International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 07-01-2024, Accepted: 22-01-2024, Published: 06-02-2024
Volume 9, Issue 2, 2024, Page No. 29-33

Efficacy of natural organic compound against aphid, *Aphis craccivora* Koch population on groundnut, *Arachis hypogaea* L

Anuj Shakya[1*], R K Dwivedi[2], Sharvan Kumar[3], Devraj Singh[3], Shiva Mohan[3]
[1] Assistant Professor, Department of Agriculture, Invertis University, Bareilly, Uttar Pradesh, India
[2] Assistant Professor, Department of Entomology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India
[3] Assistant Professor, Department of Agriculture, Invertis University, Bareilly, Uttar Pradesh, India

Abstract
The experiment was carried out to study the efficacy of various organic compound *viz*., *Neem* leaf extract 5 %, cow urine 10%, *Datura* leaf powder, *Lantana* leaf extract 5%, *Ipomoea* leaf extract 5%, eucalyptus leaf powder and cow dung ash against aphid infesting groundnut. All treatments were found significantly superior over control. The *neem* leaf extract 5% was ranked on top having mean population of aphids i.e. 1.74 and suppressing the maximum insect population. The trend of efficacy of different treatments against tested insect pests in descending order are *neem* leaf extract 5% > cow urine 10% > *Datura* leaf powder> *Lantana* leaf extract 5% > *Ipomoea* leaf extract 5% > eucalyptus leaf powder > cow dung ash. Treatment eucalyptus leaf powder in which 4.17 aphids was observed and that was also at par with cow dung ash having 4.39 population of aphids. All the treatments proved statistically superior over control in which highest aphids population i.e. 7.88 were recorded. The highest net profit (₹ 50377.00 and 49216.00/ha) was obtained from the *neem* leaf extract 5% for both the years i.e. 2018 and 2019, respectively, while the lowest net profit (₹16406.00 and 16405.00/ha for both the years, respectively) was estimated from the treatment of cow dung ash. By working out the BC Ratio it was found that the *neem* leaf extract 5% ranked 1st with highest BC i.e. 1:20.35 and 1:19.88 for both the years, respectively, and minimum in cow dung ash i.e. 1:6.98 which was quite similar for both the years.

Keywords: Groundnut, aphid, organic compound, neem leaf extract, cow urine

Introduction

Groundnut (*Arachis hypogaea L)* is a legume crop belongs to family fabaceae (leguminosae) and it is also known as as peanut, goober, or monkey nut (UK). Groundnut is the major oil seed crop in India and it plays a primary role in bridging the vegetable oil shortfall in the country. It is widely grown in the tropics and subtropics, being important to both minor and major commercial producers. It is classified both as grain and oil purpose. A usually among crop plants, peanut pods mature underground rather than aboveground due to this characteristic the botanist Linnaeus coined the specific name *hypogaea*, which meaning "under the earth". Groundnuts cultivate best in light, sandy loam soil with a pH varies 5.9–7. The primary growing states are Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra, Rajasthan, Madhya Pradesh, Odisha, and Uttar Pradesh. The crop is grow 0.95 lakh hectares with a total production of 0.98 lakh tonnes with average yield of 1011 kg/ha. in Uttar Pradesh and 55.6 lakh hectares area with production of 101 lakh tones in India with a productivity of 1816 kg/ha in 2020-21 (Anonymous, 2021) [1].

Groundnut is legume in nature, its play pivotal role in symbiotic nitrogen-fixing bacteria in root nodules due to fixation properties its require less nitrogenous containing fertilizer which helps in improving soil fertility and managing valuable crop rotation. It is nutritious profile similar to tree nuts, such as walnuts and almonds, and as a culinary nut are often served in similar ways in Western cuisines.

