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GENOTYPE DEPENDENT VARIATION IN VAM INFECTION AND GROWTH RESPONSE OF TWELVE CULTIVARS OF SESAME (*SESAMUM INDICUM* L.)

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Genotype dependent variation in VAM infection and growth response of twelve cultivars of sesame was investigated. Percentage of infection and spore density varied with type of soil and also with the cultivar. Sandy loam soil supported the maximum percentage of infection and spore density. Among the different cultivars, Krishna had shown maximum infection and spore population. *Glomus* species were found to be associated with all the cultivars and in all four types of soils. Sesame cultivars responded differently towards artificial inoculations of VAM. Some cultivars preferred exotic inoculated VAM fungi while others preferred the indigenous VAM fungi. Mycorrhizal dependency (MD) of the twelve cultivars of sesame varied considerably. Maximum dependency was shown by Rajeshwari, whereas Co-I had exhibited least dependency on VAM fungi.

Key Words : Genotype, dependent, VAM, response, sesame.

Plant growth response to mycorrhizal symbiosis depends on three major components; the plant, the mycorrhizal fungus and the soil environment. An improvement in VAM efficiency can be achieved by manipulating any of these three components. An essential requirement for good host plant response to mycorrhiza is a rapid colonization of roots during the early growth stages of the host plant. However, genotype dependent variation in nutrient uptake, for example, phosphorus uptake has been well documented (Clark, 1983 and Clark *et al.*, 1978). Information on genotype dependent difference in P uptake vis-a-vis VAM status of the plant is not available. Since mycorrhizae are considered to play a role in P uptake, it is possible that genotype differences in mycorrhizal symbiosis, and thus, growth response might also exist. In the present investigations, an attempt was made to examine the genotype dependent variation in VAM colonization in relation to phosphorus uptake and growth in 12 cultivars of sesame.

MATERIALS AND METHODS

Twelve cultivars of sesame (*Sesamum indicum* L.) (Table 1) *viz.*, were used. All these varieties were grown in four different types of soils (Sandy loam, Red loam, Black cotton and Clay loam) taken in plastic pots (size 16x 16cm) in equal quantity. Seeds were sown in each pot and after germination the seedlings were thinned down to 5 for each pot. The pots were regularly watered and occasionally with urea solution. Triplicate sets were maintained for each soil type and host variety. At the time of flowering, the plants were carefully taken out by washing the soil with slow running tap water. For the estimation of spore density, the rhizosphere soil was collected before washing the roots. The percentage of infection and number of resting propagules in the rhizosphere for each variety and soil were estimated as per the standard procedures (Pacioni, 1992). The spore types occurring in each soil were identified (Schenck and Perez, 1987).

Response of different cultivars towards inoculation of VAM fungi was also investigated. In these experiments, three sets of pots (in triplicate) for each variety were maintained. The first set contained sterile soil, second set non-sterile soil and the third set sterile soil inoculated with VAM inoculum. In the latter sets, the soil was thoroughly sterilized for two consecutive days. The inoculum containing infected roots and extra matrical and resting spores was placed in the form of a layer just below the soil so that when the seeds germinate the roots pass through the inoculum layer. The pots were regularly watered with intermittent application of 'P' deficient Hoagland solution. At the time of flowering the plants were taken out of the pots and various parameters like length of the root and shoot, dry matter, percent of mycorrhizal infection and P content was estimated. Mycorrhizal dependency of different genotypes was calculated as the dry matter yield obtained with inoculations minus the dry matter yield without inoculation,

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Table 1: Percentage of infection and spore density of VAM fungi in sesame cultivars cultivated in different soils

Genotype	Sandy loan soil		Red loam soil		Black cotton soil		Clay soil	
	Infection (%)	Spore density/ 100g	Infection (%)	Spore density/ 100g	Infection (%)	Spore density/ 100g	Infection (%)	Spore density/ 100g
Rajeshwari	86.00	168	80.40	185	62.8	185	57.90	178
Gowri	80.90	172	65.20	172	58.6	162	56.80	162
T-85	85.00	170	60-90	163	55.9	172	55.00	155
Krishna	82.10	166	62.80	193	52.7	165	56.90	145
Co-1	70.00	165	66.70	140	53.8	173	52.80	169
TMV-3	93.80	180	74.50	175	52.9	148	52.20	172
RT-46	75.20	192	68.90	182	51.6	159	51.60	152
Phuletel	68.80	183	65.80	179	59.9	169	50.80	151
Rama	69.30	188	59.50	162	56.3	170	51.80	159
Madhavi	71.50	152	60.90	155	50.8	172	56.90	165
Vinayak	64.90	169	61.20	152	49.9	180	61.60	148

divided by dry matter yield with inoculation (Plenchette *et al.*, 1983). The results are presented in tables 1-3.

