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## Effect of organic amendments on the incidence of major pests of ash gourd, *Benincasa hispida* Thunb

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**Abstract**

Field experiments were conducted to study the effect of organic amendments on the incidence of major pests of ash gourd, *Benincasa hispida* Thunb. in Agricultural College and Research Institute farm, Killikulam, Vallanadu, Thoothukudi during Rabi 2018 and Summer 2019. The results revealed that among the six organic amendments, Poultry manure @ 5.0 t/ha recorded the lowest incidence of pests viz., *Myzus persicae* Sulzer, *Liriomyza trifolii* Burgess, *Aulocophora foveicollis* Lucas and *Diaphania indica* Saunders in both the seasons followed by Farm Yard Manure @ 12.5 t/ha. Biochemical analysis of plants showed that total phenol content in leaves was higher in poultry manure applied plants compared to other organic amendments and untreated plants.

**Keywords:** Ash gourd, insect pests, organic amendments

**Introduction**

Ash gourd, *Benincasa hispida* Thunb is one of the most important vegetable crops being cultivated throughout the humid tropical and sub tropical climates. (Tindall, 1986) [17]. The immature fruits are used as vegetable and mature fruits are used for preparing candy, sweets and some ayurvedic medicines also. It is a good source of Vitamin B1 (thiamine), Vitamin B3 (niacin), Vitamin C and also rich in calcium and potassium. Ash gourd possess many medicinal properties such as muscle relaxant, antidepressant, antioxidant, anti-inflammatory, antiasthmatic, diuretic, nephroprotective, antidiabetic and antimicrobial effects (Al-Snafi, 2013) [1].

In India, the production of ash gourd is hampered by many insect pests and non-insect pests. The major sucking pests are aphids (*Aphis gossypii* Glover and *Myzus persicae* Sulzer), whitefly (*Bemisia tabaci* Gennadius), leafhopper (*Amrasca devastans* Distant) and thrips (*Scirtothrips dorsalis* Hood) (Tamilnayagan *et al.*, 2017) [15]. Serpentine leaf miner (*Liriomyza trifolii* Burgess), Pumpkin caterpillar (*Diaphania indica* Saunders), Red pumpkin beetle (*Aulacophora foveicollis* Lucas) and Melon fruit fly (*Bactrocera cucurbitae* Coquillett) are the common and serious pests of ash gourd and cause severe yield loss (Atwal, 1993; Dhillon *et al.*, 2005; Tamilnayagan *et al.*, 2017) [3, 8, 16]. In Tamilnadu, ash gourd was cultivated in an area of 441 hectares with a production of 8901.28 tonnes and productivity of 20.18 tonnes per hectare during 2016-17 (DES, 2019). Due to its medicinal purpose the area under ash gourd cultivation is increasing year after year.

Ash gourd growers mainly rely on synthetic chemical pesticides for managing the pests and indiscriminate usage of chemical insecticides disturbs the ecosystem and leaves harmful pesticide residues which cause health concerns in consumers (Azmi *et al.*, 2006) [4].

Plants supplied with organic amendments are resistant to insect pests and diseases than the plants supplied with inorganic fertilizers (Patriquin *et al.*, 1995) [11]. Since the ash gourd is consumed for its medicinal properties, avoiding the usage of chemical pesticides assumes significance. Hence the present study was undertaken to study the effect of organic amendments on the incidence of major pests of ash gourd.

**Materials and methods**

The field experiments were laid out in a randomized block design with six treatments and four replications in Agricultural College and Research Institute farm, Killikulam, Thoothukudi during Rabi 2018 (Nov 2018 – Feb 2019) and Summer 2019 (Mar 2019 – June 2019) seasons to study the effect of organic amendments on the incidence of major pests of ash gourd. The recommended doses of organic amendments were applied during last ploughing and ridges and furrows (2 m × 60 cm) were formed.

Ash gourd F<sub>1</sub> hybrid MAH 1 was sown on both the sides of the ridges at 45 cm spacing. The incidence of major pests *viz.*, aphid (*M. persicae*), serpentine leaf miner (*L. trifolii*), red pumpkin beetle (*A. foveicollis*) and pumpkin caterpillar (*D. indica*) were recorded starting from 3 weeks after sowing (WAS) till 10 WAS at weekly intervals on five randomly selected plants. The incidence of insect pests is expressed as number of insects per five plants and leaf damage by *L. trifolii* is expressed as per cent leaf damage per five plants.

