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# Management of ash weevil *Myllocerus subfasciatus* Guerin-Meneville (Coleoptera; Curculionidae) in Brinjal

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**Abstract**
Ash weevil *Myllocerus subfasciatus* Guerin-Meneville causes damage to the brinjal throughout the year. The subterranean grubs cause damage to the roots which results in wilting, drying and death of the infested plants. The farmers depend on soil and foliar insecticide application to manage grubs and adult damage in brinjal. The subterranean nature of grubs and pupae make it difficult to manage and lead to increased plant protection cost. On farm trails were laid out during 2016 -17 to compare the farmer management practices (M1) with the other management modules *viz.,* 8 – 10% oiled neem cake application @ 250 kg/ha before planting and at 45 and 90 days after planting (DAP) (M2), entomopathogenic nematode (EPN) application @ 2.5kg/ha before planting and at 30 days interval till 150 DAP (M3) and mulching along with EPN application @ 2.5kg/ha before planting and at 30 days interval till 150 DAP (M4). The farmers practice recorded 80% ash weevil damage at 150 DAP whereas in the neem cake (M2) and EPN application (M3) it was ranged between 35 to 42.50% and 15.00 to 22.50% respectively. The combination of mulching and EPN (M4) recorded zero incidence of *M. subfasciatus* up to 30 DAP and 2.50 to 7.50% damage up to 150 DAP. The yield was 825q/ha, 950q/ha 1075q/ha and 1187q/ha respectively for the farmers practice (M1), neem cake application (M2), EPN application (M3) and mulching with neem cake application (M4) modules. The cost of plant protection was Rs. 95,000/ha in the farmers practice (M1) and Rs. 30,000/ha in the mulching with EPN application (M4). The benefit cost ratio was more in the mulching with EPN application (6.78) and lower in the farmers practice (3.66). The mulching along with Entompathogenic nematode application is the ideal combination to combat the *M. subfasciatus* incidence in brinjal.

**Keywords:** Ash weevil, entomopathogenic nematode, neem cake and mulching

## 1. Introduction
Brinjal is one of the three important vegetable crop cultivated in the southeast Asian region [1]. In India, Brinjal has been cultivated in an area of 6.69 lakh hectares and production of 12400 MT with an average productivity of 18.5t/ha during 2016-17 [6]. In Dharmpuri district brinjal is cultivated in 2600 ha both in precision farming and conventional method of cultivation. The crop is cultivated throughout the year as it provides regular income to the farmers. The farmers use to spend 50% of their cost of cultivation towards the management of brinjal shoot and fruit borer *Leucinodes orbonalis* and ash weevil *Myllocerus subfasciatus* Guerin-Meneville. Farmers of Dharmapuri district reveals that after shoot and fruit borer, the ash weevil *M. subfasciatus* is the major threat for brinjal cultivation. The regular field surveys and interaction with the farmers revealed that the ash weevil damage leads to 50-60% yield loss and many time complete loss of crop also observed. The ash weevil adults cause leaf damage which can be recognized by the characteristic leaf notch symptom. The grubs are subterranean and cause root damage which results in wilting, drying and death of the infested plants. They cause damage throughout the year. Nagesh *et al.,* 2016 revealed that *M. subfasciatus* is also considered as quarantine pest because the subterranean grubs and pupa can be easily spread through the movement of planting material [9].
The occurrence of *M. subfasciatus* during the fruiting stages leads to drastic yield reduction. Gowda and Veeresh, 1986 found that one adult and 10 larvae per plant was enough to cause a total loss in 45 day old crop and 50% loss in 90 day old crop [4]. The economic threshold for grey weevil was 2.0 to 3.5 grubs/plant at 30 days after planting and 4.0 to 6.0 grubs/plant at 50 days after planting [13]. Though the farmers tend to use a combination of granular and liquid formulations for the management of *M. subfasciatus* the subterranean nature of the grubs

makes it difficult to manage. Most of the farmers tend to apply insecticide once in a week to ward off the weevil damage. The soil application dosage was many folds higher than the recommended dose. The continuous reliance on insecticides led to the unwarranted issues such as increased production cost, reduction in the natural enemies' population, environmental pollution, resistance in the target pest and residue in the produce.