The sucking insect pests complex comprising thrips *Thrips dorsalis* Hood and *Megalurothrips usitatus* Bagnall; leaf hoppers *Empoasca motti* Pruthi, *Batracomorphus angustatus* Osborn, *Cicadulina bipunctata* Melichar, *Empoascanara prima* Distant and *Leofa mysorensis* Distant and aphids *Aphis craccivora* Koch are the major pests of importance on groundnut crop specially when raised under rainfed conditions and bunch varieties are severely infested (Vasantharaj and Ramamurthy, 2011) [8]. Thrips mainly feed by lacerating and sucking the sap from leaves and are known to transmit groundnut bud necrosis virus. (Khan and Hussain, 1965) [5]. Four genera regularly swarm groundnut to be specific *Scirtothrips dorsalis* Distant, *Frankliniella schultzei* Trybom, *Thrips palmi* Karny and *Caliothrips indicus* Bagnall. Thrips live in young foliage particularly between the collapsed groundnut leaflets and blossoms that repress terminal buds and blossoms. Both nymphs and adults feed by rasping the surface of rapidly growing leaf tissues and suck the released plant fluid. They cause small scars on leaves leading to stunted plant growth. Harmed leaves might become papery and twisted, pervaded terminal leaves misfortune tone, rolled up and drop before development. (Chisholm and Lewis, 1984) [3]. Weather parameters play an important role on the population dynamics and distribution of groundnut thrips and also yield loss in groundnut crop due to thrips their incidence.

Materials and methods

During the 2018-19 and 2019-20 cropping seasons, a field experiments were conducted at New Dairy Farm at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur Nagar, (U.P.) in well leveled field having proper drainage. Geographically Kanpur Nagar falls under sub-

tropical climate zone and is located in between $25^0 26'$ and $26^0 58'$ N latitude and $79^0 32'$ and $80^0 34'$ E longitude at an altitude of 125.90 m above Mean Sea level. The mean annual rainfall is about 816 mm. It lies in the alluvial belt of Gangetic plains of Central Uttar Pradesh.

Preparation of treatments

Cow urine and cow dung ash were collected from dairy, department of animal husbandry and dairying of this university. Other treatments used as organic compound in the field and deterrent effects on crop plant are dried, crushed leaves of *neem*, *Datura*, eucalyptus, *Lantana* and *Ipomoea*. Leaves were collected from the related plants and leave for shade drying for about 15-20 days. After shade drying leaves were crushed and grinded into powder form and they were incorporated in soil before sowing.

Preparation of leaf extracts 5%

New leaves of the respective plants were collected and brought to research facility, washed thoroughly 3-4 times with faucet water. After that, they were chopped into little pieces with knife. To get one litre of 5% leaf extract, 50 gram of the chopped material were soaked overnight in 1000 ml water, squeezed through muslin cloth and residue were smashed in mortar and pestle, again extracted and filtered through muslin cloth and the volume was made up to one litre to get 5 per cent leaf extract for spraying. Bijewar *et al.* (2018) [2].

Preparation of 10% cow urine solution

Fresh cow urine was collected from Dairy farm of this university. 100 ml of cow urine was mixed in 1 litre water to get 10% cow urine solution.

To study the bio-efficacy of natural organic compounds against thrips, *Scirtothrips dorsalis* Distant were laid out. There were eight treatments replicated thrice to form twenty four plots following Completely Randomized Block Design CRBD in 5×3 m^2 plot size. In which eight treatments were opted for the management of tested insect in groundnut by spraying and dusting in the crop. These treatments were as follows: T_1 (Eucalyptus leaf powder (*Eucalyptus globules*) @ 675 gm/plot), T_2 (*Datura* leaf powder (*Datura stramonium*) @ 675 gm/plot), T_3 (*Neem* leaf extract 5%), T_4 (Cow dung ash), T_5 (cow urine 5%), T_6 (*Ipomoea* leaf extract 5%), T_7 (*Lantana* leaf extract 5%), and T_8 (Control). These treatments were applied as spray and dusting on standing crop at 40 DAS (Days After Sowing) 60 DAS and 80 DAS and data was recorded one day before application and then 5, 10 and 15 days after each application.

Observations recorded

The plant damage was estimated based on the damage caused by the thrips. The application of treatments were applied when the population were reach at Economic threshold levels (ETLs) i.e. 5 adult thrips/terminal shoots. The observation on the plant damage due to thrips was recorded from 5 randomly selected plants.

