http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 4 (7) : 818-821, 2001

Varietal Reaction of Wheat to VAM Infection

[1]Q.M.K. Anwar and M. Jalaluddin
Department of Botany University of Karachi 75270, Pakistan
[1]Department of Biology, D.A. Degree College (Men), DHA Phase VI, Karachi 75500, Pakistan.

Abstract : Six commercial wheat vars. grown in micro plots showed VAM infection in their roots after 10 days of sowing the seeds. After lag phase VAM infection in all the 6 vars. progressed exponentially in a sigmoid fashion with increasing age of plants and then attaining a plateau state at a certain stage of growth which differed significantly variety wise ($p < 0.001$). Of the six wheat vars., Blue Silver was found highly susceptible to the VAM fungi and showed highest VAM infection (80.3 ± 6.8 %) in their roots, whereas it was found least in Sonalika (65.2 ± 3.7 %). Histological study of VAM infected roots showed that the arbuscular structure appeared earlier than the vesicular structure. This information would be of great significance in boosting up the yield of wheat by growing and inoculating the var. Blue Silver on preferential basis in wheat fields of Sindh, Pakistan.

Key words: VAM infection, varietal reaction, wheat

Introduction

Vesicular arbuscular mycorrhiza (VAM) is one of the effective soil micro-organisms, that forms a symbiotic association with the roots of a wide range of vascular plants (Sieverding, 1991). In symbiotic association the absorptive area of host roots and the mobilization of available Phosphorus along with various other minerals is greatly enhanced which consequently increase the plant yield many folds (Harley, 1989). The intensity of VAM infection in roots of commercial indigenous wheat vars. of Sindh, Pakistan has not so far been studied empirically. This research work was carried out to determine the extent of VAM infection in roots of 6 commercial wheat vars. of Sindh at various growth stages, to find out the VAM susceptible vars. for cultivation and to overcome the limitation of the practical utilization of the VAM technology in our country.

Materials and Methods

The six indigenous commercial wheat vars. viz. Blue silver, Pak-70, Pavon, Sindh-83, Sonalika and ZA-77 were cultivated during wheat season (1994/95) in the experimental micro plots each of 120 cm^2, containing sandy clay loam soil (true density 2.66 g/cc, pore space 43 % and pH level 7.2). The plots were established in blocks at Karachi University Campus by randomized complete block design method. In each plot surface disinfected seeds of the 6 wheat vars. were sown in 3 straight rows of 65 cm length @ 5 seeds of each var./ row, maintained at a distance of 10 cm, whereas the distance between each row was kept 30 cm. Each var. was replicated 3 times. The seeds were allowed to germinate and grow up to the harvesting stage by irrigating them with tap water.

The lateral and fine feeder roots of wheat vars. (site of VAM infection) were collected (Kormanic & McGraw, 1982) at 10 days interval by stratified sampling method (Zar, 1984). The wheat root tissues were processed by the method of Koske & Gemma (1989) to determine the VAM infection in cortical tissues. The assessment of VAM infection percentage in roots of 6 wheat vars. was carried out separately by slide length method (Giovannettii & Mosse, 1980).

Results

When the data on VAM infection percentage of the six wheat vars. were subjected to Analysis of Variance-ANOVA (Table 1) it showed that the VAM infection percentage in roots of 6 wheat vars. growing in different blocks was significantly different. The 6 wheat vars. at various growth stages also differed significantly in respect of VAM infection percentage. A non-significant interaction was found between wheat varieties and growth stages.

Roots of all the six wheat vars. showed less than 10 % VAM infection after 10 days of sowing the seeds (Fig.1A to F). A clear lag phase (period of primary VAM infection) was found in Sonalika as compared to the other 5 vars. (Fig. 1D). Thereafter, VAM infection in roots of all the wheat vars. increased progressively in a sigmoid pattern with increasing age of plants and then attaining a plateau at certain stage of growth which differed variety wise (Figs. 1 A to F). Of the 6 wheat vars. the highest VAM infection was found in Blue silver (80.3) after 120 days of sowing, whereas the Sonalika showed least VAM infection (65.2 %) (Figs. 1 A & D) and the remaining 4 wheat vars. showed VAM infection in between the two extremes.

