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Efficacy of some indigenous products against cowpea aphid, *Aphis craccivora* Koch

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An experiment was conducted in field during 2017-18 for efficiency evaluation of seven indigenous products along with a check (imidacloprid 17.8 SL at 20g *a.i*/ha) to manage *Aphis craccivora* Koch on cowpea. In the bio-efficacy study, leaf extract of *Polygonum hydropiper* at 5% was found to be most effective and efficient in aphid population reduction (up to 77.48%), followed by neem oil at 1% (74.11%), *Ocimum sanctum* leaf extract at 5% (74.00%), *Murraya koenigii* leaf extract at 5% (70.96%), ash at 10 kg/ha (68.04%), river sand + neem leaf powder at 10 kg/ha (3:1 ratio) (44.48%) and ash + river sand at 10 kg/ha (5:1 ratio) (42.53%) after 7 days of spraying.

Keywords: *Aphis craccivora*, Bio-efficacy, Imidacloprid, Indigenous products

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Bean aphid, *Aphis craccivora* Koch (Homoptera: Aphididae) is one of the most destructive sucking pests of cowpea, attacking from vegetative to pod-forming stages. Both the nymphs and adults of the bean aphid suck the plant' scell sap. As a result, leaf distortion and stunted growth occurs and eventually poor qualities of fruits are obtained[1]. They excrete huge quantities of honeydew also, which promotes sooty mould growth and interferes with photosynthetic ability of plant[2]. Nevertheless, it is a vector of several non-persistent viruses and spreads diseases among many crops[3]. The most commonly used method of aphid control is the use of synthetic chemical pesticides, particularly neonicotinoids, but this method has several disadvantages and the overuse of pesticides has resulted in environmental pollution as well as negative effects on humans and other beneficial organisms[4,5]. Botanical pesticides are known as natural insecticides and are commonly used to protect crop plants and the environment from pesticides pollution in agro ecosystem. They are relatively harmless to non-target organisms[6]. Also, the possibility of insect developing resistance to natural plant productsis less. In the present investigation, three botanicals along with neem oil and some indigenous products (used by the local tea growers) were evaluated for their efficacy against black cowpea aphid, *A. craccivora* on cowpea.

Materials and Methods

Geographical location

The field where the experiment was conducted (Experimental farm, Department of Horticulture) is situated at 26°47'N latitude and 94°12'E longitude at an altitude of 86.6 m above mean sea level. A suitable and uniform site was selected for the experiment.

Weather and climatic conditions of Jorhat

Being situated in the monsoon sub-tropical zone, the climate of Jorhat is characterized by hot and humid summer and dry and cool winter. Monsoon season normally starts from June and extends up to September and the intensity of rainfall decreases from October. Mean annual rainfall is more than 2000 mm per annum and average humidity is around 85%. The temperature gradually increases from March and reaches maximum during August. The soil of Jorhat is mostly alluvial and sandy loam with pH ranging from 4.8 to 5.5.

Design and layout

The field experiment was conducted in AAU (Assam Agricultural University), Jorhat, Assam, campus in the year 2017-18 in a Randomized Block Design (RBD) statistical design with three replications.

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The net area for the experiment was 448 sq.m. The net area was parted into 3 blocks and each block was further divided into 9 equal plots measuring 12 sq.m (4m x 3m) each, respectively. There were a total of 27 plots. Interspacing between blocks and plots was 0.5 m. The cowpea variety "Green fall" was sown on 15.09.2017 in the field for determination of efficacy of different treatments. Agronomic practices were done to raise healthy crop according to recommendations. At the time of 50% flowering or with the appearance of the pest, the crop was sprayed with the treatments as mentioned in Table 1. Total four sprayings each at fortnight interval have been done starting from 45 days after sowing.In control plots, water spray was given. For spraying, 500 L of spray solution per hectare was used with the help of the hydraulic energy compression knapsack sprayer and other dry formulations were dusted manually.

Extraction of botanicals

The fresh leaves of plants were collected from the nearby vicinity of AAU, Jorhat campus and washed thoroughly and then were dried under shade for nearly 10 days. The plant material was ground to fine powder, sieved through an 80-mesh nylon cloth and soaked in distilled water at room temperature from 24 to 48 h after drying. The ratio of plant material and water was 1:20 (w:v), which was essential to make 5% solutions. The plant materials were then squeezed after soaking and the solution was filtered through a fine mesh nylon cloth which was free from plant residue and detritus to obtain an extract.To evaluate the efficacy, two criteria were considered: (a) estimation of pest population on 1 day before spraying and at 1, 3 and 7 days after spraying and (b) estimation of percentage reduction/increase in pest population.

Estimation of aphid population and method of observation

For recording the *A. craccivora* population, sampling technique was followed[7]. The sample for aphid count was made from randomly selected 10 plants per plot and aphid count was made from 10 cm top portion of these plants. The aphid count from the sampled portion was done *in situ*. A pre-count of aphid population was made in each plot before 1 day of spraying. The post treatment counts were made after 1 day, 3 days and 7 days of spraying.

