Research article

Bangladesh Journal of Ecology

ISSN (Print): 2708-6356, ISSN (Online): 2708-6364, URL: bsmrau.edu.bd/bjoe
Bangladesh J. Ecol. (2020) 2 (2) : 107-111

EFFICACY OF SOME PLANT EXTRACTS FOR CONTROLLING APHID AND DIAMOND BACK MOTH OF CABBAGE

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Received: 28 September 2020, Revised: 19 October 2020, Accepted: 30 October 2020

ABSTRACT

Cabbage (*Brassica oleracea* L.var. capitata) is usually infested by aphid and diamond back moth, which damage the leaves, heads and whole cabbage plant. This study assessed the dose dependent efficacy of four botanicals (Jute seeds, *Corchours capsularis* L; Water Gourd Leaves, *Lagenaria siceraria*; Lemon outer shell, *Citrus limon* and Turmeric leaves, *Curcuma longa*) to control the aphid and diamond back moth in experimental cabbage (variety Sakata F1 Hybrid Atlas 70) field during November 2019–February 2020. About 21.9% and 13.9% reduced number of aphids were found with Water gourd leaves at 5% and 10% concentrations, respectively. A high number of aphids were observed in 5% Turmeric leaves treatment. Jute seed treatments (2.5%, 5.0% and 10.0%) were found very effective against diamond back moth and protect 100% the cabbage plant from this insect. However, 10% Jute seed extract was found phyto-toxic to cabbage that deformed the leaves and stunted the plant growth, resulting 27.32% yield loss over control. Out of 13 treatments, higher yield over control was found only in five treatments (2.5% jute seed, 10% Water gourd leaves, 10% Lemon outer shell, 2.5% Turmeric leaves and 5% Turmeric leaves).

Keywords: Aphid, botanicals, cabbage, diamond back moth

Introduction

Cabbage (*Brassicae oleracea* var. capitata Linn.) is a vegetable crop belongs to the Brassicaceae family (Richardson 2016). It is a widely grown vegetable throughout the world. Cabbage is one of the most popular food crops (Embaby and Lotfy 2015). It is grown for domestic uses as well as cash-crop (Munthali and Tshegofatso 2014). It is also an important vegetable that reduces human health problems and used to make cabbage-based conventional medicines for heart disease, stroke, alleviate rheumatism and skin problems (Rokayya *et al.* 2013).

Wubie *et al.* (2014) reported that major constraints of cabbage cultivation are aphids and diamondback moth, which damage cabbage from seedling to final growth (head formation) stage. Cabbage aphid (*Brevicoryne brassicae* L.) is an insect pest, which belongs to the family Aphididae of the order Hemiptera, grouped under serious plant sap sucking pest's worldwide (Wubie *et al*. 2014). It exists in large numbers underside of the leaves and growing region of infested vegetables (Munthali and Tshegofatso 2014). The insect also appears as grayish-white to powdery blue due to waxy covering (honeydew); but naturally they are grayish green in color (Bodaiah *et al.* 2016). They can reduce cabbage yield and quality as well as marketable value and nutritional contents (Wubie *et al*. 2014).

Diamondback moth (*plutella xylostella* L.), belongs to the family of Plutellidae under the order of Lepidoptera, is the destructive pest of cabbage (Nyambo and Pekke, 1995). A high population of diamondback moth can cause 90% yield loss of cabbage (Verkerk and Wright, 1996). For many years, it has been considered as the major pest of cabbage and other brassica crops (Furlong *et al*. 2013).