### Biochemical analysis

The total phenolic content in the leaf extracts of all the treatments was determined using Folin-Ciocalteu reagent (Singleton and Rossi, 1965) [14]. Catechol was used as a reference standard for plotting the calibration curve. Leaves were collected separately from randomly selected five plants in all treatment plots and weighed to 1.0 g. The leaves were cut into small pieces and kept at hot water bath for 10 min along with 5 ml of 80 % ethanol. Then leaf bits were macerated with another 5 ml of 80 % ethanol and the content was centrifuged at 5000 rpm for 10 min. The supernatant was collected and made up to 25 ml using distilled water. One ml of aliquot was taken in a test tube and 2 ml of 20 % sodium carbonate and 1 ml of Folin-Ciocalteu reagent were added. The absorbance of the resulting blue color was measured at 660 nm in scanning UV-VIS spectrophotometer (Elico® SL 159). The total phenolic content is expressed as mg/g of leaves (Damodar *et al.*, 2011) [6].

### Statistical analysis

The data obtained from the field experiments were analyzed using AGRES ver. (7.01). The data in numbers were subjected to square root transformation and the data in percentage were subjected to arcsine transformation (Gomez and Gomez, 1984) [9].

## Results and discussion

### Incidence of aphid, *M. persicae*

The observations made on the incidence of *M. persicae* on ash gourd showed that the population was lower in poultry manure @ 5.0 t/ha applied plots *i.e.*, 4.50, 3.50, 6.00, 7.75, 5.50, 0.50, 1.75 and 1.25 per five plants during Rabi 2018 and 0.25, 1.75, 6.75, 5.75, 5.25, 7.00, 6.25 and 3.00 per five plants during Summer 2019 from 3 WAS to 10 WAS respectively. Farm Yard Manure @ 12.5 t/ha applied plots also recorded low population during both the seasons (Table 1 and 5).

### Serpentine leaf miner, *L. trifolii*

The percent leaf damage caused by *L. trifolii* was recorded as 0.00, 1.16, 0.96, 2.83, 3.01, 4.12, 4.81 and 7.04 per five plants during 3 WAS to 10 WAS respectively in Poultry manure @ 5.0 t/ha applied plots. Application of Farm Yard Manure @ 12.5 t/ha, Goat manure @ 5.0 t/ha, Vermicompost @ 2.5 t/ha and Neem cake @ 500 kg/ha also recorded low incidence of *L. trifolii* in comparison with untreated check during Rabi 2018 (Table 2). Similar trend was observed during Summer 2019, where the percent leaf damage recorded in Poultry manure @ 5.0 t/ha applied plots was 8.86, 10.66, 3.08, 2.09, 1.24, 2.57, 1.81 and 1.83 per five plants during 3 WAS to 10 WAS respectively (Table 6).

### Red Pumpkin beetle, *A. foveicollis*

During Rabi 2018, Poultry manure @ 5.0 t/ha applied plots significantly reduced the incidence of *A. foveicollis* and

recorded no incidence during 3 WAS, 7 WAS and 9 WAS. Farm Yard Manure @ 12.5 t/ha, Goat manure @ 5.0 t/ha, Vermicompost @ 2.5 t/ha and Neem cake @ 500 kg/ha applied plots also recorded less incidence in comparison with untreated check plot (Table 3). During Summer 2019, the red pumpkin beetle incidence was not there in any of the experimental plots.

### Pumpkin caterpillar, *D. indica*

During Rabi 2018, the incidence of *D. indica* was lowest in the plots applied with Poultry manure @ 5.0 t/ha *i.e.*, 0.25 and 0.75 larvae per five plants during 3 and 4 WAS respectively and there was no incidence afterwards till the harvest. However, the incidence of *D. indica* was recorded in the untreated check plots till the harvest (Table 4). During Summer 2019, the pumpkin caterpillar incidence was not there in any of the experimental plots.

