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EFFICACY OF BOTANICAL PESTICIDES AGAINST MAJOR PESTS OF BLACK NIGHTSHADE, SOLANUM NIGRUM LINN.

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ABSTRACT

Field trials were laid in the farmer's holdings at Kaalipalayam, Coimbatore district during August, 2011 to November, 2011 to assess the efficacy of selected botanical insecticides against aphids, thrips, leaf miners and defoliators infesting *Solanum nigrum*. The results of the experiments revealed that among the treatments, foliar spray of profenophos is found to be the best treatment for the management of sucking pests *viz.,* aphids and thrips as well as defoliators *viz.,* leaf miner and other defoliators and also recorded maximum leaf yield. Among the botanicals, 1% azadirachtin and 2 % aqueous extract of *Andrographis paniculata* recorded maximum reduction in pest population and also conserved more number of natural enemies like predatory coccinellids. Regarding leaf yield, all the botanical pesticides were found to be statistically on par, while the leaf yield recorded from profenophos treated plot recorded its superiority with 21.75 kg leaf /12m^2/ harvest.

KEYWORDS; **Solanum nigrum, Aphis craccivora, Thrips tabaci, defoliators, botanicals**

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INTRODUCTION

Solanum nigrum Linn. is an annual herbaceous plant belongs to the family Solanaceae. It is commonly known as black nightshade. It has proven to be a reservoir of phytochemical with pharmacological prospects. The whole plant is useful for rheumatalgia, swellings, cough, asthma, bronchitis, wounds, ulcer, vomiting, skin diseases, fever, dropsy and general debility. The plant is bitter, acrid, emollient, antiseptic, anti-inflammatory, expectorant, diuretic, diaphoretic, rejuvenating and sedative. Like any other plants, medicinal plants too have to bear the devastating attack of injurious insect pests. Fifty two different species of insect pests attacking 57 medicinal and aromatic plants, both cultivated and wild were recorded in Jammu and Kashmir[1]. It has been reported that 75 species belonging to 16 families under coleoptera and 38 species of hemiptera were found to attack 84 species of medicinal plants in Bulgaria[2]. Seven insect pests attacking 13 medicinal plants were reported from Uttar Pradesh[3].

Among the sucking pests, nymphs and adults of *Aphis gossypii* Glov. were found to suck the sap from lower surface of the leaves, flowers and flower buds of *Solanum indicum* during May to July. The aphids were more concentrated on the flower buds and hence drying and dropping of flowers was observed[4]. The grubs and adults of *Coccinella septumpunctata* Linn. was associated with aphids as a predator. Both nymphs and adults of leaf hopper, *Amrasca biguttula biguttula* Ishida were found sucking sap from the flowers and lower surface of leaves of *S. indicum*, which resulted in wilting and drying up. A coreid bug, *Cletus stali* Distant. and a lygaeid, *Lygaeus hospes* Fab., and Pentatomid bug *Bainbriggeanus fletcheri* Dist were observed sucking the sap from the tender parts of *S. indicum*. The Grasshopper species *Gastrimargus africanus* Sauss was observed to feed on the leaves of *S. indicum*. Both nymphs and adults of *Attractomorpha crenulata* were found making irregular cuts on the leaves of *S. nigrum* and *S. indicum* from June to November. Mulberry grasshopper, *Neorthacris acuticeps acuticeps* Bol. is active throughout the year and feeding on leaves of *Tinospora cordifolia, S. nigrum* and *S. indicum*. Nymphs and adults of a cricket *Tridactylus nigraenus* were observed to feed on *S. indicum*. *Henosepilachna vigintioctopunctata* (Fab.) was earlier recorded on *Solanum aviculare* and *Solanum suriatensis*[5]. Aphids and mites were predominant causing curling and drying of leaves from September 2008 to February 2009 on *S. nigrum* at Arabhavi[6].

