Madras Agric. J., 104 (4-6): 184-187, June 2017

Impact of Mulching of Green Leaves for the Management of Nematodes Associated with Banana

M.S. Nisha* and A.M. Nimisha
Department of Nematology, Kerala Agricultural University, College of Agriculture,
Vellayani - 695 522. Thiruvananthapuram, Kerala, India

Field trial was conducted to study the effect of mulching of green leaves on lesion and root-knot nematodes and its consequent effect on biometric characters and yield of banana. The treatments consisted of leaves of *Gliricidia maculata*, *Chromolaena odorata* and banana as mulch; paring+ hot water treatment at 55^0 C for 10 minutes + application of neem cake @ 500g/plant (check) and untreated control. The results revealed that, extent of galling (12.88 galls per 5g root), nematode population in root (12.18 per 5g root) and soil (114.7 per 200cc soil) were found to be the lowest in *G. maculata* green leaf mulching @5kg/pit compared to other treatments. The treatments significantly increased plant growth and yield over the untreated control. The highest yield (22.4 t/ha) and maximum population of saprophytic nematode, *Eudorylaimus* sp. (280/200cc soil) were recorded in *G. maculata* green leaf mulching @ 5 kg/pit, which could be an eco-friendly management approach for root-knot and lesion nematodes in banana.

Key words: Green leaf mulching, Glyricidia maculata, Nematode, Banana

India is the leading producer of banana with an annual production of 14.2 million tones constituting about 33 per cent of total fruit production (NHB, 2017). Several plant parasitic nematodes are known to infect banana and affect the production, of which burrowing nematode, *Radopholus similis* (Cobb, 1893) Thorne, 1949 alone caused an yield loss of 31 to 41 per cent (Tiwari *et al*., 2000). Besides direct damage, they also serve as predisposing agents in the development of disease complexes with fungi and bacteria. Preventing the nematode problem is far better than trying to manage them after it is established. The main aim in managing the nematodes is to keep the population below the injury level or the population density as low as possible, since they cannot be eliminated completely from soil. In this context, ecological manipulation is the best alternative to minimize the population of nematodes in soil. Sundararaju *et al*. (1999) reported the effectiveness of siam weed, *Chromolaena odorata* as a primary nematicide against larvae and adults of *R. similis*. Nisha and Sheela (2002) reported that green leaf mulching with neem, *Chromolaena* and *Gliricidia* leaves @ 5kg m^{-2} reduced root-knot nematode population and increased the yield of *Kaempferia galanga*. Nazli *et al*. (2008) reported that *G. sepium* leaf extract caused 60 per cent mortality of second stage juveniles of *M. incognita*.

Green leaves of number of plants are well documented for nematode suppression properties. *Gliricidia* and *Chromolaena* are two plants showing nematicidal property, which is available plenty in Kerala. However, knowledge on impact of these green leaves on soil fauna is meager. Hence, an attempt was made to study the effect of mulching with *G. maculata*, *C. odorata* and banana leaves on lesion and root knot nematode population in banana rhizosphere.

*Corresponding author's email: drnishams@gmail.com

Material and Methods

Preparation of experimental field and planting

Field trials were conducted in nematode infested sick plots with an initial population of 320 *Pratylenchus coffeae* and 260 *Meloidogyne incognita* per 200 cc soil at Instructional farm, College of Agriculture, Vellayani. Experiments were laid out in randomized block design with six treatments and four replications. Three plants were planted per replication. The treatments were T_1-mulching with green leaves of *C. odorata* @ 5kg/pit, T_2- mulching with dry leaves of *G.maculata* @ 5kg/pit, T_3 - mulching with green leaves of *G. maculata* @ 5kg/pit, T_4- mulching with dry leaves of *Musa* sp., T_5 – paring+hot water treatment at 55^{0}C for 10 minutes + neem cake @ 500 g/plant and T_6-untreated control. The green leaves were chopped and incorporated to soil 15 days prior to planting of suckers @5kg/pit. The banana cv. Nendran suckers were pared to a depth of 1 cm and treated with hot water at 55^0 C for 10 minutes and planted in pits incorporated with neem cake @500g/pit for check treatment. The suckers were planted in treated plots at a spacing of 2 x 2m. The plants were maintained as per package of practices recommended by Kerala Agricultural University (KAU, 2011). The observations on biometric characters, yield (in terms of no.of fingers, bunch weight), root-knot and lesion nematode population in soil (200cc) and root (5g), number of galls per 5g of root, number of lesions per 5g root and rhizhome were recorded at harvest. The population

of saprophytic nematodes (*Eudorylaimus* sp.) also estimated.