### Phenol content of leaves

The total phenol content of the leaves showed significant variation among the organic amendments applied plants and untreated plants. Among the organic amendments, the total phenol content was on the highest in poultry manure applied plants (3.70 and 3.71 mg/g) in both the seasons followed by Farm Yard Manure @ 12.5 t/ha (2.64 and 2.63 mg/g), Goat manure @ 5.0 t/ha (2.15 and 2.13 mg/g), Vermicompost @ 2.5 t/ha (1.94 and 1.96 mg/g) and Neem cake @ 500 kg/ha (1.41 and 1.42 mg/g). The phenol content was low in untreated plants (1.14 and 1.12 mg/g) during both the seasons (Table 7).

### Yield

The plots applied with the Poultry manure @ 5.0 t/ha recorded the highest yield (35.93 and 35.50 t/ha) followed by Farm Yard Manure @ 12.5 t/ha (31.48 and 30.98 t/ha). All other organic amendments also recorded higher yield in comparison with the untreated check (22.46 and 22.56 t/ha) in both the seasons (Table 7). The results of the present study revealed that the incidence of insect pests on ash gourd was significantly lower in all the organic amendments applied plots when compared to the untreated check plot. Earlier studies proved that plants supplied with organic amendments are resistant to insect pests (Patriquin *et al.*, 1995 and Arancon *et al.*, 2005) [11, 2]. During both the seasons, application of organic manures increased the total phenolics in the leaves of ash gourd (Table 7). The phenols are secondary phytochemicals which confer resistance against the herbivores (Boeckler *et al.*, 2011) [5]. The increased phenol content in leaves might have reduced the incidence of insect pests. Similar report on sunflower was made by Ravi *et al.* (2006) [13] where application of organic manures reduced the incidence of early season sucking pests by increasing level of the secondary compounds *viz.*, phenols, peroxidase and polyphenol oxidase. The increased activities of these enzymes in a plant are considered as resistant state of the plant to the insect pests (Wei *et al.*, 2007; Ramirez *et al.*, 2009 and Gulsen *et al.*, 2010) [18, 12, 10]. The present study and earlier reports are evident that application of organic amendments helps the plants to produce biochemicals which confer resistance against insect pests. Hence, organic amendments could be used as a viable tool to reduce the incidence of insect pests on crops.

**Table 1:** Effect of organic amendments on the incidence of aphid, *M. persicae* during Rabi 2018

S. No.	Treatments	Number of aphids/5plants*							
		3 WAS	4 WAS	5 WAS	6 WAS	7 WAS	8 WAS	9 WAS	10 WAS
T1	Farm Yard Manure @ 12.5 t/ha	7.00 (2.56) <sup>a</sup>	7.50 (2.80) <sup>ab</sup>	10.75 (3.29) <sup>ab</sup>	9.50 (3.08) <sup>ab</sup>	9.75 (3.15) <sup>ab</sup>	3.25 (1.92) <sup>b</sup>	4.50 (2.14) <sup>ab</sup>	2.75 (1.69) <sup>ab</sup>
T2	Goat manure @ 5.0 t/ha	11.75 (3.44) <sup>ab</sup>	13.75 (3.59) <sup>bc</sup>	13.25 (3.68) <sup>ab</sup>	13.25 (3.56) <sup>abc</sup>	15.00 (3.74) <sup>ab</sup>	4.75 (2.27) <sup>b</sup>	5.75 (2.46) <sup>bc</sup>	4.50 (2.16) <sup>bc</sup>
T3	Poultry manure @ 5.0 t/ha	4.50 (2.07) <sup>a</sup>	3.50 (1.87) <sup>a</sup>	6.00 (2.14) <sup>a</sup>	7.75 (2.59) <sup>a</sup>	5.50 (2.26) <sup>a</sup>	0.50 (0.93) <sup>a</sup>	1.75 (1.42) <sup>a</sup>	1.25 (1.27) <sup>a</sup>
T4	Vermicompost @ 2.5 t/ha	18.25 (4.29) <sup>bc</sup>	19.00 (4.27) <sup>b</sup>	16.00 (3.95) <sup>bc</sup>	20.25 (4.52) <sup>bcd</sup>	16.25 (3.93) <sup>ab</sup>	5.00 (2.27) <sup>b</sup>	7.75 (2.79) <sup>bc</sup>	5.00 (2.30) <sup>bcd</sup>
T5	Neem cake @ 500 kg/ha	20.75 (4.45) <sup>bc</sup>	21.25 (4.62) <sup>c</sup>	23.50 (4.86) <sup>bc</sup>	22.50 (4.74) <sup>cd</sup>	20.75 (4.60) <sup>bc</sup>	5.75 (2.26) <sup>b</sup>	9.00 (3.05) <sup>bc</sup>	7.00 (2.72) <sup>cd</sup>
T6	Untreated check	26.75 (5.20) <sup>c</sup>	24.75 (4.91) <sup>c</sup>	30.75 (5.46) <sup>c</sup>	30.25 (5.51) <sup>d</sup>	32.75 (5.69) <sup>c</sup>	11.00 (3.35) <sup>c</sup>	10.25 (3.26) <sup>c</sup>	8.75 (3.01) <sup>d</sup>

WAS – Weeks After Sowing

\*Mean of four replications.