Mounting pressure of teeming population and shrinking land resources has necessitated the production of increasingly more food and medicinal plants per unit area. Insect pests, diseases and weeds are important biotic constraints inflicting 20 to 25 per cent loss in agriculture production. Synthetic pesticides have of course, played very significant role in restricting many pest problems. However, Indiscriminate use of chemicals has resulted in pesticide resistance, resurgence of target organism or emergence of secondary pests because of destruction of parasitoids and predators, impact on non-target organisms, including humans, environmental pollution through accumulation of pesticides in soil, water and air and residues in agricultural and animal products. Increasing awareness about the deleterious effects of insecticides paved the way for integrated and eco-friendly pest management. One such method is the use of botanical pesticides, which are safe and eco-friendly, can overcome many problems associated with chemical insecticides especially in the medicinal plants eco-system. The extent to which various plant species are utilized for pest control depends, not only on their effectiveness against target pests, but also on socio-economic, environmental and policy considerations. Botanical insecticides were the earliest recorded insecticides used in agriculture. The efficacy of all neem products was observed by several workers[7]. Keeping these in mind, the present study was undertaken to test the field

efficacy of selected botanicals against pest complex of *S. nigrum viz.,* aphids, thrips, leaf miners and defoliators.

MATERIALS AND METHODS

Field trials were laid in the farmer's holdings at Kallipalayam, Coimbatore district during August, 2011 to November, 2011 to assess the efficacy of selected botanical insecticides against aphids, thrips, leaf miners and defoliators infesting *S. nigrum*. Field experiment was laid out in randomized block design (RBD) with eight treatments and three replications. Recommended package of practices were followed to raise a good crop. Pre-treatment count on pest population was taken before spraying. Post-treatment counts were taken at 1, 3, 5, 7 and 14 days after spraying. Ten plants were selected randomly from each plot and the population of sucking pests, defoliators and natural enemies were recorded and expressed as number per plant. Leaf yield from each plot was recorded. Treatment details are as follows:

T_1 - Neem seed kernel extract 5 %
T_2 - Aqueous extract of *Andrographis paniculata* 2 %
T_3 - Aqueous extract of *Vitex negundo* 2 %
T_4 - Neem oil (Azadirachtin 1%)
T_5 - Pungam oil 3 ml / litre
T_6 - Mineral oil 3 ml / litre
T_7 - Profenophos 2 ml / litre
T_8 - Untreated control

The data from field observations were analysed following the standard procedure[8]. Duncan's Multiple Range Test (DMRT) was applied to analyze the data. In the table, in each coloumn, means followed by a common letter were not significantly different at 5 per cent level.

RESULTS

1. Aphids, Aphis craccivora

Pre-treatment count on aphid population before spraying ranged from 21.6 to 25.0 aphids per plant (Table 1). At one day after treatment significant reduction in aphid population was observed in all the treatments, while it was 27.3 aphids per plant in untreated control. Maximum population reduction was observed in standard chemical check profenophos, where the population of aphids reduced to 0.2 per plant followed by pungam oil (6.7 aphids/ plant), neem oil (7.3 aphids/ plant) and NSKE (7.9 aphids/ plant). Similar trend was observed at three, five and seven days after treatment. At three days after treatment, cent per cent population reduction was observed in profenophos sprayed plots. Among the other treatments, maximum population reduction observed in neem oil (2.6 aphids/ plant), followed by NSKE (2.8 aphids/ plant) and *V. negundo* (3.1 aphids/ plant). At seven days after treatment, increase in the aphid population was observed in all the treatments. At 14 DAT, maximum population reduction was observed in standard check (0.3 aphids/ plant) followed by neem oil (4.8 aphids/ plant), NSKE (5.1 aphids/ plant) and pungam oil. Mean population reduction of aphids was maximum in the standard check (0.1 aphids/plant) followed by neem oil (3.76 aphids/plant) and NSKE (4.04 aphids/plant). Similar findings were reported in chillies[9,10]. Plant extract of *Artimesia vularis* showed highest mortality of aphids (70.65 per cent) on brinjal[11].

