Pak. J. Bot., 40(1): 391-396, 2008.

EFFECT OF *GLOMUS CALLOSUM, MELOIDOGYNE INCOGNITA* AND SOIL MOISTURE ON GROWTH AND YIELD OF SUNFLOWER

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Abstract

The effect of inoculating a VAM fungus (*Glomus callosum*) and root-knot nematode (*Meloidogyne incognita*) separately and combined before and 7 days after the inoculation of the each other were carried out in the rhizosphere regions of 10-days old sunflower seedlings growing in pots in which the water regime of the soil was maintained at 60% throughout till harvesting. The result showed that infestation by root-knot nematode was less when the VAM-fungus was inoculated 7 days before and infestation by the root-knot nematode was more when the VAM-fungus was inoculated 7 days after in combined inoculation experiments. A better growth and yield of sunflower was noticed when VAM-inocula was put in the rhizospheric regions 7 days before in the combined inoculation experiments. It was found that inoculation of VAM-fungus 7-days before can limit the infestation by root-knot nematode where the water regime in soil exceeds the requirement.

Introduction

Sunflower (*Helianthus annuus* L.) is now a good source of edible oil to meet up a part of the edible oil deficiency in Pakistan. Pakistan meets upto 65% of its edible oil demand by importing palm oil from Malaysia and soybean oil from America. Soil microorganisms either promote or hinder the growth and yield of crop plants. Vesicular-arbuscular mycorrhizal (VAM) fungi are symbiotically associated with cultivated crops including sunflower. VAM-fungi assist the plants in increasing nutrient uptake and resist root rot microorganisms from attacking plants (Gerdemann, 1968; Mosse, 1973; Nicolson, 1967; Sikora, 1981). VAM-fungi and plant parasitic nematodes occur together in rhizospheric soil and in roots of plants each having a characteristic but opposite effect on plants. The obligatory symbiotic VAM-fungi support plant growth whereas plant parasitic nematode, *Meloidogyne incognita*, cause root-knot disease.

There are studies on the interaction between VAM-fungi and root knot nematode in which diseases caused by nematodes are reported to get either limited or suppressed (Roncadori & Hussey, 1977; Strobel *et al*., 1982). There is as yet no report on the association of VAM-fungi and root-knot nematode disease in sunflower. However, we came across incidence of the disease in over irrigated farmland soil during survey work on mycorrhization of sunflower roots in Sindh (Pakistan) in 2006-07. The occurrence of the disease was found to be restricted in wet soil of the sunflower farm fields. It was therefore considered worthwhile to study the effect of interaction between *Glomus callosum*, one of the predominant VAM-fungus found associated with sunflower roots and *Meloidogyne incognita* causing root-knot disease of sunflower in wet soil.

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Materials and Methods

Earthen pots of 60 cm diam., containing 6 kg of steam sterilized sandy-clay loam soil were kept in green screen house under the influence of prevailing day and night temperature (20-30°C) and humidity (40-50%). Thirty soil pots, each pot sown with 3 seeds of sunflower var. Hysun-33 were watered regularly to maintain a water regime of 60% as determined by the method of Keen & Raczkowski (1921). After 10 days only one seedling was allowed to grow further for inoculation with or without VAM-fungus (*Glomus callosum*). In treatment No. 1, spores of *G. callosum* @ 1000 spores per 500g of soil and in treatment No. 2, eggs / larvae of *Meloidogyne incognita* @ 1000 eggs / larvae per 500g soil derived from soil-based stock culture were inoculated in the rhizospheric regions of sunflower seedlings. In the third treatment, *G. callosum* inocula were put in the rhizospheric regions 7 days before the inoculation of *M. incognita* around seedlings. In the fourth treatment, *M. incognita* inocula were placed 7 days before putting the inocula of *G. callosum* in the rhizospheric regions of the seedlings. In the fifth treatment, a series of 6 pots with seedlings were left uninoculated (control). For the determination of population of *G. callosum* in the rhizospheric regions of 50 days old sunflower plants, the method of Gerdemann & Nicolson (1963) was followed. For *M. incognita*, Cobbs method of sieving and decanting followed up by Baerman funnel technique (Southey, 1986) were used. For the presence of *G. callosum* and *M. incognita* inside roots of sunflower plants, the method of Phillips & Hayman (1970) was used. For determining the average number of seeds in sunflower heads, seeds produced in heads were counted. For the weight of sunflower seeds, 10 seeds picked up at random from each of the 5 different treatments were weighed separately to find out the average weight of seeds.

