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EFFECT OF ORGANIC SOURCES OF NUTRIENTS ON SOIL PARAMETERS AND THEIR EFFECT ON THE INCIDENCE OF SUCKING PESTS

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A field investigation on influence of soil amendments on the incidence of sucking pests in Bt cotton results revealed that there was no significant difference between the treatments with respect to soil pH. However, the organic carbon (%) was more in organic amendment treated treatment (PM+NC recorded 0.35, 0.35 and 0.36% at 30, 60 and 90 DAS, respectively). While, with respect to EC, organic amendments had both positive and negative role. The N, P and K content were on par between the treatments except untreated check. However highest amount of N, P and K was recorded in RDF and standard check which received the nitrogen, phosphorus and potash directly in to the soil. There was no significant difference between the treatments with respect to exchangeable calcium (ranges from 3.01 to 3.35 cmol(p^+) kg^{-1}) and magnesium (ranges from 0.95 to 1.31) at 30, 60 and 90DAS. Similar trend was found even with respect to sulphur content in the soil. This was ranged from 11.73 to 14.75ppm among the treatments compared to untreated check with 12.53, 12.21 and 11.73ppm sulphur content at 30, 60 and 90 DAS, respectively in the soil.

Key words : Organic nutrients, soil, effect on sucking insects

INTRODUCTION

Cotton (*Gossypium* spp.) popularly known as "white gold" is an important commercial fibre crop grown under diverse agro-climatic conditions around the world. It provides fibre, an important raw material for textile industry. More than 70 per cent demand from Indian textile industries is met by cotton fibres (Itnal, 2004). As many as 1326 species of insect and mite pests have been reported to attack cotton at various stages of crop growth across the globe (Hargreaves, 1948). However, in India the number is limited to 130 species (Agarwal *et al.*, 1984).

A complex of sucking pests *viz.*, green leaf hopper, *Amrasca biguttula biguttula* Ishida; thrips, *Thrips tabaci* Lindeman; aphids, *Aphis gossypii* Glover and whitefly, *Bemisia tabaci* Gennadius are known to have occupied major pest status (Gosh, 2001), besides red spider mite, *Tetranychus* spp. (Andre); red cotton bug, *Dysdercus cingulatus* (Fabricius) and dusky cotton bug, *Oxycarenus hyalinipennis* (Costa) are account for the yield loss in cotton.

Modern agriculture is dominated by the use of inorganic fertilizers to satisfy the heavy nutrient demand of high yielding varieties or hybrids of cotton. But, necessity to switch over to organic cultivation has been considered as indispensable prerequisite to achieve long term sustainability.

Because, organic farming involves eco-friendly practices and use of naturally available resources, both encouraging the regeneration of natural capacity of soil to supply and retain the plant nutrients so that the pest could be managed with least problems to its natural enemy fauna and environment. Therefore, the present experiment to explore the application of organic sources of nutrients, which effect soil parameters and their influence on sucking pest incidence in Bt cotton, when used either solely or in combination was envisaged.

MATERIALS AND METHODS

Bt cotton crop was grown at college of agriculture, Navile Shivamogga during *kharif*, 2008. The field trial was laid out in a randomized complete block design with twelve treatments and three replications with plot size of 5 m x 3 m. The spacing adopted was 90 cm between rows and 60 cm between plants within the row. The Bt cotton hybrid DBtHB-5 (Dharwad Bt. interspecific Hybrid) was used in the present study. As per the treatments vermicompost, neemcake, poultry manure, FYM their combination and recommended dose of fertilizers were applied to soil (on the basis of nitrogen 150:75:75 kg ha^{-1}) and mixed well before dibbling of seeds.

