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Studies on the compatibility of neem oil with predator, *Chrysoperla carnea* for the management of aphids (Homoptera: Aphididae) in canola (*Brassica napus* L.)

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The present studies were conducted to find out the compatibility of neem oil with the predator, *Chrysoperla carnea* for the management of aphids in canola. Among the different treatments tested, module consisting of neem oil 2% + *C. carnea* proved very effective in reducing the aphid population with an average of 18.6/plant. Neem oil 1% and *C. carnea* alone also produced significant results compared to untreated check where mean per plant population of aphid was 39.3 and 41.3, respectively. Maximum seed yield (3295.1 kg/ha) was recorded from neem oil 2% + *C. carnea* followed by neem oil 1% + *C. carnea* (3219.1 kg/ha) and neem oil 2% (2809.4 kg/ha), respectively. Over all mean population of *C. carnea* was highest (0.48/plant) in plots treated with predators alone. The same was second most abundant (0.40/plant) in plots treated with neem oil 1% + *C. carnea* followed by plots treated with neem oil 2% + *C. carnea* (0.36/plant). The study manifested neem oil concentrations relatively safe to beneficial insects and suitable for use in integrated pest management of aphids in canola.

Key words: Neem, *Chrysoperla carnea*, Aphids, canola, botanical pesticides, infestation.

INTRODUCTION

Canola (*Brassica napus* L.) is the traditional oilseed crop and second most important source of edible oil after cottonseed in Pakistan. Domestic rapeseed/canola production has gradually declined since 2008 and accounts for about 6% of total oilseed production in Pakistan (Rehman, 2010). There are many reasons responsible for this declined trend like competition with other crops, lack of utilization of production technology, higher prices of agricultural inputs, marketing problems but insect pests infestation seem to be the main constraint.

About 43 insect species have been recorded attacking these plants, but the most important are aphids which attack canola. The three species of aphids, that is, cabbage aphid (*Brevicoryne brassicae* L.), mustard aphid (*Lipaphis erysimi* Kalt.) and green peach aphid (*Myzus persicae* Sulz.) are more abundant and widely distributed. They suck sap from plants and can be found massed on young, rapidly growing leaves depending on the aphid species. The colonies are mainly established on the top inflorescence of the plant during flowering stage. It usually causes damage by, wilting, flower abortion and reduced pod set. They may also excrete honey dew and cover the plants, which encourage the growth of black sooty mould, thereby reducing the plants' ability to photosynthesize and generally decreases plant vigour

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(Berlandier et al., 2010). The aphids are outstanding in their distribution, in host plant range and able to transfer over 100 virus diseases of plants on about thirty different families including many major crops such as Brassica (Devi and Singh, 2007). Many factors are involved in the widespread of aphid populations. Besides indiscriminate use of insecticides without regard for economic thresholds and development of resistance, there are many interactions that affect its population trends. The farmers solely depend on pesticides for the control of this insect pest. It is a known fact, that often only 1% of the active ingredients reach the target pests, while 99% of these substances, some of which are highly toxic, trouble the environment (Hassan, 1992). Non-selective use of pesticides is responsible for water pollution, soil degradation, insect resistance and resurgence, destruction of native flora and fauna (Baloch and Haseeb, 1996). Keeping in view the ill effects of pesticides, emphasis should be focused to replace pesticides with alternative means of control that are less toxic, safe, low in cost, local in production and also environmentally friendly (Mohammad et al., 2010).

These alternatives include integrated pest management, which is bringing together and utilizing all the control measures concurrently or successively in an integrated way against a particular pest and thereby minimizing the need for chemical control (Shahid, 2003). The use of botanical insecticides and biological control for the management of aphids in canola are good alternatives for pesticides. One of the important botanicals is neem whose products are derived from the neem tree, *Azadirachta indica* A. Juss. (L.) that grows in arid tropical and subtropical regions on several continents. The principal active compound in neem is azadirachtin, a bitter, complex chemical. The neem products have been found very effective in causing aphid mortality and hence can be used for the management of aphids in different crops (Tess Henn and Weinzeiri, 1989). Similarly the bio-control agent, *Chrysoperla* spp. also play a significant role in the management of aphids while some other natural enemies feeding on aphids are chrysopids, coccinellids and syrphids (Kannan, 1999). Holland and Thomas (1997) concluded that polyphagous predators can efficiently manage aphid infestation late in the season when population increase rapidly. Messina and Sorenson (2001) reported that lacewings reduced the aphid population on some plants and their effectiveness was 84%. Neem extracts are usually safe for beneficial organisms, such as bees, predators and parasitoids, mammals, and for the environment (Tang et al., 2002). Neem oil are comparatively less toxic to bio-control agents compared to synthetic pesticides and hence can be raked as harmless (Sattar et al., 2011). Neem-derived insecticides are regarded as generally compatible with insect natural enemy conservation (Schmutterer, 1997). Devi et al. (2002) reported that neem, endosulfan and phosalone could be used along with the biological control agents for the control of mustard aphid.

