



Pongamia oil soap for managing the cowpea aphid, *Aphis craccivora* Koch

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ABSTRACT: Efficacy of pongamia oil soap against cowpea aphid, *Aphis craccivora* infesting vegetable cowpea, *Vigna unguiculata* was evaluated during rabi and summer seasons in comparison with neem oil soap, spinosad, soap solution and absolute control. Pongamia oil soap 2 per cent showed the highest efficacy without phytotoxicity followed by 1 per cent while neem oil soap 0.6 per cent was on par with pongamia oil soap 0.6 per cent. All treatments having pongamia oil soap were significantly superior to absolute control. © 2020 Association for Advancement of Entomology

KEYWORDS: Pongamia oil soap, neem oil soap, cowpea aphid

INTRODUCTION

The aphid, *Aphis craccivora* Koch is a threat for the vegetable cowpea, *Vigna unguiculata* (L.) infesting its tender parts including leaves, tender shoots, flowers and pods and suck the sap resulting in the malformation, wilting and drying up of plants. Chemical pesticides used widely for controlling this pest are though effective, but have certain disadvantages if not used properly causing resistance in target species (Khade *et al.*, 2014). Pongamia oil is a botanical insecticide which is obtained from *Pongamia pinnata* (L.). This brownish oil extracted from the seeds of pongamia called as karanj oil or pongamia oil contains several secondary metabolites (flavonoids, chalcones, steroids and terpenoids) which serve as defence agent against insect pests (Pavela, 2007). Generally pongam oil is safe to humans and other mammals (Tripathi *et al.*, 2002). Vegetable cowpea has to be harvested very frequently wherein adopting a waiting period of 4-5 days is not possible in cowpea

once yielding starts. So development of effective alternative to the chemical pesticides is very important in vegetable cowpea pest management. With this background, the efficacy of pongamia oil soap against aphid pests of cowpea was evaluated.

MATERIAL AND METHODS

Pongamia oil required for the preparation of soap was obtained from Tamil Nadu Agricultural University, and the saponification value was determined to check the purity of the oil in Soil Science and Agricultural Chemistry Lab, College of Agriculture, Padannakkad which was found to be 194 KOH/mg. It was prepared according to the technology used for the preparation of Ready to Use neem oil garlic soap. The pH value of the soap was 10.5.

A field experiment was carried out on vegetable cowpea at the instructional farm of College of Agriculture, Padannakkad for two seasons during

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October 2018 to January 2019 and February 2019 to May 2019. Cowpea variety Vellayani jyothika seeds were sown by dibbling method at a spacing of 1.5m x 0.45m during *rabi* and summer seasons with sixteen plants per treatment including four replications. So each replication of treatment had four plants. Vine trellis were fixed to trail the plants. Following seven treatments with four replications were laid under Randomized Block Design (RBD). Pongamia oil soap 0.6 per cent, 1 per cent and 2 per cent, Neem oil soap 0.6 per cent, Spinosad 45SC 0.5ml/L, Soap solution 0.5 per cent and absolute control.

Treatments were applied using a knapsack sprayer at vegetative and reproductive stages as soon as the pest infestation was seen. Observations on population density were made a day prior to spraying and post treatment population density at 1,3,5,7 and 14 DAT while damage symptoms were observed at 7 and 14 DAT, on whole plant.

The damage due to aphids, *Aphis craccivora* was assessed with total number of shoots, number of aphid infested shoots, scoring of aphid colonies based on standard scale (Egho and Emosairue, 2010). The standard scale for scoring the aphid population (Table 1) was done by observing the aphid colonies on each cowpea stands per treatment. Size of the colony was then observed visually and scored based on the scale.

% of Shoot infestation = (No. of infested shoots ÷ Total no. of shoots) X 100

Data on the population density of aphids were analysed after square root transformation and data on per cent shoot infestation were analysed after

arc sine transformation. The data were analysed using analysis of variance (ANOVA). Web Agri Stat Package (WASP) was used to compare the significance of each treatment.

