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Efficacy of different plant extracts against *Brevicoryne brassicae* and their effects on pollinators

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Abstract

The present experiment was carried out to check the efficacy of different botanicals against brassica aphid. The tested botanicals were, neem seed extract, neem leaf extract, dathora seed extract, kaner leaf extract and aak leaf extract. Insecticide, advantage 20 EC served as the positive control in the experiment. Data was recorded before and after 1, 3 and 7 days of treatment application. The results of the experiment revealed that neem seed extract exhibited maximum mortality (48.42%) followed by dathora (45.54%) and kaner leaf extract (40.29%) after 7 days of treatment application. However minimum mortality i.e. 26.64% was observed in case of aak leaf extract. Advantage encountered maximum mortality i.e. 86.14%. All treatments caused maximum mortality after 7 days of treatment application. In case of pollinators maximum population reduction was observed in case of insecticide (74.29%) while minimum reduction was observed in neem leaf extract (11.57%). Hence it was concluded that unlike insecticides, plant based products can be a better option for regulating pests and conserving beneficial insect plants.

Keywords: Brassica aphid, *Azadirachta indica*, *Datura stramonium*, *Nerium indicum*, *Calotropis procera*, Advantage 20 EC

Introduction

Brassica, locally known as Sarsoon, belongs to the family *Brassicaceae*. *Brassica* is an important short duration oil seed crop which is cultivated on area 307,000 hectares with annual production of 233,000 tonnes and contributes about 17% to the domestic production of edible oil. *Brassica* is one of the most important edible oil not only in Pakistan but in the rest of the world. *Brassica* is a major oil-producing crop that is widely grown across winter season in various regions of Pakistan [1]. The accessibility to improved varieties adoptions of better crop production and excellent price made canola truly striking to growers leading to its speedy expansion [2]. In Pakistan, it is valued as a source of good income for the growers. The seed has oil as high as 46-48%. Whole seed meal has 43.6 percent protein. Rapeseed meal is an excellent feed for animals [3].

Rapeseed-mustard is highly vulnerable to several pests. It has been reported more than 30 pests are involving in infestation of oil crop. Among those pests, aphids, painted bug and pea leaf miner, aphids have devastated oil crops [4]. The Aphid, *Brevicoryne brassicae* studied as major insect pest of the oil crop [5]. Aphids multiply very rapidly under favorable conditions on leaves, stems and inflorescence from where these pests suck the sap. They cause direct feeding damage to plant and transmit different viruses to particular crop. Due to the attack of aphids on *Brassica* affected pods and seeds remain stunted [6]. The yield loss ranges 30-35% by the attack of aphids on *Brassica* species [7]. The yield loss may rise up to 70% by the attack of aphids on *Brassica* [8]. Late sown *B. napus* and *B. juncea* and *B. carinata* suffered 75.06, 77.25 and 81.86% losses from aphids in yield where insecticides were not applied at Multan [9]. The factors responsible for low yield have been identified as the lack of suitable varieties and several abiotic and biotic environmental stresses; the more important are insect pests, diseases, drought and frost [10, 11]. *Brevicoryne brassica* (L.), *Lipaphis erysimi* (Kalten back) and *Myzus persicae* (Sulz.) are the most important aphid species attacking rape and mustard crops and causing tremendous losses from 70-80% [10].

In order to control this insect pest farmers extensively applied chemical insecticides consequently several problems have occurred like pesticide pollution, insecticide resistance, resurgence of secondary pests, elimination of beneficial insects and human health hazards. Most of the farmers are not aware with the ill effect of chemical pesticides and still using most of the systemic and organic chemicals to control the insect pest [12]. Almost 221 plant species possessing insecticidal properties in this country [13]. The different leaf extracts of plants effects on physiological systems of brassica aphid. Previous findings about the neem extract against aphids are as *Toxoptera citricida* on citrus, *Rhopalosiphum padi* on cereals and in case of *Nasonovia ribis nigri* on lettuce [14, 15, 16]. Therefore, scientists have switched to use of botanicals as well as plant extracts instead of chemical insecticides for the control of insect pest of agricultural importance. Plant extract is an eco-friendly management tactics of aphid. It is cheap and safe for pollinators and natural enemies, especially coccinellid predators attacking aphids and also safe for the environment. Keeping in view the importance of oil crops and healthy environment, the aim of this study is to evaluate the efficacy of different plant extracts against the brassica aphid.

