

VAM-FUNGI IN WHEAT AND RICE FIELDS

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Abstract

Vesicular-arbuscular mycorrhizae (VAM) extracted from the soil of different agroecological zones showed an average population of 1260 spores / 100 g in wheat and 1137 / 100 g in rice fields of Pakistan. The population of VAM-spores in rhizospheric and non-rhizospheric regions of both wheat and rice varied on cultivation of the crop plants. On crop cultivation, at seedling stage VAM population decreased in the rhizospheric regions which after harvest of the crop showed an increase of upto 1860/ 100 g soil in wheat and 1668 / 100 g soil in rice fields. At crop maturity, 16 VAM-species belonging to 5 genera were isolated from the rhizospheric soil of wheat and rice. Atleast 16 VAM-fungi belonging to 5 genera are being reported for the first time from the soil of wheat and rice fields of Pakistan.

Introduction

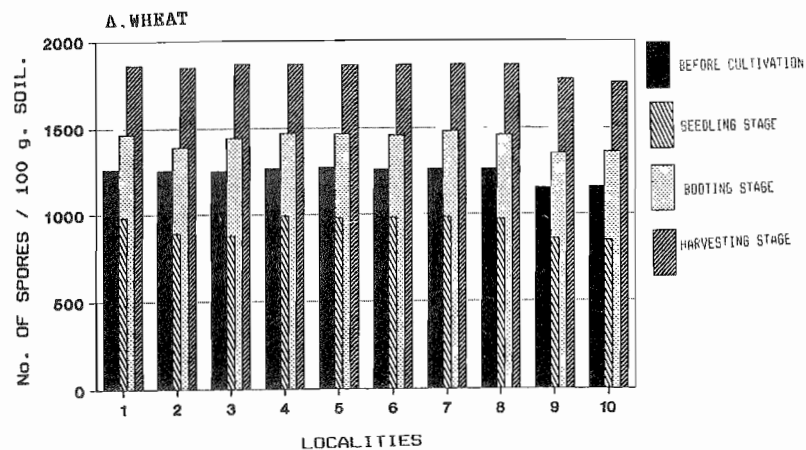
Vesicular-arbuscular mycorrhizal (VAM) fungi are ubiquitous and regular component of soil microflora (Mosse & Bowen, 1968) which infect tissues of plant roots much more than any other fungal groups (Gerdemann, 1968). They are obligate mutualistic symbionts (Cook, 1977) which have extensive host range and are not strongly host specific (Hayman, 1981). The population of VAM-spores varies considerably from place to place according to the physical and chemical nature of soil (Mosse & Bowen, 1968; Hayman, 1970; Powell, 1977). The role of VAM-fungi in increasing nutrient uptake especially phosphate is now well documented (Nicolson, 1967; Mosse, 1973; Bowen *et al*, 1975). Considering the importance of VAM-fungi in agriculture, the population and identity of VAM-fungi in the soil of wheat and rice fields of Pakistan were investigated.

Materials and Methods

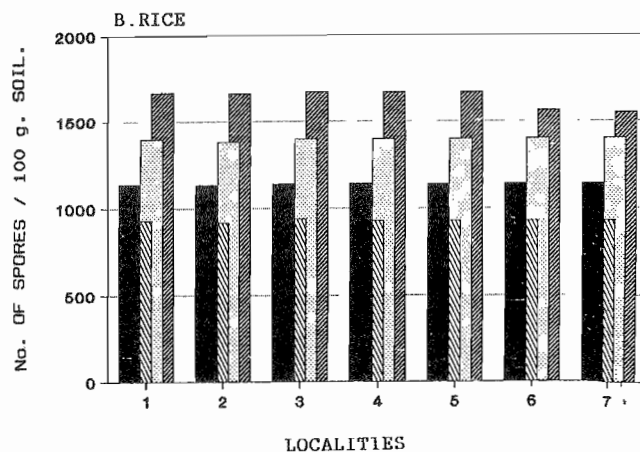
Soil samples were collected before and during the wheat and rice crop seasons of 1988 to 1990 from different agroecological zones of Pakistan. Six replicate soil samples of rhizospheric and non-rhizospheric soils were collected randomly from wheat and rice fields. The VAM-spores were extracted from the soil samples by wet sieving and decanting method (Gerdemann & Nicolson, 1963). The extracted spores were quantified by eelworm counting slide method and spores per 100 g soil calculated. The extracted spores were mounted in Polyvinyl alcohol-lactophenol solution and the morphology of spores studied under compound microscope and identified after referring to the manual for the identification of VA-mycorrhizal fungi by Schenck & Perez (1990).