Experimental materials

Table 1: List of treatments

S. No.	Treatments Symbol	Treatments	Dose/ha.	Availability
1	T_1	Eucalyptus leaf powder	@ 500 kg/ha.	Prepared in laboratory
2	T_2	*Datura* leaf powder	@ 500 kg/ha.	Prepared in laboratory
3	T_3	*Neem* leaf extract 5%	@ 25 lit/ha	Prepared in laboratory
4	T_4	Cow dung ash	@ 500 kg/ha	Prepared in laboratory
5	T_5	Cow urine 10%	@ 50 lit/ha	Prepared in laboratory
6	T_6	*Ipomoea* leaf extract 5%	@ 25 lit/ha	Prepared in laboratory
7	T_7	*Lantana* leaf extract 5%	@ 25 lit/ha	Prepared in laboratory
8	T_8	Control	-	-

Benefit cost Ratio

The benefit cost ratio was calculated on the basis of prevailing market prices of groundnut, botanicals and spraying/dusting cost. Benefit cost ratio was calculated as follows :

$$\text{BC ratio } \frac{\text{Net profit over control}}{\text{Cost of treatments}}$$

Table 2: Effect of different botanicals and organic compounds on the population of aphid, *Aphis craccivora* Koch. during *Kharif* 2018 and 2019 (Pooled Data). First application

S.N.	Treatments	Dose/ha.	Population of *Aphis craccivora*				
			Before application	After application			
			1 DBS	5 DAS	10 DAS	15 DAS	Mean
1	Eucalyptus leaf powder	@ 500 kg/ha.	6.61 (2.67)	4.67 (2.27)	3.96 (2.11)	4.19 (2.17)	4.27 (2.18)
2	*Datura* leaf powder	@ 500 kg/ha.	6.05 (2.56)	3.14 (1.91)	2.81 (1.82)	3.1 (1.90)	3.01 (1.87)
3	*Neem* leaf extract 5%	@ 25 lit/ha	6.61 (2.67)	2.08 (1.61)	2.06 (1.60)	2.3 (1.67)	2.14 (1.62)
4	Cow dung ash	@ 500 kg/ha	6.66 (2.68)	4.74 (2.29)	4.69 (2.28)	4.58 (2.25)	4.67 (2.27)
5	Cow urine 10%	@ 50 lit/ha	6.11 (2.57)	2.62 (1.77)	2.44 (1.71)	2.76 (1.81)	2.51 (1.73)
6	*Ipomoea* leaf extract 5%	@ 25 lit/ha	6.16 (2.58)	3.91 (2.10)	3.54 (2.01)	3.87 (2.09)	3.78 (2.07)
7	*Lantana* leaf extract 5%	@ 25 lit/ha	6.78 (2.70)	4.19 (2.17)	3.30 (1.95)	3.52 (2.00)	3.67 (2.04)
8	Control	-	7.16 (2.77)	7.00 (2.74)	6.91 (2.72)	7.52 (2.83)	7.14 (2.76)
SE.m. ±			0.28	0.08	0.20	0.17	0.11
CD at 5%			N.S	0.24	0.61	0.50	0.33

Data given in parentheses are $\sqrt{x} + 0.50$ transformed values, DBS-Day Before Spraying, DAS-Day After Spraying

Table 3: Effect of different botanicals and organic compounds on the population of aphid, *Aphis craccivora* Koch. during *Kharif* 2018 and 2019 (Pooled Data). Second application

S.N.	Treatments	Dose/ha.	Population of *Aphis craccivora*				
			Before application	After application			
			1 DBS	5 DAS	10 DAS	15 DAS	Mean
1	Eucalyptus leaf powder	@ 500 kg/ha.	5.16 (2.38)	4.52 (2.24)	3.75 (2.06)	4.01 (2.12)	4.09 (2.14)
2	*Datura* leaf powder	@ 500 kg/ha.	4.62 (2.26)	2.93 (1.85)	2.69 (1.79)	2.81 (1.82)	2.80 (1.82)
3	*Neem* leaf extract 5%	@ 25 lit/ha	4.19 (2.17)	2.25 (1.66)	1.74 (1.50)	2.13 (1.62)	2.03 (1.59)
4	Cow dung ash	@ 500 kg/ha	5.54 (2.46)	4.64 (2.27)	4.35 (2.20)	4.80 (2.30)	4.59 (2.26)
5	Cow urine 10%	@ 50 lit/ha	4.38 (2.21)	2.40 (1.70)	2.09 (1.61)	2.60 (1.76)	2.36 (1.69)
6	*Ipomoea* leaf extract 5%	@ 25 lit/ha	5.32 (2.41)	3.81 (2.08)	3.23 (1.93)	3.76 (2.06)	3.60 (2.02)
7	*Lantana* leaf extract 5%	@ 25 lit/ha	4.68 (2.28)	3.35 (1.96)	3.19 (1.92)	3.42 (1.98)	3.32 (1.95)
8	Control	-	6.83 (2.71)	7.76 (2.87)	7.49 (2.83)	7.81 (2.88)	7.68 (2.86)
SE.m. ±			0.49	0.06	0.12	0.12	0.09
CD at 5%			NS	0.19	0.38	0.37	0.26