Entomopathogenic nematodes (EPNs) belonging to the genera *Heterorhabitis* Poinar and *Steinernema* Travassos (Nematoda;Rhabitida) are potential biological control agents against insect pests [9]. They along with bacterial symbionts (*Photorhabdus* and *Xenorhabdus* spp.) are highly effective against soil inhabiting insect pests. The larval and pupal period of *M. subfasciatus* ranges between 21-30 days and 7-10 days in soil. The application EPNs in the soil during planting and the intermittent application will manage the subterranean life cycle of *M. subfasciatus*. The EPN species *Steinernema carpocapsae* and *Heterorhabditis indica* were able to reproduce in third instar and prepupal stages of *M. subfasciatus* [5]. Prabhuraj *et al*., 2000 found that entompothogenic nematodes *Sterinernema* and *Heterorhbditis* were effective against ash weevil *M. discolour* than chlorpyriphos [11]. The use of EPNs against *M. subfasciatus* was not practiced by the farmers in this district. The potential of EPNs in managing *M. subfasciatus* under precision farming conditions has to be studied because the irrigation method differs from that of conventional cultivation. Farmer's widely practice the use of plastic mulch for weed management in vegetables. The impact of plastic mulch along with EPN on the incidence of subterranean insects has to be studied. On farm trials were laid out in farmers' field to find out the efficacy of EPN against *M. subfasciatus* under precision farming conditions.

**2. Material and Methods**

The onfarm trials were conducted in five farmers' field in Dharmapuri district during rabi season of 2016 - 17. The hybrid brinjal seedlings were raised in seedling trays under shadenet. The seedlings were transplanted at the age of 25 to 30 days in the farmers' fields. The standard agronomic practices were mostly kept uniform except the plant protection aspects for *M. subfasciatus*. The one acre field has been equally divided to impose different treatment modules. In each farmer field the modules were replicated three times. The following treatment modules were imposed to study their efficacy against *M. subfasciatus*.

| Modules | | Particulars |
|---|---|---|
| M1 | : | Farmers Practice:<br>Soil application of Phorate or carbofuran granules @ 10 Kg/ac during 30th day or whenever the incidence of Ash weevil adults noticed.<br>Spraying of Fipronil 5SC along with Pyrethroids or Organophosphates once in week or twice a week based upon the visual symptoms (noticing the adult weevil movement or leaf damage)<br>Drenching with Chlorpyriphos @ 5ml/lt along with fungicides or granular insecticide application after noticing the withering symptoms |
| M2 | : | Application of 8 – 10% oiled neem cake @ 250kg/ha before planting and repeated after 45 days after planting (DAP) & 90 DAP and need based insecticide application based on ETL |
| M3 | : | Entomopathogenic nematode application (Commercial formulation containing Heterorhabditis indica) @ 2.5kg/ha before planting and repeated after every 30 days |
| M4 | : | Plastic Mulching using 40 Micron plastic film and application of Entomopathogenic nematode application (Commercial formulation containing Heterorhabditis indica) @ 2.5kg/ha in the beds before laying the plastic mulch in the field and repeated after every 30 days at the root zone |

The farmers are allowed to use their own combination of insecticides for the management in the farmers practice module. The common insecticide combinations used by the farmers have been given in the module 1. In modules M2, M3 and M4 the farmers were not allowed to apply any insecticide apart from the recommended practice in the module. Twenty plants were randomly selected to record the incidence of ash weevil damage. The characteristic leaf damage symptoms and plants showing withering symptoms were counted to study the *M. subfasciatus* damage. The damage symptoms were recorded at weekly intervals and repeated up to 150 days in all the farmers' field. The completely withered plants were uprooted and observed for presence of grubs to confirm the withering was due to *M. subfasciatus* incidence. The yield data in the different treatments were recorded during each harvest and pooled to calculate the per hectare yield. The percent incidence of *M. subfasciatus* in different treatments were statistically analysed after performing necessary transformation. The statistical package SPSS 16.0 was used for the analysis. The economic analyses of the different modules were calculated to find out the benefit cost ratio of different modules.

