA	NA	NA
	CD (p=0.05)	3.54	6.19	6.99	4.88	4.67	4.76	5.03	5.24	5.57
	SE(m)	1.21	2.12	2.40	1.67	1.60	1.63	1.72	1.80	1.91

NA: Aphid incidence was not countable

Table 2. Effect of plant extracts on growth, yield and quality attributes of brown mustard

S. No.	Treatments	Plant height (cm)	Number of primary branches	Leaf length (cm)	Leaf width (cm)	Number of leaves/ plant	Weight of leaf (g)	Leaf yield/ plant (g)	Moisture content (%)	Ascorbic acid (mg/ 100g)
1	T_1 (*Schima wallichii*@ 5%)	120.57	7.43	28.14	20.20	18.43	25.58	480.00	90.29	48.14
2	T_2 (*Schima wallichii*@ 10%)	108.1	6.64	24.29	17.65	16.43	23.57	379.41	85.19	42.20
3	T_3 (*Piper betle*@ 5%)	84.13	4.31	17.67	13.36	13.42	18.44	255.26	74.42	29.31
4	T_4 (*Piper betle*@ 10%)	89.51	4.55	18.12	13.92	13.69	19.34	273.66	75.59	31.46
5	T_5 (*Alnus nepalensis* @ 5%)	95.63	5.63	21.24	15.81	14.61	21.26	348.65	78.42	36.71
6	T_6 (*Alnus nepalensis* @ 10%)	94.16	5.35	20.44	15.26	14.42	21.31	303.84	77.22	34.26
7	T_7 (*Athyrium filix-femina*@ 5%)	99.00	5.53	22.16	16.56	15.47	22.67	376.49	81.18	38.45
8	T_8 (*Athyrium filix-femina*@ 10%)	97.53	5.56	21.68	16.61	15.29	22.16	336.23	80.25	37.19
9	T_9 (*Artemisia vulgaris* @ 5%)	116.40	6.64	26.62	18.63	14.47	24.58	440.21	88.51	46.30
10	T_{10} (*Artemisia vulgaris* @ 10%)	102.26	5.76	23.48	17.35	16.19	22.54	377.09	82.46	39.34
11	T_{11} (*Datura stramonium* @ 5%)	92.41	5.36	20.30	14.59	14.60	20.38	313.12	76.53	32.37
12	T_{12} (*Datura stramonium* @ 10%)	90.27	4.80	19.40	14.51	13.98	19.67	265.61	76.14	31.63
13	T_{13} (Neem oil @ 5%)	115.4	6.38	23.52	18.33	15.19	24.37	411.73	87.09	44.11
14	T_{14} (Neem oil @ 10%)	106.64	6.57	24.42	17.56	16.28	23.10	387.95	84.40	41.45
15	T_{15} (Cow urine @ 5%)	64.34	3.63	12.69	11.31	7.10	13.08	90.14	70.15	22.09
16	T_{16} (Cow urine @ 10%)	68.21	3.45	13.07	9.06	8.14	14.37	114.79	68.12	21.15
	CD (p=0.05)	4.56	1.98	3.38	2.85	3.20	2.76	89.05	7.90	3.27
	SE(m)	1.57	0.68	1.17	0.98	1.10	0.95	30.77	2.73	1.13

and *Schima wallichii*. These extracts were selected for further use in aphid control. Natural antioxidant such as phenolics, flavonoids, and tannins play an important role in protecting cells from free radical-induced damage without causing any side effect (Mansoori et al., 2020). There was significant response after first, second and third application (Table 1). The spray of T_1 (*Schima wallichii@* 5%) imparted maximum control (60.81, 90.22, 90.30 and 78.52%) at 1st, 3rd, 5th, and 7th day after first application, respectively. Similar pattern was observed after second spray and maximum control was in the same treatment. Third application was at 7 days after the second spray. The data was recorded one day after spraying only and *Schima wallichii@* 5% was found to be the most effective. The phytochemical compounds in the *Schima wallichii*, especially the phenolics and steroids are well-known for their insecticidal or repellent quality. These compounds are predominantly responsible for natural plant defence mechanism (Pal and Pal, 2016; Bargah, 2015; Tadasse et al., 2016; Sharma and Patel, 2016; Campos et al., 2019). Some bioactive compounds isolated from *S. wallichii* such as kaemferol-3-O-ramnosida have bioactivity as rotenone with antimicrobial and insecticidal properties (Widiyarti and Fitrianingsih, 2019). Singh and Lal (2012) found significant effect of locally available plant extracts like panchphuli and garlic leaf extracts. Similar results were also shown by earlier workers against mustard aphid (Baloch et al., 2018; Mvumi and Maunga, 2018; Gouvea et al., 2019). Cow urine spray control the aphid population and found to be ineffective.

All morphological traits were found significantly improved through with application of plant extracts (Table 2). Plant height (120.57cm), number of primary branches/ plant (7.43), leaf length (28.14 cm), leaf width (20.20cm), number of leaves/ plant (18.43), weight of leaf (25.58 g) and leaf yield (480g)was found maximum in treatment T_1 (*Schima wallichii@* 5%). Significant effect of *Schima wallichii@* 5% upon morphological attributes was possibly due to the presence of high amount of phytochemical compounds, which enabled plants to sustain severe infestation of aphids. The resistance results in better photosynthetic activities, which increased these growth and yield attributes and in turn the leaf yield (Meena et al., 2019; Yusuf et al., 2020). There existed a significant variation in ascorbic acid and moisture content with treatments. Moisture content (90.29%) and ascorbic acid (48.14 mg/ 100) was recorded maximum in T_1 (*Schima wallichii@* 5%). There was a significant increase in ascorbic acid and moisture content with application of *Schima wallichii* @ 5% (Reddy et al., 2019).

Based on experiment results, T_1 (*Schima wallichii@* 5%), was found significantly superior over rest of the plant extracts in aphid incidence control, additionally it also improved growth, yield and quality attributes of the crop. Cow urine spray is most common and traditional practice of the farmers for aphid control in Sikkim Himalayas, remained ineffective. The treatment may be further recommended for commercial utilization for plant protection in organic farming system in Sikkim towards the single window standard organic production technology of brown mustard.

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AUTHOR CONTRIBUTION STATEMENT

Rajesh Kumar conceptualized and framed the research proposal; Kunal Kaushik conducted the experiment, curated data and prepared original draft.

CONFLICT OF INTEREST

No conflict of interest.

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