Estimation of nematode population

The nematode population in soil was estimated at two months, four months (vegetative phase), six months after planting (flowering phase) and at the time of harvest. Each sample consisting of 10 cores was randomly collected at a depth of 15-20 cm in rhizosphere of plants from each plot. These cores were pooled together into a composite sample (200cc/ plot). Nematodes were extracted by Cobb's Sieving and decanting technique and cleared by modified Baermann funnel technique (Southey, 1986). Roots collected from twelve plants of each treatment were pooled and 5g was collected from that composite. Nematode population in root was estimated by the technique adopted by Carlier *et al*. (2003). The data generated were subjected to analysis of variance (ANOVA). The variables which do not satisfy the basic assumption of ANOVA were subjected to appropriate transformations before analysis.

Results and Discussion

There was statistically significant variation in the population of root knot and lesion nematodes and saprophytic nematodes (*Eudorylaimus* sp.) in the rhizosphere of banana at 2, 4 and 6 months after planting (Fig. 1). The population of *M.incognita* and *P.coffeae* in various treatments ranged from 70 to 150 per 200cc soil while the population of *Eudorylaimus* sp. (saprophytes) ranged from 72 to 280 per 200cc soil. Highest population of saprophytes was recorded in plants mulched with green leaves of *G.maculata* at four month after planting of banana. The increased multiplication of saprophytic nematodes exert antagonism by means of competition for space resulting in reduction in population of plant parasitic nematodes. Stirling (1991) reported antagonistic competition effect of free living bacterial feeding nematodes against plant parasitic nematodes. Sheela *et al.* (2008) reported the stimulatory effect of *C.odorata* leaf application as green manure in the multiplication of beneficial microbial flora and predatory and saprophytic nematodes in the root zone of okra and cowpea. Here in this study also incorporation of *G.maculata* green leaves as mulch resulted in increased multiplication of saprophytic nematodes.

The lowest population of *M.incognita* and *P.coffeae* was observed in mulching with green leaves of *G.maculata* followed by check treatment, paring+ hot water treatment at 55^0 C+ neem cake @ 500g /plant at vegetative and flowering stages of the plant giving 85 to 91 per cent reduction in nematode population over the untreated control. At harvest, the lowest number of root knot and lesion nematodes (114.7 per 200cc soil) was recorded in mulching with green leaves of *G.maculata* followed by check treatment (139 per 200 cc soil) and mulching with dry leaves of banana (141.13 per 200 cc soil) and the effect of these three treatments was statistically on par (Table. 1).

Table 1. Effect of mulching on nematode population in banana

Treatments	Root-knot and lesion nematode population at harvest		No. of galls (5g)	No. of lesions in root (5g)	No. lesions in rhizome (10g)
	Soil (200cc)	Root (5g)			
T_1- Mulching with green leaves of *C.odorata*	160.78 (12.68)v	20.07 (4.48)	31.69 (5.63)	21.99 (4.69)	20.79 (4.56)
T_2 - Mulching with dry leaves of *G.maculata*	167.70 (12.95)	32.37 (5.69)	43.69 (6.61)	25.70 (5.07)	25.70 (5.07)
T_3- Mulching with green leaves of *G.maculata*	114.70 (10.71)	12.18 (3.49)	12.88 (3.59)	9.61 (3.1)	10.36 (3.22)
T_4- Mulching with dry leaves of *Musa sp*	141.13 (11.88)	13.67 (3.71)	21.80 (4.67)	13.39 (3.66)	13.32 (3.65)
T_5-Paring+ hot water treatment at 55^0 C + neem cake @ 500g/ plant (Check)	139.00 (11.79)	13.54 (3.68)	18.74 (4.33)	13.16 (3.62)	11.56 (3.40)
T_6 - Untreated	683.82 (26.15)	78.41 (8.86)	81.18 (9.01)	74.47 (8.63)	69.05 (8.31)
CD (P=0.05)	1.768	0.674	0.693	0.685	0.634