2. Materials and methods

2.1 Study area and experimental design

The experiment was conducted in vegetable area at Ayub Agricultural Research Institute Faisalabad during Rabi seasons (2016). Randomized Block Design (RBD) was used in seven treatments each with three replications for the experiment. The plot size was kept (row-to-row distance, 45 cm and plant-to-plant distance 15 cm with all agronomic practices except plant protection. Treatments were *N. indicum* 5% (T1), *N. indicum* 5% (T2), *D. stramonium* 5% (T3), *N. indicum* 5% (T4), *C. procera* 5% (T5), Advantage 20EC=500ml/acre (T6) and (T7) untreated control treatments were evaluated against brassica aphid under field condition. The plant extracts were prepared and applied with the help of knapsack sprayer at the pod formation stage and the appearance of pest. Data regarding aphid population were recorded from 10 central tillers of 10 plants 24 hours, 72 hours and 7 days after each application. The data were than subjected to appropriate statistical analysis.

2.2 Data collection

Pre-spray population of aphids were recorded at regular intervals from randomly selected ten plants from each sampling unit and number of aphid present were visually counted and averaged to get mean population from each replication. When aphid population reached 30-40 aphid/plant and then the above botanicals were sprayed. The effectiveness of each plant extract was determined by counting the aphids on 10 plants randomly taken from each replication. The post spray data was taken after 24 hours, 72 hours and 7 days intervals.

2.3 Data Analysis

The data was analyzed using Statistical Analysis Software. Analysis of variance (ANOVA) also constructed to test for significant differences between the variables. Shiberu and Negeri, (2014) reported the efficacy percentages by using the following formulas:

$$\text{Efficacy (\%)} = \frac{\text{Pre spray count} - \text{Post spray count}}{\text{Pre spray count}} \times 100$$

$$\text{Reduction efficacy \%} = \frac{\text{Control count} - \text{Post spray count}}{\text{Control count}} \times 100$$

3. Results and Discussion

All the botanicals assured the control of Brassica aphid at variable levels as compared to untreated check. The population of aphids (both nymphs and adults) per plant a day before application of treatments in different treatments was uniform which ranged from 31 to 38. Advantage 20 EC 500l/acre (i.e. used as positive control) recorded significantly least population of aphids/plant and highest reduction percentage in pollinators population all data recording interval. Efficacy of botanical treatments decreased with increase in data collecting interval. After 24 hours of botanicals application neem seed extracts gave highest reduction percentage (39.21) followed by dathora seed extracts, neem leaf extracts and kaner leaf extracts were 37.42, 32.86 and 28.02 respectively, however minimum reduction was observed in case of aak leaf extracts that is 20.23%. Among the botanicals neem seed extracts recorded reduction in percentage of pollinators and highest reduction percentage in the entire data collecting interval. In case of botanicals efficacy of plant extracts increased with increase of the data collecting interval but after 3 days efficacy was decreased. After 3-days and 7-days results showed significantly maximum percentage reduction of aphids/plant recorded in neem seed extracts (48.42), (29.42) followed by dathora seed extracts, neem leaf extracts and kaner leaf extracts i.e. (45.54), (25.33), (21.54), (40.29) and (32.33), (17.21) respectively and minimum reduction was observed in aak leaf extracts (26.64), (12.62) and its reduction percentage of pollinators were (20.05), (17.22) (15.85), (14.39) and (11.57) respectively followed by Dathora seed extracts, Kaner leaf extracts, Aak leaf extracts, Neem seed extracts and Neem leaf extracts.

Advantage 20EC gave maximum reduction against aphids 78.41%, 72.66% it is treated as positive control for comparison and gave best control against aphids because it consists of active ingredients carbusulfan. Advantage 20EC is a systemic insecticide, which acts as an insect neurotoxin and acts on the central nervous system. Due to the presence of active ingredient it enhances the activity of insecticide and killed more insects as compared to other insecticides. Similarly [17], reported that results from three field trials and a screen house study conducted in 1985 and 1986 using carbusulfan dust formulation at 0, 10, 20, 30 and 40 g/kg cowpea seed indicated that infestation and/or damage by aphids, foliage beetles and leafhoppers was satisfactorily reduced with treatment levels above 20 g carbusulfan/kg seed. Leaf extracts of plants showed insecticidal activity, as Indian neem followed by *Mexican marigold* reduced the aphid population to a great extent [18]. The neem tree, *Azadirachta indica*, a source of several insecticidal alkaloids is a sub tropical tree native to the arid areas of Asia and Africa. Neem seed kernel extracts containing azadiractin, salanin and meliontriol have extensively been studied and demonstrated for plant shows stunted insect pest control efficacy [19]. The active ingredient of neem extract is Azadirachtin which is considered as main component among other active

ingredients. It is distasteful and repels insects and may reduce the insect infestation ^[20]. Neem seed extracts reduced slightly higher aphid population 39.21 % than the neem leaf extracts 37.81%. The findings of the present study are almost similar to the findings of several authors as Azadirachtin the main pesticidal component of neem extracts specially neem seed extract possessed feeding deterrent, repellent, toxic, and growth disruption properties against numerous pest species ^[21]. In previous studies neem extract and neem oil reduced 73-83% aphid population in mustard crop in Bangladesh ^[22, 23]. The result revealed that neem seed extracts are effective in checking the aphid population in mustard up to 72 hours about 48.42% reduction achieved. Therefore, present study revealed that all the botanical treatments showing insecticidal activity against mustard aphid. Extracts from plant origin containing insecticidal properties are indigenously available and are considered comparatively safe for environment and public health. It has been reported that over 2000 plant species belonging to about 170 natural families are known to have insecticidal properties ^[24].