The histological study of VAM infected roots of the 6 wheat vars. showed aseptate hyphae of VAM fungi, intracellular and dichotomously branched haustoria like arbuscules and round to oval, thick walled inter and intracellular vesicles in their root cortical tissues (Plate 1 and 2). The number of arbuscules and vesicles cm^{-1} root segments differed variety wise. The arbuscules (Plate 1) appeared in cortical tissues of 10 days old roots, increased progressively and reached to the highest in 80 days old roots of all vars. except Sonalika (Figs. 2 A to F). Of the six wheat vars., Blue silver showed highest number of arbusclues (48.8 cm^{-1} root segment) in their 80 days old root cortical tissues (Fig. 2 A) whereas it was lowest (36.5 cm^{-1} root segment) in the roots of Sonalika (Fig. 2 D). The vesicles began to appear in cortical tissues of 20 days old roots which increased rapidly after 70 days of sowing. The vesicles became highest in 100 to 110 days old roots (Figs. 2 A to F). The highest number of vesicles was found in roots of Blue silver (58.7 cm^{-1} root segment) and least was in Sonalika (47.8 cm^{-1} root segment) (Fig. 2 A and D).

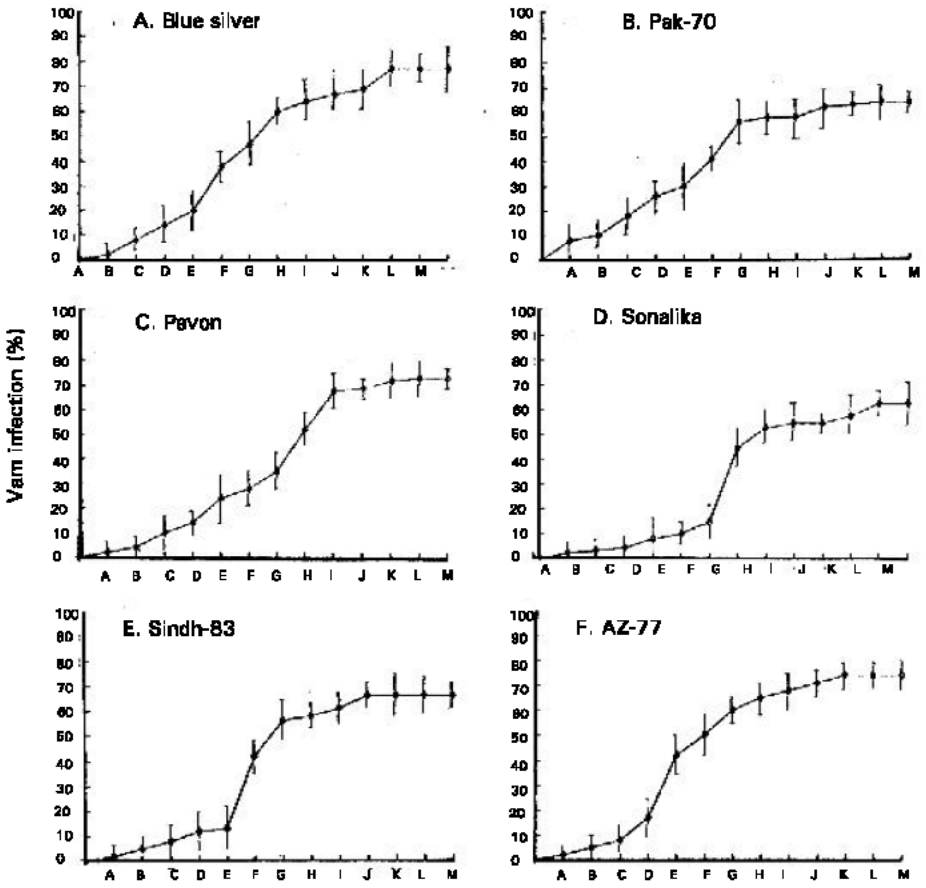
Discussion

VAM fungi are found naturally in all terrestrial ecosystem and infect roots of wide range of vascular plants. Its pattern of root infection in different plants of different species and genera has been studied by many scientists. Smith & Smith (1981) obtained sigmoid curves against VAM infection percentage verses time in roots of *Trifolium subterraneum* and *Allium cepa* which support the present findings. The sigmoid form of the curve against VAM infection and time has also been illustrated by Land & Shonbeck (1991) in

Table 1: Analysis of variance on VAM infection percentage in the roots of 6 wheat vars.