Bangladesh and many other Asian countries are rich in plant products. Traditionally rural inhabitants of these countries use botanicals for medicinal and insect control purposes (Talukder and Howse 1993). Botanical pesticides tend to have a broad spectrum activity, are relatively specific in their mode of action and easy to process and use at farm-level. They are also safe for higher animals and the environment. Plants are rich sources of natural substances that can be utilized in the development of environmentally safe methods for insect

control (Sadek 2003). Certain plant families, particularly Meliaceae, Rutaceae, Asteraceae, Labiaceae, Piperaceae and Annonaceaeare viewed as exceptionally promising sources of plant-based insecticides. Botanicals can easily be prepared from local plants and their use in controlling cabbage aphids is sustainable. Therefore, the present study was carried out to evaluate the efficacy of aqueous extracts of four botanicals (Jute seeds, Water gourd leaves, Turmeric leaves and Lemon outer shell) in experimental cabbage field to control the aphids and diamond back moths.

Materials and Methods

Experimental site: The field experiment was carried out during growing season 2019-2020 at IES Botanical Pesticides Research Field of University of Rajshahi. The climate of Rajshahi is sub-tropical with little arid than other parts of Bangladesh and winter season extends from November to February. Average annual rainfall of Rajshahi area is 1542 mm. The area was situated at 24° 22' North latitude and 88° 36' East longitude with an elevation of 18.0 m above sea level. The experiment was laid down in a randomized complete block design (RCBD) with three replications having an experimental unit size 10 m X 10 m. Twenty one days old cabbage seedlings variety Sakata F1 Hybrid Atlas 70 was collected from Nouhata Nursery, Rajshahi and transplanted on 11th November, 2019 in the field and completed the experiment on 15th February, 2020. Plant to plant distance of cabbage is was 60 cm and row to row distance was 60 cm (Sultana *et al*., 2019). During this experiment, standard agronomic practices including ploughed the soil, normal weeding, fertilization, irrigation and sanitation were followed.

Botanical extract preparation and spray: Jute (*Corchours capsularis* L) seeds, Water gourd (*Lagenaria siceraria*) leaves, Lemon (*Citrus limon*) outer shell and Turmeric (*Curcuma longa*) leaves were collected from the campus of University of Rajshahi, Bangladesh . After collection, seeds, leaves and plant parts were washed in running tap water. About 100 gm of grinding or cutting leaves, outer shell of fruits and seeds were dissolved in one liter of water and boiled for 45 min. Then the solutions were cool down and filtered with plastic filter. Then three different concentrations were prepared as 10%, 5% and 2.5%. The aqueous extract was preserved in plastic bottles at room temperature.

Botanicals extracts were sprayed on experimental cabbage field twice a week with the help of sprayer. One control treatment of without botanical pesticide was maintained in this experiment where only water was sprayed. Botanicals were sprayed 16-times in cabbage field, started on 18th December, 2019 and finished on 10th February, 2020.

Pest monitoring: The pest attack was monitored regularly in the experimental field. The number of leaves and plants attacked by diamond back moth was recorded every 7-days in the field.

Aphid population was recorded from the start of aphid colonization until the maturity of the cabbage plant. The numbers of aphid was counted as per leaf-sampling system (Church and Strickland, 1954). For the estimation of aphid, outer three leaves of cabbage were collected randomly from each replication of the treatment and aphid in each leaf (both upper and lower) was counted manually and then average population per leaf was made. The aphid population was monitored in cabbage field at 30 days, 45 days and 65 days after plantation.

Data collection and analysis: Aphid numbers, infestation of diamond back moth, phyto-toxicity and cabbage yield data were collected during this experiment. The mean values of data were separated according to Duncan's Multiple Range Test. The analyses were performed using statistical software SPSS version 20.0.

Results and Discussion

Table 1 demonstrates the effect of botanicals on number of plants attack, leaves attack and leaves perforation. The highest number of leaves attacked by insects was found in 5% Lemon outer shell and 2.5% Water gourd leaves treatments, whereas leaves perforations were high in 2.5% Turmeric leaves and 2.5% Water gourd leaves treatments. Out of 12 botanical treatments, good protection against insects was observed in 10% Turmeric leaves treatment. Besides the cabbage leave infestation by leaf-eating caterpillars, different kinds of leaf-borer snail were also observed in the field because Rajshahi region is famous molluscan biodiversity. Turmeric leaves extract (10%) may act as the repellant of snail because a low number of leaves attack (20.39%) was found in this treatment compare to the control (45.21%) treatment (Table 1).

