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Induction of resistance through organic amendments for the management of spotted leaf beetle, *Epilachna vigintiocto punctata* Fab. on Ashwagandha

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ABSTRACT

Ashwagandha or Asgandh (*Withania somnifera* Dunal.), is an important medicinal plant which is attacked by several insect pests including spotted leaf beetle, *Epilachna vigintioctopunctata* Fab. The present investigation was carried out to under field conditions. Results revealed that farmyard manure (FYM) (12.5 t/ha) + Azophos (2 kg/ha) + neem cake (1000 kg/ha) was found to be very effective in reducing the damage of spotted leaf beetle by 69.79 per cent. FYM + Azophos + neem cake combination was less preferred for oviposition which recorded 62.00 eggs/plants, coupled with a minimum feeding area of 6.75 cm^2.

Key words: *Withania somnifera, Epilachna vigintioctopunctata*, eco-friendly pest management, biology studies

INTRODUCTION

In India, the use of several medicinal plants to cure specific ailments is in vogue from ancient times. The WHO has estimated that over 80 per cent of the world population meets their primary health care needs through traditional medicine (Lambert, 1997). In India Ashwagandha is cultivated in about 4000 ha in marginal lands of Madhya Pradesh and Rajasthan (Nigam *et al*., 1984). In Tamil Nadu, the commercial cultivation of this plant is gaining momentum in certain areas *viz.,* Erode, Namakkal, Salem and Coimbatore districts. It is ravaged by a few major insect pests like, *Epilachna vigintioctopunctata* Fab. (Coccinellidae: Hemiptera) has been reported as a serious defoliator of some solanaceous medicinal plants. *Epilachna vigintioctopunctata* F. damage the foliage and is considered a major pest of Ashwagandha (Mathur and Srivastava, 1964; Parjhar *et al.,* 1997; Patra *et al.,* 2004).

The inorganic fertilizers provide the nutrients in appreciable quantities for a shorter period to the plants. Thereby the plants are endowed with luxuriant growth which offers adequate food to the insects leading to heavy insect population build up. The organic manures act as a slow release fertilizers providing balanced nutrition to the plants and ensure balanced growth, thereby making them less prone to pest incidence. Induced resistance is the qualitative and quantitative enhancement of plant's defence mechanisms which is a non heritable resistance where host plants are induced to impart resistance to tide over pest infestation (Heinrichs, 1988; Dilawari and Dhaliwal, 1993; Panda and Khush, 1995). Through the addition of organic sources of nutrients and amendments the production of defensive chemicals in plant increases. So, organic farming provides an eco-technological stability in pest management and is a vital component of sustainable agriculture. The integration of organic nutrients can play a vital role in creating unfavorable environment to the herbivores by the mechanism of induced resistance either by antibiosis or antixenosis. Ashwagandha, being a medicinal herb, frequent and large scale application of insecticides for the control of these pests often leads to the endangerment of ecosystem. Keeping these aspects in view, the present investigations were carried out to test the efficacy of organic components in order to combat the incidence of insect pests of Ashwagandha.

MATERIALS AND METHODS

The field trial was conducted at Agricultural College and Research Institute, Madurai. All the Agronomic practices were adopted uniformly for all the treatments. The details of the treatments are as follows: FYM (12.5 t/ha) alone (T_1), FYM (12.5 t/ha) + Azophos (2 kg/ha)+ Neem cake (1000 kg/ha) (T_2), FYM (12.5 t/ha) + Azophos (2 kg/ha)+ Pungam cake (1000 kg/ha) (T_3), FYM (12.5 t/ha) + Azophos (2 kg/ha)+ Mahua cake (1000 kg/ha) (T_4), NPK + Botanicals (3 %) (T_5), FYM (50%) + Azophos (2 kg/ha) + NPK (50%) + Neem cake (50%) (T_6), FYM (50%)+ Azophos (2 kg/ha) + NPK (50%) + Pungam cake (50%) (T_7), FYM (50%) + Azophos (2 kg/ha)+ NPK (50%) + Mahua cake (50%) (T_8), NPK + Malathion (2 ml/lit) (T_9), NPK as inorganic form (90:50:50 kg/ha) (T_{10}) and Untreated control (T_{11}) .The treatments were replicated thrice in randomized block design. The variety Jawahar was used. Farmyard manure (FYM) with computed quantity was applied basally at the time of main field preparation in the respective treatments. The biofertilizer *viz.*, Azophos @ 2 kg/ha was incorporated with soil in the respective treatments. Half of the dose of the total requirements of other organic amendments *viz.,*