Table 1
Field efficacy of botanicals against Aphis craccivora on Solanum nigrum

Treatments	Number of aphids per three leaves per plant						
	PTC	1 DAT	3 DAT	5 DAT	7 DAT	14 DAT	Mean
T_1 - NSKE	21.9[a]	7.9[b]	2.8[b]	1.6[b]	2.8[b]	5.1[b]	4.04
T_2 - *Andrographis paniculata*	21.7[a]	8.1[b]	3.6[b]	1.9[b]	3.3[b]	6.3[b]	4.64
T_3 - *Vitex negundo*	22.8[a]	8.7[b]	3.1[b]	2.0[b]	3.9[b]	7.1[b]	4.96
T_4 - Neem oil	23.7[a]	7.3[b]	2.6[b]	1.5[b]	2.6[b]	4.8[b]	3.76
T_5 - Mineral oil	22.9[a]	8.9[b]	3.8[b]	2.1[b]	4.2[b]	8.1[b]	5.42
T_6 - Profenophos	25.0[a]	0.2[a]	0.0[a]	0.0[a]	0.0[a]	0.3[a]	0.1
T_7 - Pungam oil	24.1[a]	6.7[b]	3.5[b]	1.9[b]	3.8[b]	5.8[b]	4.34
T_8 - Untreated control	21.6[a]	27.3[c]	31.6[c]	34.1[c]	28.8[c]	39.5[c]	32.26

- ***The values are mean of three replications.***
- ***In each coloumn, means followed by a common letter were not significantly different at 5 per cent level.***

2. Thrips, Thrips tabaci

Pre-treatment population count of thrips ranged from 8.1 to 9.7 thrips/plant (Table 2). At one day after treatment significant population reduction was observed in all the treatments. Maximum reduction was observed in the standard chemical check profenophos (0.1 thrips per plant) followed by neem oil, *A. paniculata* and NSKE with a population of 1.9, 2.1 and 2.3 thrips/plant, respectively. At three days after treatment, cent per cent population reduction was observed in profenophos sprayed plot. Similar findings were reported by Chandrasekaran and Veeravel (1998)[12]. Among the other treatments, maximum population reduction was observed in *A. paniculata* (0.9 thrips/plant) followed by neem oil (1.2 thrips/plant) and *V. negundo* (1.3 thrips/plant). At 5 DAT, maximum population reduction was observed in *A. paniculata* and neem oil (0.6 thrips/plant) followed by pungam oil and NSKE with a population of about 0.7 and 0.8 thrips/plant, respectively. At seven days after treatment, *A. paniculata* recorded maximum reduction (0.3 thrips/plant) followed by NSKE and mineral oil (0.5 thrips/plant). At 14 DAT, increase in thrips population was observed in all the treatments. Maximum population reduction was observed in standard chemical check (0.3 thrips/plant) followed by *A. paniculata* (0.7 thrips/plant) and NSKE (0.9 thrips/plant). Mean reduction in thrips population was maximum in standard chemical check (0.08 thrips/plant) followed by *A. paniculata*, neem oil and NSKE with a population of 0.92, 1.22 and 1.28 thrips/plant, respectively. The present findings are in line with Varghese (2003)[13] who reported that nimbecidine five per cent spray was found to be highly effective in reducing thrips on chillies. Neem cake application @ 500 kg/ha and seedling root dip with 1 per cent neem oil followed by neem oil spray at weekly intervals reduced the thrips population to lower levels in chilli[14]. Similarly, GCKE 5 per cent (garlic chilli kerosene extract) along with half dose of nimbecidine (2.5 ml/l) registered the lowest incidence of thrips in chilli[15]

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Table 2
Field efficacy of botanicals against Thrips tabaci on Solanum nigrum

Treatments	Number of thrips per plant						
	PTC	1 DAT	3 DAT	5 DAT	7 DAT	14 DAT	Mean
T_1 - NSKE	8.5^{a}	2.3^{b}	1.9^{c}	0.8^{b}	0.5^{a}	0.9^{a}	1.28
T_2 - *Andrographis paniculata*	8.7^{a}	2.1^{b}	0.9^{b}	0.6^{b}	0.3^{a}	0.7^{a}	0.92
T_3 - *Vitex negundo*	8.1^{a}	3.2^{b}	1.3^{b}	1.0^{b}	1.1^{b}	1.4^{b}	1.60
T_4 - Neem oil	9.7^{a}	1.9^{b}	1.2^{b}	0.6^{b}	0.8^{b}	1.6^{b}	1.22
T_5 - Mineral oil	9.0^{a}	2.8^{b}	2.2^{c}	0.9^{b}	0.5^{a}	1.9^{b}	1.66
T_6 - Profenophos	8.9^{a}	0.1^{a}	0.0^{a}	0.0^{a}	0.0^{a}	0.3^{a}	0.08
T_7 - Pungam oil	8.8^{a}	2.6^{b}	1.6^{c}	0.7^{b}	0.8^{b}	1.7^{b}	1.48
T_8 - Untreated control	9.2^{a}	10.3^{c}	9.4^{d}	8.2^{c}	7.3^{c}	8.7^{c}	8.78

