American-Eurasian J. Agric. & Environ. Sci., 16 (2): 224-228, 2016
ISSN 1818-6769

DOI: 10.5829/idosi.aejaes.2016.16.2.12754

High Pressure Water Spray Technique for Controlling Mustard Aphid (Lipaphis *Erysimi)* on *Brassica* Crop

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Abstract: Miraculous results of a nozzle modified by the authors at Oilseeds Research Institute, Faisalabad to dislodge the aphid colony with simple tap water have been presented. A study was carried out to tackle the serious problems posed by the Mustard aphid (*Lipaphis erysimi)* in *Brassica juncea* using different types of hollow cone nozzles such as hollow cone single orifice (modified), single orifice (original), double orifice, triple orifice and tetra orifice nozzle (Check). These nozzles were tested for dislodging the mustard aphid by spraying simple tap water through them. The study revealed that among the nozzles tested, the hollow cone nozzle (modified) showed highest percentage of rapid reduction in aphid population (90.8%) recorded immediately after spraying of water followed by hollow cone nozzle single orifice (original) with the results (65.9%). Whereas, the other nozzles used for the study did not prove their worth as their aphid dislodging percentage remained low. It ranged from 40.4 to 49.2 %.

Key words: *Brassica juncea* · Mustard · Water spray · High pressure

INTRODUCTION

Brassica spp. family Cruciferae, is an important oilseed crop of the world. The most common species grown in Pakistan include *Brassica compestris* L, *B. napus* L and *B. juncea* L. [1]. Rape and mustard oilseed crops are the most important sources of vegetable oil grown during the winter season. The area and production level of rape and mustard in Pakistan during 2012-13 were about 452000 acres, 158000 tonnes oil seeds and 51000 tonnes oil and that of canola is about 30000 acres, 18000 tonnes of oilseeds and 10000 tonnes of oil [2]. Insect pest infestation plays a limiting factor in its production. Cabbage butterflies, shield bugs, pea leaf miner are the insect pests of Brassica crop. Brassica aphids (*Lipaphis erysimi* Kalt) are of the great importance and have attained the level of key pest [1].

Mustard aphid, *Lipaphis erysimi* Kalt., is widely distributed throughout the world on all Brassica crops [3] This pest is serious in Pakistan, India, Bangladesh, other countries of South-East Asia and USA [4-6].

It is the most destructive pest of rapeseed and mustard and a major limiting factor for successful cultivation of the crop [7-9]. The aphid population increases during winter at such a level that it reduces the yield and quality of Brassica. [10]. Both the nymphs and adults suck sap from leaves, inflorescence, stems, flowers and pods; as a result, the plant shows stunted growth, flowers wither and pod formation is hindered. Honeydews secreted by aphids are medium for the development of sooty mold on plants. As a result crop gets black and dies before bearing of seeds [1].

The losses of mustard due to aphids infestation varied from 35 to 90 percent depending upon the seasons [11, 9, 12, 13] reported the yield losses from 9 to 96 and 15% oil reduction [4]. High incidence of the pest can sometimes cause complete loss of the crop in mustard, severely infested plants often fail to bear siliqua or leads to poor pod formation [14].

Control of aphids by any measure is a hard task because of fast growth, mode of reproduction, polymorphism and wide adaptability [15]. Numbers of chemical insecticides have been evaluated against this insect pest and some of them have been found successful to control it insect [16-18]. In Pakistan, aphid is controlled by the use of insecticides but owing to the undesirable effects of insecticides, total dependence should not be advisable [19]. Our farmers spray insecticides in their

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fields indiscriminately. These insecticidal chemicals have been found more or less toxic to a number of natural enemies of aphids (i.e. *Diaeretiella rapae*, *Chrysoperla carnea,* coccinellids and syrphid flies) present in mustard fields [20,18]. These chemicals also cause phytotoxicity to the plants [20]). The pesticides are also liable for ecological pollution, health hazards to human beings, toxicity to pollinators, pest resurgence, development of resistance in insect-pests and residue in oil and cake [21,13].

An eco and user friendly pest control approach against mustard aphid is crucial to protect the natural enemies and pollinators as well as human health [15,22]. Use of high-pressure water spray to dislodge spider mites, aphids, small caterpillars and other pests from host plants has long been suggested as a "non-chemical" or "organic" method of pest control [23]. According to [24] giving infested plants a good, hard hosing down will dislodge many insect pests, particularly aphids, thrips and various caterpillars. But accomplishing this method of pest suppression, however, is not as easy as it sounds, as certain pressure must be build up for the successful dislodging (insects and mites) otherwise this method may or may not work in certain situations [24]. This method can be compatible with biological control programs. In addition, water spray treatments may be capable of removing the sugary honey dew emitted by aphids deposited on the plant thus preventing it from sooty molds. Keeping in view the above facts the present exploration was carried out to appraise the safest and the most eco-friendly method of controlling the mustard aphid. The idea was to build a device to supply enough pressure to dislodge the aphid colony by using simple tap water. In the present study was carried out to check out different nozzles available in market were carried out along with our modified nozzle for their effectively to control aphid.