RESULTS AND DISCUSSION

Scoring of aphid colonies on shoots during *rabi* season

Pre count of aphid population showed no significant difference between the treatments, indicating that the population density of aphids was uniform in all the treatments prior to the first spraying. One day after first spray application, pongamia oil soap 2 per cent reduced the aphids to a minimum scoring level of 0.12 followed by same oil soap at 1 per cent (0.75) and at 0.6 per cent (1.37) as against the highest score of 2.50 in absolute control followed by soap solution 0.5 per cent (2.25) and spinosad 45SC (2.00). Neem oil soap 0.6 per cent (1.43) was statistically on par with pongamia oil soap 0.6 per cent (1.37) and soap solution 0.5 per cent and spinosad 45SC were on par with control. All the treatments were significantly superior over the control except soap solution 0.5 per cent. Minimum count of aphid population was seen in pongamia oil soap 2 per cent (0.12) followed by pongamia oil soap 1 per cent (0.75) and pongamia oil soap 0.6 per cent (1.37) on third day after first spray. Maximum aphid population score was recorded in control (2.62) followed by soap solution at 0.5 per cent (2.37) and spinosad 45SC (2.00). Absolute control (2.62) and soap solution at 0.5 per cent (2.37) were statistically on par. Treatment of neem oil soap 0.6 per cent (1.43) was statistically on par with pongamia oil soap 0.6 per cent (1.37). All the treatments were significantly superior over the

Table 1. Scale for assessing the population of aphids

Sl. No.	Rating	Number of aphids	Appearance
1	0	0	no infestation
2	1	1-4	a few individual colonies
3	3	5-20	a few isolated colonies
4	5	21-100	several small colonies
5	7	101-500	large isolated colonies
6	9	>500	Large continuous colonies

control except soap solution at 0.5 per cent. A gradual increase in the aphid population was seen on five days after spray. Minimum count of aphid population was seen in pongamia oil soap 2 per cent (0.31) followed by pongamia oil soap 1 per cent (0.87) and pongamia oil soap 0.6 per cent (1.75). Maximum aphid population score was recorded in control (3.62) followed by soap solution at 0.5 per cent (2.62) and spinosad 45SC (2.25). Treatment having neem oil soap 0.6 per cent (1.68) was statistically on par with pongamia oil soap 0.6 per cent (1.75). All the treatments were significantly superior over the control except soap solution at 0.5 per cent.

Observations at seventh day after first spray revealed that minimum count of aphid population was seen in pongamia oil soap 2 per cent (0.31) followed by pongamia oil soap 1 per cent (1.00) and neem oil soap 0.6 per cent (1.68). Maximum aphid population score was recorded in control (3.75) followed by soap solution at 0.5 per cent (3.37) and spinosad 45SC (2.25). Treatment having pongamia oil soap 0.6 per cent (2.00) was statistically on par with neem oil soap 0.6 per cent and spinosad 45SC. All the treatments were significantly superior over the control except soap solution at 0.5 per cent. At fourteenth day, minimum count of aphid population was seen in pongamia oil soap 2 per cent (0.43) followed by pongamia oil soap 1 per cent (1.06) and neem oil soap 0.6 per cent (1.75). Maximum aphid population score was recorded in control (5.06) followed by soap solution at 0.5 per cent (5.00) and spinosad 45SC (2.31). Pongamia oil soap 0.6 per cent (2.06) was statistically on par with neem oil soap 0.6 per cent and spinosad 45SC. All the treatments were significantly superior over the control except soap solution at 0.5 per cent. (Table 2)

Scoring of aphid colonies on shoots during summer

One day after first spray application, pongamia oil soap 2 per cent reduced the aphids to a minimum scoring level of 0.00 followed by same oil soap at 1 per cent (0.75) and at 0.6 per cent (2.56) as against the highest score of 9.00 in absolute control followed by soap solution 0.5 per cent (9.00) and spinosad

45SC (6.00). Neem oil soap 0.6 per cent (3.12) was statistically on par with pongamia oil soap 0.6 per cent and soap solution 0.5 per cent and spinosad 45SC were on par with control. All the treatments were significantly superior over the control except soap solution 0.5 per cent. Minimum count of aphid population was seen in pongamia oil soap 2 per cent (0.00) followed by pongamia oil soap 1 per cent (0.62) and pongamia oil soap 0.6 per cent (2.31) on 3rd day after first spray. Maximum aphid population score was recorded in control (9.00) and soap solution at 0.5 per cent (9.00) followed by spinosad 45SC (6.00). Treatment having neem oil soap 0.6 per cent (2.43) was statistically on par with pongamia oil soap 0.6 per cent. All the treatments were significantly superior over the control except soap solution at 0.5 per cent.

