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Population and infestation assessment of red pumpkin beetle (*Aulacophora foveicollis* Lucas) and management using botanicals

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Abstract
Importance of cucurbits is evident from its routine life usage as salad, desert, fruits and as essential part of kitchen item as vegetable. Different aspects responsible for yield reduction contain attack by the insect pest including red pumpkin beetle. This pest cause damage losses 35-75% to seedlings of cucurbits, leaves and fruits stage. Effect of plant three plant extracts viz., Neem seed kernel extract (*Azadirachta indica*), *Moringa oleifera*, *Aloe vera* for the management of the pest was studied during the experiment to screen out one promising botanical. The minimum population (4.31 insects plant^{-1}) and minimum percent leaf infestation (9.1% plant^{-1}) recorded in neem (*Azadirachta indica* L) treated plots. Population and percent leaf infestation reduction percentage was calculated. Maximum population reduction percentage (36.43 insect plant^{-1}) and maximum percent leaf infestation reduction percentage (37.50% plant^{-1}) was recorded in neem treated plots.

Keywords: *Moringa oleifera*, red pumpkin beetle, *Aulacophora foveicollis,* non-chemical management

1. Introduction

Cucurbits being an important kitchen item used as domestic food are cultivated as routine crop every year with slight variation of area. Salad (cucumber, cucumber, long melon), sweet (gray loofah gourd), pickles (cucumber), deserts (melons) and cooking as vegetable are its various consumable forms. Cucurbits like bitter gourd are renowned due to their unique medicinal properties. Approximately 35% of the total vegetable production in Pakistan include melons, according to the FAO estimate [1].

Quality deteriorating and low yielding factors in vegetable production directly involve the impact of insect pests, however, weeds, mismanagement, diseases, seed viability percentage as secondary problems [2]. Chewing and sucking both type of insect pest attacks to vegetables especially to cucurbits and pumpkin beetle (banded pumpkin beetle and the plain pumpkin beetle) known as symbol for yield losses [3, 2]. Damage severity by the as seedling stage sometime require crop re-sowing. Defoliation percentage gradually declines from 70-15% as the leaf canopy upturns [4]. Losses percentages ranges from 35-75% vary at early stages which can be calculated from percent damage [5, 6]. The beetle feeds cotyledonous leaves from underside by biting holes into them.

Pest control using botanicals (biochemicals) is old techniques having merely health hazards and obviously short life span. Botanicals for the management of insect pests including red pumpkin beetle, mainly used as deterrent or feeding inhibitor sometime mortality of the pests also reported [7]. Triterpenoid extract from bitter gourd was used against the beetle as deterrent during 1983 [8]. Leaf extract of *Ageratum conyzoides* [9], plant extract of *Mentha piperita, Pogostemon heyneaus*, *Mentha longifolia*, *Mentha spicata*, *Ocimum canum*, *Ocimum basilicum*, *Salvia officinalis* [10] and seed extract of *Strychnos nuxvomica* and *Pachyrhizus erosus* [11] were also considered effective in the management of red pumpkin beetle.

Extracts of bakain, hermal, neem kernel and neem oil [5, 12] are commonly used botanicals. Use of sweat-pineapple, shankhpushpi [13] and *Parthenium* spp. and *Eucalyptus* [1] is also evident in the history for red pumpkin beetle management.

Botanical usage is quite safer and conventional practice of keeping crops out of the pest reach. Synthetic chemicals like performance cannot be restrained using botanicals, though the safety of public health could be ensured. Present study was designed to evaluate the effectiveness of botanical as control measure for the red pumpkin beetle management.

2. Materials and Methods

Three botanicals viz., Neem [Neem Seed Kernel Extract], *Aloe vera*, and *Moringa oleifera*) and a check treatment (without application of any control measure) were used in experiment with Faisalabad landrace (FSD) of Indian snap melon as host. Experiment was conducted using 6m X 3m plot and plot-to-plot difference was 3m at Square #09 area, Institute of Horticultural Sciences, near the club rest house, University of Agriculture Faisalabad. Sowing was done on 17 March 2011. Experiments was started with the sowing of Indian snap melon and completed as the creeping vine dried taking a period of 4-5 months. Experiments was laid according to a randomized complete block design with three blocks and each block was serving as a replicate. A control treatment was also the part of experiment. In this treatment, there was no application of any artificial control against for management of red pumpkin beetle. Data was collected as adult density per plant of red pumpkin beetle and beetle % leaf infestation per plant. Data was recorded after every 5th day starting 15 days after sowing.

2.3. Extract Preparation and Application

Initially, for the preparation of extracts, stem of *Aloe vera* (50g), seed kernels of neem (50 g) [14] and roots of *Moringa oleifera* (50 g) were used. These plant material were air dried, grounded into power form using an electric grinder (Westpoint blender, model WF-7381). Afterward 5 g grounded material was dissolved in 100ml water to prepare 5% solution for spraying purpose [15-17]. Application of botanicals was done on every 15th day beginning 15 days after sowing with multiple applications and multiple sampling events.