Data given in parentheses are √x + 0.50 transformed values, DBS-Day Before Spraying, DAS-Day After Spraying

Table 4: Effect of different botanicals and organic compounds on the population of aphid, *Aphis craccivora* Koch. during *Kharif* 2018 and 2019 (Pooled Data). Third application

S.N.	Treatments	Dose/ha.	Population of *Aphis craccivora*				
			Before application	After application			
			1 DBS	5 DAS	10 DAS	15 DAS	Mean
1	Eucalyptus leaf powder	@ 500 kg/ha.	6.52 (2.65)	4.35 (2.20)	4.34 (2.20)	3.82 (2.08)	4.17 (2.16)
2	*Datura* leaf powder	@ 500 kg/ha.	6.44 (2.63)	2.76 (1.81)	2.81 (1.82)	2.43 (1.71)	2.66 (1.78)
3	*Neem* leaf extract 5%	@ 25 lit/ha	6.94 (2.73)	1.86 (1.54)	1.72 (1.49)	1.63 (1.46)	1.74 (1.50)
4	Cow dung ash	@ 500 kg/ha	6.12 (2.57)	4.59 (2.26)	4.58 (2.25)	4.00 (2.12)	4.39 (2.21)
5	Cow urine 10%	@ 50 lit/ha	6.52 (2.65)	2.25 (1.66)	2.52 (1.74)	2.11 (1.62)	2.29 (1.67)
6	*Ipomoea* leaf extract 5%	@ 25 lit/ha	6.54 (2.65)	3.80 (2.07)	3.81 (2.08)	3.17 (1.92)	3.59 (2.02)
7	*Lantana* leaf extract 5%	@ 25 lit/ha	6.80 (2.70)	3.39 (1.97)	3.62 (2.03)	2.96 (1.86)	3.32 (1.95)
8	Control	-	6.63 (2.67)	7.19 (2.77)	7.47 (2.82)	7.39 (2.81)	7.35 (2.80)
SE.m. ±			0.13	0.09	0.09	0.19	0.11
CD at 5%			NS	0.27	0.28	0.56	0.34

Data given in parentheses are √x + 0.50 transformed values, DBS-Day Before Spraying, DAS-Day After Spraying

Results

Effect of different botanicals & organic compounds on the population of aphid, *Aphis craccivora* Koch. First application

The results obtained through pooled data analysis and given in Table- 2 mandated similar trend of results as we observed in whole study period i.e. years 2018 and 2019. The *neem* leaf extract 5% was proved significantly superior over all treatments with mean number of thrips population i.e. 1.93 adults, which was closely followed in terms of efficacy was cow urine 10 % with 2.36 insects population and also differed significantly with other treatments. The next effective treatment was *Datura* leaf powder in which 2.88 adults population were recorded. *Lantana* leaf extract 5% ranked next in terms of efficacy with 3.47 thrips population however, it was at par with treatment *Ipomoea* leaf extract 5%, with 3.67 adults population. Treatment eucalyptus leaf powder with 4.24 adults population was recorded which was also statistically differed with control. Cow dung ash showed similar trend as in case of efficacy in both years and proved most inferior among all the treatments with mean population of insects i.e. 4.74 however, it was statistically superior in comparison to control in which maximum i.e. 6.47 thrips population was recorded.

Second application

Data arranged in Table- 3 indicated that the *neem* leaf extract 5% with the mean population of thrips i.e. 2.07, proved best and suppressed the maximum thrips population. Next treatment was cow urine 10% with 2.35 thrips population which was differed statistically with *neem* leaf extract and other treatments followed by *Datura* leaf powder with 2.70 thrips population. *Lantana* leaf extract 5% with 3.19 thrips, *Ipomoea* leaf extract 5% with 3.47 thrips, and eucalyptus leaf powder with 4.05 thrips population were recorded, which were also significantly differed in terms of efficacy with other treatments. Cow dung ash with the mean population of thrips i.e. 4.39, found least effective and poorly managed insect population however, it was statistically superior in comparison to control in which 7.35 thrips population were recorded. In this observation strikingly none of any treatment was found at par with one another in terms of efficacy.