All the treatments were significantly superior over the control except soap solution at 0.5 per cent on five days after spray. Minimum count of aphid population was seen in pongamia oil soap 2 per cent (0.00) followed by pongamia oil soap 1 per cent (0.62) and pongamia oil soap 0.6 per cent (2.25). Maximum aphid population score was recorded in control (9.00) followed by soap solution at 0.5 per cent (8.00) and spinosad 45SC (5.50). Neem oil soap 0.6 per cent (2.31) was statistically on par with pongamia oil soap 0.6 per cent.

Observations at seventh day after first spray found that minimum count of aphid population was seen in pongamia oil soap 2 per cent (0.06) followed by pongamia oil soap 1 per cent (0.75) and pongamia oil soap 0.6 per cent (2.56). Maximum aphid population score was recorded in control (9.00) and soap solution at 0.5 per cent (9.00) and followed by spinosad 45SC (6.00). Neem oil soap 0.6 per cent (3.12) was statistically on par with pongamia oil soap 0.6 per cent. All the treatments were significantly superior over the control except soap solution at 0.5 per cent. At fourteenth day after first spray revealed that minimum count of aphid population was seen in pongamia oil soap 2 per cent (0.12) followed by pongamia oil soap 1 per cent (1.00) and neem oil soap 0.6 per cent (2.56). Maximum aphid population score was recorded in control (9.00) followed by soap solution at 0.5 per cent (8.00) and spinosad 45SC (5.50). Treatment

Table 2. Scoring of aphid colonies on shoots based on standard scale during *rabi* season from October 2018 to January 2019

Treatments	Aphids scoring on shoots (mean of 16 plants)					
	1DBFS	1DAFS	3DAFS	5DAFS	7DAFS	14DAFS
Pongamia oil soap 0.6%	1.62(1.26)	1.37(1.36) ^c	1.37(1.36) ^c	1.75(1.49) ^c	2.00(1.57) ^b	2.06(1.59) ^b
Pongamia oil soap 1%	1.68(1.28)	0.75(1.11) ^d	0.75(1.11) ^d	0.87(1.16) ^d	1.00(1.22) ^c	1.06(1.24) ^c
Pongamia oil soap 2%	1.62(1.26)	0.12(0.78) ^e	0.12(0.78) ^e	0.31(0.88) ^e	0.31(0.88) ^d	0.43(0.95) ^d
Neem oil soap 0.6%	1.75(1.32)	1.43(1.39) ^c	1.43(1.39) ^c	1.68(1.47) ^c	1.68(1.47) ^b	1.75(1.49) ^b
Spinosad 45 SC @ 0.5 ml/L	1.87(1.36)	2.00(1.57) ^b	2.00(1.57) ^b	2.25(1.64) ^{bc}	2.25(1.64) ^b	2.31(1.66) ^b
Soap solution 0.5%	1.87(1.36)	2.25(1.65) ^{ab}	2.37(1.69) ^a	2.62(1.76) ^b	3.37(1.96) ^a	5.00(2.34) ^a
Control	2.37(1.53)	2.50(1.73) ^a	2.62(1.76) ^a	3.62(2.03) ^a	3.75(2.06) ^a	5.06(2.35) ^a
CD (0.05)	NS	0.08	0.09	0.19	0.20	0.20

Figures in parentheses denote square root transformed values.

Means followed by similar letters are not significantly different

DBFS- Day before first spray; DAFS- Days after first spray; NS – No Significant

having pongamia oil soap 0.6 per cent (2.75) was statistically on par with neem oil soap 0.6 per cent. All the treatments were significantly superior over the control except soap solution at 0.5 per cent (Table 3).

