

## **Impact of *Melia azedarach* Linn. (Meliaceae) Dry Fruit Extract, Farmyard Manure and Nitrogenous Fertilizer Application Against Cabbage Aphid *Brevicoryne brassicae* Linn. (Homoptera: Aphididae) in Home Garden**

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**Abstract:** Aim of the present study was to check the impact of *Melia azedarach* dry fruit extract, farmyard manure and nitrogenous fertilizer application against cabbage aphid *Brevicoryne brassicae*. *B. brassicae* is one of the key pests affect the quality and market value of cabbage. The home garden experiment was conducted in two season (September to December 2009 and February to May 2010). For this experiment totally five plots were prepared with 4 m length and 0.6 m width. Among the five plots one was used as control and another four was experimental plot for the application of nutrient and botanical spraying. *M. azedarach* dry fruit extract (5%) was mixed with 0.2% local soap solution and sprayed in experimental plot. Purposive sampling method was adopted for data collection for which the number of aphids was recorded from three leaves of each plant. The experimental results indicates that except farmyard manure and combination of farmyard manure+urea treated plot remaining all showed significant difference ( $p < 0.025$ ) in aphid population compared to control. The weight of the cabbage head did not show any significant difference ( $p > 0.025$ ) in control and farmyard manure treated plot but the remaining showed statistically significant difference. The experimental results for both cropping seasons were consistent. Nitrogenous fertilizer applications influence the growth of the plants but did not show any remarkable changes in cabbage head weight except plant growth. The study concludes that foliar and basal application of *M. azedarach* dry fruit powder had significant impact on cabbage aphid, *B. brassicae*. It can be a suitable alternative method to protect cabbage crop against aphid infestation particularly small farming community those who are unable to afford cost of chemical pesticides.

**Key words:** Aqueous, *Brevicoryne brassicae*, cabbage, extract, farmyard, fertilizer, manure, *Melia azedarach*, urea

### **INTRODUCTION**

Cabbage aphid, *Brevicoryne brassicae* is one of the key pests affect the quality and market value of cabbage (Birhanu *et al.*, 2011). These pests are source for transmitting 20 plant viruses to cause damage to many plant species belongs to the family Cruciferae (Blackman and Eastop, 2000). The estimated annual damage caused by these pests in an average of about 30% in USA even though pest control technologies are available and in Turkey the potential is higher, averaging 50% or more (Roberson, 1999). In Ethiopia, study conducted at Bridge to Israel children village farm at Gondar reports 70-80% of the plants were severely infested by aphid (Gebrelibanos *et al.*, 2011). According to Clark and Yamaguchi (2002) cabbage aphids are developed quicker and stronger resistance to increased application of insecticide than any other insects. In addition, aphid population levels are not significantly reduced by insecticide treatment due to the toxicity to natural enemies as well as the slow generation times and genetic variability of the aphid (Xu *et al.*, 2009).

To overcome this problem botanical pesticides are one of the safer alternative sources to suppress some threatening pests. Even though, botanicals are practiced since time immemorial recent time scientific communities showing great interest to identify potential bioactive plants for pest control program due to environmental pollution and health hazard. Persian lilac or Chinaberry tree *Melia azedarach* L. (Meliaceae), a close relative of neem presents a promising approach for integrated pest management. The insecticidal properties of *M. azedarach* extracts could be equivalent to that of neem extract based on the source material and the type of pest in question (Champagne *et al.*, 1989; Lee *et al.*, 1991). This plant extract inhibits 99.41% on the development of sugarcane woolly aphid, *Ceratovacuna lanigera* (Wabale and Kharde, 2010); more toxic to cabbage armyworm, *Pseudaletia impuncta* and sweet potato whitefly, *Bemisia tabaci* (Aktar *et al.*, 2009; Jazzar and Hammad, 2003); protect 88.3% feeding by cabbage white fly, *Pieris brassicae* (Sharma and Gupta, 2009); induce 100% mortality on *Ocneridia volxemi* which is feeding on cereal and other crops (Bounechada and Fenni, 2007); 76.9%

mortality on *Brevicoryne brassicae* (Zaki *et al.*, 2008) and 90% mortality in *Drosophila melanogaster* (Italo Chiffelle *et al.*, 2009).