Figures in parentheses are  $\sqrt{x + 0.5}$  transformed values.

In a column, means followed by common letters are not significantly different by LSD (P=0.05).

**Table 2:** Effect of organic amendments on the incidence of serpentine leaf miner, *L. trifolii* during Rabi 2018

S. No.	Treatments	Per cent leaf damage/5plants*							
		3 WAS	4 WAS	5 WAS	6 WAS	7 WAS	8 WAS	9 WAS	10 WAS
T1	Farm Yard Manure @ 12.5 t/ha	1.22 (3.19) <sup>a</sup>	3.92 (7.55) <sup>a</sup>	2.21 (7.38) <sup>ab</sup>	4.22 (10.15) <sup>ab</sup>	4.55 (12.11) <sup>ab</sup>	8.17 (16.10) <sup>ab</sup>	8.91 (16.86) <sup>ab</sup>	10.96 (16.83) <sup>a</sup>
T2	Goat manure @ 5.0 t/ha	1.70 (5.30) <sup>ab</sup>	4.18 (10.18) <sup>a</sup>	3.54 (8.87) <sup>ab</sup>	6.09 (12.23) <sup>ab</sup>	6.82 (15.07) <sup>bc</sup>	9.33 (17.70) <sup>bc</sup>	10.48 (18.70) <sup>b</sup>	14.78 (22.51) <sup>ab</sup>
T3	Poultry manure @ 5.0 t/ha	0.00 (0.00) <sup>a</sup>	1.16 (3.11) <sup>a</sup>	0.96 (2.83) <sup>a</sup>	2.83 (6.88) <sup>a</sup>	3.01 (8.52) <sup>a</sup>	4.12 (11.41) <sup>a</sup>	4.81 (12.22) <sup>a</sup>	7.04 (14.95) <sup>a</sup>
T4	Vermicompost @ 2.5 t/ha	2.41 (6.21) <sup>ab</sup>	6.64 (12.39) <sup>ab</sup>	4.40 (10.28) <sup>ab</sup>	7.74 (13.90) <sup>abc</sup>	7.01 (15.28) <sup>bc</sup>	10.64 (18.74) <sup>bc</sup>	10.72 (18.88) <sup>b</sup>	15.91 (22.94) <sup>ab</sup>
T5	Neem cake @ 500 kg/ha	4.75 (12.35) <sup>bc</sup>	12.90 (20.92) <sup>bc</sup>	6.83 (14.86) <sup>bc</sup>	11.32 (19.53) <sup>ab</sup>	7.09 (15.23) <sup>bc</sup>	12.21 (20.15) <sup>bc</sup>	13.26 (20.97) <sup>b</sup>	18.75 (25.55) <sup>b</sup>
T6	Untreated check	10.49 (18.80) <sup>c</sup>	17.56 (24.67) <sup>c</sup>	11.97 (20.02) <sup>c</sup>	15.96 (23.40) <sup>c</sup>	11.03 (18.87) <sup>c</sup>	14.69 (22.49) <sup>c</sup>	15.27 (22.67) <sup>b</sup>	19.48 (25.86) <sup>b</sup>

WAS – Weeks After Sowing

\*Mean of four replications.

Figures in parentheses are arc-sine transformed values.

In a column, means followed by common letters are not significantly different by LSD (P=0.05).