Source of Variation	Sum of squares	DF	Mean squares	F	Probability Level
Blocks	8104.02	17	9552.01	14.15	< 0.01
Varieties	6704.51	5	1340.90	33.09	< 0.00
Growth stages	128503.75	13	28086.50	243.93	< 0.001
Interaction					
Varieties x growth stages	2590.32	65	39.85	0.98	NS
Error	6726.64	166	40.52		
Total	152629.24	266			

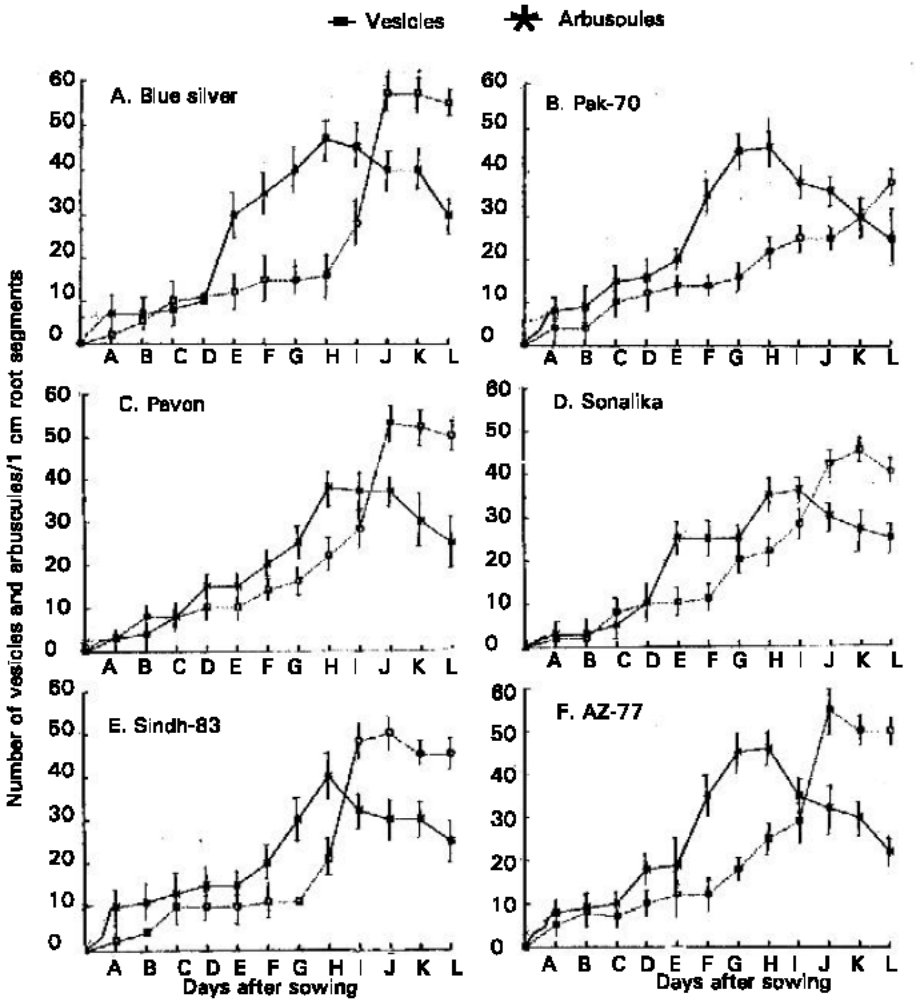
NS = Non significant



Figs. 1 A – F: VAM infection percentage in roots of 6 wheat vars. At various growth stages. The alphabets on x-axis represent the days after sowing seeds at an internal of 10 days and the vertical bars on each graphic line represent the standard deviation of the mean value $LSD_{0.05}$ (WHEAT VARS.) = 2.74, $LSD_{0.05}$(days after sowing) = 4.18

different plants which corroborate our results. Many workers (Sutton, 1973; Saif, 1977; Mosse,1981; Harley & Smith 1983) have described the existence of lag phase in VAM infection as found in present work in Sonalika (Fig. 1 D).

Our results showed that after attaining the plateau, there was no further increase in VAM infection up to harvesting stage, which is similar to the findings of Sieverding (1991). Our results clearly indicate that the 6 commercial wheat vars. which were grown in ecologically similar area showed their own varietal reaction against VAM infection. The difference in VAM infection percentage in 6 different wheat vars. can also be due to the difference in wheat varieties within a species having different infection levels as pointed out by Crush (1978). According to Hall (1981) there are more than 100 different VAM species in soil, each differs in the extent to which it infect the particular plant species / vars. However, the root system of a growing plant is usually infected by more than one VAM species which can not be identified perfectly in side the root tissues. Since the identification of VAM fungi in the infected roots is very controversial due to lack of comprehensive works. Present results are further supported by Sieverding (1991), who pointed out that different



Figs. 2 A to F: The pattern of appearance and number of vesicles and arbuscules in the root cortical tissues of wheat at various growth stages. The alphabets on x-axis represent the days after sowing seeds at an internal of 10 days and the vertical bars on each graphic line represent the standard deviation of the mean value