MATERIALS AND METHODS

A field experiment was conducted at the farm of Oilseeds Research Institute Faisalabad during 2013-14 and a variety Khanpur Raya was used for this study. A hollow cone nozzle single orifice modified by the authors, was used with the purpose to wash the aphid population from *Brassica juncea*. While other nozzles single, double, triple and tetra orifice were purchased from market and used in the present studies. All the nozzles were used with battery operated hand sprayer (2.4 bars). The treatments were arranged in Randomized Complete Block Design with 3 replications. Firstly, the treatments were applied when aphid population reached at ETL and the same were repeated at fortnightly intervals.

Data regarding mustard aphid population was recorded from top 10 cm terminal shoot of 5 randomly selected plants in each treatment before and immediately after the application of the treatments. Percentage reduction in aphid population was recorded with following formula.

% reduction in aphid population = (Population recorded before application of treatment – Population recorded after the treatment.)/ Population recorded before application of treatment.

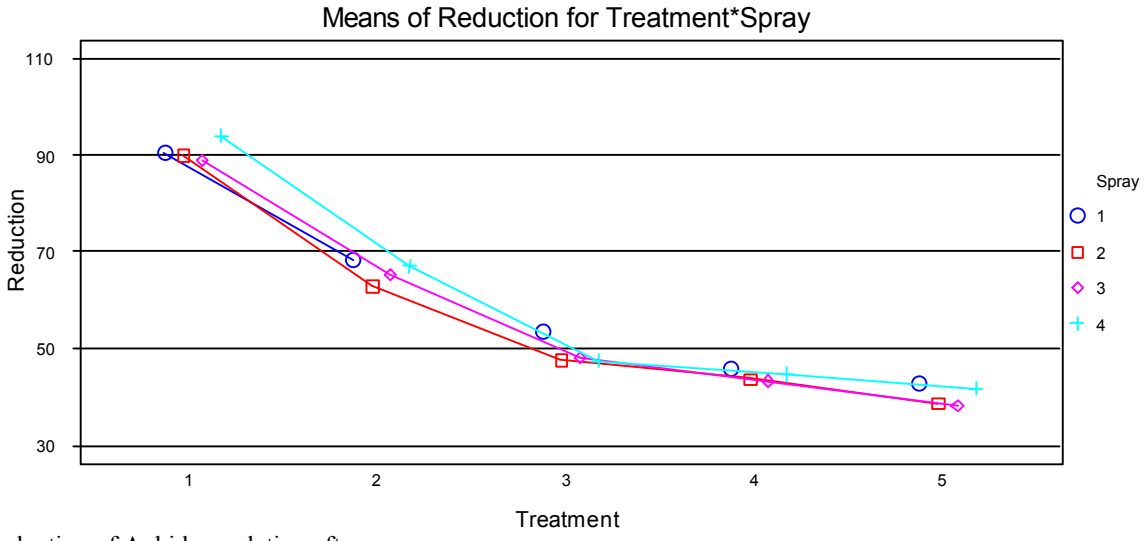
RESULTS AND DISCUSSION

Investigations on the interaction between nozzles and the sprays of simple tap water showed significant variation among all treatments. In the present study (Table 1), significantly high percent rapid reduction of aphid population (90.875 ± 0.6508) was observed in the treatment using hollow cone nozzle (HCN) single orifice (modified). It was followed by the treatment hollow cone nozzle single orifice (original) depicting (65.938 ± 0.6522) percent reduction in aphid population. In the other treatments *viz;* HCN double orifice, HCN triple orifice and HCN tetra orifice aphid population reduction was recorded as 49.248 ± 0.8922, 44.462 ± 0.7990 and 40.455 ± 0.7560 percent, respectively. Interestingly, mean of reduction for treatment * spray indicates that the first spray of simple water with HCN single orifice (modified) dislodged the aphid population to a level below economic threshold. The 2nd and 3rd sprays with treatment No. 1 further dislodged the population to negligible levels. Whereas, the 4th spray of simple water with treatment No. 1 gave the highest percentage of reduction in the aphid population (93.97) as depicted in the chart. While the second treatment HCN single orifice (original) showed 68.393, 63.02, 65.18 and 67.157 percent reduction in aphid population with the 1st, 2nd, 3rd and 4th sprays of water, respectively. However, the results of spray of water with all the remaining treatments did not show any considerable decrease in aphid population and are not even worth mentioning (Table 1). Pair wise comparisons test of reduction for spray clearly indicates that mean of 1st (60.375) and 4th spray (59.023) in all the treatments were statistically at par. While, 2nd (56.643) and 3$^{rd\ sprays}$ (56.742) were similar to each other.