Results and Discussion

Population of VAM-spores in soil of wheat and rice fields varied before cultivation, during cultivation and after harvesting of the crops (Figs.1 A & B). At seedling stage there was a gradual reduction in the number of VAM-spores in rhizospheric soil of wheat and rice plants (Figs.1 A & B). There was an increase at booting stage showing a maximum number at harvesting stage with an average of 1860 VAM-spores per 100 g of soil in wheat and 1668 VAM-spores per 100 g of soil in rice (Figs. 1 A & B). Saif (1977) also observed a general reduction in number of the VAM:



1=KARACHI, 2=HYDERABAD, 3=THATTA, 4=NWABSHAH, 5=THARPARKAR, 6=SUKKUR, 7=JACCOBABAD, 8=BADIN, 9=LAHORE, 10=FAISALABAD.



1=KARACHI, 2=HYDERABAD, 3=THATTA, 4=LARKANA, 5=THARPARKAR, 6=LAHORE, 7=FAISALABAD.

Fig.1. Population of VAM-Spores/100 g. Soil in wheat and rice fields at different stages of growth.

Table 1. Frequency of individual Vam-spores/100 g. of soil from wheat and rice fields of Sindh and Punjab.

Species of Vam-spores.	Wheat		Rice	
	Sindh	Punjab	Sindh	Punjab
<i>Acaulospora laevis</i>	180	150	00	00
<i>A. mellea</i>	58	48	00	00
<i>Gigaspora coralloidea</i>	00	00	192	365
<i>Glomus aggregatum</i>	107	62	00	00
<i>G. fasciculatus</i>	88	60	190	287
<i>G. cerebriforme</i>	80	170	00	00
<i>G. dimorphicum</i>	00	00	146	210
<i>G. macrocarpus</i>	360	280	400	382
<i>G. melanosporus</i>	64	240	250	89
<i>G. microcarpus</i>	70	00	00	00
<i>G. monosporus</i>	100	270	00	00
<i>G. mosseae</i>	300	350	290	212
<i>G. radiatus</i>	280	00	00	00
<i>G. warcupii</i>	78	00	00	00
<i>Scutellispora erythropha</i>	53	210	212	112
<i>Sclerocystis pachycaulis</i>	62	00	00	00
Total	1880	1840	1680	1657

spores during the early stages of growth of several vegetable plants followed by an increase in the number of spores as the plants matured. Saif & Khan (1975) found 750 spores per 100 g of soil in wheat fields of northern Pakistan. Thus the number of VAM-spores extracted from the soil of wheat fields of Sindh and Punjab differed considerably from the number of spores reported from the soil of wheat fields of northern areas (N W F P) in Pakistan. A slight variation in the number of VAM-spores in the soil of Sindh and Punjab was also observed (Figs. 1 A & B). The frequency of occurrence of individual VAM-spores in the soil of wheat and rice fields of Sindh and Punjab is shown in Table 1. It is now known that VAM-spores in different soil types vary in population (Mosse & Bowen, 1968; Hayman, 1970; Powell, 1977). This explains the difference in the number of VAM-spores occurring in the soils of different agroecological zones of Pakistan.