Estimation of aphid population reduction or increase

To calculate aphid populationreduction or increase, the data observed in 1, 3 and 7 days of spraying were deducted from the pre-count data and divided by the pre-count data and converted into percentage.

$$\text{Per cent Reduction} = \frac{\text{Numbers of aphids at pre count - Numbers of aphids at post count}}{\text{Numbers of aphids at pre count}} \times 100$$

Statistical analysis

Randomized block design (RBD) was used to conduct the experiment and the data obtained were statistically analyzed by using SPSS-20 software.

Table 1 — Effect of treatments on aphid, *Aphis craccivora* population at different days after spraying (DAS)

Treatment	Dose	Aphid population at Pre-treatment	1 DAS	Per cent reduction in population	3 DAS	Percentage reduction in population	7 DAS	Percentage reduction in population
Ocimum sanctum	5%	32.43	14.76	54.48 (47.57)	10.50	-67.62 (55.31)	8.43	-74.00 (59.34)
Polygonum hydropiper	5%	31.53	13.20	58.13 (49.67)	8.53	-72.94 (58.65)	7.10	-77.48 (61.67)
Murraya koenigii	5%	27.90	13.33	52.22 (46.27)	9.16	-67.16 (55.03)	8.10	-70.96 (57.39)
Neem oil	1%	31.80	13.67	-57.01 (49.03)	9.40	-70.44 (57.07)	8.23	-74.11 (59.41)
River sand + Neem leaf powder (3:1)	10 kg/ha	30.73	22.86	-25.61 (30.40)	18.63	-39.37 (38.86)	17.06	-44.48 (41.83)
Ash(Paddy straw)	10 kg/ha	29.20	14.83	-49.21 (44.54)	11.10	-61.98 (51.93)	9.93	-68.04 (55.57)
Ash + river sand (5:1)	10 kg/ha	30.16	19.23	-36.24 (37.01)	16.33	-45.85 (42.61)	17.33	-42.53 (40.70)
Imidacloprid	20 g *a.i*/ha	28.90	9.10	-68.51 (55.86)	5.30	-81.66 (64.64)	2.90	-89.96 (71.52)
Control	Water spray	31.43	30.86	-1.81 (7.73)	32.16	+2.32 (8.76)	32.4	+3.08 (10.11)
S.Ed±		5.44		1.58		0.96		0.78
CD (p=0.05)		Non-significant		3.34		2.05		1.67

Results

Number of aphids 1 day before and 1, 3 and 7 days after spraying are presented in the Table 1. The incidence of aphid prior to spraying did not vary significantly among the treatments, including the untreated plots, indicating uniform distribution of aphids in the field. The average number of aphids ranged from 27.90 to 32.43 per 10 cm terminal shoot.

Effect of treatments at different days after spraying

One day after spraying

The numbers of aphids per 10 cm terminal shoot after 1 day of spraying were 14.76, 13.20, 13.33, 13.67, 22.86, 14.83, 19.23 and 9.10 in plots treated with *Ocimum sanctum*, *Polygonum hydropiper*, *Murraya koenigii* each at 5%, neem oil at 1%, river sand + neem leaf powder (1:3 ratio), ash, ash + river sand (5:1 ratio) each at 10 kg/ha, imidacloprid 17. 8 SL 20 g*a.i.*/ha respectively in comparison to 30.86 in control (Table 1).

While comparing the differences among all the treatment means, the lowest aphid population was recorded in plots treated with imidacloprid 20 g*a.i.*/ha which differed significantly with all the treatments. Among natural products the lowest aphid population was recorded in plots treated with *P. hydropiper* at 5% (13.20) which differed significantly with ash + river sand (5:1 ratio) (19.23) and river sand + neem leaf powder (3:1 ratio) (22.86) and was at par with all other treatments. Similar trend of result was also observed in case of neem oil at 1%, *O. sanctum* and *M. koenigii* each at 5% and ash at 10 kg/ha.

Three days after spraying

The incidence of aphid, after 3 days of spraying ranged from 5.30 to 32.16 numbers per 10 cm shoot. The botanicals that were tested recorded high reduction on aphid population (39.37%to 72.94%) over pre-treatment count in comparison to increase (2.32%) in case of untreated control plots (Table 1). Among the indigenous products the lowest aphid population was observed in plots treated with *P. hydropiper* at 5% (8.53) which differed significantly with ash + river sand (5:1 ratio) (16.33), river sand + neem leaf powder (3:1 ratio) (18.63) and ash (11.10) each at 10 kg/ha but at par with all other treatments. Neem oil at 1% (9.40) differed significantly with ash + river sand (5:1 ratio) (16.33) and river sand + neem leaf powder (3:1 ratio) (18.63) each at 10 kg/ha but at par with all other treatments. Similar trend of result was also observed in case of *O. sanctum* and *M. koenigii* each at 5%.