Third application

The data depicted in Table- 4 declared that the treatment *neem* leaf extract 5% proved, best however, it was at par with the treatment cow urine 10% with mean number of thrips population i.e. 1.64 and 1.92, respectively, both were significantly differed over all other treatments. Next best treatment i.e. *Datura* leaf powder with 2.45 thrips population was observed which was closely followed by *Lantana* leaf extract 5% in which 2.89 thrips population were recorded. *Ipomoea* leaf extract 5% with 3.28 thrips population, eucalyptus leaf powder with 3.90 thrips population and cow dung ash with mean number of thrips i.e. 4.28 were observed which were significantly differed with other treatments, however these all treatments were statistically superior over control in which maximum i.e. 7.20 thrips were recorded.

Table 5: Economic analysis of different treatments for the management of *Aphis craccivora* Koch. on groundnut during 2019

Tr. No.	Treatments	Dose	Cost of insecticide (Rs/ha)	No. of labour require/ha	Labour cost (Rs/ha)	Total expenditure (Rs/ha)	Yield (q/ha)	Gross income (Rs/ha)	Net return Over control (Rs/ha)	BC Ratio
T_1	Eucalyptus leaf powder	@ 500 kg/ha.	1225	6	1200	2425	19.11	100805	25795	1:10.63
T_2	*Datura* leaf powder	@ 500 kg/ha.	1350	6	1200	2550	21.33	112516	37506	1:14.70
T_3	*Neem* leaf extract 5%	@ 25 lit/ha	1275	6	1200	2475	23.77	125387	50377	1:20.35
T_4	Cow dung ash	@ 500 kg/ha	1150	6	1200	2350	17.33	91416	16406	1:6.98
T_5	Cow urine 10%	@ 50 lit/ha	950	6	1200	2150	22.22	117210	42200	1:19.62
T_6	*Ipomoea* leaf extract 5%	@ 25 lit/ha	1175	6	1200	2375	20.22	106660	31650	1:13.32
T_7	*Lantana* leaf extract 5%	@ 25 lit/ha	1450	6	1200	2650	20.67	109034	34024	1:12.83
T_8	Control	-	-	-	-	-	14.22	75010		

Total cost of crop protection from insecticide included (cost of insecticides + cost of application)
1: Market price of groundnut Rs. 5275/q
2: Labour charges @ Rs. 200
3: No. of spray 3

Yield assessment (q/ha) 5: Grain yield during *Kharif*, 2019.

The results presented in Table- 5 revealed that all the treatments regarding the yield were proved significantly superior over control and ranged from 14.22 to 23.77 q/ha during *Kharif*, 2019. The maximum grain yield of 23.77 q/ha was obtained from the field which was treated with *neem* leaf extract 5%. The second best treatment was cow urine 10% with the grain yield to the tune of 22.22 q/ha, followed by *Datura* leaf powder, *Lantana* leaf extract 5%, *Ipomoea* leaf extract 5%, eucalyptus leaf powder and cow dung ash with the grain yield of 21.33, 20.67, 20.22, 19.11 and 17.33 q/ha, respectively. Among the different treatments, the lowest grain yield of 14.22 q/ha was recorded in untreated field which differed significantly and inferior among all treatments.

Benefit Cost Ratio (BC Ratio) for different insecticidal treatments.

The data regarding (BC Ratio) Table-5 proved that the highest net profit (₹ 50377.00 /ha) was obtained from the *neem* leaf extract 5%, while the lowest net profit (₹16406.00 /ha) was estimated from the treatment of cow dung ash by working out the BC Ratio (Table-5) and also showed that the *neem* leaf extract 5% ranked 1st with highest i.e. 1:20.35, and minimum in cow dung ash i.e. 1:6.98.