Application of farmyard manure and nitrogenous fertilizers are commonly used agricultural practices to improve the soil fertility and plant growth respectively. The organic matter availability in the soil enhances the level and diversity of soil micro- and macrobiota which indirectly support plant health by various processes (McGuinness, 1993). However, larger infestation of flea beetles and some cases cabbage aphids was noticed in nitrogenous fertilizer applied broccoli, *Brassica oleraceae* (Altieri *et al.*, 1998). In addition, excessive nutrient application can also lead to pest problem by increasing reproduction, longevity and overall fitness of certain pests (Jahn, 2004). Therefore, farmers failed to achieve below their expected yield in fertilized field and again advocates of organic agriculture often assert that plants supplied exclusively with nutrient from biological materials are more resistant to insects than those grown using chemical fertilizers (Mochiah *et al.*, 2011).

*Melia azedarach* is one of the fast growing trees in Ethiopian highlands. It is abundantly grown as an avenue tree for shade along the road side of University of Gondar campuses particularly in Maraki and Tewodros. The farmyard manure in this area is also abundant which is not properly utilized for the management of soil fertility. Therefore, the objective of the present study was to explore the utilization of local resources for the management of cabbage aphid *B. brassicae* in a sustainable way.

## MATERIALS AND METHODS

The home garden experiment was conducted in two cropping season (September to December 2009 and February to May 2010) at Kabele 18, Samunaber village, Gondar. The plant extraction was done at Botany laboratory, Department of Biology, Faculty of Natural and Computational Sciences, University of Gondar, Gondar, Ethiopia from September to October 2009.

**Preparation of materials:** Physiologically matured *M. azedarach* fruits were collected from kabele 18, Samunabaur village, Gondar, Ethiopia. The fruits were thoroughly dried under shade at botany laboratory. The dried fruits were ground to make powder using mortar and pestle. The fine powder was obtained from the grounded fruits after sieving through the kitchen strainer. The powder was used to prepare 5% aqueous solution for foliar spray and kept for basal application. Aqueous extract was prepared from the powdered fruits because this method is easily applicable for local farming communities. This simple reproducible method is economically viable and easily adoptable. The required

amount of farmyard manure and nitrogenous fertilizer (urea) were gifted by the farmers settled nearer to Sinta River, Samunabaur, Gondar.

**Experimental plot preparation:** The home garden experiment was conducted at Sumunabaur village nearer to University of Gondar, Gondar, Ethiopia. The experimental site was located at 12°36' N latitude and 37°28' E longitude with an elevation of 2133 meter above sea level. The experimental plot was prepared with 4m length and 0.6 m width. Totally five plots were prepared with the same size. In between the plot 0.3 m furrow was prepared for irrigation purpose. Among the five plots one was used as control and the remaining four was experimental. In each experimental plot 15 kg of farmyard manure was added individually and mixed well before partition.

**Establishment of cabbage:** Cabbage, *Brassica oleracea* L. var. *capitata* seedlings with three or four true leaves were collected from the farmer's nursery field near Sinta River at Samunabaur. The seedlings were transplanted on first week of December 2009 for first season and first week of February 2010 for second season. The distance maintained between the seedlings was 0.3 m × 0.6 m length and width respectively. Totally 50 seedlings were transplanted with 10 seedlings for each plot. The seedlings were irrigated every alternative day for first three weeks later on furrow irrigation was used at weekly interval.

**Brevicoryne brassicae introduction:** Apterous forms of *B. brassicae* were collected from heavily infested cabbage plants in the farmer's field. The aphids were brought to the experimental plot along with infested leaves. In each tender leaves of the cabbage plant 20 fourth instar aphids were released by using fine camel brush and monitored their multiplications.

**Experimental design:** The experiment was conducted in completely randomized block design. In entire experimental plot 5% concentration of *M. azedarach* dry fruit extract was sprayed. Before spraying 0.2% local soap solution was added to the extract as a surfactant. The cabbage grown in the control plot was sprayed with water and 0.2% soap solution mixture. The other treatment includes basal application of urea, farmyard manure and the powder of *M. azedarach* dry fruits. The first spray was done 15 days after the introduction of aphids. The second spray was done 15 days after the completion of first spray.