- ***The values are mean of three replications.***
- ***In each coloumn, means followed by a common letter were not significantly different at 5 per cent level.***

3. Defoliators (Spodoptera litura, Henosepilachna vigintioctopunctata, Plusia peponis)

Pre-treatment count on defoliation percentage ranged from 10 to 11.4 per cent. One day after spraying, there was no significant difference in the defoliation percentage. At three days after treatment, significant reduction in defoliation was observed in the following treatments *viz., V. negundo* (1.3 %), *A. paniculata* (1.4%) and profenophos (4.1%). Similar trend was observed on five and seven days after treatment. At 14 DAT, maximum reduction in defoliation percentage was observed in the standard check (no damage) followed by *A. paniculata* (0.9 %), neem oil (1.0 %) and *V. negundo* (1.1 %). Mean defoliation percentage was observed to be minimum in *A. paniculata* and *V. negundo* (2.82 %) followed by profenophos (2.86 %) and neem oil (4.60%) (Table 3). The antifeedant property of neem seed kernel was first described against desert locust *Schistocerca gregaria* Forsk[16]. Similarly, NSKE 7 per cent resulted in cent per cent mortality of *S. litura* and prolonged the pupal period[17].

Table 3.
Bio-efficacy of botanicals on defoliation

Treatments	Defoliation* (%)						
	PTC	1 DAT	3 DAT	5 DAT	7 DAT	14 DAT	Mean
T_1 - NSKE	10.6^{a}	10.4^{a}	8.1^{b}	2.3^{a}	1.2^{a}	1.6^{b}	4.72
T_2 - *Andrographis paniculata*	11.2^{a}	9.9^{a}	1.4^{a}	1.1^{a}	0.8^{a}	0.9^{a}	2.82
T_3 - *Vitex negundo*	11.4^{a}	10.2^{a}	1.3^{a}	0.9^{a}	0.6^{a}	1.1^{a}	2.82
T_4 - Neem oil	11.0^{a}	10.5^{a}	7.6^{b}	3.1^{ab}	0.8^{a}	1.0^{a}	4.60
T_5 - Mineral oil	10.0^{a}	10.1^{a}	6.8^{b}	4.7^{b}	2.2^{a}	1.9^{b}	5.14
T_6 - Profenophos	11.2^{a}	9.4^{a}	4.1^{a}	0.6^{a}	0.2^{a}	0.0^{a}	2.86
T_7 - Pungam oil	10.8^{a}	10.2^{a}	6.4^{b}	3.1^{ab}	1.6^{a}	2.1^{b}	4.68
T_8 - Untreated control	10.9^{a}	11.3^{a}	12.3^{c}	12.1^{c}	12.7^{b}	18.4^{c}	13.36

* ***Spodoptera litura, Henosepilachna vigintioctopunctata, Plusia peponis***

- ***The values are mean of three replications.***
- ***In each coloumn, means followed by a common letter were not significantly different at 5 per cent level.***

4. Leaf miner

Pre-treatment count of per cent leaf damage by leaf miner in different treatments ranged from 4.0 to 8.2 per cent. There was no significant difference in the leaf damage per cent at one day after treatment. Leaf damage was reduced at three days after treatment with maximum reduction in standard check profenophos (1.8%) followed by pungam oil (2.9%) and mineral oil (3.0%). Similar trend was observed at five and seven DAT. At 14 DAT, maximum reduction in leaf damage percent was observed in profenophos (no damage) followed by mineral oil (0.9%) and *A. paniculata* (1.1%). Among the treatments, mean defoliation percentage was observed to be maximum in neem oil (2.96%), while it was minimum in profenophos (1.04%) followed by mineral oil (1.96%) (Table 4).