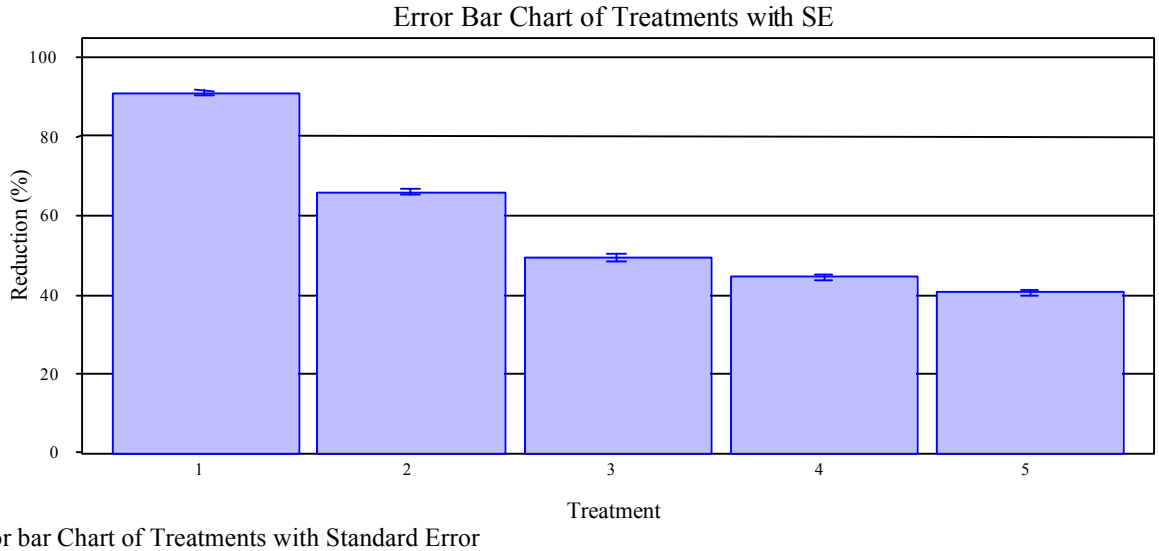
Table 1: % Reduction in Aphid Population

Sr. no.	Nozzle type	1.02.14 % Red. in Aphid pop.	15.02.14 % Red. in Aphid pop.	1.03.14 % Red. in Aphid pop.	15.03.14 % Red. in Aphid pop.	Average % Reduction in Aphid population
1	hollow cone nozzle single orifice (modified)	90.61	89.95	88.96	93.97	90.87
2	Hollow cone nozzle single orifice (original)	68.39	63.02	65.18	67.16	65.94
3	Hollow cone nozzle double orifice	53.73	47.69	47.99	47.58	49.25
4	Hollow cone nozzle triple orifice	46.04	43.79	43.33	44.69	44.46
5	Hollow cone nozzle tetra orifice	43.11	38.76	38.24	41.71	40.46

Interaction Plot:



% Reduction of Aphid population after spray



Error bar Chart of Treatments with Standard Error

To eliminate Aphid from Mustard crop without using any chemical pesticide has always been a hard task. But modification in Hollow Cone Nozzle (single orifice) has made it possible to wash aphids off the plants promptly and effectively. This was also confirmed by [25] who have reported that a strong spray of water from your garden hose can help reduce pest numbers. The spray knocks the insect pests off your plants, interrupting their life cycle. Repeated sprays can make it difficult for the pests to reestablish themselves on plants. The efficacy of this treatment may be due to increase in pressure of water emitted from this modified nozzle. The application of this

treatment not only dislodged the aphid from the plant but also saved precious edible oil crop from the hazardous effects of pesticides. Whereas, the rest of the treatments did not exhibit good results as percentage of dislodging aphid remained low except treatment No.2, which has been moderately effective in its performance.

CONCLUSION

It can be concluded that this technique could easily be used on mustard crop as it is eco-friendly and harmless to pollinators like honeybees visiting the crop for pollination. Moreover, toxicity to natural enemies and human beings does not occur. The growers will get organic crop. Furthermore; wheat aphids can also be managed with this technique.

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