Discussion

The results obtained through pooled data analysis, similar trend of results as we observed in whole study period i.e. years 2018 and 2019. The *neem* leaf extract 5% was proved significantly superior over all treatments with mean number of thrips population i.e. 1.93 adults, which was closely followed in terms of efficacy was cow urine 10 % with 2.36 insects population and also differed significantly with other treatments. The next effective treatment was *Datura* leaf powder in which 2.88 adults population were recorded. *Lantana* leaf extract 5% ranked next in terms of efficacy with 3.47 thrips population however, it was at par with treatment *Ipomoea* leaf extract 5%, with 3.67 adults population. Treatment eucalyptus leaf powder with 4.24 adults population was recorded which was also statistically differed with control. Cow dung ash showed similar trend as in case of efficacy in both years and proved most inferior among all the treatments with mean population of insects i.e. 4.74 however, it was statistically superior in comparison to control in which maximum i.e. 6.47 thrips population was recorded. Oparaeke *et al.* (2006) [7] supported this review and explored the effectiveness of aqueous *neem* and eucalyptus leaf extracts in combinations other plant species extracts for the management of the bean flower bud thrips, a significant post-blossoming insects of cowpea in Research Farm of the Institute for Agricultural Research, Ahmadu Bello University, Zaria, Nigeria. Plant extracts combinations were applied at 10:10% w/v in equivalent proportion and sprayed four times at weekly intervals. The outcomes showed that thrips strain on cowpea blossoms was fundamentally ($P < 0.05$) less (< 1.0/bloom) on plants sprayed with leaf extract combinations of *Neem* + Eucalyptus, *Neem* + lemon grass, *Neem* + bitter leaf, *Neem* + tomato, and Eucalyptus + African curry (in that order) than on unsprayed plants. Iqbal *et al.* (2015) [4] reported that the botanicals as an alternative approach to control sucking insect pests. The plant concentrates of 8 native plants *viz*., tumha (*Citrullus colosynthis* L.), *Datura* (*Datura innoxia* M.), *neem* (*Azadirachta indica* A.), castor (*Ricinus communis* L.), hing (*Ferula asafetida* L.), eucalyptus (*Eucalyptus* spp.) bitter gourd (*Memordica chrantia* L.) and garlic (*Allium sativum* L.) were tried for their potential insecticidal efficacy against sucking insect pests, jassid (*Amrasca bigutulla bigutulla* I.), whitefly (*Bemisia tabaci* G.) and thrips (*Thrips tabaci* L.). It was revealed that, *neem* followed by garlic significantly decrease the mean population of jassid (6.31, 6.86), whitefly (7.41, 8.21) and thrips (11.99, 12.43), respectively. *Neem* also showed least fruit damage percentage (3.38%) followed by garlic (6.67%). The most extreme case yield (3178.7 kg/ha) was seen in *Neem* leaf extract treated plots. It was reasoned that the plants could be the conceivable substitute choice in pest management. Naik *et al.* (2017) [6] supports present findings who reported that the use of bio-rational like Agniasthra, Brahmasatra, Punchapatta, plant extracts, bio-pesticides, botanicals and native advancements to reduce the population of leafhopper, *Empoasca kerri* in groundnut field. Among various biorationals assessed, the *Neem* Seed Kernal Extract (NSKE) at 5% was viewed as more successful in decreasing

the leaf hoppers population by recording less numbers of leaf hoppers (4.67/two sweep net) during 7th day after spraying.

Conclusions

The results with pooled data analysis for safer management of thrips revealed a similar trend in whole study period for both the years i.e. 2018 and 2019. The *neem* leaf extract 5% was proved best and significantly superior over all treatments with highest reduction of thrips population in both the years. Cow dung ash was found poorest treatments which reduced minimum thrips population in terms of efficacy in both the years. The trend of efficacy of different treatments against tested insect pests in descending order are *neem* leaf extract 5% > cow urine 10% > *Datura* leaf powder> *Lantana* leaf extract 5% > *Ipomoea* leaf extract 5% > eucalyptus leaf powder > cow dung ash. The highest net profit (₹ 50377.00 /ha) was obtained from the *neem* leaf extract 5%, while the lowest net profit (₹16406.00 /ha) was estimated from the treatment of cow dung ash. By working out the BC Ratio (Table-5) it was found that the *neem* leaf extract 5% ranked 1st with highest BC i.e. 1:20.35 and minimum in cow dung ash i.e. 1:6.98.

Declarations

Conflict of intrest: The authors have no conflicts of intrest.

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