2.4. Data collection

Average of the data was taken using the following formulae;

$$X = [\Sigma (X_1 + X_2 + \text{----------} + X_n)]/N$$

X = Average population of red pumpkin beetle in each replication of each treatment;
X_1 =Population of the beetle for 1 observation; X_2 = Population of the beetle for 2 observation; Xn = Population of the beetle for last observation;
N= Total number of observations of the crop.
Number of beetles was counted on each plant and population of the beetle calculated as mean number of beetle per plant. Similarly, percentage leaf infestation was calculated on per plant basis by counting total leaves and infested leaves per plant. Leaf infestation was calculated by following formula [18];

$$\% \text{ leaf infestation} = \frac{\text{Number of damaged leaves}}{\text{Total number of leaves}} \times 100$$

Population reduction caused by botanical treatments application for each interval over control was calculated by the following formulas described by Khan *et al.* [19]:

$$PRC_{dx} (\%) = 100 \frac{PL_{dx}}{P_c} \times 100$$

PRC_{dx} = Population reduction of red pumpkin beetle over control treatment for x days interval;
P_c =Population of red pumpkin beetle in control plots; PL_{dx}= Population of red pumpkin beetle in botanical treated plot at x days interval; dx = different botanical treatments (*Aloe vera*, neem and *Moringa oleifera*).

2.5 Statistical Analysis

Data were analyzed using 2 analysis of variance and mean were compared using DMR test at $P \leq 0.05$. Data were analyzed using Statistica 8.0 [20].

3. Results

Results obtained from the data collected regarding population of red pumpkin beetle per plant and percent leaf infestation caused by the red pumpkin beetle per plant was analyzed and divided in two parts as;

3.1 Response of botanicals based on Population

ANOVA table of population-based data revealed significant variation for botanical treatments however, in population mean comparison of botanicals using DMR test showed non-significant results in between the botanicals. Minimum population density was observed in neem (4.31 insects plant^{-1}) treated plots, therefore, minimum population reduction percentage was received in *Aloe vera* (26.7 insects plant^{-1}) treated plots.

Table 1: Analysis of variance of the data regarding botanical insecticides (plant extracts) against population of red pumpkin beetle.

S. O. V.	D. F.	SS	MS	F	P
Treatment	3	10.30	3.43	11.43	0.0068*
Replication	2	0.38	0.19	0.63	0.56ns
Error	6	1.80	0.30		
Total	11	12.49			

*= significant, ns= non-significant, $P \leq 0.05$

Population at lowest (4.31 insect plant^{-1}) recorded in neem treated plots followed by population 4.89 insect plant^{-1} recorded in *Moringa oleifera* treated plots. Highest population was calculated 4.97 insect plant^{-1} in *Aloe vera* treated plots lower than the untreated plots (control plots, 6.78 insect plant^{-1}).

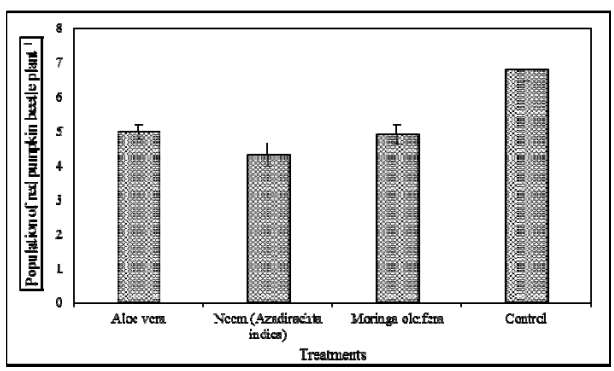

Fig 1: Population of red pumpkin beetle in different treatments plant^{-1}

3.2 Response of botanicals based on Infestation

AONVA table of the data regarding percentage leaf infestation analyzed using ANOVA depicted significant deviation within botanical treatments, moreover comparison of the mean of the selected botanicals revealed significant results.
Infestation trend was not the same as in case of population of red pumpkin beetle. Botanical treatments varied on percent leaf infestation basis. Minimum percent leaf infestation was recorded in neem treated plots with 9.1% infestation plant^{-1}. Maximum percent leaf infestation (14.56% plant^{-1}) was recorded in control plots followed by the percent leaf infestation calculated in *Aloe vera* treated plots (10.96% plant^{-1}).

Table 2: Analysis of variance of the data regarding botanical insecticides (plant extracts) against % leaf infestation of red pumpkin beetle.