The extracted spores when examined under stereoscopic and compound microscopes for their morphology, size, subtending hyphae and internal contents could be placed in one family *Endogonaceae* (Harley & Smith, 1983) comprising of 13 VAM-species belonging to 3 genera viz., *Acaulospora laevis*, *A. mellea*, *Glomus aggregatum*, *G. fasciculatus*, *G. cerebriforme*, *G. dimorphicum*, *G. macrocarpus*, *G. microcarpus*, *G. monosporus*, *G. mosseae*, *G. radiatus*, *G. warcupii* and *Scutellispora erythropha* from the soil of wheat fields (Fig. 2 A-M). From the soil of rice fields 6 VAM-species belonging to 3 genera viz., *Gigaspora coralloidea*, *Glomus macrocarpus*, *G. melanosporus*, *G. fasciculatus*, *G. mosseae* and *Sclerocystis pachycaulis* were extracted and identified (Fig. 2 N-P). On the basis of the morphology and colour of VAM-spores, Khan (1971) reported 6 types of VAM-spores viz., yellow vacuolated, funnel-shaped base, non-endosporic bulbous, brown laminate, white reticulate funnel shaped and honey coloured sessile spores from the soil of northern Pakistan but did not furnish the identification of VAM-fungi. Saif & Khan (1975) reported 4 types of VAM-spores viz., yellow vacuolated, endosporic type, red-brown-laminate and bulbous vacuolated but did not identify the VAM-fungi. In this study, identity of 16 species of VAM-fungi extracted from the soil of wheat and rice fields of Sindh and the Punjab is given in Table 2 which are being reported for the first time from Pakistan.

Acknowledgement

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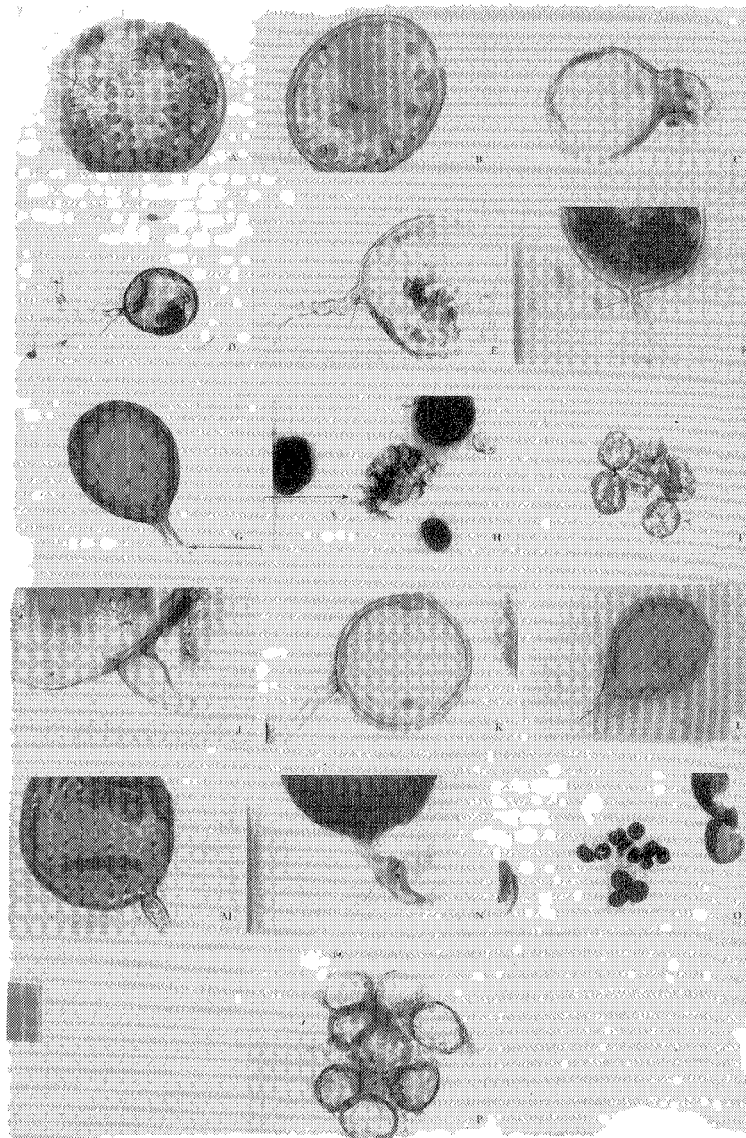


Fig.2. External and internal characteristics of VAM-Spores extracted from the soil of wheat and rice fields.