RESULTS AND DISCUSSION

From the Table-1 it is evident that in all the genotypes of the sesame, both the percentage of infection, and spore density were maximum in sandy loam soil followed by red loam. Least values of these parameters were recorded in clay soil. Percentage of infection and spore density varied not only with the soil but also with cultivar. In sandy loam soil, TMV-3 cultivar has shown maximum infection followed by Rajeshwari. Least infection was exhibited by Vinayak. However, in red loam soil, Rajeshwari cultivar got maximum infection followed by TMV-3. In this soil minimum colonization was observed in RT-54. Similar to red loam, in black cotton soil maximum infection was shown by Rajeshwari. Interestingly, Vinayak cultivar was found to be colonized maximum in clay soil and minimum colonization was observed in Phuletel.

Similar to per cent of infection spore densities also varied. Among all the varieties, Krishna harboured maximum number of spores in red loam soil. In sandy loam soil spore population was found to be more in RT-46 followed by Rama. Madhavi has shown least number in this soil. In red loam soil maximum spore density was recorded in the rhizosphere of Krishna followed by Rajeshwari and RT-4. Least number was recorded in Co-1. In both black cotton soil and clay soil maximum spore density was recorded in the rhizosphere soil of Rajeshwari. TMV-3 rhizosphere revealed least number in black cotton soil and Krishna in clay soil. A critical perusal and comparison between the per cent of infection and spore densities in the rhizosphere revealed no relation either positive or negative between these two parameters. For instance, in red loam soil Rajeshwari cultivar with 80.4 per cent infection supported 185 spores/100 gms and RT-54 cultivar with very low infection (58.6%) supported almost the same number of spores. Similarly, T-85 cultivar with 85 per cent infection harboured 170 spores and the same cultivar has supported more number of spores with very less infection in black cotton soil.

Occurrence of different endophyte genera in four types of soils in association with 12 cultivars of sesame is presented in table-2. It is evident from the table that *Glomus* species were found to be associated with all the cultivars and in all four types of soils. Sandy loam soil supported more number of species followed by red loam and then black cotton soil. Least number of species were recorded in clay soil. With respect to dominance, *Glomus* species were followed by *Gigaspora* and *Sclerocystis*. A majority of the cultivars have harboured more than one genus of VAM fungi. However, it varied according to the soil. In clay and black cotton soil majority of the cultivars harboured only one genus and one species of the VAM endophytes. There appears to be no specificity between any cultivar and VAM endophytes. Similarly, there is no relationship between the type of soil and fungal symbiont. Association of *Glomus* with all the cultivars and soils suggests its ubiquitous and wide spread occurrence. A number of investigators all over the world, reported the very common occurrence of *Glomus* species in all soils in associa-

Table 2. Occurrence of different VAM fungal genera in different soils in association with twelve cultivars of sesame

Genotype	Sandy loam soil				Red loam soil				Black cotton soil				Clay soil			
	GL	GS	SC	AS	GL	GS	SC	AS	GL	GS	SC	AS	GL	GS	SC	AS
Rajeshwari	+	+	+	-	+	-	+	-	+	-	+	-	+	-	-	-
Gowri	+	-	+	-	+	+	-	-	+	+	-	-	+	-	-	-
T-85	+	+	+	-	+	-	-	+	+	-	-	-	+	-	-	-
Krishna	+	+	-	-	+	-	+	-	+	-	-	+	+	-	-	-
Co-1	+	-	+	-	+	-	-	+	+	-	-	-	+	-	-	-
TMV-3	+	-	-	+	+	-	-	-	+	-	-	-	+	-	-	-
RT-46	+	-	+	-	+	+	-	-	+	-	-	-	+	+	-	-
RT-54	+	+	-	-	+	+	-	-	+	-	-	-	+	-	-	+
Phuletel	+	-	+	-	+	-	+	-	+	+	-	-	+	-	+	-
Rama	+	+	-	-	+	-	-	+	+	-	+	-	+	-	-	-
Madhavi	+	-	-	+	+	+	+	-	+	-	-	+	+	-	-	-
Vinayak	+	+	-	-	+	-	-	-	+	-	-	-	+	-	-	-

Note : GL = *Glomus;* GS = *Gigaspora;* SC = *Sclerocystis;* AS = *Acaulospora.*

Table 3. Genotype dependent variation in VAM colonization, growth response and phosphorus uptake as influenced by mycorrhizal inoculation in twelve cultivars of sesame