**3. Results and Discussion**

The results of the present investigation were presented in Fig.1 to Fig.4. The incidence of *M. subfasciatus* was ranged between 28 – 40% during 30 days after planting (DAP) in the farmers' fields. As the crop period advanced the incidence of *M. subfasciatus* was more in the insecticide applied fields. This was evident from the 80% damage caused by *M. subfasciatus* at 150 DAP (Fig.1). The combination of insecticides, non-coincidence of insecticide application with the pest occurrence and survival of grubs in the soil are the major reasons for the higher incidences of *M. subfasciatus* in the farmers practice. The 8 – 10% oiled neem cake application before planting and repeated after 45 DAP& 90 DAP (M2) recorded 15 to 25% damage in 30 DAP, 17.50 to 27.50% damage in 60 DAP, 25.00 to 37.50% damage in 90 DAP, 30.00 to 42.50% damage in 120 DAP and 35 to 42.50% damage during 150 DAP in all the locations (Fig.2). Rahman *et al*., 2009 recorded highest reduction of brinjal shoot and fruit borer for the treatment combination of 4% neem oil and 250kg/ha neem cake application at 15 days interval [12]. In the present investigation also the 8-10% oiled neem cake application @ 250 kg/ha recorded reduced incidence of *M. subfasciatus* compared to farmers practice.

The percentage damage was ranged between 0 to 7.50%, 2.50 to 7.50%, 7.5 to 10.00%, 10.00 to 17.50 % and 15 to 22.50% respectively during 30 DAP, 60 DAP, 90 DAP, 120 DAP and 150 DAP in the entomopathogenic nematode application (M3) (Fig.3). Nagesh *et al*., 2016 compared six different EPN strains and found that more than 80% mortality of *M.*

*subfasciatus* larvae at 40 IJS/cm$^2$ [9]. They also found that the EPNs performed better in terms of larval mortality in loamy sand, alluvial, mountain soil, red laterite than black cotton soil. In the present investigation also EPNs provided 90% control of *M. subfasciatus* in brinjal. The soil type variation recorded by Nagesh *et al*., 2016 was not studied in the present investigation [9]. Moreover Campbell & Gaugler, 1993 revealed that the inherent virulence of entomopathogenic nematodes primarily attributed to the foraging behaviour of each nematode species [2]. The higher efficiency of EPN in the present investigation might be due to the precision farming condition where optimum soil moisture is maintained through the drip irrigation. This might have helped the EPNs for the mobility and easy access to the host. McGrew *et al*., 2010 found that the entomompathogen application time should coincide with the peak larval emergence period in their study on the management of annual bluegrass weevil *Listronotus maculicolis* (Coleoptera; Curculionidae) [8]. In the present onfarm trails EPN was applied at 30 days interval to maintain optimum infective juvenile population in the field and also to coincide with the active grub stages of *M. subfasciatus.*

Mulching and entomopathogenic nematode application (M4) recorded nil incidence of ash weevil damage up to 30 DAP. *M. subfasciatus* damage was ranged between 2.50 to 7.50% during 60 DAP, 90 DAP, 120 DAP and 150 DAP in the Module 4 (Fig.4). Hummel *et al*., 2002 revealed that plastic mulch deters female striped cucumber beetle *Acalymma vittata* F. (Coleoptera; Chrysomelidae) from egg deposition sites, decrease larval growth and speeds plant growth [7]. The mulching increases the soil temperature which might have influenced the hatchability of eggs [3]. They found that the striped pumpkin beetle develops more quickly in warmer soils under plastic mulch up to 32°C threshold but no emergence when the temperature reaches 35°C. In the present investigation mulching along with entomopathogenic nematode recorded lower the incidence throughout the crop compare to other modules. The non-availability of free soil space for egg laying, increased temperature under mulching and action of entomopathogenic nematode synergistically reduced the incidence of *M. subfasciatus*. The characteristic leaf notching symptoms also very less in the mulched field compare to other modules.