- A. *Acaulospora laevis* (X 400), B. *Acaulospora mellea* (X 400), C. *Glomus aggregatum* (X 400)
 D. *Glomus cerebriforme* (X 100), E. *Glomus dimorphicum* (X 400), F. *Glomus fasciculatus* (X 400)
 G. *Glomus macrocarpus* (X 400), H. *Glomus microcarpus* (X 400), I. *Glomus monosporous* (X 400)
 J. *Glomus mosseae* (X 1000), K. *Glomus radiatus* (X 400), L. *Glomus warcuppi* (X 400).
 M. *Scutellispora erythropha* (X 400), N. *Gigaspora coralloidea* (X 400), O. *Glomus melanosporus* (X 100)
 P. *Sclerocystis pachycaulis* (X 400).

Table 2. Characteristics of VAM-spores extracted from wheat and rice fields.

Species of VAM-spores.	Morphology and size	Spore wall	Spore inclusions	Hyphal attachment	Septa in Subtending Hypha	Pore connection B/W spore & Subt. Hypha
<i>Acaulospora laevis</i>	Globose to polygonal (200 x 253 µm)	3 layered Inner most roughened	Dense Reticulate	---	---	---
<i>A. mellea</i>	Sub globose (120 x 90 µm)	3 layered	White	Sessile	---	---
<i>Gigaspora coralloidea</i>	Globose (300 x 320 µm)	Thick	Dark brown	Wart present	Irregular	Closed pore
<i>Glomus aggregatum</i>	Sub globose (82 x 70 µm)	Double	Hyaline	Cylindrical	Present	Closed
<i>G. cerebriforme</i>	Globose (60 x 65 µm)	Thick, Laminate	Viscous	Elongated, Cylindrical	Curved, membranous	Closed by Septum
<i>G. dimorphicum</i>	Subglobose (80x90 µm)	Thick	Rough	Cylindrical	---	Wide pore
<i>G. fasciculatus</i>	Subglobose (120 x 90 µm)	Double thick	Crystalline	Cylindrical Persistent	---	Closed pore
<i>G. macrocarpus</i>	Subglobose (102 x 110 µm)	Outer thin, Inner thick	Viscous	Cylindrical Persistent	---	Pore Present
<i>G. melanosporus</i>	Obovoid (160 x 207)	Thin	Creamy Latex	Not observed	---	---
<i>G. microcarpus</i>	Globose, in small cluster (22 x 27 µm)	Thin	Aquous	---	---	---
<i>G. monosporus</i>	Subglobose (149 x 157 µm)	2 layered Inner echinulated	Crystalline	---	---	---

<i>G. mosseae</i>	Subglobose (212 x 239um)	2 layered Outer thin	Crystalline	Funnel shaped	curved Septum	closed by Septum
<i>G. radiatus</i>	Globose (110 x 115um)	Thick, Laminate	Viscous	Cylindrical	No sep- tum	Opening partially occluded
<i>G. warcupii</i>	Subglobose (118 x 170 um)	Thick	Hyaline	Cylindrical thin outer wall thick inner wall	Curved	Closed
<i>Scutellispora erythropha</i>	Globose (183x 190 um)	Thick	Crysaline	Bulbous	Curved	Minutely open.
<i>Sclerocystis</i>	Chlamydo- pore Obovid (186 x 150)	Thick	Dense	Present	Present	----

----- = not seen/known

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