Genotype	Vam colonization				Plant dry matter (g/plant)				Myco-rrhizal depen-dency	Phosphorus uptake (mg/plant)			
	Sterile inocula-ted	Non-sterile non-inocu-lated	Sterile Non-inocu-lated	Mean	Sterile Non-inocu-lated	Sterile inocula-ted	Non-sterile non-inocu-lated	Mean		Sterile Non-inocu-lated	Sterile inocula-ted	Non-Sterile non-inocu-lated	Mean
Rajeshwari	86	82	0	84.00	6.40	16.80	17.00	13.40	163	12	28	26	22
Gowri	81	72	0	76.50	13.0	17.60	16.40	15.70	133	11	26	29	22
T-85	85	80	0	82.50	14.20	15.40	16.60	15.40	108	16	32	17	22
Krishna	82	78	0	80.00	14.80	16.90	17.30	16.30	144	22	26	17	25
Co-1	70	65	0	67.50	15.60	14.80	15.20	15.20	95	8	20	15	15
TMV-3	74	68	0	71.00	16.90	18.90	16.20	17.30	112	7	16	14	13
RT-46	75	65	0	70.00	13.70	15.70	14.50	14.60	115	6	15	8	10
RT-54	73	64	0	68.50	12.60	14.30	15.90	14.20	113	9	18	11	13
Phuletel	68	58	0	63.00	10.20	13.80	14.80	12.90	135	12	19	14	15
Rama	69	64	0	66.50	11.90	15.20	16.80	14.60	128	11	18	13	14
Madhavi	72	66	0	69.00	16.50	19.30	18.20	18.00	128	10	16	12	13
Vinayak	64	55	0	59.50	15.10	18.50	18.90	17.50	123	13	18	14	15

tion with a variety of plants.

Twelve genotypes of sesame were grown under three different types of experimental conditions i.e. sterile inoculated soil, non sterile uninoculated soil and sterile non-inoculated soil, and the VAM colonization was recorded and the results are precised in table-3. It is evident from the table that more VAM colonization occurred in sterile inoculated soil than the non sterile uninoculated soil. It also shows that all the genotypes responded positively towards the inoculation of VAM fungi. Maximum colonization occurred in Rajeshwari cultivar followed by T-85 and minimum in Vinayak. Krishna *et al.* (1985) reported that pearl millet genotypes grown in the same field, colonization can vary from 25 to 56 per cent. Menge (1983)believes that rapid and high levels of colonization may be the prime determinant of the efficiency of the symbiosis. Huisman (1982) pointed out that percentage colonization is often, if not always confounded by differential root growth rates between genotypes or species. The number of infection sites on the root could be a factor (Smith and Walker, 1981). Graham and Eissenstat (1994) reported that among closely related citrus genotypes, there is a greater tendency for less dependent species to limit the rate but not the extent of colonization even in high P soils. Further, they hypothesized that colonization represents a significant carbon cost that may be regulated by the host genotype.

A critical perusal of the table-3 also reveals that dry matters obtained by different cultivars of sesame are more in either sterile inoculated soil or non-sterile soil. Cultivars like Growri, TMV-3, RT-46, Madhavi and Vinayak have obtained more dry weight in sterile inoculated soil, where as in Rajeshwari, T-85, Krishna, CO-1, RT-54, Phuletel and Rama the dry weight was more in non sterile soil. In all the cultivars the dry weight put-up was very less in sterile non inoculated soils. The variation in the response of cultivars while growing in sterile inoculated and non sterile soil may be due to the genotype specificity towards the fungal symbiont. It appears that some cultivars preferred the artificially inoculated fungal symbiont and others the native VAM fungi. Azcon and Ocampo (1980) found that cultivars of wheat have differed in the dry matter response to VAM inoculation.

Mycorrhizal dependency of the twelve cultivars of sesame varied considerably. Maximum mycorrhizal dependency was shown by Rajeshwari followed by Phuletel, Gowri, Rama and Madhavi. Least or no dependency was exhibited by C0-1. The remaining varieties were moderately dependent. Howeler *et al.* (1987) reported that at high levels of applied P in cassava was still extremely dependent, the legumes were intermediately dependent, and the grasses were not dependent, mainly because of their finer and more highly branched root system, which makes them more efficient in P uptake. However, they warned that this generalization does not always apply. Similar to present observations. Krishna *et al.* (1985) reported the variation in the mycorrhizal dependency of pearl millet genotypes. He found that cultivar WCC-75 was unique with no effect of the VAM on plant growth or P uptake.

Phosphorus uptake by different cultivars varied and also with the type of treatment. P uptake was more in sterile inoculated soil followed by non sterile soil. In sterile non-inoculated plants 'P' uptake was least. This is not difficult to understand, since in sterile soils all the beneficial organisms related to P uptake are eliminated by sterilization. Mean values of P uptake reveal that maximum uptake was observed in Krishna followed by Rajeshwari, Gowri and T-85. Least uptake was recorded in RT-46. Krishna *et al.* (1985) felt that VAM activity with regard to P uptake and translocation may be under the control of host genetic constitution and the physiological need for this element.

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