Out of four botanicals, only Jute seed was found 100% effective against diamond back moth (*Plutella xylostella*) (Table 1). In other three treatments (Water gourd, Lemon

Table 1. Effect of different plant extracts on infestation of diamond back moth on cabbage

Treatments	Infested plant (%)	Leaves attacked (%)*
Control	33%	45.21ab
Jute Seed (10%)	0.00	41.21ab
Jute Seed (5%)	0.00	31.25ab
Jute Seed (2.5 %)	0.00	39.56ab
Water Gourd Leaves (10%)	33%	31.35ab
Water Gourd Leaves (5%)	0.00	35.71ab
Water Gourd Leaves (2.5%)	33%	51.05ab
Lemon outer shell (10%)	0.00	39.23ab
Lemon outer shell (5%)	33%	58.31a
Lemon outer shell (2.5%)	33%	38.29ab
Turmeric Leaves (10%)	0.00	20.39b
Turmeric Leaves (5%)	33%	31.97ab
Turmeric Leaves (2.5%)	33%	43.75ab

*Besides the diamond back moth, leaves were also attacked by leafborer snail.

Table 2. Effect of different plant extracts on the abundance of aphid on cabbage

Treatments	Aphid Abundance (number/Leaf)	
	45 DAT	60 DAT
Control	61.67bc	186.67bc
Jute Seed (10%)	59.67bc	179.00bc
Jute Seed (5%)	78.67ab	237.00ab
Jute Seed (2.5 %)	94.67a	283.33a
Water Gourd Leaves (10%)	53.33bc	160.00bc
Water Gourd Leaves (5%)	48.33bc	145.33bc
Water Gourd Leaves (2.5%)	69.67abc	210.00abc
Lemon outer shell (10%)	78.33ab	235.00ab
Lemon outer shell (5%)	73.33abc	220.00abc
Lemon outer shell (2.5%)	69.33abc	209.33abc
Turmeric Leaves (10%)	75.33abc	225.67abc
Turmeric Leaves (5%)	95.67a	287.00a
Turmeric Leaves (2.5%)	78.33ab	235.33ab

DAT – Day after transplantation

outer shell and Turmeric leaves) 33% cabbage plants were affected by diamond back moth in experimental field. Diamond back moth infestation caused heavy damages to cabbage in the field. Krishnamoorthy (2003) reported 52% yield loss of cabbage due to diamondback moth in India. Because, this insects perforate most cabbage leaves and stunted the normal growth of cabbage. Farmers are unable to sell the cabbage moth infested cabbage in the market. According to Isman (2006) despite the potential advantages of botanical insecticides, these are not gained widespread usage globally because farmers usually want a very rapid knock-down to demonstrate effective application to the crop but botanical insecticides operate more slowly, some act as repellant other than killing toxicity to insect.

Aphid attack is dependent on weather condition and plant maturity. During this experiment, aphid was not noticed within 30 days of seedlings plantation. Aphid infestation was first observed on 45 days of seedlings plantation and second time after 60 days. The number of aphids per leaf is presented in Table 2. Aphid infestation was found higher after 60-days of plantation than early stage of cabbage at 45 days. Out of 13 treatments of this study, Water gourd leaves (both 5% and 10%) showed good protection of cabbage from aphids compare to other treatments. About 21.9% and 13.9% less number of aphids was found in Water gourd leaves (5%) and Water gourd leaves (10%), respectively (Table 3).The highest attack of aphid was found in 2.5% Jute seed treatment and 5% Turmeric leaves treatment (Table 2).