Soil samples were collected before sowing of crop and after 30, 60 and 90DAS from 0-30 cm soil depth from each treatment in all the three replications. The soil samples were analyzed for pH, EC, OC, available phosphorus, potassium, sulphur, exchangeable calcium and magnesium status in soil was done as per the method suggested by Jackson (1967) and available nitrogen by Sharawat & Burford (1982) method. Ultimately correlated their effect on the incidence of major sucking pests *viz.*, aphids, leaf hoppers, whiteflies, thrips and mites in Bt cotton.

RESULTS AND DISCUSSION

It was noticed that organic amendments had no influence on pH because all the treatments exhibited non-significant differences. But soil pH increased over the untreated check due to the imposed organic amendments in different treatments and highest pH was recorded in RDF and standard check. The relationship between soil pH and sucking pests incidence, exhibited non-significant positive correlation with aphid, whitefly and leafhopper but non-significant negative correlation with thrips incidence at 30 and 60 DAS. At 90 DAS, aphid, thrips and mites showed negative correlation with pH but whitefly and leafhopper was recorded positive correlation with pH. No supportive data is available to compare the present data.

Electrical conductivity was influenced by different treatments and it was observed that RDF involving NPK fertilizers recorded significantly increased electrical conductivity in soil probably because of soluble nature of NPK fertilizers that might increased the ion concentration in soil solution. Therefore EC was highest in T_1 and T_{11}. Among the organic amendments T_9 (FYM+PM) exhibited highest EC 0.45, 0.44 and 0.42dsm^{-1} at 30, 60 and 90DAS, respectively but inferior to RDF which had significantly higher electrical conductivity in soil (0.47, 0.45 and 0.43 d sm^{-1}) at 30, 60 and 90 DAS, respectively. These results are in agreement with those of Haan ((1983) and Bevaqua (1994). The relationship between EC and sucking pest exhibited non-significant correlation with aphid, leaf hopper and whiteflies but non-significant negative correlation Effect of organic source of nutrients on soil parathemeters (N, P and K) at different with thrips at 30, 60 and 90 DAS. However mites at 90 DAS recorded non-significant negative correlation.

Table I : Effect of organic source of nutrients on soil parameters (pH, EC and OC) at different growth stages of Bt cotton.

Treatments	Nitrogen (Kg/ha)			Phosphorus (Kg/ha)			Potash (Kg/ha)		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T_1 RDF	204.23^{a}	205.53^{a}	201.13^{a}	61.53^{a}	63.50^{a}	62.18^{a}	181.77^{a}	181.67^{a}	179.50^{a}
T_2 VC	193.93^{abc}	198.30^{ab}	196.13^{a}	54.57^{abc}	55.86^{b}	54.55^{b}	176.27^{a}	173.37^{a}	172.43^{a}
T_3 PM	183.57^{bc}	179.27^{bc}	184.97^{ab}	54.67^{abc}	54.40^{b}	52.52^{bc}	179.20^{a}	178.33^{a}	177.67^{a}
T_4 NC	183.40^{bc}	184.27^{abc}	186.17^{ab}	54.13^{abc}	55.07^{b}	57.38^{ab}	175.73^{a}	177.20^{a}	177.23^{a}
T_5 VC+ PM	189.40^{abc}	187.63^{abc}	187.40^{ab}	56.03^{abc}	55.79^{b}	55.80^{ab}	178.37^{a}	177.50^{a}	176.70^{a}
T_6 PM+ NC	180.67^{bc}	180.83^{bc}	183.73^{ab}	55.57^{abc}	58.10^{ab}	57.22^{ab}	177.50^{a}	178.63^{a}	176.83^{a}
T_7 NC=VC	182.07^{bc}	186.00^{abc}	185.67^{ab}	52.60^{bc}	55.19^{b}	57.58^{ab}	176.23^{a}	176.43^{a}	178.20^{a}
T_8 FYM+NC	188.13^{abc}	187.87^{abc}	189.33^{ab}	58.80^{ab}	58.28^{ab}	57.77^{ab}	176.50^{a}	179.90^{a}	177.73^{a}
T_9 FYM+PM	187.37^{abc}	188.33^{abc}	185.17^{ab}	57.30^{ab}	57.90^{ab}	58.69^{ab}	179.93^{a}	181.40^{a}	179.93^{a}
T_{10} FYM+VC	196.70^{ab}	172.87^{c}	193.40^{a}	56.93^{ab}	58.17^{ab}	56.59^{ab}	177.53^{a}	179.83^{a}	176.83^{a}
T_{11} Standard check	204.07^{a}	206.00^{a}	201.33^{a}	59.78^{a}	58.23^{ab}	58.94^{ab}	183.59^{a}	178.24^{a}	177.90^{a}
T_{12} Untreated check	175.73^{c}	172.93^{c}	171.23^{b}	47.87^{c}	47.12^{c}	47.62^{c}	165.96^{a}	167.83^{a}	166.07^{a}
S.Em. ±	5.55	7.32	5.98	2.63	2.34	2.19	5.43	6.10	6.63
CD at 5%	16.27	21.48	17.55	7.72	6.85	6.42	15.92	17.90	19.44
CV (%)	5.08	6.76	5.49	8.17	7.16	6.72	5.30	5.95	6.51