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Table 1. Effect of organic sources of nutrients on *Epilachna* beetle damage

Treat ments	Days After Transplanting															
	15		25		35		45		55		65		75		Mean	
	% Damage	% reduction over NPK	% Damage	% reduction over NPK	% Damage	% reduction over NPK	% Damage	% reduction over NPK	% Damage	% reduction over NPK	% Damage	% reduction over NPK	% Damage	% reduction over NPK	% Damage	% reduction over NPK
T_1	2.46 (9.02)^{d}	37.08	5.57 (13.65)^{f}	32.97	8.24 (16.68)^{g}	33.81	9.05 (17.50)^{g}	36.97	11.53 (19.85)^{gh}	31.49	8.65 (17.10)^{ef}	29.15	5.73 (13.85)^{f}	21.29	7.31 (15.68)^{f}	32.06
T_2	0.97 (5.65)^{a}	75.19	2.26 (8.64)^{a}	72.80	3.45 (10.70)^{b}	72.28	3.9 (11.39)^{bc}	72.84	4.98 (12.89)b	70.40	4.22 (11.85)^{b}	64.43	3.02 (10.00)^{b}	58.51	3.25 (10.38)^{a}	69.79
T_3	1.74 (7.58)^{b}	55.49	3.82 (11.27)^{c}	54.03	5.58 (13.66)^{cd}	55.18	6.02 (14.20)^{d}	58.07	7.32 (15.69)^{cd}	56.50	5.94 (14.10)^{c}	51.35	3.74 (11.15)^{c}	48.62	4.88 (12.76)^{c}	54.64
T_4	1.22 (6.34)^{a}	68.79	3.08 (10.10)^{b}	62.93	4.55 (12.31)^{c}	63.45	4.82 (12.68)^{c}	66.43	6.23 (14.45)^{bc}	62.93	4.83 (12.69)^{b}	60.44	3.38 (10.59)^{bc}	53.57	4.01 (11.55)^{b}	62.73
T_5	3.7 (11.09)^{f}	5.37	8.1 (16.53)^{h}	2.52	2.98 (9.94)^{ab}	76.06	3.68 (11.06)^{b}	74.37	3.75 (11.16)^{a}	77.71	2.82 (9.66)^{a}	76.90	2.22 (8.56)^{a}	69.50	3.89 (11.37)^{ab}	63.84
T_6	1.79 (7.68)^{b}	54.21	4.2 (11.82)^{cd}	49.45	6.07 (14.26)^{de}	51.24	6.82 (15.13)^{de}	52.50	8.32 (16.76)^{de}	50.56	6.83 (15.15)^{cd}	44.06	4.36 (12.05)^{d}	40.10	5.48 (13.53)^{cd}	49.07
T_7	2.36 (8.83)^{cd}	39.64	5.32 (13.33)^{ef}	35.98	7.86 (16.28)^{fg}	36.86	8.74 (17.19)^{fg}	39.13	10.66 (19.05)^{fg}	36.66	7.92 (16.34)^{de}	35.13	5.02 (12.94)^{e}	31.04	6.84 (15.16)^{ef}	36.43
T_8	2.02 (8.17)^{bc}	48.33	4.58 (12.35)^{de}	44.88	6.82 (15.13)^{ef}	45.22	7.45 (15.84)^{ef}	48.11	9.2 (17.65)^{ef}	45.00	7.54 (15.93)^{de}	38.24	4.72 (12.54)^{de}	35.16	6.04 (14.22)^{de}	43.86
T_9	3.89 (11.37)^{f}	0.51	8.18 (16.61)^{h}	1.56	2.45 (9.00)^{a}	80.32	2.7 (9.45)^{a}	81.19	2.82 (9.66)^{a}	83.24	2.34 (8.79)^{a}	80.83	1.98 (8.08)^{a}	72.80	3.48 (10.75)^{ab}	67.65
T_{10}	3.91 (11.40)^{f}	-	8.31 (16.75)^{h}	-	12.45 (20.66)^{i}	-	14.36 (22.26)^{h}	-	16.83 (24.22)^{i}	-	(24.22) (20.45)^{g}	-	7.28 (15.65)^{g}	-	10.76 (19.14)^{h}	-
T_{11}	3.22 (10.33)^{e}	17.64	6.94 (15.27)^{g}	16.48	10.12 (18.54)^{h}	18.71	10.89 (19.26)^{i}	24.06	12.84 (20.99)^{h}	23.70	9.85 (18.29)^{f}	19.32	6.06 (14.25)^{f}	16.75	8.56 (17.0)^{g}	20.44