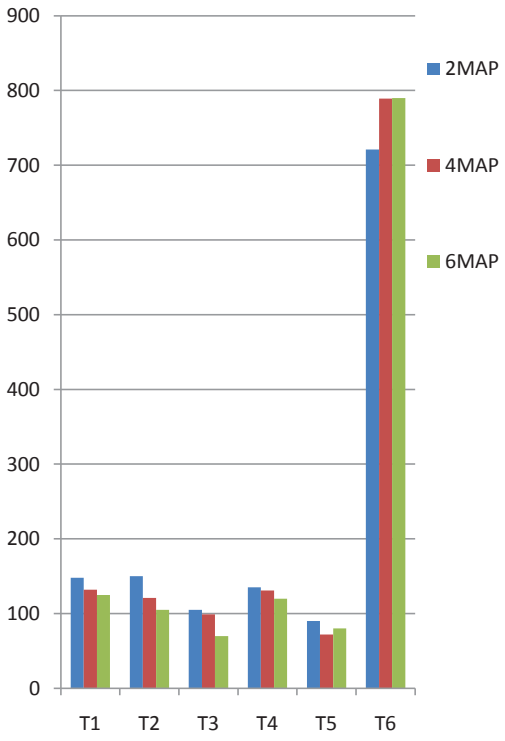
The percentage reduction in nematode population in these treatments ranged from 79 to 83 per cent. Similar trend was observed in the case of nematode population in roots, number of lesions in root and rhizome also. The lowest number of galls (12.88/5g root) was recorded in mulching with green leaves of *G.maculata* and it showed statistically significant variation from other treatments. The reduction in nematode population due to mulching with green leaves of *G.maculata* directly reflected in the biometric characters and yield of banana. This finding is in agreement with Jasy and Koshy (1992) who reported that application of chopped leaves of *G. maculata* as green manure reduced the population of *R. similis* and promoted growth of black pepper under pot culture condition.

The biometric characters *viz*. number of leaves, top and bottom girth was significantly higher in plants mulched with leaves than the untreated control (Table.2). Maximum number of leaves was recorded by the plants mulched with green leaves of glyricidia (9.52) followed by check treatment and effect of these two treatments was statistically on par. Regarding the pseudostem girth, plants mulched with green leaves of *G.maculata* and dry leaves of *Musa* sp. found statistically on par with check treatment, paring+hot water treatment at 55^0C for 10 minutes + neem cake @ 500 g/plant. Highest bunch weight (8.96 kg) was

recorded by plants mulched with *G.maculata* green leaves and it was significantly different from all other treatments. Maximum number of fingers was recorded in mulching with green leaves of *G.maculata* (45.33) followed by mulching with dry leaves of *Musa* sp.(45) and the effect of these two treatments was statistically on par. The use of organic mulches for managing nematodes has been widely studied and there are various examples of plant debris having beneficial effects on plant growth. Pakeerathan *et al.* (2009) reported that extent of galling (35.87), gall index (0.327), yield (17.87 mt/ha), reproductive

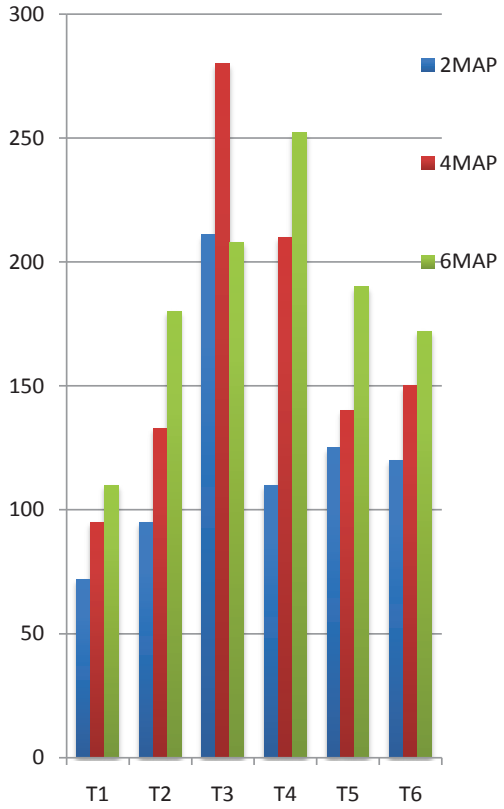
Table 2. Effect of mulching on biometric characters and yield of banana

Treatments	Height (m)	No. of leaves	Bottom girth (cm)	Top girth (cm)	No. of hands	No. of fruits	Weight of bunch (kg)
T_1- Mulching with green leaves of *C.odorata*	2.63	8.50	18.83	12.66	4.6	43.16	8.00
T_2 - Mulching with dry leaves of *G.maculata*	2.81	8.83	18.16	12.33	4.8	41.16	8.25
T_3 - Mulching with green leaves of *G.maculata*	3.01	9.52	19.83	13.83	5.0	45.33	8.96
T_4- Mulching with dry leaves of *Musa sp*	2.64	9.17	19.66	13.50	4.8	45.00	8.90
T_5 - Paring+ hot water treatment at 55^0 C + neem cake @ 500g /plant	2.54	9.33	19.33	13.66	4.8	44.00	8.88
T_6 - Untreated	2.47	4.66	17.33	10.83	4.6	26.66	5.33
CD (P=0.05)	NS	0.208	0.550	0.864	NS	0.750	0.022



T_1-Mulching with green leaves of *C.odorata*
T_2-Mulching with dry leaves *G.maculata*
T_3-Mulching with green leaves of *G.maculata*
T_4-Mulching with dry leaves of *Musa* sp.
T_5-Paring+hotwater treatment at 55 ^{0}C for 10 minutes + neemcake @ 500 g/ plant
T_6-Untreated control