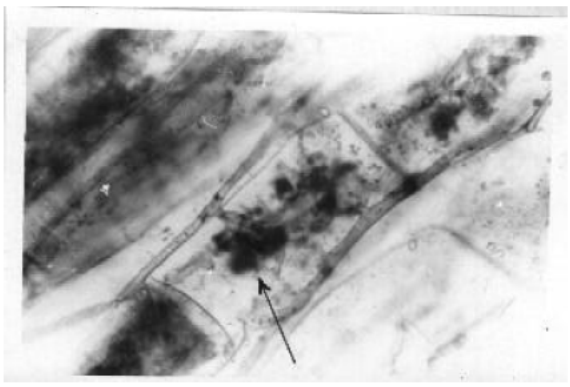


Plate 1 : The microphotograph showing aseptate hyphae and intracellular dichotomously branched arbuscules in the root cortical tissues of wheat var. Blue silver

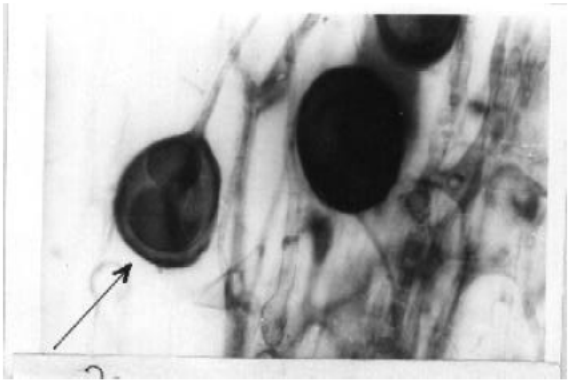


Plate 2: The Microphotograph showing aseptate hyphae, intercellular and intracellular vesicles in the root cortical tissues of wheat var. Blue silver

mycotrophic (mycorrhizal) plants differ in rate of VAM formation in their roots due to the variation in susceptibility towards the VAM fungi.

On the basis of result it has been inferred that the six wheat vars. showed a clear varietal reactions against VAM infection. Of the six vars., Blue silver showed maximum susceptibility to the VAM infection as compared to the rest of the 5 vars. whereas Sonalika was found least susceptible towards the VAM fungi. This information would be of great significance in boosting up the yield of wheat by growing and inoculating the var. Blue Silver on preferential basis in wheat fields of Sindh, Pakistan.

Acknowledgment

This was a part of the Ph.D. thesis of senior author which has been successfully awarded. The work of the thesis was carried out under the research projects for which research grants were received from National Scientific Research and Development Board (NSRDB) and Pakistan Atomic Energy Commission (PAEC), Islamabad, Pakistan which are gratefully acknowledged.

References

Crush, J.R., 1978. Change in effectiveness of soil endomycorrhizal fungal population during pasture development. NZ. J. Agric. Res., 19: 473-476.

Giovannetti, M. and B.Mosse, 1980. An evaluation of technique for measuring vesicular arbuscular mycorrhizal infection in roots. New Phytol., 84: 489-500.

Hall, I.R., 1981. Fungus could replace fertilizer. NZ. J. Agric., p: 63.

Harley, J.L., 1989. The Significance of mycorrhiza. Mycol. Res., 92:129-139.

Harley, J.L. and S.E. Smith, 1983. Mycorrhizal Symbiosis. Academic Press. London, p: 483.

Kormanic, P.P. and A.C. McGraw, 1982. Quantification of vesicular arbuscular mycorrhizae in plant roots. pp. 37-45. In: Methods and Principles of Mycorrhizal Research., (Ed.) N.C. Schenck. Am. Phytopath. Soc., St. Paul Minnesota, USA.

Koske, R. E. and Gemma. 1989. A modified procedure for staining roots to detect vesicular arbuscular mycorrhizas. Mycol. Res., 4 : 486-505.

Land, S. and F. Shonbeck. 1991. Influence of different soil types on abundance and seasonal dynamics of vesicular arbuscular mycorrhizal fungi in arabal soil of North Germany. *Mycorrhiza*, 1: 39-44.

Powell, C.L. and D.J. Bagyaraj, 1984. VA Mycorrhiza. CRC Press, Inc., USA, pp: 234.

Sieverding, E., 1991. Vesicular arbuscular mycorrhiza management in tropical agrosystems. *Deutsche Gesellshaft fur Technische Zusammenarbeit* (GTZ) GmbH Federal Republic of Germany, pp: 371.

Smith, F.A. and S.E. Smith, 1981. Mycorrhizal infection and growth of Trifolium subterraneum: comparison of natural and artificial inocula. New Phytol., 88: 722-725.

Zar, J.H., 1984. Biostatistical Analysis Prentice -Hall, England, Cliffs, N.J. USA.