Table 4
Bio-efficacy of botanicals on leaf miner damage

Treatments	Leaf damage (%)						
	PTC	1 DAT	3 DAT	5 DAT	7 DAT	14 DAT	Mean
T_1 - NSKE	6.4[b]	6.2[b]	4.1[b]	1.8[b]	1.1[b]	1.5[b]	2.94
T_2 - *Andrographis paniculata*	7.8[b]	7.4[b]	3.8[a]	1.4[a]	0.9[a]	1.1[b]	2.92
T_3 - *Vitex negundo*	4.1[a]	3.8[a]	3.2[a]	1.1[a]	0.9[a]	1.6[b]	2.12
T_4 - Neem oil	6.3[b]	6.1[b]	4.3[b]	1.9[b]	1.2[b]	1.3[b]	2.96
T_5 - Mineral oil	4.0[a]	3.9[a]	3.0[a]	1.3[a]	0.7[a]	0.9[a]	1.96
T_6 - Profenophos	5.3[a]	3.1[a]	1.8[a]	0.2[a]	0.1[a]	0.0[a]	1.04
T_7 - Pungam oil	3.8[a]	3.4[a]	2.9[a]	2.0[b]	0.8[a]	1.3[b]	2.08
T_8 - Untreated control	8.2[b]	7.9[b]	9.6[c]	11.3[c]	12.6[c]	16.7[c]	11.62

- ***The values are mean of three replications.***
- ***In each coloumn, means followed by a common letter were not significantly different at 5 per cent level.***

5. Predatory coccinellids

Pre-treatment count on predatory coccinellid population ranged from 1.3 to 1.7/plant (Table 5). At one day after treatment, maximum reduction in coccinellid was observed in the chemical treatment profenophos (100% reduction) followed by *Andrographis* (0.3/plant) and *V. negundo* (0.4/plant). Similar trend was observed on three and five days after treatment. Predatory population was observed to increase from seven days after treatment. At 14 DAT, reduction in coccinellid population was maximum in profenophos (0.1 no.) followed by mineral oil, pungam oil and *A. paniculata* (0.6/plant). Maximum mean reduction of coccinellids was observed in profenophos (0.02/plant) followed by pungam oil (0.58/plant), *A. paniculata* (0.60/plant) and mineral oil (0.66/plant). Coccinellid population was maximum in untreated control (1.22/plant) followed by NSKE (0.90/plant).

Table 5
Bio-efficacy of pesticides on predatory coccinellids

Treatments	Predatory coccinellids* per plant						
	PTC	1 DAT	3 DAT	5 DAT	7 DAT	14 DAT	Mean
T_1 - NSKE	1.7[a]	0.9[b]	0.5[b]	0.7[b]	1.1[b]	1.3[b]	0.90
T_2 - *Andrographis paniculata*	1.6[a]	0.3[a]	0.8[b]	0.4[a]	0.9[b]	0.6[a]	0.60
T_3 - *Vitex negundo*	1.3[a]	0.4[a]	1.0[b]	0.6[a]	0.8[b]	1.1[b]	0.78
T_4 - Neem oil	1.5[a]	0.8[b]	0.6[b]	0.5[a]	0.8[b]	1.2[b]	0.78
T_5 - Mineral oil	1.7[a]	1.0[b]	0.7[b]	0.4[a]	0.6[a]	0.6[a]	0.66
T_6 - Profenophos	1.5[a]	0.0[a]	0.0[a]	0.0[a]	0.0[a]	0.1[a]	0.02
T_7 - Pungam oil	1.3[a]	0.8[b]	0.5[b]	0.7[b]	0.3[a]	0.6[a]	0.58
T_8 - Untreated control	1.5[a]	1.2[b]	0.9[b]	1.3[b]	1.6[c]	1.1[b]	1.22

* ***Menochilus sexmaculatus, Harmonia octomaculata, Chilocorus sp***

- ***The values are mean of three replications.***
- ***In each coloumn, means followed by a common letter were not significantly different at 5 per cent level.***

6. Leaf yield

Leaf yield from different treatments ranged from 12.85 to 21.75 kg/12m^2 plot /harvest (Table 6). Maximum leaf yield was obtained from the profenophos treated plot, which was about 21.75 kg/12m^2 plot/harvest, followed by NSKE and neem oil treated plots which recorded the leaf yield of about 17.55 and 17.18 kg/12m^2 plot/harvest, respectively. Minimum yield was recorded in untreated control with the leaf yield of 12.85 kg/12m^2 plot/harvest, followed by pungam oil treated plots, which recorded the leaf yield of 15.60 kg/12m^2 plot/harvest.

