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Research Article

INTERACTION BETWEEN VESICULAR ARBUSCULAR MYCORRHIZA AND *HETERODERA AVENAE* ON WHEAT AT VARIED INOCULUM SEQUENCES

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ABSTRACT
Influence of VAM on *Heterodera avenae* was studied, under pot trials at different time of inoculation. The potentiality of *Glomus fasciculatum* at varied inoculums sequence was monitored on *Triticum aestivum*, L. var.wh-147 infected by. *H. avenae*. *G. fasciculatum* was added to wheat 5, 10 and 15 days prior to nematode inoculation and vice-versa. Pre inoculation by endomycorrhizae enhanced wheat growth and grain yield by hampering nematode reproduction. However, when VAM was inoculated after nematode infection the results were reversed. Overall assessment revealed that wheat growth was boost up by pre inoculation of *G.fasciculatum.*

Key Words*: Wheat, Heterodera Avenae, Vesicular Arbuscular Mycorrhiza, Glomus Fasciculatum, Inoculum Sequence.*

INTRODUCTION

During the past two decades, discoveries by scientists on VAM have generated an explosion of interest in the field of research. Vesicular arbuscular mycorrhizal associations with plants are worldwide and geographically ubiquitous. Mycorrhizae are common form of symbiosis between plants and fungi (Harley and smith, 1983). The interaction between VAM and plant parasitic nematodes has been studies by many workers (Bagyaraj et al., 1979 Hussey and Ren cadori, 1982). Pre inoculation of cowpea with VAM reduced *Meloidogyne incognita and Heterodera cajani* population (Jain and Hasan, 1988, 1994, Jain and sethi 1987, 1988). Response of wheat to various VAM inoculation was also studies (Al - Nahid and Gomah, 1991). Prior mycorrhization of plants, modified the deleterious influences of nematode on plant growth to a significant extent (Suresh and Bagyaraj, 1984; Sharma et 1994).

Cyst nematode, *Heterodera avenae* dominates in the wheat growing fields of Rajasthan state, India causing 'Molya' disease of wheat. In the native language 'Molya' means deformed and hampers wheat production which is the major cereal of Rajasthan state. Preceding survey done earlier unveiled, association of VAM with rhizosphere of wheat. Frequency distribution comprehended the predominance of *G.fasciculatum*, inhabiting in most of the wheat cultivated fields, with greatest 92.34 percent occurrence. Percent loss in the surveyed areas ranged from 15 to 45 percent. Therefore an experiment was undertaken to study the interaction of VAM and *H.avenae* on wheat, as shaped by the time of inoculation.

MATERIALS AND METHODS

Fifteen local fields were surveyed and soil samples were collected. Samples were than proceed to determine the endomycorrhizal infection, cyst of *H.avenae* and other soil attributes.

VAM was isolated and pure cultures were maintaned on onion, *Cenchrus ciliaris* and wheat. VAM colonization was a more conspicuous on onion. The identification was made by using standard key by N.C.Schenck and Yvohne Pe'rez, (1988). Spores were isolated from the soil by wet sieving and decanting technique (Gerdemann & Nicolson, 1963) and cysts were collected from the soil and roots of wheat by simple sieving and floatation process. Mycorrhizal inoculums comprised of chlamydospores, azygospores, infective fungal hyphae and fungal roots, which were then placed just below the seeds during sowing. They were surface sterilized by 0.1% $Hgcl_2$ and then sown in 15cm earthen pots containing steamed soil. One week old seedlings then were inoculated with 1000 freshly hatched

juveniles of *H.avenae*, by pouring larval suspension. The pots were arranged in randomized complete block design. *G.fasciculatum* was used in nine treatments including un-inoculated control and nematode alone treated plants, which are sequenced as:

1. Un-inoculated control (c).
2. Nematode alone (N).
3. Nematode and VAM inoculation simultaneously (N+V).
4. Nematode and VAM inoculation after 5days ($N+V_{-5d}$).
5. Nematode and VAM inoculation after 10 days ($N+V_{-10d}$).
6. Nematode and VAM inoculation after 10 days ($N+V_{-15d}$).
7. VAM and Nematode inoculation after 5 days ($V+N_{-5d}$).
8. VAM and Nematode inoculation after 10 days ($V+N_{-10d}$).
9. VAM and nematode inoculation after 15 days ($V+N_{-15d}$).

All the above treatments were replicated five times. After 90 days, at the time of termination of experiment, the plants were uprooted and various growth parameters were noted in terms of shoot-root length, fresh and dry weight of plants, ear length and its fresh and dry weight, total cyst per plant, total spores per gram of soil, percent VAM colonization. All the data were statistically analyzed. The significance of difference between length and weight of host, number of cyst and other quantitative data were calculated from original figures by analysis of variance. Critical difference at 5% and 1% level of significance were calculated for significant comparison. Root infection was assessed by using staining technique (Sankaranarayanan and Sundarababu, 1984 and Phillips and Hyman, 1970) and slide method (Giovanneti and Mosse, 1980).