**Nutrient application:** The nutrient was applied twice before harvesting the cabbage head for each season. The first application was done 15 days after transplantation and the second was given at 5 weeks after transplantation.

Table 1: Mean number of aphid population and the yield of cabbage grown at different nutrient application and spraying with 5% concentration of *M. azedarach* dry fruit extract in first season (September-December 2009)

Treatment	5% <i>M. azedarach</i> dry fruit extract		Cabbage weight (g)
	After I <sup>st</sup> spray	After II <sup>nd</sup> spray	
Control	413.3 ± 54.68 <sup>a</sup>	1048.4 ± 243.84 <sup>a</sup>	485.6 ± 158.77 <sup>a</sup>
FYM	202.4 ± 39.35 <sup>ab</sup>	75.0 ± 18.06 <sup>b</sup>	606.1 ± 180.79 <sup>a</sup>
FYM + MDFP	159.2 ± 47.51 <sup>b</sup>	47.7 ± 19.58 <sup>b</sup>	750.1 ± 206.83 <sup>bc</sup>
FYM + UREA	216.5 ± 35.50 <sup>ab</sup>	70.7 ± 35.50 <sup>b</sup>	801.6 ± 184.60 <sup>bc</sup>
FYM+UREA + MDFP	160.5 ± 49.35 <sup>b</sup>	34.3 ± 11.25 <sup>b</sup>	898.5 ± 203.35 <sup>c</sup>

FYM-Farmyard manure, MDFP-*Melia* Dry Fruit Powder. Values are Mean and Standard Deviation of 10 replications. The same alphabets within the column are statistically not significant by LSD ( $p>0.025$ )

Table 2: Mean number of aphid population and the yield of cabbage grown at different nutrient application and spraying with 5% concentration of *M. azedarach* dry fruit extract in second season (February-May 2010)

Treatment	5% <i>M. azedarach</i> dry fruit extract		Cabbage weight (g)
	After I <sup>st</sup> spray	After II <sup>nd</sup> spray	
Control	588.8 ± 147.28 <sup>a</sup>	1163.0 ± 225.81 <sup>a</sup>	424.1 ± 123.39 <sup>a</sup>
FYM	178.9 ± 32.21 <sup>b</sup>	53.9 ± 17.52 <sup>b</sup>	586.1 ± 121.90 <sup>ab</sup>
FYM + MDFP	111.6 ± 29.88 <sup>b</sup>	40.1 ± 10.54 <sup>b</sup>	557.6 ± 136.90 <sup>ab</sup>
FYM + UREA	145.1 ± 74.32 <sup>b</sup>	41.1 ± 10.61 <sup>b</sup>	587.9 ± 148.76 <sup>ab</sup>
FYM+UREA + MDFP	109.6 ± 27.89 <sup>b</sup>	32.9 ± 8.34 <sup>b</sup>	840.3 ± 135.47 <sup>b</sup>

FYM-Farmyard manure, MDFP-*Melia* dry fruit powder. Values are Mean and Standard Deviation of 10 replications. The same alphabets within the column are statistically not significant by LSD ( $p>0.025$ )

In the experimental plots 50 g of farmyard manure/plant was applied. In addition, 10 g of *M. azedarach* dry fruit powder/plant was applied to plot three; 5 g of urea/plant was applied to plot four; 10 g of *M. azedarach* dry fruit powder and 5 g of urea/plant was applied to plot five. The *M. azedarach* dry fruit powder and urea was applied 5 cm distance from the root zone by making a hole with iron rod. The plot one was the control group and left without any treatment.

**Data collection:** The purposive sampling method was adopted for data collection. The number of aphids was recorded from three leaves of each plant. The data collection was started 15 days after the introduction of aphids and sprayed. Three days after spraying same procedure was followed for data collection. The second spray was done 15 days after first spray. The yield was assessed based on the weight of cabbage heads collected from each plot.