DAS – Days after sowing RDF- Recommended dose of fertilizer VC-Vermicompost PM-Poultry manure NC - Neem cake FYM- Farm yard manure

Means in the column followed by same alphabet do not differ significantly by DMRT (0.05).

The results indicated that organic status significantly improved in all organic treatments (T_2 to T_{10}) over the untreated check due to the imposed organic amendments. But among the organic amendments, T_6 (PM+NC) recorded significantly higher organic carbon status (0.35, 0.35 and 0.36%) at 30, 60 and 90 DAS and they are on par with rest of the treatments except untreated check. Indicating that the addition of organic material is essential for maintenance of organic carbon status in soil. These results are in conformity with those of Sharma *et al.* (2002) and Chidanandappa (2003). The correlation between organic matter and sucking pest indicated that mites had significant negative correlation (r=-0.65*) at 90 DAS and non-significant positive correlation with other sucking pests. Organic carbon in soil may increase the available soil nitrogen may be the cause for positive correlation with aphid, whitelfly and leafhopper. These results are in agreement with Godase & Patel (2001).

There was no significant difference between the treatments except control (T_{12}). However, T_1 and T_{11} recorded highest nitrogen both at 30, 60 and 90 DAS. The higher availability of nitrogen in soil under standard check and RDF was attributed to the addition of nitrogen through NPK fertilizers and in organic amended plots the release of nitrogen from the added organic sources due to higher biological activity. Further, the available nitrogen status in soil decreased with the crop growth probably because of increased uptake by crop and other losses that took place during the crop growth period. The higher population of pests is mainly attributed to higher nitrogen content supplied through RDF resulted in luxurious growth. This vulnerability to pest attack by application of fertilizers was reported by Sureka and Arjuna Rao (2001). This is in agreement with the present results. When this was correlated with sucking pest incidence,

Table II : Effect of organic source of nutrients on soil parameters (N, P and K) at different growth stages of Bt cotton.