Bio-potential of many species of plants have been studied by several workers globally against aphid species. Wubie *et al*. 2014 carried out laboratory experiments on *Mentha piperita* plant extracts and found effective against cabbage aphid, *Brevicoryne brassicae* in terms of repellent and insecticidal activity. Birhanu *et al.* (2011) studied with

Table 3. Aphid abundance (%) over control

Treatments	Abundance (%) over control	
	45 DAT	60 DAT
Control		
Jute Seed (10%)	- 3.2	- 4.11
Jute Seed (5%)	+ 27.56	+ 26.97
Jute Seed (2.5 %)	+ 53.49	51.78
Water Gourd Leaves (10%)	- 13.52	- 14.28
Water Gourd Leaves (5%)	- 21.63	- 22.17
Water Gourd Leaves (2.5%)	+12.92	+ 12.50
Lemon outer shell (10%)	+27. 01	+ 25.89
Lemon outer shell (5%)	+ 18.90	+ 17.85
Lemon outer shell (2.5%)	+ 12.42	+12.14
Turmeric Leaves (10%)	+ 22.50	+ 20.89
Turmeric Leaves (5%)	+ 55.13	+ 53.75
Turmeric Leaves (2.5%)	+ 27.01	+ 26.07

DAT – Day after transplantation; Increase (+) aphid abundance over control; Reduce aphid abundance (-) over control

botanicals of *Melia azedarach* and *Mentha piperita* plant extracts against cabbage aphid. Zaki (2008) studied the field application of some plant extracts against the aphid and their side effects on their predators and parasites. Khatun *et al*. (2018) observed a less number of aphid attack in the Lemon outer shell treatment in bean fields. This result is similar to the present findings. Kwon *et al.* 2019 observed lowest abundance of aphid in neem oil treatment in country bean field.

Jute seed (10%) was found phyto-toxic to cabbage plant, made leaves short and deformed. Phyto-toxicity was observed on more than 50% leaves of cabbage of this treatment (Table not shown). Therefore, a lowest yield (1681.33 g) was found compare to other treatments. The yield loss was 27.32% less over control treatment (Table 4). However, a higher yield over control was found in five treatments such as Jute seed (2.5%), Water gourd leaves (10%), Lemon outer shell (10%), Turmeric Leaves (2.5%) and 5% Turmeric Leaves (Table 4). The highest yield of cabbage (3454.00 g) was recorded in 2.5% Turmeric leaves treatment compare to control (2313.33 g) treatment (Table 4).

Table 4. Effect of plant extracts on cabbage yield

Treatments	Weight (g)/ Cabbage	Yield over control (%)
Control	2313.33bc	
Jute Seed (10%)	1681.33c	- 27.32
Jute Seed (5%)	2280.00bc	- 1.44
Jute Seed (2.5 %)	2657.67abc	+ 14.89
Water Gourd Leaves (10%)	2626.67abc	+ 13.54
Water Gourd Leaves (5%)	2036.67bc	- 11.96
Water Gourd Leaves (2.5%)	2210.00bc	- 4.47
Lemon outer shell (10%)	2432.67abc	+ 5.16
Lemon outer shell (5%)	2304.67bc	- 0.37
Lemon outer shell (2.5%)	2224.67bc	- 3.83
Turmeric Leaves (10%)	2215.67bc	- 4.22
Turmeric Leaves (5%)	2893.00ab	+ 25.06
Turmeric Leaves (2.5%)	3454.00a	+ 49.30

Increase (+) yield over control; Decrease (-) yield over control

Conclusion

Water gourd leaves extract showed good efficacy against aphid in experimental cabbage field. Jute seed extract was found very effective against diamond back moth infestation. However, 10% extract of jute seed showed phyto-toxic effect to cabbage plant, deformed the leaves and stunted the plant growth.

References

Ahmed MT, Miah MRU, Amin MR, Hossain MM, Suh SJ and Kwon YJ. 2019. Plant material as an alternative tool for management of aphid in country bean field. International Journal of Pest Management, *65*: 171-176.