Although neem seed extract reduced comparatively low aphid population than Advantage 20 EC which caused 86.14% reduction, but it is non toxic and non chemical. It is safe for honeybee and other pollinators and also conserves natural enemies in the mustard fields. Similar results were obtained where plant extracts were used as antifeedant, repellent, and insect growth regulatory effects are present in neem product which can be used for insect management in crop production. Although neem extracts failed to reduce about maximum

aphid population like chemical insecticides but usage of neem extract is an eco-friendly management tactics of aphid. It is cheap and safe for pollinators and natural enemies, especially coccinellid predators attacking aphids and also safe for the environment. These products are distasteful or repelled plants even quicker than larger insects and adversely to the insect and may reduce the insect infestation affects market value on cruciferous crops. Injudicious use of insecticides may be deleterious to agro-ecosystem, public health and create residual problems ^[25]. Hence, Plant extracts potential antifeedant for the control as well as reduced the infestation of the aphid on Brassica crop. Moreover, these plants extracts can be used as an alternative tool to conventional synthetic insecticides and are friendly to human health as well as to the environment. The use of these bio-pesticides could play an important role in integrated pest management programs in future.

4. Conclusion

This experiment concluded that neem seed extracts recorded least population of aphids/plant and highest reduction percentage in all data recording intervals among the treated botanicals. While Insecticide gave maximum reduction of aphid population as compared to plant extracts but also significantly affected the population of pollinators however, plant extracts gave competitively less reduction of aphid population. The reduction of the pollinators was very low in plant extract applied treatments.

Table 1: Treatments, active ingredients and dose rate applied on brassica aphids

Treatments	Treatments name	Active ingredient	Dose rate/acre
T1	<i>Azadirachta indica</i> Seed	Tetranortriperpernoids	5%/acre
T2	<i>Azadirachta indica</i> Leaves	Liminoids	5%/acre
T3	<i>Datura stramonium</i>	Hyoscyamine	5%/acre
T4	<i>Nerium indicum</i>	Cardiac glycosides	5%/acre
T5	<i>Calotropis procera</i>	Calotropin	5%/acre
T6	Advantage 20 EC	Carbosulfan	500ml/acre
T7	Control		

Table 2: Mean reduction percentage of aphid population

Sr. #	Treatments name	Aphid pop. Reduction(%) after			%age reduction of pollinators
		24 hours	After 3 days	After 7 days	
1	Neem seed extract	39.21b	48.42b	29.42b	14.39
2	Neem leaves extract	32.86bc	40.29c	21.54cd	11.57
3	Dhatura seed extract	37.42b	45.54b	25.33bc	20.05
4	Kaner leaf extract	28.02c	32.33d	17.21b	17.22
5	Aak leaves extract	20.23d	26.64e	12.62e	15.85
6	Advantage 20 EC	78.41a	86.14a	72.66a	74.29
7	Control	0.0e	0.0f	0.0f	0.0
	Lsd @ 5%	4.94	3.59	4.53	