Treatment	Exchangeable Calcium (cmol $(p^+)kg^{-1}$)			Exchangeable Magnesium (cmol $(p^+)kg^{-1}$)			Sulphur (ppm)		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T_1 RDF	3.32^{a}	3.35^{a}	3.18^{a}	1.28^{a}	1.31^{a}	1.12^{ab}	13.83^{abc}	13.63^{abc}	13.11^{a}
T_2 VC	3.28^{a}	3.22^{a}	3.19^{a}	1.19^{ab}	1.19^{a}	1.16^{a}	14.22^{ab}	13.47^{abcd}	12.75^{abc}
T_3 PM	3.21^{a}	3.20^{a}	3.15^{a}	1.19^{ab}	1.20^{a}	1.13^{ab}	13.49^{abc}	13.57^{abcd}	13.00^{ab}
T_4 NC	3.27^{a}	3.18^{a}	3.10^{a}	1.22^{a}	1.25^{a}	1.10^{abc}	12.86^{bc}	12.62^{bcd}	12.14^{abc}
T_5 VC+PM	3.23^{a}	3.22^{a}	3.06^{a}	1.18^{ab}	1.19^{a}	1.12^{ab}	14.62^{a}	14.19^{a}	12.73^{abc}
T_6 PM+NC	3.30^{a}	3.25^{a}	3.17^{a}	1.22^{a}	1.22^{a}	1.20^{a}	14.62^{a}	14.16^{a}	12.97^{ab}
T_7 NC+VC	3.23^{a}	3.20^{a}	3.07^{a}	1.13^{ab}	1.13^{ab}	1.10^{abc}	13.47^{abc}	13.23^{abcd}	12.67^{abc}
T_8 FYM+NC	3.28^{a}	3.20^{a}	3.19^{a}	1.18^{ab}	1.18^{a}	1.16^{a}	14.13^{abc}	13.36^{abcd}	12.10^{abc}
T_9 FYM+PM	3.32^{a}	3.21^{a}	3.08^{a}	1.17^{ab}	1.16^{a}	1.15^{ab}	14.75^{a}	13.09^{abcd}	12.49^{abc}
T_{10} FYM+VC	3.26^{a}	3.23^{a}	3.11^{a}	1.15^{ab}	1.14^{ab}	1.14^{ab}	14.60^{a}	13.86^{ab}	11.82^{abc}
T_{11} Standard Check	3.33^{a}	3.01^{a}	3.05^{a}	1.20^{a}	1.31^{a}	1.14^{ab}	13.04^{abc}	13.20^{abcd}	13.06^{a}
T_{12} Untreated check	3.01^{a}	3.05^{a}	3.03^{a}	0.97^{c}	0.97^{b}	0.95^{c}	12.53^{c}	12.21^{d}	11.73^{bc}
S.Em.±	0.11	0.10	0.09	0.05	0.06	0.05	0.48	0.39	0.38
CD at 5%	0.31	0.29	0.28	0.15	0.17	0.16	1.42	1.14	1.11
CV (%)	5.70	5.43	5.34	7.99	8.37	8.64	6.05	5.02	5.32

DAS – Days after sowing RDF- Recommended dose of fertilizer VC-Vermicompost PM-Poultry manure
NC - Neem cake FYM- Farm yard manure Means in the column followed by same alphabet do not differ
significantly by DMRT (0.05).

significant positive correlation with aphids (r=0.62* and 0.60* respectively) and leafhopper(r=0.57* and 0.64*, respectively) at 30 and 60 DAS and whiteflies had significant positive correlation (r=0.69*) at 60 DAS. These results are in close agreement with Godase & Patel (2001), who reported that higher level of nitrogen in soil was significantly increased the population of aphids and leafhopper.

Similarly, available P_2O_5 (phosphorus) in soil also significantly increased over control due to the applied fertilizer *i.e.* in T_1 and T_{11}. Among the organic treatments the performance were on par and superior than control. As observed in case of nitrogen, the RDF and standard check significantly increases the available P_2O_5 status in soil at all stages. This indicated that the treatment which received NPK fertilizers or organic materials were found to be significantly superior over control with respect of available P_2O_5 status due to addition of phosphorus through above materials. When available P_2O_5 was correlated with incidence of sucking pests *viz.*, aphids had significant positive correlation (r=0.66*) at 30 DAS and non-significant positive with whitefly, leafhopper and mites at 30, 60 and 90 DAS but thrips recorded negative correlation with available P_2O_5 at 30, 60 and 90 DAS. Here available P_2O_5 may helps in the incidence of sucking pests. Similar results were noticed by Jayaraj & Venugopal (1964) reported that the plots received P alone recorded the lowest population of leaf hoppers (1.80/ leaves). par with each other. However, among organic amendments highest (179.93, 181.40 and 179.93kg/ha) was noticed in T_9 (FYM+PM) at 30, 60 and 90 DAS. The correlation between available K_2O and sucking pests indicated that the thrips recorded negative correlation with available K_2O at 30, 60 and 90 DAS, whereas, aphids and mites at 90 DAS recorded negative correlation. Available K_2O may be induced resistance to the