Birhanu M, Awoke Y, Tahgas A and Raja N. 2011. Efficacy of *Melia azedarach* and *Mentha piperita* plant extracts against cabbage aphid, *Brevicoryne brassicae* (Homoptera: Aphididae). World Applied Sciences Journal, *12*: 2150-2154.

Bodaiah B, Kumar A, Varma R, Anuhya G and Sudhakar P. 2016. Pesticidal activity of plants on selected insects. International Journal of Recent Scientific Research, 7: 9298-9304.

Church BM and Strickland AH. 1954. Sampling cabbage aphid populations on Brussels sprouts. Plant Pathology, *3*: 76-80.

Embaby S and Lotfy D. 2015. Ecological studies on cabbage pests. Journal of Agricultural Technology, *11*: 1145-1160.

Furlong MJ, Wright DJ and Dosdal LM. 2013. Diamond back moth ecology and management: problems, progress and prospects. Annual Review of Entomology, *58*: 517-541.

Isman MB. 2006. Botanical insecticides, deterrents, and repellents in modern agriculture and an increasingly regulated world. Annual Review of Entomology, *51*: 45-66.

Khatun JA, Azad MAK and Ahmed MS. 2018. Eco-friendly management of aphid with botanical pesticides in country bean field at Rajshahi, Bangladesh. Rajshahi University Journal of Environmental Science, *7*: 1-10.

Krishanamoorthy A. 2003. IPM package for cabbage with safe pesticide residue. IIHR, Bangalore, India. p. 8.

Munthali D and Tshegofatso A. 2014. Factors affecting abundance and damage caused by cabbage aphid, *Brevicoryne Brassicae* on four *Brassica* leafy vegetables: *Brassica oleracea, var. Acephala, B.chinense, B. napusand B. carinata*. The Open Entomology Journal, *8*: 1-9.

Nyambo BT and Pekke A. 1995. *Brassica* pest management. In. proc. of the *Brassica* planning workshop: East and South Africa Region. Lilongwe, Malawi.

Richardson K. 2016. Evaluation of the Broccoli (*Brassica oleraceae* L.) Variety imperial. Gladstone Road Agricultural Centre Crop Research Report.

Rokayya S, Li C, Zhao Y, Ying L and Sun C. 2013. Cabbage (*Brassica oleracea* L.var. capitata) phytochemicals with antioxidant and anti-inflammatory potential. Asian Pacific Journal of Cancer Prevalence, *14*: 6657-666.

Sadek MM. 2003. Antifeedant and toxic activity of *Adhatoda vasica* leaf extract against *Spodoptera littoralis* (Lepidoptera: Noctuidae). Journal of Applied Entomology, *27*: 396-404.

Sultana MS, Khatun MF, Alam SN and Miah MRU. 2019. Population abundance of leaf-eating caterpillars of cabbage. Bangladesh Journal of Agricultural Research, *44*: 79-87.

Talukder FA and Howse OE. 1993. Deterent and insecticidal effects of pithraj, *Aphanamixi spolistachya* against *Tribolium castanium* in storage. Journal of Chemical Ecology, *19*: 2463-2471.

Verkerk RHJ and Wright DJ. 1996. Multitrophic interactions and management of the diamondback moth: a review. Bulletin of Entomological Research, *86*: 205-216.

Wubie M, Negash A, Guadie F, Molla G, Kassaye K and Nagappan R. 2014. Repellent and insecticidal activity of *Mentha piperita* (L.) plant extracts against cabbage aphid (*Brevicoryne brassicae*)Linn. (Homoptera: Aphididae)]. American-Eurasian Journal of Scientific Research, *9*: 150-156.

Zaki FN. 2008. Field application of plant extracts against the aphid, *B. brassicae* and the whitefly, *B. tobaci* and their side effects on their predators and parasites. Archives of Phytopathology and Plant Protection, *41*: 462-466.