Fig.1.Effect of mulching on the population of *M. ingonita* and *P. coffeae*



T_1-Mulching with green leaves of *C.odorata*
T_2-Mulching with dry leaves of *G.maculata*
T_3-Mulching with green leaves of *G.maculata*
T_4-Mulching with dry leaves of *Musa* sp.
T_5- Paring+hot water treatment at 55^0C for 10 minutes + neem cake@500 g/plant
T_6-Untreated control

Fig.2. Effect of mulching on the population of *Eudorylaimus* sp.

factor (0.411) and plant growth parameters viz. height and dry matter (22.47 cm and 45.08 g) were significantly best in tomato plants treated with green leaf manures of *G. maculata.* Addition of organic matter has shown to increase soil microbial activity (Widmer and Abawi, 2000). The increased number of *Eudorylaimus* sp. observed in *G.maculata* mulched plots might be due to the addition of organic matter into soil after decomposition of *G. maculata* leaves. Result of this study indicated that application of *G. maculata* as green leaf mulch reduced the number of root-knot and lesion nematodes nematodes and increased the multiplication of beneficial saprophytic nematodes (*Eudorylaimus* sp.) which improved the plant growth and yield. The availability of foliage is plenty in Kerala so that green leaf mulching with *G. maculata* can be included in the integrated nematode management strategy in banana .

Conclusion

Thus, it is concluded that green leaf mulching with *G. maculata* @5kg/pit could be recommended as an effective eco-friendly method for nematode management in banana. In organic cultivation of banana, incorporation of *G. maculata* as green leaf mulch will improve the physical and chemical properties of soil apart from antihelminthic properties. During decomposition endothermic reaction occurs and organic acids are released which also aid the nematode management in addition to increased crop production.

References

Carlier, J., De Waele and J.V. Escalante. 2003. Global evaluation of *Musa* germplasm for resistance to Fusarium wilt, *Mycosphaerella* leaf spot diseases and nematodes.In: INIBAP Technical guide lines 7-performance evaluation, A.Vegine and C.Pig (Eds). INIBAP, Montpellier, France pp.108-115.

Jasy, T. and P.K. Koshy. 1992. Effect of certain leaf extracts and leaves of *Glyricidia maculata* as green manure on *Radopholus similis. Indian J. Nematol.* **22(2)**: 117-121.

Nazli, R., Ahfter,M., Ambreen,S., Solangi,A.H. and N. Sultana. 2008. Insecticidal, nematicidal and antibacterial activities of *Glyricidia sepium. Pakist. J. Botany* **40(6)**:2625-2629

NHB (National Horticulture Board).2017. Horticultural Statistics at a Glance 2015 (on line). *http://nhb.gov.in/area-pro/hort_galance_2016.pdf (14 June 2017)*

Nisha, M. S. and M.S. Sheela. 2002. Effect of green leaf mulching for the management of root-knot nematode in kacholam. *Indian J. Nematol*.**32 (2)**: 183-233.

Pakeerathan, K., Mikunthan, G. and N. Tharshani. 2009. Eco-friendly management of root-knot nematode *Meloidogyne incognita* using different green leaf manures on tomato under field conditions. *Am.-Eurasian J. Agric. and Environ. Sci.* **6(5)**: 494-497.

Sheela, M.S., Ajith, K. and M.S. Nisha. 2008. Impact of green leaf application on the management of plant parasitic nematodes and its effect on the population of predatory and saprophytic nematodes and micro flora in soil. In: *Proc. 3 Int. Congress Nematol.* 13-18 July, 2008, Brisbane, Australia, pp. 37-38.

Southey,J.F.1986. Laboratory methods for work with plant and soil nematodes. Ministry of Agriculture, Fisheries and Food, Her Majesty's Stationary office, London. p.202

Stirling,G.R.1991. Biological control of plant parasitic nematodes, Chichester, England, p.282.

Sundararaju, P., Banu, G. and K. Ratnakaran. 1999. Effect of various plant extracts on mortality of *Radopholus similis*. *Indian J. Nematol.***29**: 78-111.

Tiwari, S.P., Vadhera,I. and G.S. Deve. 2000. Burrowing nematode, *Radopholus similis* associated with banana crop in Madhya Pradesh. *Indian. J. Nematol*.**30(1)**:38-41

Widmer, T.L. and G.S. Abawi. 2000. Mechanism of suppression of *Meloidogyne hapla* and its damage by a green manure of sudan grass. *Plant Dis*. **84**: 562-568.

Received after revision : April 24, 2017; Accepted : May 25, 2017