Figures in parentheses are arc sine transformed values, in a column, means followed by same letter(s) are not significantly different at P=0.05 DMRT neem cake, mahua cake and pungam cake were applied as basal and the remaining half was applied as top dressing in two equal splits at 20 days interval. Inorganic fertilizers in the form of urea, single super phosphate and muriate of potash were applied at recommended doses. Fifty per cent of total N and entire P and K were applied as basal and the rest of the 50 per cent N was applied in two equal splits as top dressing at 20 days interval. Neem oil @ 3 per cent and malathion 0.1 per cent were sprayed in the respective treatments on 30^{th}, 45^{th} and 60^{th} day after transplanting (DAT). Pest damage was assessed on ten randomly selected plants from each plot. The total number of leaves and the number of scraped leaves were counted to compute the per cent leaf damage. The observations were recorded at ten days interval commencing from 15^{th} to 75^{th} DAT besides a pretreatment count. Root yield was recorded in kg / plot and converted for hectares.

Screen house and laboratory experiments were conducted with the following treatments in completely randomized block design with three replications. The material and methods, the treatment details were the same as adopted for field trial. A free choice test using 60 days old potted plants of various treatments in an insect rearing cage of the size 2 x 1.5 x 2 m was conducted. Ten pairs (male and female in 1:1 ratio) of freshly emerged beetles were released into the cage for oviposition. Ten days later, the number of eggs laid on each plant was observed. Leaf discs of 5 cm diameter from respective treatments were collected and placed in a petridish over a moist filter paper. Two prestarved (4 hours) adult *Epilachna* beetles were released in each petridish and treatment setup was replicated thrice. After 24 hours, the feeding rate was assessed in terms of the total leaf area scraped by adult beetles through graphical method.

RESULTS AND DISCUSSION

The present study revealed that the overall mean values of the results revealed that per cent damage in various treatments was FYM + Azophos + NC (69.79 %) was superior to all other treatments except NPK + malathion (3 sprays) and NPK + botanical (3 sprays) in reducing the damage with corresponding per cent reduction of 67.65 and 63.84 per cent respectively (table 1). This is in close agreement with the earlier findings of Rajendran and Chandramani (2002) who reported that application of FYM along with neem cake and biofertilizers was effective in reducing the incidence of aphid (*Myzus persicae*) and thrips (*Scritothrips dorsalis*) on chillies. The efficacy of these treatments is also in conformity with the findings of Suresh (2003) and Kavitha (2004) who demonstrated the reduction of *Epilachna* beetle in brinjal by the application of neem cake combined with FYM and biofertilizers. Further Mohan *et al*. (1987) also proved that the combination of FYM + biofertilizers either with neem cake or mahua cake significantly reduced the *E.pilachna* beetle infestation on brinjal.

The data on fresh root yield (table 2) revealed that FYM + Azophos + neem cake registered the yield of 991.16 kg / ha with corresponding per cent increase of 34.88 over NPK as inorganic form. This was followed by NPK + malathion (3 sprays) (926.13 kg / ha) and NPK + botanical sprays (902.13 kg / ha) with 30.31 and 28.45 per cent increase of fresh root yield over NPK. Further, the treatments with yield increase over NPK were high in organics, FYM + Azophos + mahua cake (24.48%) and NPK + Azophos + pungam cake (21.36 %). This is in conformity with the findings of Swarnapriya *et al*. (2006) who reported that the application of FYM + neem cake recorded the highest root yield in ashwagandha. Earlier Subbaiah et *al*. (1982) explained that the yield increase with organic manure was due to solubilization of nutrients in the soil and increased availability to the plants.