**Table 3:** Effect of organic amendments on the incidence of red pumpkin beetle, *A. foveicollis* during Rabi 2018

S. No.	Treatments	Number of beetles/5plants*						
		3 WAS	4 WAS	5 WAS	6 WAS	7 WAS	8 WAS	9 WAS
T1	Farm Yard Manure @ 12.5 t/ha	0.25 (0.84) <sup>a</sup>	0.50 (0.93) <sup>a</sup>	0.75 (1.10) <sup>ab</sup>	0.75 (1.06) <sup>a</sup>	0.50 (0.93) <sup>ab</sup>	0.50 (0.97) <sup>a</sup>	0.25 (0.84) <sup>ab</sup>
T2	Goat manure @ 5.0 t/ha	0.50 (0.97) <sup>a</sup>	0.75 (1.10) <sup>ab</sup>	1.25 (1.31) <sup>bc</sup>	1.00 (1.18) <sup>a</sup>	0.75 (1.06) <sup>ab</sup>	0.75 (1.06) <sup>ab</sup>	0.75 (1.06) <sup>abc</sup>
T3	Poultry manure @ 5.0 t/ha	0.00 (0.71) <sup>a</sup>	0.25 (0.84) <sup>a</sup>	0.25 (0.84) <sup>a</sup>	0.50 (0.97) <sup>a</sup>	0.00 (0.71) <sup>a</sup>	0.25 (0.84) <sup>a</sup>	0.00 (0.71) <sup>a</sup>
T4	Vermicompost @ 2.5 t/ha	0.75 (1.06) <sup>ab</sup>	1.00 (1.18) <sup>ab</sup>	1.50 (1.40) <sup>bc</sup>	1.25 (1.27) <sup>a</sup>	1.00 (1.18) <sup>abc</sup>	1.00 (1.18) <sup>abc</sup>	1.25 (1.26) <sup>bcd</sup>
T5	Neem cake @ 500 kg/ha	1.50 (1.40) <sup>bc</sup>	1.50 (1.40) <sup>bc</sup>	1.75 (1.49) <sup>bc</sup>	2.75 (1.79) <sup>b</sup>	1.25 (1.27) <sup>bc</sup>	2.00 (1.56) <sup>bc</sup>	1.50 (1.40) <sup>cd</sup>
T6	Untreated check	2.00 (1.56) <sup>c</sup>	2.25 (1.64) <sup>c</sup>	2.50 (1.70) <sup>c</sup>	3.50 (1.98) <sup>b</sup>	2.25 (1.64) <sup>c</sup>	2.50 (1.70) <sup>c</sup>	2.00 (1.56) <sup>d</sup>

WAS – Weeks After Sowing

\*Mean of four replications.

Figures in parentheses are  $\sqrt{x + 0.5}$  transformed values.

In a column, means followed by common letters are not significantly different by LSD (P=0.05).

**Table 4:** Effect of organic amendments on the incidence of pumpkin caterpillar, *D. indica* during Rabi 2018

S. No.	Treatments	Number of larvae/5plants*						
		3 WAS	4 WAS	5 WAS	6 WAS	7 WAS	8 WAS	9 WAS
T1	Farm Yard Manure @ 12.5 t/ha	1.00 (1.13) <sup>ab</sup>	2.25 (1.63) <sup>ab</sup>	0.50 (0.97) <sup>ab</sup>	0.25 (0.84) <sup>a</sup>	0.25 (0.84) <sup>a</sup>	0.25 (0.84) <sup>ab</sup>	0.00 (0.71) <sup>a</sup>
T2	Goat manure @ 5.0 t/ha	1.25 (1.26) <sup>bc</sup>	2.75 (1.76) <sup>ab</sup>	0.75 (1.10) <sup>bc</sup>	0.50 (0.93) <sup>ab</sup>	0.25 (0.84) <sup>a</sup>	0.50 (0.97) <sup>ab</sup>	0.25 (0.84) <sup>ab</sup>
T3	Poultry manure @ 5.0 t/ha	0.25	0.75	0.00	0.00	0.00	0.00	0.00