Results and Discussion

VAM-fungus extracted from the rhizospheric regions of sunflower growing in pots contained globose, thick walled spores, 270 µm in diam. Subtending hyphae infundibuliform; soil particles often adhering to ageing spores and hyphal connections (Fig. 1A & 1B). The characteristic features of the spores extracted from the pots were similar to the description given by Sieverding (1988) and as such identified as *Glomus callosum*. The species of *Meloidogyne* were identified on the basis of characteristic perineal pattern of the mature females (Eisenback *et al*., 1981).

The data scored on the interactions between *G. callosum* (VAM-fungus) and *M. incognita* (Table 1) showed that the VAM-fungus inoculated 7 days prior to the inoculation of the root-knot nematode in the rhizospheric region of sunflower seedlings had lesser nematode eggs and larval count and root-knot formation at harvest. Sunflower seedlings inoculated with VAM-fungus 7 days after the inoculation of root-knot nematode had more nematode eggs and larvae. The highest number of VAM-spores was recovered when the seedlings were inoculated with VAM-fungus only (Figs. 2&3) and the highest number of knots/larvae of root-knot nematode was recovered when the seedlings were inoculated with root-knot nematode only (Figs. 4-6). The height of stem, number of leaves, number of seeds and average weight of seeds of sunflower were found to be more when the VAM-fungus was inoculated 7 days before the inoculation of root-knot nematode in the rhizospheric regions of sunflower at harvesting time (Table 1). The effect of interactions between VAM-fungi and plant parasitic nematodes on cotton (Roncadori & Hussey, 1977), peach (Strobel *et al*., 1982) and grape (Atilano *et al*., 1976) showed a positive role of VAM-fungi in limiting and/or suppressing the effect of parasitic nematodes. Schenck *et al*., (1973), Schenck & Kellam (1978) are of the opinion

Table 1. Effect of interaction of *Glomus callosum* and *Meloidogyne incognita* with varying treatments on the growth and yield of sunflower in soil pots with 60% moisture in soil.

reatments	No. of VAM-spore / g of soil	No. of larvae of RKN / g of soil	Stem length (cm)	No. of leaves per plant	No. of seeds per head	Average weight of 10 seeds (g)	RKN formation (%)	Water regime of soil in pots (%)	VAM infection in roots (%)
ontrol	-	-	90	16	385	0.69	-	60	-
lomus callosum VAM-fungus)	17	-	92	18	410	0.89	-	60	90
leloidogyne incognita RK nematode)	-	24	83	13	341	0.52	60	60	-
AM + RKN-7 days fter inoculation	13	8	88	16	370	0.72	10	60	70
KN + VAM after 7 ays of inoculation	9	12	85	14	358	0.66	40	60	60
SD	2.26	6.63	14.13	3.59	71.72	0.02	20.91	0.0	15.75

ibility level at $p < 0.05$ is significant.

that each VAM-fungus and plant parasitic nematode combination is unique and generalization shouldn't be applied to other system without additional studies. Generally however mycorrhizal association brings benefit to the crop plants and is utilized in agriculture to raise productivity (Bagyaraj, 1986). Since the root knots of sunflower were observed in farm field soil with 60% water regime as determined by the method of Keen & Raczkowski (1921) and nowhere else, it was concluded that wet soil was the contributory factor for the formation of root-knots.

Acknowledgement

The authors are grateful to the Higher Education Commission Pakistan for facilitating this research through a research project funding on the use of Mycorrhizal Biotechnology to the senior author Dr. M. Jalaluddin.

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(Received for publication 10 October 2007)