There was no significant difference between the treatments with respect to available K_2O at all the stages. However, organic treatments exhibited almost similar available K_2O status in soil and they are inferior to T_1 (RDF) and T_{11} (standard check) but all are on plants against sucking pests. These results were close agreement with Jayaraman &

Table III : Effect of organic source of nutrients on soil parameters (Ca, Mg and S) at different growth stages of Bt cotton

Treatment	pH			EC (dsm^{-1})			OC (%)		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T_1 RDF	5.46^{a}	5.48^{a}	5.44^{a}	0.47^{a}	0.45^{a}	0.43^{a}	0.30^{abc}	0.28^{abc}	0.27^{bcd}
T_2 VC	5.35^{a}	5.36^{a}	5.41^{a}	0.39^{cde}	0.36^{fg}	0.32^{d}	0.25^{abc}	0.23^{c}	0.26^{bcd}
T_3 PM	5.37^{a}	5.35^{a}	5.39^{a}	0.41^{bcde}	0.39^{def}	0.36^{cd}	0.31^{abc}	0.34^{a}	0.32^{ab}
T_4 NC	5.28^{a}	5.35^{a}	5.44^{a}	0.42^{abcd}	0.40^{cde}	0.36^{cd}	0.28^{abc}	0.30^{abc}	0.30^{abcd}
T_5 VC+PM	5.39^{a}	5.44^{a}	5.48^{a}	0.41^{bcde}	0.41^{bcd}	0.38^{bc}	0.33^{ab}	0.31^{abc}	0.32^{ab}
T_6 PM+NC	5.39^{a}	5.36^{a}	5.43^{a}	0.43^{abcd}	0.42^{abcd}	0.39^{abc}	0.35^{a}	0.35^{a}	0.36^{a}
T_7 NC+VC	5.34^{a}	5.41^{a}	5.44^{a}	0.45^{ab}	0.41^{bcd}	0.39^{abc}	0.30^{abc}	0.30^{abc}	0.30^{abcd}
T_8 FYM+NC	5.42^{a}	5.47^{a}	5.49^{a}	0.45^{ab}	0.43^{abc}	0.41^{ab}	0.35^{a}	0.35^{a}	0.34^{ab}
T_9 FYM+PM	5.29^{a}	5.32^{a}	5.51^{a}	0.45^{ab}	0.44^{ab}	0.42^{ab}	0.30^{abc}	0.31^{abc}	0.31^{abc}
T_{10} FYM+VC	5.37^{a}	5.47^{a}	5.54^{a}	0.44^{abc}	0.41^{bcd}	0.40^{abc}	0.31^{abc}	0.32^{ab}	0.33^{ab}
T_{11} Standard Check	5.44^{a}	5.42^{a}	5.41^{a}	0.43^{de}	0.42^{abcd}	0.42^{ab}	0.26^{abc}	0.25^{abc}	0.25^{bcd}
T_{12} Untreated check	5.21^{a}	5.10^{a}	5.10^{a}	0.36^{e}	0.34^{c}	0.33^{d}	0.23^{bc}	0.23^{c}	0.22^{d}
S.Em. ±	0.21	0.21	0.17	0.02	0.01	0.01	0.03	0.03	0.03
CD at 5%	0.62	0.61	0.50	0.05	0.04	0.04	0.10	0.09	0.08
CV (%)	6.83	6.65	5.41	7.20	5.93	5.85	19.14	17.61	15.99

DAS – Days after sowing RDF- Recommended dose of fertilizer VC-Vermicompost
PM-Poultry manure NC - Neem cake FYM- Farm yard manure
Means in the column followed by same alphabet do not differ significantly by DMRT (0.05).