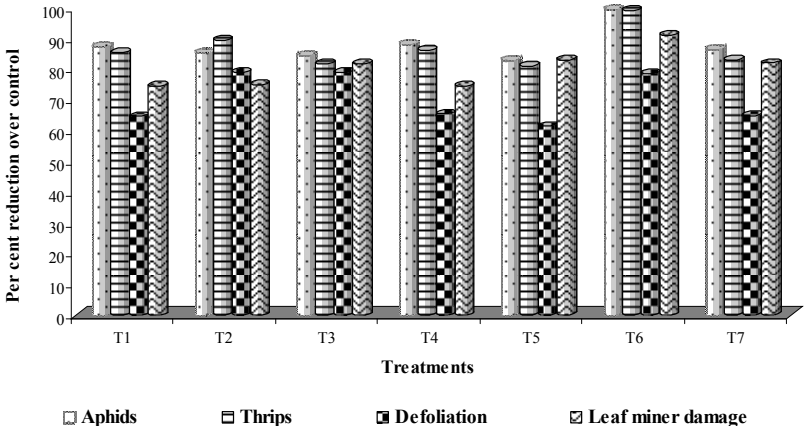
Table 6
Effect of different botanicals against sucking pests on leaf yield of Solanum nigrum

Treatments	Leaf yield (kg /12m^2 / harvest)
T_1 - NSKE	17.55[b]
T_2 - *Andrographis paniculata*	16.90[b]
T_3 - *Vitex negundo*	16.15[b]
T_4 - Neem oil	17.18[b]
T_5 - Mineral oil	16.25[b]
T_6 - Profenophos	21.75[a]
T_7 - Pungam oil	15.60[b]
T_8 - Untreated control	12.85[c]

- ***The values are mean of three replications.***
- ***In each coloumn, means followed by a common letter were not significantly different at 5 per cent level.***

DISCUSSIONS

Figure.1
Efficacy of botanicals against major pests of Solanum nigrum



Results of the field experiments to test the bio-efficacy of botanicals on major pests of *S. nigrum* revealed that per cent reduction in aphid population over untreated control was maximum upto 99.7 per cent in standard chemical check profenophos followed by neem oil (88.3) and neem seed kernel extract (87.5). Similarly, per cent reduction in thrips population over untreated control was maximum in profenophos treated plots followed by the plots treated with 2% aqueous extract of *A. paniculata* (89.5) and neem oil (86.1). Percentage reduction in defoliation was observed to be the maximum in plots treated with 2% aqueous extracts of *A. paniculata* (78.9) and *V. negundo* (78.9). Per cent reduction in leaf miner damage over untreated control was found to be the maximum in chemical check (91.0) followed by mineral oil (83.1) and aqueous extract of *V. negundo* (81.8) treated plots. Increase in leaf yield over untreated control was maximum in profenophos (40.9 per cent) treated plots followed by neem seed kernel extract (26.8) and neem oil treated plots (25.2).

CONCLUSION

From the results of present study on field efficacy of selected botanicals against pest complex of *S. nigrum*, it is concluded that foliar spray of profenophos is found to be the best treatment for the management of sucking pests *viz.,* aphids and thrips as well as defoliators *viz.,* leaf miner and other defoliators and also recorded maximum leaf yield. Among the botanicals, 1% azadirachtin and 2 % aqueous extract of *A. paniculata* recorded maximum reduction in pest population and also conserved more number of natural enemies like predatory coccinellids. Regarding leaf yield, all the botanical pesticides were found to be statistically on par, while the leaf yield recorded from profenophos treated plot recorded its superiority with 21.75 kg leaf yield per $12m^2$ plot per harvest.

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