**Statistical analysis:** The data collected were subjected to statistical analysis in order to derive mean number of aphids and standard deviation. The significant difference of cabbage head weighed was compared with one way ANOVA. The significant difference in aphid population under different treatment was compared with two way ANOVA. The individual mean significant difference in aphid counts and yield weight was further confirmed by using Least Significant Difference (LSD) test at 2.5% level ( $p<0.025$ ).

## RESULTS

Mean number of aphid population in the first growing season (September to December 2000) after the

application of 5% concentration of *M. azedarach* dry fruit extract was presented in Table 1. Results indicate that the number of aphids recorded in experimental plot under different nutritional application did not show any statistical significant ( $p>0.025$ ) after first spraying. However, when the results were compared with control plot except farmyard manure and the combination of farmyard manure and urea treated plot remaining showed significant difference ( $p<0.025$ ). After IInd spraying, aphid populations in all the nutrient applied plots are statistically significant compared to control plot. The control plot was showed maximum number of aphid populations. The weight of the cabbage head did not show any significant difference in control and farmyard manure treated plot. However, the heads collected from the plot treated with farmyard manure + *M. azedarach* dry fruit powder, farmyard manure+urea and farmyard manure+urea+*M. azedarach* dry fruit powder were significantly different ( $p<0.025$ ) compared to control.

In the second cropping season (February to May 2010), almost consistent results were recorded (Table 2). The number of aphid population in all the nutrient applied plots were statistically significant ( $p<0.025$ ) compared to control. However, within the nutrient application results were not statistically significant ( $p>0.025$ ). The head weight of the cabbage except farmyard manure+urea+*M. azedarach* dry fruit powder applied plot remaining all the plots did not show any significant difference ( $p<0.025$ ).

## DISCUSSION

Aqueous extract of *M. azedarach* dry fruit was effective in reducing the population of cabbage aphid, *B. brassicae*. The aqueous extract preparation was easily

adoptable by small farming communities and economically viable since the materials are collected locally. The benefit of crude plant extracts often consist of complex mixtures of active compounds. Therefore, the use of complex mixtures as pest control agents could be advantageous as natural mixtures may act synergistically (Berenbaum, 1985). They may also show greater overall bioactivity compared to the individual constituents (Berenbaum *et al.*, 1991; Chen *et al.*, 1995).

Repeated application of botanical preparation is important to get maximum benefits. It is evident from the present study that number of aphid population was drastically reduced from the first spraying to second spraying. The effectiveness of *M. azedarach* dry fruit extract was in corroborate with the report of Kruas (2002) who has reported that *Melia* seed extracts contain a number of triterpenoids, the meliacarpin that are similar but not identical to the azadirachtin and these to have insect growth regulating bioactivities. In addition, present findings are also in agreement with the report of Chiu (1988) who has reported that the triterpenoid based toosendanin from *M. toosendan* to be stomach poison for chewing insects.

Nutrient application influences the growth of the plant but did not show any significant variation in aphid population. Mochiah *et al.* (2011) reported that the application of nutrients to boost the growth and yield of cabbage negatively impacted on the plants by increasing the insect population. It is acceptable because the present study due to the application of plant extract aphid population was under the control. The potentiality of *M. azedarach* dry fruit extract was statistically not significant among the nutrient applied plot in both the season. However, when compared to control the results were statistically significant. From the study the followings are become very clear that the application of nitrogenous fertilizer is not much important for cabbage crop if the manure is properly applied. The basal and foliar application of *M. azedarach* dry fruit powder extract had significant impact on *B. brassicae*. The repeated application of botanical spray was important to achieve maximum suppression of pest population.

Conclusion of the study indicates that head weight of the cabbage did not show any significant difference in *M. azedarach* + farmyard manure treated plot and *M. azedarach* + farmyard manure + urea applied plot. Therefore, *M. azedarach* dry fruit powder extract and application of farmyard manure itself is unquestionably protects the cabbage against *B. brassicae*. The source materials are locally available and methodology is effortlessly adoptable to the farming community. The only drawback, farming communities around the study area is need awareness about the importance of local resources and their utilization.

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