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Research Article

Improved Environment by Identification of More Susceptible Plant Between Cowpea and Mulberry for Root-Knot Disease

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Abstract

The root-knot disease of mulberry (*Morus alba L.*, Cv.'S1') caused by Meloidogyne incognita Kofoid & white, Chitwood is very wide spread affecting more than 80% plantation in different parts in India. This disease reduces plant growth, leaf-yield and leaf-protein content significantly. The use of chemical pesticides may achieve a measure of control of those mulberry diseases but there remain the problems. To move forward, it will require new and more efficient solutions, technologies and products. Our best endeavor is to focus on the Cowpea plants which may have important economic implications for sericulture in future. Cowpea (*Vigna ungyculata L.*) cv.5269 and mulberry were alternately grown together along a ring in a large circular vessel; *M. incognita* larvae (J2) were applied as an inoculum at the center of the ring so that all the plants were equidistant from the larvae. A control vessel containing the same plants without inoculation was maintained simultaneously. Plants were harvested 70 days after inoculation. Of the two plant species; Cowpea received maximum infection in terms of root- gall number, root protein content, and nematode population in root and plant growth parameters. Thus, Cowpea could serve as highly effective cover crop protecting mulberry from invading larvae. This way Cowpea could serve as highly effective Climate Friendly Catch Crop protecting other crops from invading larvae and increase soil fertility. The farmers would be benefited double; by controlling root-knot nematodes in the naturally infected sericulture field and by buying and selling the cowpea fruits regularly from the intercropped sericulture field by enriching soil nitrogen and improve environments also. Intercropped cowpea also improves the plant growth by effectively which directly increase photosynthesis rate and significantly reduce CO_2 in the environment and it would not only be easier way, easily available, cheap but also conserve our biodiversity which will contribute towards "Global Green, Growth and Green Economy i.e. Sustainable Climate, Health and Development by controlling root-knot diseases which is sometime devastating to all kinds of natural and artificial vegetation".

Keywords: Mulberry; Meloidogyne incognita; Cowpea; Inoculums; Cover crops

Introduction

The use of chemical pesticides may achieve a measure of control of those mulberry diseases but there remains the problem of residual toxicity in the treated plants and this toxicity results in reduced palatability of the leaves to the feeding. silkworm larvae, reduction in growth of the larvae and in silk production as with the nematicide furadan @ 13kg/ha [1,2]. A number of plant bio-nematicides though effective and easily biodegradable [3,4] are not easily available in large quantities from natural sources and isolation of only a small quantity of an effective metabolites requires huge quantities of plant materials. This would result in rapid depletion of natural resources, particularly in tropical regions. Indiscriminate use of plant resources has already created problem of biodiversity conservation in these areas [5]. Bio-nematicides from animal origin (nematode extract) reduce Meloidogyne incognita infestation in different plants and root callous by using their defense response against *M. incognita* infection. But it has some problems about collection of large quantity of *M. incognita* females, preparation of nematode extract (NE) and some limitation in field application. To overcome these situations, primarily we have already observed that cowpea could serve as highly effective cover crops protecting other susceptible crops from invading larvae [6,7]. The objective of the current study is to observe the relative attractiveness of two plant species; mulberry and cowpea for *M. incognita*, which would help in identifying the more susceptible plants for possible use as cover crops.

Materials and Methods

Preparation of soil

Two circular concrete vessels of 68cm diameter and 22.5cm depth were filled with a mixture of sandy soil and yard manure (2:1 vol./vol.). Vessels were placed on polythene sheet before filling the soil. The vessels were then treated with boiling water five times for denematization.

Plantation

The vessel was planted with mulberry (*Morus alba* L) Cv. 'S1,' cutting (10inch length and 12g weight) collected from Sericultural Composite Unit, Sriniketan, Birbhum, West Bengal, India. Seeds of Cowpea (*Vigna ungyculata L.*) cv.5269 were germinated aseptically and planted to the vessel alternately with mulberry in a circle of 36 cm diameter around the center of the vessel. There were 20-plants; 10 from each species of plants. Though Cowpea was a fast-growing plant, it was planted 15-days later than the mulberry plant because mulberry cutting took some days for developing its root system which maintained the plant growth as uniform as possible and at the time of cowpea plantation all the plants of mulberry were pruned. A duplicate vessel containing the same plants were maintained as the control. All the plants were irrigated every morning and evening with tap-water.

Inoculation

The plants were inoculated at the day- 30 from mulberry cutting plantation when they were 6-leaf stage. At the center of the vessel a hole (1.5 cm wide and 4cm deep) was produced. Inoculation in the form of 3,40,000 J2 in 10- ml tap- water was applied in the hole which was immediately covered with soil.

Harvesting

Seventy days after inoculation all the plants were uprooted from each vessel and the following parameters of growth and nematode infection were recorded: shoot length and weight , root length and weight, root-gall number, nematode population per 2g root and 200g soil, root and leaf-protein content and the leaves per plant. Three samples of root and leaf from each species of plants were taken at random and the total protein fraction in each sample was estimated [7-9]. Data were analyzed by ANOVA. The experiment was repeated five times with similar results and all the data from the third experiment reported here (Table1).

Table 1: Comparison between cowpea and mulberry for root-knot disease in circular plots.