These reports emphasize the importance of testing neem-derived insecticides against not only the target pest insects but also key biological control agents. Keeping this backdrop in view, the present research studies were executed to deal with the population of aphids using neem oil and augmenting *C. carnea* and to find out the compatibility of neem oil with the predator, *C. carnea* under field conditions.

MATERIALS AND METHODS

The experiment was conducted on field located at the experimental farm of Nuclear Institute of Agriculture, Tandojam, Sindh, Pakistan during winter season 2011. The test cultivar Wester was used for this study. Crop sowing was completed in the third week of November, after rice had been harvested. The field was properly prepared, weeds and stubbles were removed, and the land was finally leveled and prepared by laddering. The pure non contaminated canola seed was planted with a hand drill at appropriate soil moisture. Standard agronomic practices were followed for raising the crop and the field was hand weeded periodically. The plants were maintained at 10 cm spacing by thinning of plants and 30 cm between rows. The experiment was laid out in a randomized complete block design with six treatment (neem oil 1%, neem oil 2%, neem oil 1% + *C. carnea*, neem oil 2% + *C. carnea*, *C. carnea* alone and untreated check) replicated three times. The plot size was 1 m x 3.5 m (3.5 m²). The bio-control agent *C. carnea* obtained from insect rearing laboratory of Nuclear Institute of Agriculture, Tandojam, were released regularly at fortnightly interval to the field. Neem oil was purchased from the local market and used at concentration of 1 and 2%. The neem oil concentrations, in the respective treatments, were applied on the crop in the form of spray with the help of knapsack hand sprayer having 20 liters capacity fitted with hollow cone nozzle. Pest sampling started with the appearance of aphids in the field and continued till harvesting of the crop. The prevalence of aphid per treatment was assessed based on numbers recorded on 5 randomly selected plants, at least one of which had been colonized by the aphids in each replicate from the start of infestation. The population of *C. carnea* was also regularly recorded by observing five randomly selected plants from each replication. Yield per plot was also taken to evaluate the loss of plants by the attack of aphid and subsequent effects of treatments. Data on yield were taken from three replicates of each treatment which was as g/3.5 m² plot and further transformed into kg per hectare. The aphid densities were transformed to mean values for analyses. Computer software Statistix was used to analyze the data and significance of difference in mean population of aphids was sorted out with LSD (5% significance level).

RESULTS AND DISCUSSION

Results revealed (Table 1) significant differences in the aphid densities among different treatments at all the post treatment observations. Among the different treatments tested, module consisting of neem oil 2% + *C. carnea* proved the most effective in reducing the aphid population with an average 18.6/plant followed by module neem oil 1% + *C. carnea* (22.6) and treatment of neem oil 2% (29.0). Neem oil 1% and *C. carnea* alone also produced

Table 1. Mean population of aphids and seed yield recorded from different treatments.

Treatments	Aphids/plant	Yield (g/3.5 m²)	Yield (kg/ha)
Neem oil 1%	39.3^B^	956.7^B^	2733.4^B^
Neem oil 2%	29.0^C^	983.3^B^	2809.4^B^
Neem oil 1% + *C. carnea*	22.6^CD^	1126.7^A^	3219.1^A^
Neem oil 2% + *C. carnea*	18.6^D^	1153.3^A^	3295.1^A^
C. Carnea alone	41.3^B^	856.7^C^	2447.7^C^
Untreated control	98.4^A^	683.3^D^	1952.2^D^
LSD	9.45	67.31	192.31

Means within a column followed by different letters are significantly different (P<0.05).