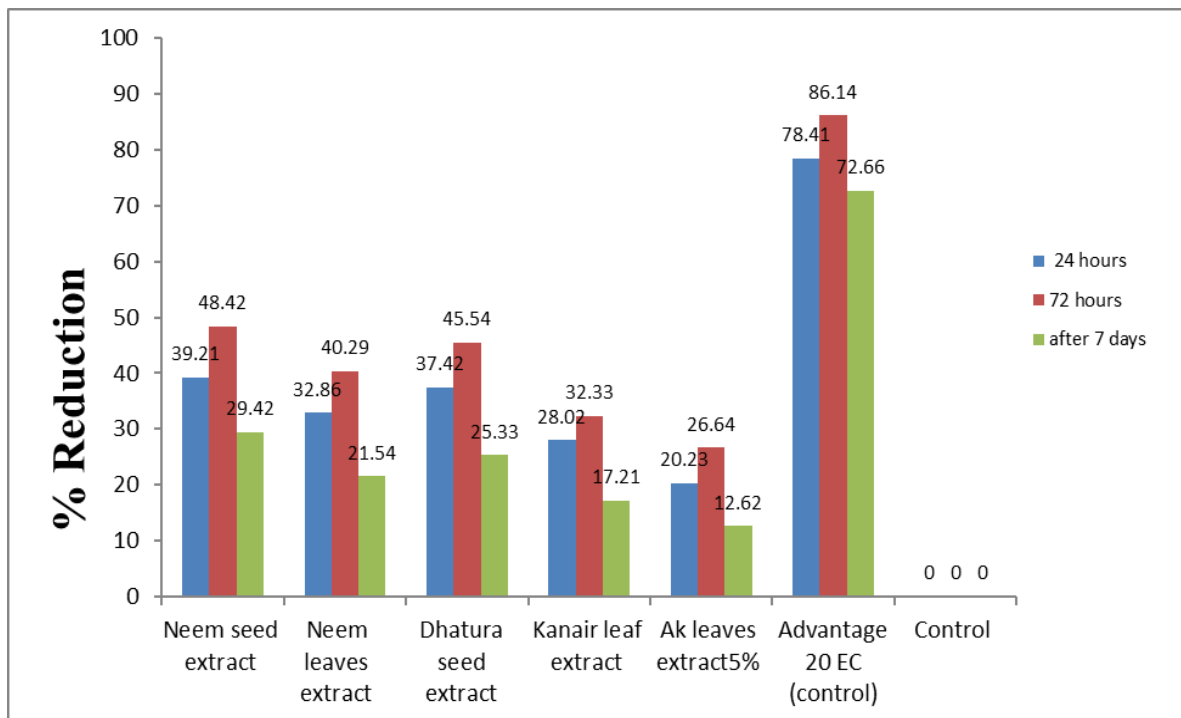


Fig 1: Percentage efficacy of Botanicals against brassica aphids

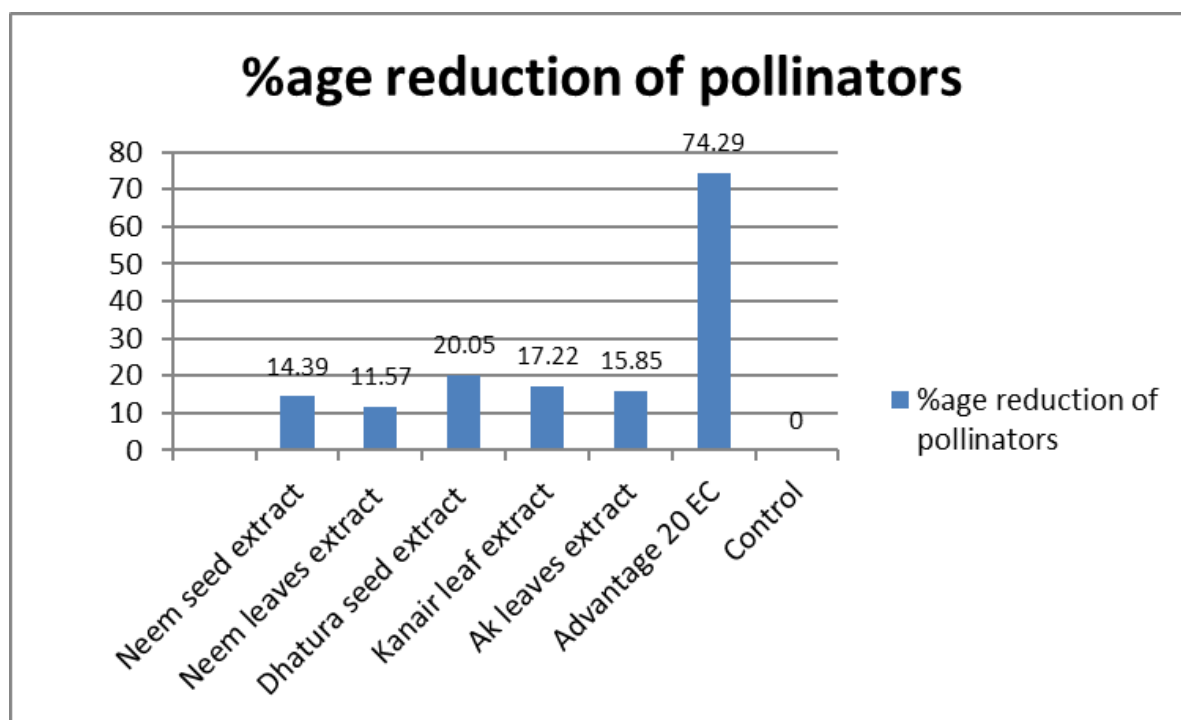


Fig 2: Percentage reduction in pollinators along with the control

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