Ovipositional preference

FYM + Azophos + neem cake (62.00 eggs/plants) and FYM + Azophos + mahua cake (67.33 eggs/plants) treated plants were least preferred for oviposition (Table 3). The present investigation revealed that the least ovipositional preference might be associated with the low level of leaf nitrogen which was in agreement with the findings of Waghray and Shivaraj Singh (1965). Kavitha (2004) also has reported that ovipostional preference of *E.pilachna*

Table 2. Effect of organic sources of nutrients on fresh root yield

Treatments	Yield of fresh roots (kg/ha)	Increase over NPK (%)
T_1	602.29[f]	-
T_2	991.16[a]	34.88
T_3	820.71[c]	21.36
T_4	854.65[c]	24.48
T_5	902.10[b]	28.45
T_6	765.12[d]	15.64
T_7	724.32[d]	10.89
T_8	740.00[d]	12.78
T_9	926.13[b]	30.31
T_{10}	645.38[e]	-
T_{11}	464.42[g]	-

In a column, means followed by same letter(s) are not significantly different at P=0.05 by DMRT

Table 3. Ovipositional preference of *E.pilachna* beetle

Treatments	Eggs / Plant	Oviposition (%)
T_1	183.67 (15.33)^f	14.92^e
T_2	62.00 (7.87)^a	5.03^a
T_3	95.67 (9.78)^b	7.77^b
T_4	67.33 (8.20)^a	5.47^a
T_5	112.67 (10.61)^c	9.15^c
T_7	151.67 (12.31)^e	12.32^d
T_8	126.66 (11.25)^d	10.29^c
T_{10}	235.67 (15.35)^h	19.15^f
T_{11}	195.00 (13.96)^g	15.84^e

Figures in parentheses are square root transformed values
In a column, means followed by a same letter are not significantly different at P=0.05 (DMRT).

beetle was least when treated with FYM + biofertilizers + neem cake and FYM + biofertilizers + mahua cake as compared to NPK as inorganic form.

Feeding deterency

The treatment with FYM + Azophos + neem cake recorded a minimum feeding area of 6.75 cm^2 and on a par with FYM + Azophos + mahua cake (8.25 cm^2) as against 18.75 cm^2 in NPK as inorganic form. The corresponding per cent reduction of feeding over NPK was 64.00 and 56.00 respectively (table 4). The result obtained from the laboratory study shows that the feeding preference

Table 4. Feeding deterrency of different manure and fertilizer treatments to *Epilachna* beetle on

Ashwagandha. Treatments	Feeding area	
	cm^2	% reduction over NPK
T_1	16.75 (4.09)^{ef}	10.67
T_2	6.75 (2.59)^a	64.00
T_3	9.50 (3.08)^b	49.33
T_4	8.25 (2.87)^{ab}	56.00
T_5	12.50 (3.53)^c	33.33
T_7	15.25 (3.90)^{de}	18.67
T_8	14.00 (3.74)^{cd}	25.33
T_{10}	18.75 (4.33)^g	-
T_{11}	17.50 (4.18)^{fg}	6.67

Figures in parentheses are square root transformed values
In a column, means followed by a same letter are not significantly different at P=0.05 (DMRT)

increased with the increased levels of nitrogenous fertilizers. The feeding area of *Epilachna* beetle was more on leaves treated with NPK as inorganic form. Adverse effect of organics on feeding activity of BPH and WBPH in rice was earlier been observed by Chandramani (2003). Kavitha (2004) has also reported that the feeding area by *Epilachna* beetle was less in the combination of FYM + biofertilizers + neem cake. The increase in the feeding preference of brinjal leafhopper with increased fertilizer application is also in agreement with the findings of Godase and Patel (2001); Yein and Singh (1982) in green gram and Rote and Puri (1992) in cotton.

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