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Survival of VAM Fungi in Wheat Fields

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Abstract

Survival of VAM spores in soil of the wheat fields of 8 districts of Sindh differed significantly ($p<0.001$) during 12 months. It was found in the range of 40.2 to 50.3 percent in soil without crop, however, it was found significantly higher ($p<0.001$) in the presence of wheat crop during March/April and was recorded within the range of 74.2 to 88.6 percent. After harvesting the crop the survival of VAM spores reached to the value as was found without crop.

Introduction

Vesicular arbuscular mycorrhiza (VAM) is one of the effective microorganisms found in soil, form a symbiotic relationship with vascular plants. During symbiosis absorptive area of the host roots is greatly increased by which available phosphorus from soil is mobilised to the host plants results in the increase of their yield (Harley and Smith, 1983; Harley, 1989). The presence of viable VAM spores in soil is directly related to the intensity of VAM infection in roots and ultimately to the better growth and yield of host plants (Powell and Bagyaraj, 1984). Hence the study on the survival of VAM spores in natural soil field condition is an important factor but such study has not so far been carried out in Sindh, Pakistan. This papers deals with the study of survival of VAM spores in soil of wheat fields of 8 districts of Sindh for 12 months in a view to determine their viability with the passage of time and to know the percent of viable VAM spores available to the next wheat crop season.

Materials and Methods

The soil samples were collected by random sampling method (Zar, 1984) from the wheat fields of 8 districts of Sindh. viz. Badin, Hyderabad, Jaccobabad, Mirpurkhas, Nawabshah, Sanghar, Sukkur and Thatta before sowing the wheat seeds (October/November, 1994) and 30 days interval after sowing the seeds up to the September 1995. Three wheat fields were selected in each district from where 3 replicate samples each of 100 g with 20 sub-samples were collected at 30 meter apart. During wheat crop season soil samples were collected from the rhizospheric region whereas in absence of crop, samples were taken from a depth of 10 cm after removing organic debris from the surface. The sub-samples of each district of each month were then thoroughly mixed to make a composite soil sample. Spores of VAM fungi were extracted from the samples of each district of each month by wet sieving and decanting method (Gerdemann and Nicolson, 1963) followed by centrifugal floatation technique (Jenkins, 1964) and counted by the method given by Southey (1985). The survival value of VAM spores in soil of wheat fields was based on the percent of viable spores extracted from the samples determined by the under mentioned formula.

$$\text{Survival of VAM spores/g soil} \quad \frac{\text{No. of viable VAM spores obtained}}{\text{Total No. of VAM spores studied}} \times 100$$

Results

Table 1 showed that the 8 districts of Sindh were significantly differed with each other in respect of survival value of VAM spores ($p<0.001$). The survival value of VAM spores was also found to be differed significantly during 12 months ($p<0.001$). A non significant interaction was found between 12 months and 8 districts of Sindh. The survival value of VAM spores in the soil of 8 districts of Sindh was found between the range of 40.2 (Jaccobabad) to 50.3 percent (Mirpurkhas and Nawabshah) during the month of September/October when the wheat fields were without crop (Fig. 1C, D and E). The survival value was found to be increased with the growth of wheat crop after sowing the seeds and reached to its maximum during March/April, the time of harvesting (Fig, 1A to H). At this stage it ranged from 74.2 percent (Jaccobabad) to 88.6 percent (Nawabshah) within the 8 districts of Sindh (Fig. 1C and E). The soil of Hyderabad, Mirpurkhas, Nawabshah and Sanghar showed maximum survival value in the month of March (Fig. 1B, D, E and F) whereas the soil of Badin Jaccobabad, Sukkur and Thatta showed highest survival in the month of April (Fig. 1A, C, G and H). The survival value of VAM spores in all the 8 districts after attaining its maximum, begin to decline gradually and finally reached more or less to the value of without crop (Fig. 1A to F).

Discussion

The survival of VAM spores was determined by the method that was found to be a convenient and rapid technique than the test plant method (Moorman and Reeves, 1979) and by the method given by An and Hendrix (1988). The present study showed that the aforesaid methods are time consuming and usually reliable result not obtained since the intensity of VAM infection in roots of test plants depend on the types of species used for this purpose.