Seven days after spraying

After 7 days of spraying the aphid population was 8.43 in plots treated with *O. sanctum* at 5%; 7.10 in *P. hydropiper* at 5% treated plot; 8.10 in *M. koenigii* at 5% treated plot; 8.23 in plots treated with neem oil at 1%; 17.06 in plots treated with river sand + neem leaf powder (3:1 ratio) at 10 kg/ha; 9.93 in ash treated plot at 10 kg/ha; 17.33 in plots treated with ash+ river sand (5:1 ratio) at 10 kg/ha; 2.90 in plots treated with imidacloprid 20 g *a.i.*/ha and 32.40 in control plots (Table 1). The data depicted in the table revealed that imidacloprid 20 g *a.i.*/ha differed significantly with all other treatments. Among the natural products the lowest aphid population was observed in *P. hydropiper* at 5% treated plot which differed significantly with ash + river sand (5:1 ratio), river sand + neem leaf powder (3:1 ratio) and ash each at 10 kg/ha but at par with all other treatments. Similar trend of result was also observed in case of neem oil at 1%.

O. sanctum (8.43 aphids) and *M. koenigii* (8.10 aphids) each at 5% differ significantly with ash + river sand (5:1 ratio) (17.33 aphids), river sand + neem leaf powder (3:1 ratio) (17.06 aphids) but at par with all other treatments. It was evident from the present investigation that all the botanicals (plant extracts) along with ash and river-sand tested against *A. craccivora* were found effective in reducing the population of aphid in comparison to untreated plots after 1, 3 and 7 days of spraying. The order of toxicity of different treatments with respect to percentage reduction of aphid population after 7 days of spraying was *P. hydropiper* (77.48%) > neem oil (74.11%) > *O. sanctum* (74.00%) >*M. koenigii* (70.96%) > ash (68.04%) > river sand + neem leaf powder (44.48%) > ash + river sand (42.53%).

Discussion

P. hydropiper (5%) was found to be the most effective treatment resulting in 58.13%, 72.94% and 77.48% reduction of aphid population at 1, 3 and 7 days after spraying respectively. The efficacy of *P. hydropiper* was earlier reported and it was found to be most effective against *A. craccivora* and it was also reported that with increase in concentration, the mortality also increased[8]. Similar result was also reported that *P. hydropiper* at 5% caused 74.35% mortality in mustard aphid (*Lipaphis erysimi*) after

7 days of spraying[9]. The reduction of *A. craccivora* due to leaf extracts of *O. sanctum* was found to be 54.48%, 67.62% and 74.00% and it was at par with *P. hydropiper* leaf extract (5%), neem oil (1%), *M. koenigii* (5%) and ash (10kg/ha) after 1, 3 and 7 days after spraying. Similar result was also reported that basil leaf extract (*O. sanctum*) at 2% is an effective protectant against *Lipaphis erysimi* and its predator, *Coccinella septempunctata*[8]. Similar results from an earlier report also revealed that basil leaf extract (*O. sanctum*) at 2% is an effective protectant against *Lipaphis erysimi* and is also safe to its predator, *Coccinella septempunctata*[10]. Neem oil at 1% caused 57.01% and 70.44% reduction in aphid population after 1 and 3 days after spraying. After 7 days the aphid population was reduced to 74.11% which was at par with *P. hydropiper, O. sanctum* and *M. koenigii* leaf extract. Similar results on efficacy of neem oil against *Aphis gossypii* also observed that neem oil at 1% caused mortality of *Lipaphis erysimi* up to 68.01%[11,12]. Efficacy of ash revealed that after 7 days aphid population was reduced up to 68.04% which reveals that ash could also be effective for management of aphid[13]. *M. koenigii* leaf extract showed 52.22%, 67.16% and 70.96% reduction in aphid population after 1, 3 and 7 days of spraying. Other scientists also reported that ethanolic extract of *M.koenigii* has good acaricidal property against *Rhipicephalus microplus*[14]. Ash + river sand reduced aphid population upto 36.24% and 45.85% after 1 and 3 days after spraying. Again after 7 days the aphid population was increased and it was found to be 42.53%. In case of river sand + neem leaf powder there was 25.61%, 39.37% and 44.48% reduction in aphid population after 1, 3 and 7 days of spraying. Both these treatments were found to be less effective for the management of aphids as compared to the other botanicals but superior than the untreated control plots. The dried powders of some locally available plants have a repellent effect against stored grain insects[15]. The present study also indicated that there is slow reduction in aphid population after 3 days of spraying of the botanicals. So repeated spraying in 7 days interval is necessary to obtain a good result in reduction of pest population.

Conclusions

While considering the efficacy in terms of aphid population reduction, *P. hydropiper* at 5%, neem oil at 1%, *O. sanctum* at 5% and *M. koenigii* at 5% showed better results over other treatments. These initial findings on bio-efficacy are useful to find out the potentiality of natural products. Further research might be conducted to find out the effect of plant extracts on the reproductive cycle of aphid in future and should promote development of new commercial indigenous products suitable for controlling *A. craccivora.*

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Conflict of interest

The authors declare that they have no conflict of interest.

Author Contribution

SM has conducted the entire work under the guidance of Dr Gogoi and Dr Bhattacharyya. As a statistician,BN has provided all the facilities for statistical analysis. PDN has given constructive suggestions while writing this manuscript.

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