Table 2. Population of different stages of bio-control agent *C. Carnea.*

Treatments	Population of *C. carnea*/plant		
	Eggs	Larvae	Adult
Neem oil 1%	0.11^B^	0.11^C^	0.14^B^
Neem oil 2%	0.11^B^	0.11^C^	0.11^B^
Neem oil 1% + *C. carnea*	0.44^A^	0.33^AB^	0.44^A^
Neem oil 2% + *C. carnea*	0.37^A^	0.29^B^	0.44^A^
C. Carnea alone	0.49^A^	0.44^A^	0.51^A^
Untreated control	0.14^B^	0.14^C^	0.11^B^
LSD	0.13	0.12	0.20

Means within a column followed by different letters are significantly different (P<0.05).

significant results compared to untreated check where mean per plant population of aphid was 39.3 and 41.3, respectively. The highest prevalence of insect pest was found in the control treatment (98.4/plant) which was significantly higher than all treatments. Yield data also confirmed the same trend as maximum 1153.33.5 g/3.5 m² (3295.1 kg/ha) was recorded from neem oil 2% + *C. carnea* followed by 1126.7 g/3.5 m² (3219.1 kg/ha) and 983.3 g/3.5 m² (2809.4 kg/ha) from neem oil 1% + *C. carnea* and neem oil 2%, respectively. But there was no statistically significant difference observed in the yield data obtained from neem oil 2% + *C. carnea* and neem oil 1% + *C. carnea* during the course of study. One factor of particular interest in this study was to find out the negative effect of neem oil on the survival of *C. carnea*. Data recorded on the establishment of released predators revealed that neem oil had no serious effect on the survival of predator, *C. carnea* (Table 2). Highest mean population of eggs, larvae and adults of *C. carnea* per plant (0.49, 0.44 and 0.51 respectively) was investigated in treatment where *C. carnea* alone were released. However it was found non significantly different with treatments of neem oil 1% + *C. carnea*, and neem oil 2% + *C. carnea*, except for the population of larvae in the latter treatment where it was significantly lower. Over all mean population of *C. carnea* was maximum (0.48/plant) in plots where predators alone were released. The same was second most abundant (0.40/plant) in plots treated with neem oil 1% + *C. carnea* followed by plots treated with neem oil 2% + *C. carnea* (0.36/plant). These two treatments also exerted a negative effect on aphids showing drastic reduction in their population as discussed above. Furthermore, the encouraging population of predators in the neem treated plots pointed out that the predatory insects are not affected to a great extent reflecting the undamaging effects of neem oil on the bio-control agents. These findings confirmed that the strategy of using both (neem oil and predators) does not affect key biological control agents. These results are in conformity with those of Schuster and Stansly (2000), who tested Azatin EC on two species of green lacewings and found Neem product non toxic to eggs, larvae and adults. Similarly Hermann et al. (1997) reported no negative effect of NeemAzal T/s and NeemAzal-F on *C. carnea* efficacy. The initial application of NSKE 5% followed by the release of *C. carnea* effectively managed the mustard aphid population (Pandey and Narendra, 2008). Unlike these findings NeemAzal-T/S was found harmful to larvae of the lacewing *C. carnea* (Stephen) causing mortality (Srinivasan and Babu, 2000). Medina et al. (2004) revealed no effect on mortality or fertility of the adult green lacewings, *C. carnea* (Stephens), when provided with azadirachtin treated water. The treatments where neem oil alone (1 and 2%) was applied also proved effective for the management of aphids (Dhaliwal et al., 1998). It is important to mention that the compatibility of bio-control agents to botanical pesticides is based on the type of botanical, natural enemy and stage of development. Therefore, further studies are needed to screen out different other botanicals for compatibility with the natural enemies in order to avoid disrupting successful biological control programs.

Conclusion

The present research findings elucidated neem oil very effective and compatible with predator, *C. carnea* for the management of aphids in canola. Neem oil concentrations appeared to be relatively benign to beneficial insects and are suitable for inclusion in integrated pest management programs. However, a short delay between the treatment and the release of the bio-control agents is suggested for the successful combination of the use of neem and *C. carnea* in conjunction.

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