Aphid infestation on shoots during *rabi*

A significant reduction in aphid infestation on shoots was observed in the plot treated with pongamia oil soap 2 per cent (1.57 per cent) after seven days of first spray followed by same oil soap at 1 per cent

(6.59 per cent) and neem oil soap at 6 per cent (11.34 per cent) against highest aphid infestation on shoots in absolute control (44.57 per cent) which was at par with soap solution at 0.5 per cent (38.93 per cent) followed by spinosad 45SC (21.23 per cent). Neem oil soap 0.6 per cent was statistically on par with pongamia oil soap 0.6 per cent (11.86 per cent). All the treatments were significantly superior over the control except soap solution 0.5 per cent.

The observation on infestation on shoots after fourteen days of first spray showed that treatment

Table 3. Scoring of aphid colonies on shoots during summer season from February 2019 to May 2019

Treatments	Aphids scoring on shoots (mean of 16 plants)					
	1DBFS	1DAFS	3DAFS	5DAFS	7DAFS	14DAFS
Pongamia oil soap 0.6%	4.37(2.09)	2.56(1.74) ^c	2.31(1.67) ^c	2.25(1.65) ^c	2.56(1.74) ^c	2.75(1.79) ^c
Pongamia oil soap 1%	4.43(2.10)	0.75(1.06) ^d	0.62(1.01) ^d	0.62(1.01) ^d	0.75(1.07) ^d	1.00(1.22) ^d
Pongamia oil soap 2%	4.37(2.08)	0.00(0.70) ^e	0.00(0.70) ^e	0.00(0.70) ^e	0.06(0.74) ^e	0.12(0.78) ^e
Neem oil soap 0.6%	4.5(2.12)	3.12(1.90) ^c	2.43(1.71) ^c	2.31(1.67) ^c	3.12(1.90) ^c	2.56(1.74) ^c
Spinosad 45 SC @ 0.5 ml/L	4.62(2.14)	6.00(2.54) ^b	6.00(2.54) ^b	5.50(2.44) ^b	6.00(2.54) ^b	5.50(2.44) ^b
Soap solution 0.5%	4.62(2.14)	9.00(3.08) ^a	9.00(3.08) ^a	8.00(2.91) ^a	9.00(3.08) ^a	8.00(2.91) ^a
Control	5.12(2.26)	9.00(3.08) ^a	9.00(3.08) ^a	9.00(3.08) ^a	9.00(3.08) ^a	9.00(3.08) ^a
C.D. (0.05)	NS	0.28	0.23	0.25	0.26	0.19

Figures in parentheses denote square root transformed values.

Means followed by similar letters are not significantly different

DBFS- Day before first spray; DAFS- Days after first spray; NS – No Significant

having pongamia oil soap 2 per cent (5.32 per cent) found with minimum per cent of aphid infestation on shoots which was on par with pongamia oil soap 1 per cent (8.48 per cent) and neem oil soap 0.6 per cent (13.87 per cent). Maximum per cent of aphid infestation on shoots was recorded in control (56.83 per cent) which was at par with soap solution at 0.5 per cent (40.21 per cent) followed by spinosad 45SC (24.59 per cent). Treatment having neem oil soap 0.6 per cent was statistically on par with pongamia oil soap 0.6 per cent (15.87 per cent) and pongamia oil soap 1 per cent. All the treatments were significantly superior over the control except soap solution at 0.5 per cent (Table 4).

Aphid infestation on shoots during summer

A significant reduction in aphid infestation on shoots was observed in the plot treated with treatment pongamia oil soap 2 per cent (0.20 per cent) after seven days of first spray followed by same oil soap at 1 per cent (3.22 per cent) and at 0.6 per cent (14.69 per cent) against highest aphid infestation

on shoots in absolute control (89.00 per cent) which was at par with soap solution at 0.5 per cent (88.08 per cent) followed by spinosad 45SC (44.42 per cent). Pongamia oil soap 0.6 per cent was statistically on par with neem oil soap 0.6 per cent (16.13 per cent). All the treatments were significantly superior over the control except soap solution at 0.5 per cent.

After fourteen day of spray, minimum per cent of aphid infestation on shoots was recorded in pongamia oil soap 2 per cent (0.54 per cent) which was at par with pongamia oil soap 1 per cent (5.62 per cent) followed by pongamia oil soap 0.6 per cent (18.94 per cent). Maximum per cent of aphid infestation on shoots was recorded in soap solution at 0.5 per cent (87.75 per cent) which was at par with control (85.58 per cent) followed by spinosad 45SC (49.27 per cent). Treatment having neem oil soap 0.6 per cent (32.45 per cent) was statistically on par with pongamia oil soap 0.6 per cent and spinosad 45SC. All the treatments were significantly superior over the control except soap solution at 0.5 per cent (Table 4).