Table IV : Correlation co-efficient between major sucking pests of Bt cotton and soil parameters at 30, 60 and 90DAS.

	30 DAS								
	pH	EC	OC	N	P	K	Ca	Mg	S
Aphids	0.50	0.46	0.46	0.62*	0.66*	-0.64*	-0.19	0.53	0.49
Whitefly	0.20	0.32	0.15	0.48	0.33	-0.15	-0.08	-0.03	0.51
Leaf hopper	0.16	0.16	0.00	0.57*	0.41	-0.09	-0.22	0.00	0.25
Thrips	-0.15	-0.37	-0.24	0.08	-0.18	-0.29	-0.88*	-0.48	-0.13
	60 DAS								
Aphids	0.23	0.17	-0.37	0.60*	0.37	-0.15	0.39	0.31	-0.07
Whitefly	0.15	0.35	0.05	0.69*	0.43	-0.35	0.46	0.40	0.29
Leaf hopper	0.43	0.05	-0.25	0.64*	0.43	-0.16	0.56	0.50	0.49
Thrips	-0.22	-0.30	-0.47	0.04	-0.15	-0.25	-0.14	-0.35	-0.35
Mites	0.39	0.33	0.34	0.09	0.37	-0.48	0.44	0.35	0.51
	90 DAS								
Aphids	-0.17	0.26	-0.36	0.34	0.11	-0.08	0.12	-0.26	-0.04
Whitefly	0.09	0.44	0.04	0.13	0.15	-0.18	0.10	0.17	0.26
Leaf hopper	0.20	0.16	0.20	0.45	0.18	0.23	0.44	0.41	0.66*
Thrips	-0.07	0.01	-0.37	0.23	-0.10	-0.15	0.02	-0.24	-0.14
Mites	-0.40	-0.29	-0.65*	0.21	-0.16	-0.39	0.23	-0.24	0.07

* : Significant at 5%.
DAS : Days after sowing.

Balasubramanian (1988) who reported that increased potash content in soil resulted in significant reduction in aphids and thrips population compared to no potassium application. Godase & Patel, (2001) reported that significantly least population of leafhoppers (9.14/9leaves) was noticed at double dose of K (75 kg/ha).

Exchangeable calcium in soil was non-significant in all the treatments, among the treatments, it was noticed that the standard check (T_{11}) and RDF (T_1) increased the exchangeable calcium but they are on par with all other treatments. Similarly, exchangeable magnesium exhibited no significant difference in all the treatments, however, standard check (T_{11}) and RDF (T_1) increased the exchangeable magnesium, but they are on par with all other treatments. Exchangeable calcium and magnesium in soil was increased in the treatments applied with organic amendments, this indicates the organic material served as source of calcium and magnesium and were released from bound form to exchangeable form.

During the decomposition of organic mater which in tern dependent on biological activity in soil. Because of high biological activity under standard check a increase in exchangeable calcium and magnesium was noticed. However, when exchangeable calcium and magnesium were correlated with pest incidence, at 30 DAS thrips with significant negative correlation with exchangeable calcium but non-significant negative correlation with other pests, thrips and whitefly were non-significant negative correlation with exchangeable magnesium. At 60 DAS, aphid, whitefly, leafhopper and mites recorded non-significant positive correlation, thrips recorded non-significant negative correlation with exchangeable calcium and magnesium. Whereas, at 90 DAS, aphid, whitefly and leafhopper were non-significant positive correlation with exchangeable calcium and magnesium. Probably exchangeable calcium and magnesium induced the pest incidence.