Circular Plots* (Plant Species)	Shoot*+		Root*+	Protein Content (%)		Nos. of Leave / Plant*+	Root Gall Number / Plant*+	Root nodules Number / Plant*+	Nematode population*+	
Inoculated / Control	Weight(g)	Length(cm)	Weight (g)	root	leaf				Root (2g)	Soil (200g)
Inoculated Cowpea	157.00a± 2.30	132.70a± 1.53	21.80a± 1.99	6.02a± 0.01	5.07a± 0.01	80.07a± 0.38	NIL	558.08a± 12.00	NIL	NIL
Mulberry	181.15± 1.43	135.03± 1.70	168.02a± 1.34	7.09a± 0.04	7.58a± 0.01	68.89a± 0.24	NIL	NIL	NIL	NIL
Control Cowpea	186.00b± 2.30	156.70b± 1.24	29.80b± 1.99	9.99b± 0.03	7.01b± 0.01	89.79b± 0.11	5331.80a ±23.00	958.08b± 12.00	1778.00a± 18.00	54.00a± 2.85
Mulberry	182.01a± 1.11	136.08a± 1.21	170.01a± 1.41	8.06a± 0.02	8.55a± 0.08	78.51a± 0.47	38.00b± 0.10	NIL	91.00b± 11.65	54.00a± 2.85

Results

All the data are expressed in the form of a ratio; Control / Test and presented in Table 1. Cowpea showed maximum in growth with high intensity of nematode infection. Cowpea was more susceptible than mulberry in terms of root-gall number, root population of nematode, root- and leaf- protein content and the number of leaves per plant. Further, mulberry plants showed comparable growth, root-and leaf- protein content and the number of leaves per plant between the control and inoculated vessels. It has also the lowest root–gall number and root population of nematodes (Table 1).

Discussion

The result of the vessel experiment confirmed our earlier observation [6,7,10-14] that nematode infected plant showed reduced growth, leaf protein content and leaf yield and the root protein content at mulberry plants did not increase as in other vegetable crops [6,10-14,17]. It is evident from the observation that cowpea was more susceptible to *M. incognita* than mulberry. This does not mean that mulberry is resistant to root-knot nematodes. In contrary, mulberry is a very good host of this nematodes. However, root-knot nematodes preferred to feed on cowpea rather than mulberry when it had a choice. It can be assumed that the relative size and biomass of the two root systems are responsible for the difference in susceptibility between the two plant species. Here the Cowpea root system colonizes and occupies the large area, it is likely that the plant parasitic nematodes will preferably be found in its roots [6,10-13]. And the positive effects of growth of both mulberry and cowpea plans may be responsible for defense resistance against other plants pathogens and induced growth in all parameters [6,10-13,18].

It may also be assumed that the critical role of biological nitrogen fixation and the amounts of N transferred to associated non-leguminous crop- mulberry determines the extent of benefits. It is also reported that in intercropping, land equivalent ratio (LER), benefit cost ratio (BCR) and monetary advantage index (MAI) are used to assess the productivity and its economic benefits [19]. Choosing of the right crop combination is very important in intercropping systems due to the fact that plant competition could be minimized not only by spatial arrangement, but also by combining those crops best able to exploit soil nutrients [20]. Plant density has also been reported to influence N_2- fixation, but total N_2-fixation activity on an area basis appeared less variable [21].

We have already observed that cowpea was more susceptible to *M. incognita* [6]. The present vessel experiment further showed that cowpea was more susceptible to *M. incognita* than mulberry plant. This does not mean that mulberry is resistant to *M. incognita*. Rather mulberry is very good hosts of this nematode [1, 2,3,7,10,18]. However, *M. incognita* preferred to feed on cowpea than mulberry when it had a choice. Thus cowpea could serve as good cover crops there by reducing *M. incognita* infection of other vegetables and they can also be cultivated as intercrop with many highly economical plants where chemical control possess health hazard to many economically important larvae , herbivores, soil micro and macro fauna, and man due to residual toxicity in leaves and soil. In the latter case cowpea could be harvested at frequent intervals to keep the nematode population to a minimum level. Thus, cowpea could serve as highly effective cover crop protecting other susceptible crops from invading larvae and the farmers would be benefited by shelling the cowpea fruits regularly. In this way we not only protect our environment from pollution but also conserve biodiversity [23].

Conclusion

Thus, Cowpea plants could serve as a good catch crop there by reducing *M. incognita* infection of mulberry. It can also be cultivated as intercrop with many highly economical plants as substitute for chemical control as this possess health hazard due to residual toxicity in leaves and soil to many economically important larvae, herbivores, soil micro- and macro- fauna, and man. This system is useful in terms of increasing productivity and profitability, water and radiation use efficiency, control of weeds, pests and diseases. It is noted that the inoculated ones are as good as control in all parameters for the critical role of biological nitrogen fixation and the amounts of N transferred to associated non-leguminous crop- mulberry determines the extent of benefits in intercropping, land equivalent ratio (LER), benefit cost ratio (BCR) and monetary advantage index (MAI) which are used to assess the productivity and its economic benefits. The principal reasons for smallholder farmers to intercrop are flexibility, profit maximization, risk minimization, soil conservation and improvement of soil fertility, weed, pests and diseases control and balanced nutrition. This way Cowpea plant could serve as highly effective Climate Friendly Catch Crop protecting other crops from invading larvae. The farmers would be benefited double; by controlling root-knot nematodes in the naturally infected sericulture as well as agricultural field, and by buying and selling the edible fruits regularly from the intercropped field. We easily enrich our economy, protect our climate from pollution, conserving solar energy by photo synthesis of plants, reducing CO_2 by increasing O_2 which resist global warming, and also conserve our biodiversity. These cost-effective eco-friendly cowpea plants are easily available, high environmental tolerant, biodegradable, non-phytotoxic and non-pollutant. It can be used as Cover plant. It conserves our biodiversity contributing towards "Sustainable Climate Health and Development i.e. Global Green, Growth and Green Economy" and it is the most appropriate, economic and sustainable solution in the recent time. And finally, Cowpea plant may not only have important economic implications in sericulture but also in agriculture to fulfill its Food and Nutrition requirement".

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