Table 4. Mean per cent of aphid infestation on shoots during *rabi* and summer seasons 2019-20 (mean of 16 plants)

Treatments	Infestation during <i>rabi</i>			Infestation during summer		
	1 DBFS	7 DAFS	14 DAFS	1 DBFS	7 DAFS	14 DAFS
Pongamia oil soap 0.6%	18.33 (25.08)	11.86 (20.14) ^c	15.87 (23.37) ^{cd}	64.97 (53.93)	14.69 (22.52) ^c	18.94 (25.79) ^d
Pongamia oil soap 1%	18.28 (24.60)	6.59 (14.84) ^d	8.48 (16.83) ^{de}	60.87 (51.47)	3.22 (9.05) ^d	5.62 (13.51) ^d
Pongamia oil soap 2%	20.51 (26.91)	1.57 (1.57) ^e	5.32 (11.53) ^e	66.98 (55.35)	0.20 (1.69) ^e	0.54 (3.25) ^e
Neem oil soap 0.6%	21.10 (27.23)	11.34 (19.68) ^c	13.87 (21.83) ^d	69.29 (56.58)	16.13 (23.66) ^c	32.45 (33.90) ^{bc}
Spinosad 45 SC @ 0.5 ml/L	18.36 (25.30)	21.23 (27.43) ^b	24.59 (29.68) ^c	57.50 (49.34)	44.42 (41.78) ^b	49.27 (44.57) ^b
Soap solution 0.5%	17.17 (24.41)	38.93 (38.56) ^a	40.21 (39.27) ^b	67.38 (55.68)	88.08 (69.81) ^a	87.75 (69.53) ^a
Control	20.68 (26.86)	44.57 (41.88) ^a	56.83 (48.95) ^a	67.85 (55.57)	89.00 (70.64) ^a	85.58 (67.70) ^a
C.D. (0.05)	NS	3.48	7.01	NS	3.88	11.50

Figures in parentheses denote arc sine transformed values.

Means followed by similar letters are not significantly different

DBFS- Day before first spray; DAFS- Days after first spray; NS – No Significant

From the results obtained, it is noticeable that all the treatments except soap solution 0.5 per cent was effective in reducing aphid population during both *rabi* and summer seasons from October 2018 to January 2019 and February 2019 to May 2019 respectively. In general, the efficacy of pongamia oil soap at 0.6, 1 and 2 per cent and neem oil soap 0.6 per cent were significantly superior over control. Similar findings were reported by Ranawat (2018) who stated that karanj oil 1 per cent and neem oil 1 per cent showed significant reduction in cowpea aphid *Aphis craccivora* population over the control. Balikai (2001) that *Pongamia pinnata* kernel 2 per cent and *Pongamia pinnata* leaves 5 per cent showed significant reduction in sorghum aphid *Melanaphis sacchari* over the control. This reduction may be due to insecticidal property of pongamia oil in the pongamia oil soap. Pongamia oil contains secondary metabolites which show insecticidal activity (Pavela, 2007).

It was also seen that efficacy of pongamia oil soap increased with the increase in concentration of the oil and pongamia oil soap 2 per cent showed highest efficacy. The neem oil soap 0.6 per cent and pongamia oil soap 0.6 per cent showed statistically similar reduction in aphid population. Similar findings were reported by Akash *et al.*, (2013), they stated that 83.6 per cent decline in aphid population was recorded with 1 per cent karanj oil treatment which was statistically at par with 1 per cent neem oil (81.03). There is an increase in the population of aphids as can be seen from 7 days to 14 days after application of treatments. Singh (2013) found similar results when he treated pongamia oil 1 per cent against the peach leaf curl aphid *Brachycaudus helichrysi*. Soap solution 0.5 per cent always showed results similar to control indicating that the reduction in aphid population was solely due to the insecticidal properties of the oil rather than the soap solution which is a component of pongamia oil soap.

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