The benefit cost analyses of the different components were given in Table 1. The results revealed that the plant protection cost was more in farmers practice (M1) followed by 8-10% oiled neem cake application (M2), EPN application (M 3) and Mulching along with EPN application (M4) for the *M. subfasciatus* management. The yield was 825q/ha, 950q/ha 1075q/ha and 1187 q/ha respectively for the modules M1, M2, M3 and M4. The plant protection cost was Rs. 95,000/ha, Rs. 62,500/ha, Rs.35,000/ha and Rs. 30.000/ha respectively for the modules M1, M2, M3 and M4. The benefit cost ratio was more in the mulching along with EPN application (M4) (6.78) and lower in the farmers practice (3.66). Orozio-santos *et al*., 1995 recorded lower incidence of fruitfly and whitefly in *Cucumis melo* L. in the plastic mulched field. They also found that positive correlation between yield and mulching [10]. The mulching along with the EPN application recorded increased yield and higher benefit cost ratio. The injudicious use of insecticides for the *M. subfasciatus* management led to reduced benefit and more expense in the farmer practice. The untimely application also causes many unwarranted problems in brinjal cultivation in this region. The mulching along with the EPN application reduces the dependence on insecticides for the *M subfasciatus* management. The farmers can use this method to effectively manage *M. subfasciatus* and for higher returns in brinjal.

**Table 1:** Benefit cost analysis of different treatments

| Modules | Average yield (t/ha)* | Plant protection cost (in Rs/ha) | Gross return (in Rs/ha) | Net return (in Rs/ha) | BC ratio |
|---|---|---|---|---|---|
| M1 | 825 | 95000 | 825000 | 605000 | 3.75 |
| M2 | 950 | 62500 | 950000 | 762500 | 5.06 |
| M3 | 1075 | 37500 | 1075000 | 912500 | 6.61 |
| M4 | 1187 | 30000 | 1187500 | 1012500 | 6.78 |