		(0.84) <sup>a</sup>	(1.10) <sup>a</sup>	(0.71) <sup>a</sup>	(0.71) <sup>a</sup>	(0.71) <sup>a</sup>	(0.71) <sup>a</sup>	(0.71) <sup>a</sup>
T4	Vermicompost @ 2.5 t/ha	1.75 (1.48) <sup>bcd</sup>	3.25 (1.90) <sup>b</sup>	1.00 (1.18) <sup>bc</sup>	1.00 (1.22) <sup>bc</sup>	0.75 (1.06) <sup>ab</sup>	0.75 (1.10) <sup>ab</sup>	0.50 (0.97) <sup>ab</sup>
T5	Neem cake @ 500 kg/ha	2.75 (1.79) <sup>cd</sup>	4.50 (2.22) <sup>bc</sup>	1.25 (1.31) <sup>c</sup>	2.00 (1.56) <sup>cd</sup>	1.75 (1.48) <sup>bc</sup>	1.25 (1.27) <sup>bc</sup>	1.00 (1.18) <sup>bc</sup>
T6	Untreated check	3.75 (2.03) <sup>d</sup>	7.25 (2.74) <sup>c</sup>	3.25 (1.92) <sup>d</sup>	3.00 (1.86) <sup>d</sup>	2.25 (1.61) <sup>c</sup>	2.00 (1.56) <sup>c</sup>	1.75 (1.48) <sup>c</sup>

WAS – Weeks After Sowing

\*Mean of four replications.

Figures in parentheses are  $\sqrt{x + 0.5}$  transformed values.

In a column, means followed by common letters are not significantly different by LSD (P=0.05).

**Table 5:** Effect of organic amendments on the incidence of aphid, *M. persicae* during Summer 2019

S. No.	Treatments	Number of aphids/5plants*							
		3 WAS	4 WAS	5 WAS	6 WAS	7 WAS	8 WAS	9 WAS	10 WAS
T1	Farm Yard Manure @ 12.5 t/ha	3.00 (1.71) <sup>a</sup>	9.25 (2.89) <sup>ab</sup>	12.00 (3.49) <sup>ab</sup>	14.75 (3.83) <sup>ab</sup>	15.50 (4.00) <sup>ab</sup>	11.50 (3.41) <sup>ab</sup>	8.75 (3.03) <sup>a</sup>	8.25 (2.93) <sup>b</sup>
T2	Goat manure @ 5.0 t/ha	1.50 (1.28) <sup>a</sup>	14.00 (3.77) <sup>bc</sup>	23.00 (4.70) <sup>b</sup>	28.75 (5.34) <sup>bc</sup>	23.50 (4.83) <sup>b</sup>	19.50 (4.45) <sup>b</sup>	12.25 (3.49) <sup>a</sup>	17.50 (4.19) <sup>cd</sup>
T3	Poultry manure @ 5.0 t/ha	0.25 (0.84) <sup>a</sup>	1.75 (1.42) <sup>a</sup>	6.75 (2.64) <sup>a</sup>	5.75 (2.45) <sup>a</sup>	5.25 (2.29) <sup>a</sup>	7.00 (2.63) <sup>a</sup>	6.25 (2.56) <sup>a</sup>	3.00 (1.72) <sup>a</sup>
T4	Vermicompost @ 2.5 t/ha	12.00 (3.44) <sup>b</sup>	28.00 (5.30) <sup>cd</sup>	48.50 (6.99) <sup>c</sup>	50.25 (6.98) <sup>cd</sup>	65.25 (7.96) <sup>c</sup>	24.50 (4.98) <sup>b</sup>	24.50 (4.98) <sup>b</sup>	15.75 (4.01) <sup>c</sup>
T5	Neem cake @ 500 kg/ha	12.25 (3.31) <sup>b</sup>	37.75 (5.90) <sup>de</sup>	39.50 (6.20) <sup>c</sup>	52.25 (7.15) <sup>cd</sup>	88.25 (9.41) <sup>c</sup>	82.25 (8.99) <sup>c</sup>	34.50 (5.90) <sup>b</sup>	25.50 (5.08) <sup>d</sup>
T6	Untreated check	19.75 (4.36) <sup>b</sup>	54.50 (7.21) <sup>e</sup>	95.75 (9.80) <sup>d</sup>	74.50 (8.60) <sup>d</sup>	161.25 (12.38) <sup>d</sup>	193.75 (13.71) <sup>d</sup>	81.75 (9.01) <sup>c</sup>	43.00 (6.56) <sup>e</sup>

WAS – Weeks After Sowing

\*Mean of four replications.

Figures in parentheses are  $\sqrt{x + 0.5}$  transformed values.

In a column, means followed by common letters are not significantly different by LSD (P=0.05).