S. O. V.	D. F.	SS	MS	F	P
Treatment	3	48.83	16.27	43.37	0.00018*
Replication	2	0.98	0.49	1.30	0.33
Error	6	2.25	0.37		
Total	11	52.06			

*= significant, ns= non-significant, $P \leq 0.05$

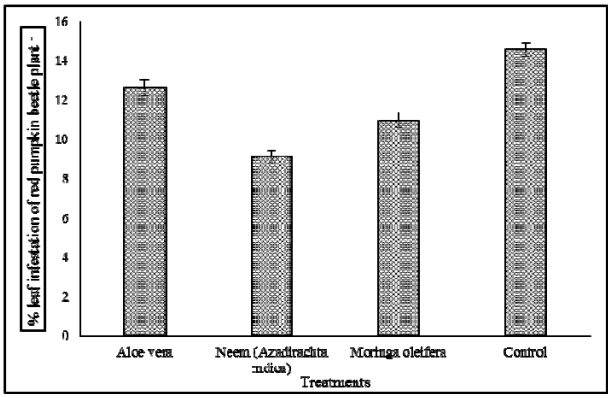

Fig 2: Percent (%) leaf infestation caused by red pumpkin beetle in different treatments plant^{-1}

3.3 Population/percent (%) leaf infestation reduction percentage

Percent population reduction over control was calculated to estimate effectiveness of treatments in beetle invasion reduction. Minimum population reduction percentage 26.70 worked out in *Aloe vera* treated plots, correspondingly minimum percent (%) leaf infestation reduction percentage came out in the same plots (13.46%). However, maximum percentage reduction in population (36.43) was recorded in neem treated plots.

Percent (%) leaf infestation reduction percentage (37.50%) was maximum obtained from neem treated plots followed by *Moringa oleifera* (24.73%). Minimum % leaf infestation reduction percentage was calculated in *Aloe vera* treated plots (13.46%).

Table 3: Comparison of the data regarding population reduction percentage and percent (%) leaf infestation reduction percentage of red pumpkin beetle against different botanical insecticides (plant extracts)

Treatment	% Population reduction	% leaf infestation reduction percentage
Aloe vera	26.70	13.46
Neem (*Azadirachta indica*)	36.43	37.50
Moringa oleifera	27.88	24.73
Control	-	-

4. Discussion

Three different botanical or plants extracts were involved for the assessment of most effective one. Extracts were sprayed on the crop by making a solution of equal percentage and effect was recorded based on the population of red pumpkin beetle plant^{-1} and percent (%) leaf infestation plant^{-1}. Neem (*Azadirachta indica*) plant extract was recorded as most effective one for the control of red pumpkin beetle in Faisalabad district using 5% concentration as spray in water when compared with *Moringa oleifera* and *Aloe vera*. Minimum population of red pumpkin beetle was observed in plots treated with neem seed kernel extract and population was 4.31 insects plant^{-1}. Similarly, minimum infestation of the red pumpkin beetle was recorded in the plots treated using neem extract and percent leaf infestation was 9.1% plant^{-1}. Present studies are not in line with but can be compared to the studies of Pande *et al.* [9] checked out the effect of 0.1, 0.2, 0.3, 0.4, 0.5 and 0.6% of *Ageratum conyzoides* leaf extract against red pumpkin beetle. No mortality was observed below 0.2% and highest mortality was observed at 0.6%. Gujar and Mehrotra [14] studied different neem derivatives as repellent and as killing agent, i.e. as neem seed kernel extract, as neem oil. Repellency percentage was observed 50% by these extracts but no mortality of the beetle was observed. Tandon and Sirohi [13] conducted bioassay studies to test the efficacy of 5% and 10% concentrations of neem extracts, sweat-pineapple, shankhpushpi and bakain. All of these plant extracts were effective for repelling the beetle. Difference between these chemicals was expressed by dividing them in different classes based on their percentage repellency. Rathod *et al.* [7] examined the efficacy of NeemAzal-F(0.1%), Gronim (0.5%), Vanguard (0.5%), Econeem (0.1%), Achook (0.5%), Azadex (0.5%), NSKE (neem seed kernel extract) (5.0%), NLE (neem leaf extract) (10.0%) and synthetic insecticides for the control of red pumpkin beetle. Highest mortality was observed with Gronim (49.89%) and the lowest mortality with neem leaf extrat (20.16%). Ali *et al.* [21] studied neem, *Parthenium* spp. and *Eucalyptus* leaf extracts for the control of red pumpkin beetle. *Parthenium* spp. was found highly effective for controlling the red pumpkin beetle.

5. Conclusion

From the present study, it can be concluded that application of neem seed kernel extract for the management of red pumpkin beetle is an appropriate control measure with less health risks. Role of *Moringa oleifera* and *Aloe vera* in comparison with control treatment cannot be ignored, although minimum effectiveness was calculated of *Aloe vera* plant extract.

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