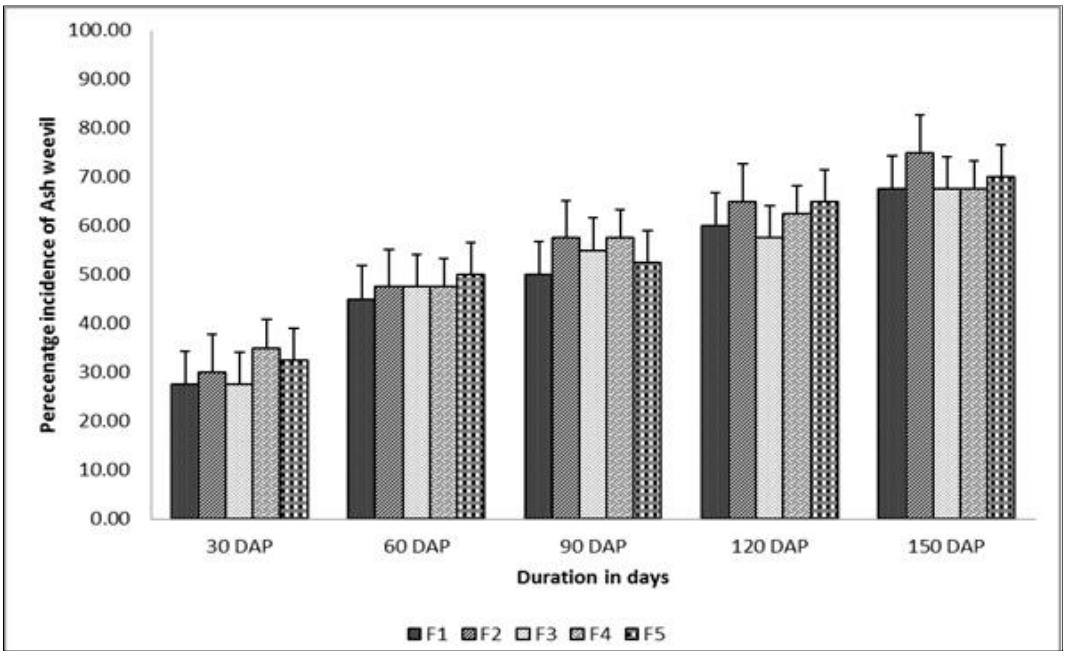


**Fig 1:** Incidence of Ashweevil *Myllocerus subfasciatus* during different stages in farmer management practices

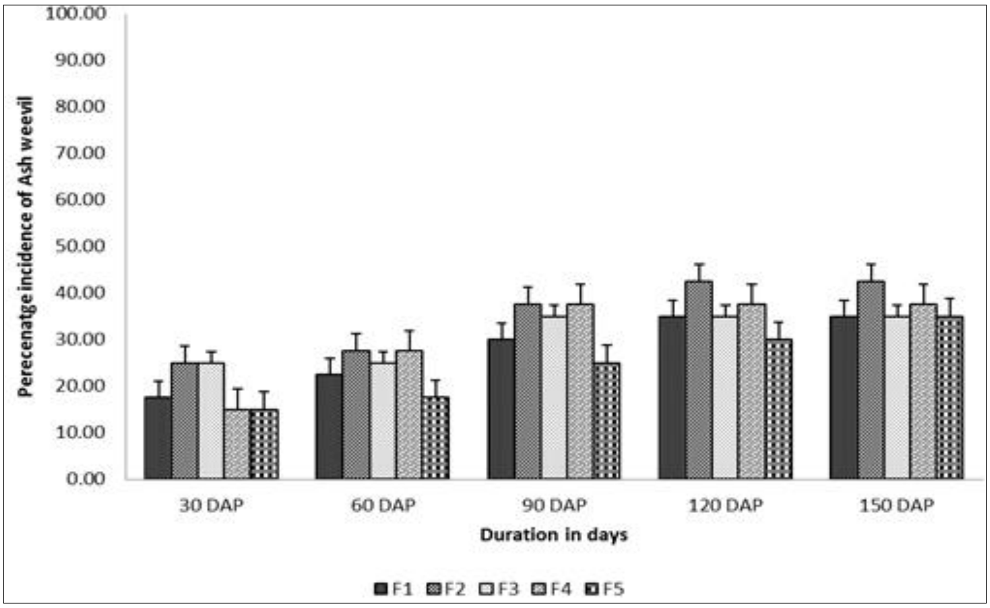


**Fig 2:** Incidence of Ashweevil *Myllocerus subfasciatus* during different stages in Neem cake (8-10%) application

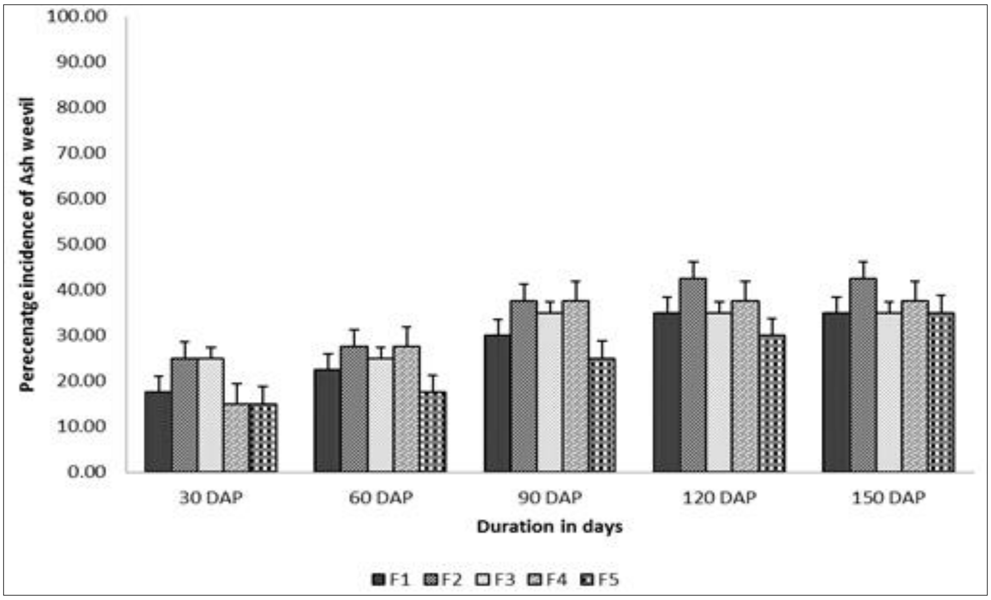


**Fig 3:** Incidence of Ashweevil *Myllocerus subfasciatus* during different stages in Entmopathogenic nematode application

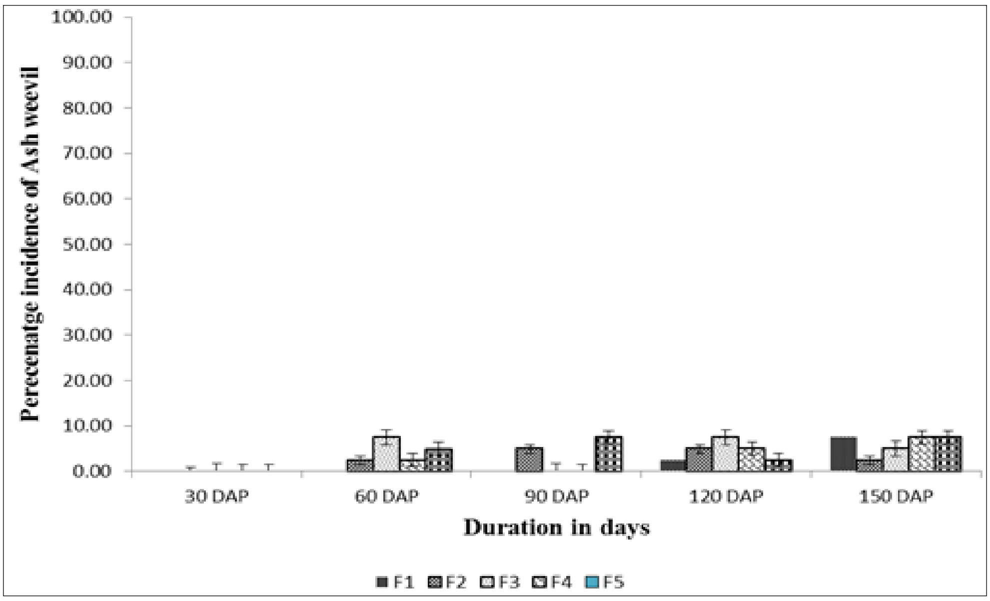


**Fig 4:** Incidence of Ashweevil *Myllocerus subfasciatus* during different stages in mulching along with entomopathogenic nematode application

## 4. Conclusions

The different management modules *viz.*, farmers practice (M1), 8 – 10% oiled neem cake application @ 250 kg/ha before planting and at 45 and 90 DAP (M2), entomopathogenic nematode application @ 2.5kg/ha before planting and at 30 days interval till 150 DAP (M3) and mulching along with entomopathogenic nematode application @ 2.5kg/ha before planting and at 30 days interval till 150 DAP (M4) to manage *M. subfasciatus* in brinjal recorded lower incidence of *M. subfasciatus* damage and lower plant protection cost in Module 4. The mulching along EPN application at definite intervals (M4) recorded nil incidence of *M. subfasciatus* damage up to 30 DAP and 2.50 to 7.50% damage up to 150 DAP with plant protection cost of Rs. 30,000 /ha. Hence the farmers can use EPN along with mulching for the effective management of ash weevil *M. subfasciatus* in brinjal.