Table 1: Analysis of variance for the survival of VAM spores in fallow-wheat fields in 8 districts of Sindh

Source of variation	d.f.	Sum of squares	Mean square	F value	P level
Months (M)	11	25500.44	2125.03	32.37	<0.001
Districts (D)	7	3542.43	506.06	7.70	<0.001
M x D	77	3149.19	37.49	0.57	NS
Error	208	13652.66	65.63		
Total	303	45844.72			

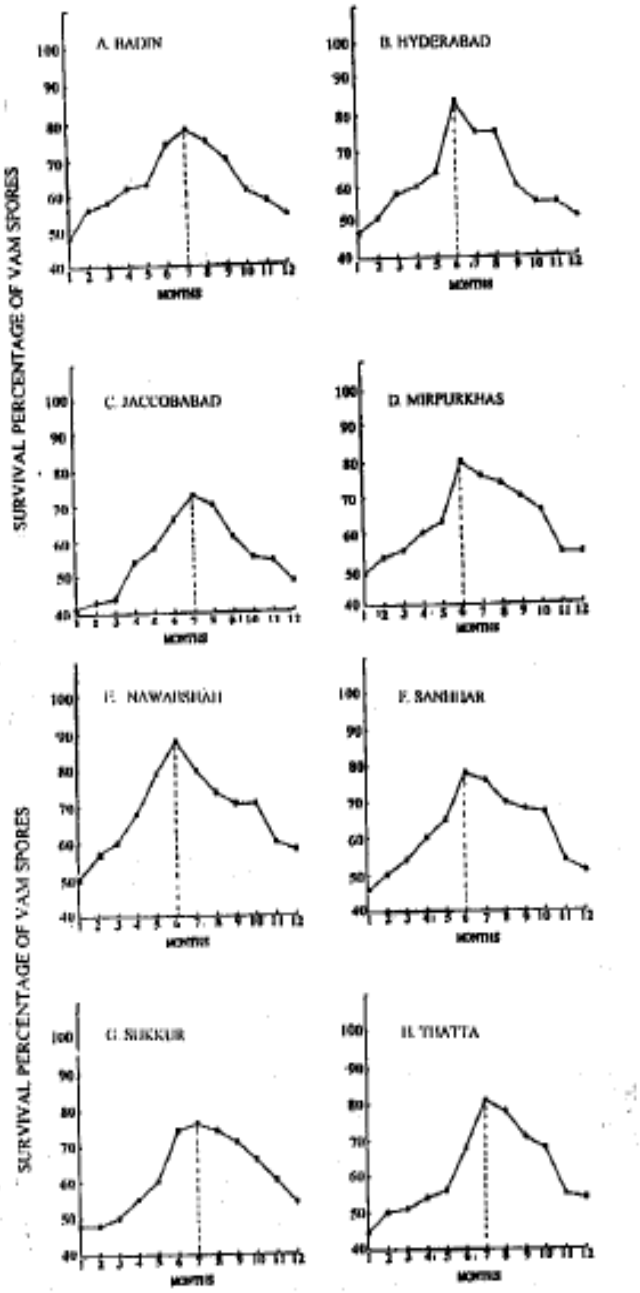

Fig. 1: A to H showing the survival percentage of VAM spores in the soil of 8 districts of Sindh during 12 months (time) $LSD_{0.05}$ (Time) = 4.61, $LSD_{0.05}$ (Districts) = 3.61. The progressive numeral value on the X-axis represent the different months

There is a very few work on the status of survival of VAM spores in soil during 12 months. However, Nirmala *et al*. (1988) found similar increase and decrease in the survival value of VAM spores in the soil as obtained by us. The presence or absence of host plants in soil obviously play a vital role to produce a large number of viable VAM spores (Ocampo *et al*., 1980). According to the Harley and Smith (1983) VAM spores survive in soil but the time of their survival varies greatly which in turn depends on the living host in soil since they are strictly obligate in nature. It has also been reported that the population of viable VAM spores also increase as a result of intermittent plant growth (Mosse and Bowen, 1968) which corroborate our results. Our result also showed that VAM spores have different survival value in different districts (Figs. A to H) which is supported by the work of Daft *et al*. (1987). According to them survival also affected by the different environmental condition.

Results of the present study showed much sensitivity to the presence of host plants in the soil under natural condition which indicates that VAM spores could not be survived for a longer 4 period of time without crop. However, it has been observed by the ascribes (authors) in another study that the VAM spores can survive up to the 95 percent at low temperature ($5 \pm 2^{\circ}C$) for 360 days-12 months without any crop (Anwar and Jalaluddin, 1997). From our results it is now concluded that, if wheat fields remain crop less after harvesting the previous crop then viable VAM spores available to the forthcoming season would be very low (40.2 to 50.3 %) which is not sufficient for optimum VAM infection in the newly growing seedlings. Since in host roots each site of VAM infection is dependent on individual infective unit, because hyphae developed by the infection of VAM spores have limited growth and run longitudinally from the site of infection rather than circumferential direction (Cox and Sanders, 1974; Carling and Brown, 1982; Harley, 1989). Thus more viable VAM spores in soil is however, be required at the time of sowing to bring about the maximum VAM infection in roots of newly growing seedlings for better growth and yield particularly in those fields which remain crop less after harvesting the previous crop. This information would be of great significance in boosting up the yield of various crops particularly wheat (staple crop) in Sindh, Pakistan.

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