RESULTS AND DISCUSSION

The results revealed that pre inoculation with VAM extensively augmented the biomass and growth of wheat in contrast to nematode alone inoculated plants and mollify the adverse effects of *H.avenae*. Greatest root and shoot length was observed in control, followed by $V+N_{-15d}$ treatments. Pre-establishment of VAM in the root boosts up the plant growth and inhibit the nematode development. Nematode solely treated plants had maximum cyst population (73.65 cm), with stunted growth, smaller yellower leaves and beggared yield. When, *H.avenae* J_2 juveniles were inoculated 15 days later after VAM inoculation, the endomycorrhizae was able to institute and dominate in the feeding sites. Thus, it prevented the multiplication of nematode and offset the damage with average 24.34 cysts / plant. When nematode were inoculated 15 days prior, the results were counterclockwise. When VAM was inoculated simultaneously along with nematode, the total cysts were 52.32. It is supported by inferences achieved on tomato in which pre inoculation with mycorrhiza retards the development of plant parasitic nematode *Rotylenchulus reniformis* to a greater extent than with simultaneous inoculation with both organisms (Sikora and Schonbeck, 1975; Sitaramiah & Sikora, 1982). These beneficial effects of VAM become apparent, even though symbiont and parasite engross the host root at the same time. Similar findings have been reported by Strobel *etal* (1982) on peach, Suresh and Bagyaraj, (1984) on tomato and Siddigni and Akhtar (2006) on chickpea. In N+V treated plants, the spike length and its fresh (2.98g) and dry (0.64g) weight were greater than the nematode alone treated plants (Table : 1). Nematode un-inoculated plants were taken as control.

The VAM colonization varied from 52% in $V+N_{-5d}$ treatments to 77.63% in $N+V_{-15d}$ treated plants. Thus overall assessment showed that *G.fasciculatum* significantly increased the dry matter content of the root and shoot biomass and phosphorus uptake as compared to nematode solely treated plants. Maximum improvement in the root and shoot biomass, yield, nitrogen and phosphorus contents, was obtained in the given $V+N_{-15d}$ treatments, though $V+N_{-10d}$ and $V+N_{-5d}$ resulted in the improvement of the above parameters over plants raised from $N+V_{-15}$d, $N+V_{-10d}$ and $V+N_{-5d}$ treatments. Application of *G.fasciculatum* 15days prior affected the root penetration of *Heterodera cajani* in cowpea (Jain and Sethi, 1988). Same results were achieved by Sankaranarayanan and Rajeshwari Sundarababu (1984) in

Table 1: Effect of inoculum sequences of *Glomus fasciculatum* on *Heterodera avenae* infecting wheat.

S.No.	Treatments	Fresh weight (g)		Dry weight (g)		Ear length (cm)	Ear weight (g)		Total cysts /plant	Total eggs/cyst	% VAM Coloniz-ation
		Shoot	Root	Shoot	Root		Fresh	Dry			
1	2	3	4	5	6	7	8	9	10	11	12
1	N+V	16.63	4.02	1.56	0.53	14.30	3.14	0.64	52.32 (7.28)	120.65 (11.02)	65.83 (8.16)
2	$N_{(5D\ prior)}$ +GF	14.86	3.08	1.50	0.43	13.58	2.27	0.57	62.64 (7.94)	141.63 (11.92)	52.00 (7.20)
3	$N_{(10D\ prior)}$ +GF	14.26	2.39	1.32	0.37	13.16	1.84	0.48	57.00 (7.59)	172.00 (13.08)	56.06 (7.36)
4	$N_{(15D\ prior)}$ +GF	13.64	2.02	1.22	0.32	10.23	1.53	0.37	66.00 (8.15)	149.33 (12.25)	68.78 (8.34)
5	$GF_{(5D\ prior)}$ +N	16.41	3.93	1.66	0.56	14.75	3.36	0.64	47.00 (6.21)	173.00 (13.09)	70.00 (8.41)
6	$GF_{(10D\ prior)}$ +N	17.80	4.83	1.95	0.60	15.27	3.94	0.71	37.68 (6.21)	149.69 (12.16)	70.67 (8.45)
7	$GF_{(15D\ prior)}$ + N	18.41	5.03	2.12	0.64	15.93	4.19	0.78	24.34 (4.97)	171.31 (13.12)	77.63 (8.86)
8	Control	18.92	5.56	2.30	2.69	16.15	4.45	0.86	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
9	Nematode	12.72	1.67	1.07	0.27	8.21	2.98	0.14	73.66 (8.64)	187.67 (13.65)	0.00 (1.00)
	SEM ±	*0.31*	*0.17*	*0.02*	*0.03*	*0.21*	*0.89*	*0.42*	*0.48*	*1.02*	*0.68*
	CD at 5%	*0.90*	*0.50*	*0.09*	*0.09*	*0.61*	*2.57*	*0.12*	*1.40*	*2.96*	*1.95*
	CD at 1%	*0.65*	*0.36*	*0.68*	*0.67*	*0.45*	*1.87*	*0.08*	*1.02*	*2.16*	*1.42*

Values are means of four replications. Figures in parenthesis are $\sqrt{n+1}$ *transformed values. N=Nematode, GF=Glomus fasciculatum, D=Days*

in black gram, when *G.fasciculatum* was inoculated 15 and 20 days earlier than *Meloidogyne incognita*. Thus in natural habitat, endomycorrhizae may have significant circuitous impacts on plant and nematode population dynamics and ecosystem level. Overall collectively, VAM should be exploited for the bio-control of *H. avenae* as it is eco-friendly and gives very accomplishing results.

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