## 5. References


1. Alam SN, Hossain MI, Rouf FMA, Jhala RC, Patel MG, Nath LK, *et al*. Control of eggplant fruit and shoot borer in South Asia. Technical Bulletin 36, AVRDC-The World Vegetable Center, Shanhua, Taiwan, 2006.
2. Campbell JF, Gaugler R. Nictation behaviour and ecological implications in host search strategies of entomopathogenic nematodes. Behaviour. 1993; 126:155.
3. Ellers-Kirk C, Fleischer SJ. Development and life table of *Acalymma vittatum* (Coleoptera: Chrysomelidae), a vector of Erwinia tracheiphila in cucurbits. Environ. Entomol. 2006; 35(4):875-880.
4. Gowda KS, Veeresh GK. Assessment of crop loss in brinjal (*Solanum melongena* L.) due to ash weevil *M. subfasciatus* Gurien. (Curculionidae; Coleoptera). Journal of Soil Biology and Ecology. 1984; 4(1):41-52.
5. Gowda M, Jagadeesh P, Devindrappa M, Vijayakumar R, Abraham Verghese. Entomopathogenic nematodes: A potential biocontrol agent against eggplant ash weevil *Myllocerus subfasciatus* Guerin (Coleoptera: Curculionidae). Nematology. 2016; 18:743-750.
6. Horticultural Statistics At A Glance. Published by Ministry of Agriculture and Farmers Welfare, Department of Agriculture, Cooperation & Farmers Welfare, Horticultural Statistical Division. 2017, 481.
7. Hummel RL, Walgenbach JF, Barbercheck ME, Kennedy GG, Hoyt GD, Arrellano C. Effects of production practices on soil-borne entomopathogens in western North Carolina vegetable systems. Environ. Entomol. 2002; 31(1):84-91.
8. McGraw BA, Vittum PJ, Cowles RS, Koppenhoer AM. Field evaluation of entomopathogenic nematodes for the biological control of the annual bluegrass weevil *Listronotus maculicolis* (Coleoptera; Curculionidae) in golf course turfgrass. Biocontrol Science and Technology. 2010; 20(2):149-163.
9. Nagesh N, Krishnakumar NK, Shylesha AN, Srinivas N, Saleem Javeed. Thippisamy. *Comparative virulence* of strains of entomopathogenic nematodes for the management of eggplant grey weevil *Myllocerus subfasciatus* Guerin (Coleopetra; Curculionidae). Indian Journal of Experimental Biology. 2016; 54:834-842.
10. Orozio-santos M, Perez-Zamora O, Lopez-Arriga D. Effect of transparent mulch on insect populations, virus diseases, soil temperature and yield of cantaloupe in a tropical region. Newzealand Journal of Crop & Horticultural Science. 1995; 23:199-204.
11. Praburaj A, Virakmath CA, Kumar ARV. Field evaluation of entomopathogenic nematodes against brinjal root weevil *M. discolour* Boh. Pest Management in Horticultural Ecosystem. 2000; 6(2):149-151.
12. Rahman MM, Islam KS, Jahan M, Uddin MA. Efficacy of some botanicals in controlling brinjal shoot and fruit borer *Leucinodes orbonalis*. Progress. Agric. 2009; 20(1 & 2):35-42.
13. Tewari GC, Krishnamoorthy PN. Economic threshold levels for the grey weevil (*M. subfasciatus* Guerin.) grubs in brinjal. Annals of Arid Zone. 1987; 26(4):215-220.