**Table 6:** Effect of organic amendments on the incidence of serpentine leaf miner, *L. trifolii* during Summer 2019

S. No.	Treatments	Per cent leaf damage/5plants*							
		3 WAS	4 WAS	5 WAS	6 WAS	7 WAS	8 WAS	9 WAS	10 WAS
T1	Farm Yard Manure @ 12.5 t/ha	11.92 (20.17) <sup>ab</sup>	16.12 (23.58) <sup>ab</sup>	7.00 (4.01) <sup>ab</sup>	3.95 (11.17) <sup>ab</sup>	3.08 (9.99) <sup>ab</sup>	3.87 (11.23) <sup>a</sup>	3.20 (9.79) <sup>a</sup>	3.16 (9.93) <sup>a</sup>
T2	Goat manure @ 5.0 t/ha	15.01 (22.57) <sup>bc</sup>	20.35 (26.64) <sup>bc</sup>	7.51 (4.31) <sup>ab</sup>	5.45 (13.36) <sup>b</sup>	6.25 (14.33) <sup>bc</sup>	6.41 (14.61) <sup>a</sup>	8.89 (16.74) <sup>b</sup>	10.20 (18.59) <sup>b</sup>
T3	Poultry manure @ 5.0 t/ha	8.86 (17.12) <sup>a</sup>	10.66 (18.71) <sup>a</sup>	3.08 (1.76) <sup>a</sup>	2.09 (8.14) <sup>a</sup>	1.24 (9.15) <sup>a</sup>	2.57 (9.15) <sup>a</sup>	1.81 (7.68) <sup>a</sup>	1.83 (7.78) <sup>a</sup>
T4	Vermicompost @ 2.5 t/ha	22.26 (28.00) <sup>d</sup>	23.93 (29.25) <sup>cd</sup>	11.68 (6.71) <sup>bc</sup>	9.37 (17.79) <sup>c</sup>	11.62 (19.92) <sup>cd</sup>	16.03 (23.48) <sup>b</sup>	17.29 (24.51) <sup>c</sup>	13.34 (21.39) <sup>c</sup>
T5	Neem cake @ 500 kg/ha	20.94 (27.14) <sup>cd</sup>	27.55 (31.61) <sup>d</sup>	19.54 (11.27) <sup>c</sup>	12.71 (20.86) <sup>c</sup>	12.62 (20.71) <sup>cd</sup>	16.48 (22.52) <sup>b</sup>	24.69 (29.56) <sup>d</sup>	24.35 (29.52) <sup>d</sup>
T6	Untreated check	27.13 (31.19) <sup>d</sup>	38.00 (38.05) <sup>e</sup>	37.57 (22.07) <sup>d</sup>	22.58 (28.06) <sup>d</sup>	21.66 (32.76) <sup>d</sup>	29.78 (32.76) <sup>c</sup>	27.90 (31.86) <sup>d</sup>	39.67 (39.03) <sup>d</sup>

WAS – Weeks After Sowing

\*Mean of four replications.

Figures in parentheses are arc-sine transformed values.

In a column, means followed by common letters are not significantly different by LSD (P=0.05).

**Table 7:** Effect of organic amendments on phenol content of leaves and fruit yield

S. No.	Treatments	Total phenol content (mg /g of leaf sample)		Yield (t/ha)	
		Rabi 2018	Summer 2019	Rabi 2018	Summer 2019
T1	Farm Yard Manure @ 12.5 t/ha	2.64 <sup>b</sup>	2.63 <sup>b</sup>	31.48 <sup>b</sup>	30.98 <sup>b</sup>
T2	Goat manure @ 5.0 t/ha	2.15 <sup>c</sup>	2.13 <sup>c</sup>	29.59 <sup>c</sup>	29.75 <sup>c</sup>
T3	Poultry manure @ 5.0 t/ha	3.70 <sup>a</sup>	3.71 <sup>a</sup>	35.93 <sup>a</sup>	35.50 <sup>a</sup>
T4	Vermicompost @ 2.5 t/ha	1.94 <sup>d</sup>	1.96 <sup>d</sup>	28.68 <sup>d</sup>	28.12 <sup>d</sup>
T5	Neem cake @ 500 kg/ha	1.41 <sup>e</sup>	1.42 <sup>e</sup>	26.12 <sup>e</sup>	25.85 <sup>e</sup>
T6	Untreated check	1.14 <sup>f</sup>	1.12 <sup>f</sup>	22.46 <sup>f</sup>	22.56 <sup>f</sup>

In a column, means followed by common letters are not significantly different by LSD (P=0.05).

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