All the treatments were almost on par with each other with respect to available sulphur except untreated check, indicating that organic mater served as a main source of available sulphur in soil. These results are in confirmity with the results of Srikanth *et al.* (2000). The results were correlated with sucking pests. Thrips recorded negative correlation with available sulphur content in soil at all stages. Aphids also recorded negative correlation with available sulphur at 60 and 90 DAS. Whereas, mites had non-significant positive correlation at 60 and 90 DAS whereas, it had positive correlation with leafhoppers at 90 DAS but non-significant negative correlation with thrips at all the stages. The present findings are in agreement with Chattarjee *et al.* (2000), Suresh (1988) and Surekha & Arjuna Rao (2001).

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REFERENCES

AGARWAL, R.A., GUPTA, G.P. & GARG, D.O. 1984. *Cotton pest management in India.* Research Publications, Azadnagar, Delhi, pp: 1-191.

BEVAQUA, R.F. 1994. Effect of different organic sources of nutrient on soil properties. *Commun. Soil Sci. Pl. Anal,* **25** : 395.

CHATTERJEE C., DUBE B.K. & JOYTI, G. 2000. Influence of variable sulphur application on cotton. *Indian J. Pl. Physiol.* **5** : 19-55.

CHIDANANDAPPA, H.M. 2003. Dynamics of zinc and copper organic materials amended soils. *Ph.D. Thesis,* submitted to the Univ. Agric. Sci., Bangalore, India.

GODASE, S.K. & PATEL, C.B. 2001. Studies on the influence of organic manure and fertilizer doses on the intensity of sucking pests, *Amrasca biguttula biguttula* Ishida and *Aphis gossypii* Glover infesting brinjal. *Pl. Prot. Bull.* **53** : 10-12.

GOSH, P.K. 2001. Genetically modified crops in India with special reference to Bt cotton. *J. Indian Soc. Cotton Improv.* **8** : 106-107.

HAAN, S.D. 1983. Influence of organics on available nutrient status of soil. *Neth. J. agric. Sci.* **29** : 49.

HARGREAVES, H. 1948. List of recorded cotton insects of the world, *Commonw. Inst. Ent.*, London, pp: 50.

ITNAL, C.J. 2004. Organic cotton production in India- present status and future strategy. In: international symposium on "*Strategies for sustainable cotton production – A global vision.*" **2.** Crop production, pp: 40-42.

JACKSON, M. L., 1973. *Soil Chemical Analysis*, Prentice Hall of India Private Limited, New Delhi, p: 22.

JAYARAJ, S. & VENUGOPAL, M.S. 1964. Observations on the effect of manuring and irrigation on the incidence of cotton leaf hopper, *Empoasca devastans* Dist. and the cotton aphids, *Aphis gossypii* G. at different periods of crop growth. *Madras Agric. J.* **51** :189-196.

JEYARAMAN, S. & BALASUBRAMANIAN, R. 1988. Role of potassium treatment on yield and incidence of pests and diseases in chilli. *J. potassium Res.* **4** : 67-70.

SHARAWAT, K.L. & BURFORD, J.R. 1982. Modification of alkaline permanganate method for assessing the availability of soil nitrogen in upland soils. *Soil Sci,* **133** : 53-57.

SHARMA, S.P. & SUBEHIA, S.K. 2002. Effects of twenty-five years of fertilizer use on maize and wheat yields and quality of an acidic soil in the western himalayas. *Expl. Agric.,* **39** : 55-64.

SRIKANTH, K., SRINIVASMURTHY, C.A., SIDDARAMAPPA, R. & RAMAKRISHNA PARAMA, V. R. 2000. Direct and residual effect of enriched compost, FYM, vermicompost and fertilizers on properties of an Alfisol. *J. Indian Soc. Soil Sci.* **41** : 366-367.

SUREKHA, J. & ARJUNA RAO, P. 2001. Management of aphids on bhendi with organic sources of NPK and certain insecticides. *The Andhra Agric. J.* **1** : 56-60.

SURESH, G., 1988, Plant natural products in relation to insect resistance an analysis. In: *Dynamics of Insect Plant Interactions*. Oxford and IBH Publishing Co., New Delhi, pp:100.

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