

RECEPTIVITY OF VARIOUS WHEAT CULTIVARS TO INFECTION BY VESICULAR ARBUSCULAR MYCORRHIZAL FUNGI

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Four cultivars of wheat i.e. NI-8629, CPAN-2005, Raj-1777 and CC-464 were tested for their receptivity to VA endophyte *Glomus caledonium*. Symbiotic efficiency varied with different cultivars. Cultivar NI-8629 was found to be highly benefited in association compared to other three cultivars.

Keywords : VAM fungi; *Glomus Caledonium*; Symbiotic efficiency.

Introduction

Vesicular arbuscular mycorrhiza (VAM) fungi has wide distribution and they form obligate symbiotic associations with most families of plants. Although the relationship between VAM and host plants is non specific, they exhibit certain host preference¹. Considerable variation in VA mycorrhizal development and its effects on host plants occur. The present studies were undertaken to examine the difference in receptivity of four wheat cultivars to infection by VAM fungi, level of VA colonization and the influence of the VA fungus on plant growth.

Materials and Methods

Experiments were carried out on plants grown in open earthen pots containing soil. The soil was of clay loam type with pH 8.5, organic carbon 0.225%, available P 18.43 kg/ha and N-125.44 kg/ha. The soil was steam sterilized in an autoclave at 121°C for about 1 hr. Four wheat cultivars Raj-1777, CPAN-2005, CC-464 and NI-8629 were used as test plants. Seeds were germinated in moist chamber after their surface sterilization with 5% NaOCl for about 5 minutes, followed by rinsing with sterile

distilled water 4-5 times. Ten days old seedlings were transplanted in pots after inoculations with VAM and grown under green house conditions. The VA inoculum consisted of chlamydospores of *G. caledonium*. Spores were isolated from soil by wet sieving and decanting technique², collected on wet filter paper (Whatman No.1) and stored at 4°C. Twenty five spores were placed on roots of each plantlet before sowing into pots. Fifteen inoculated seedlings of each cultivar were maintained. Simultaneously control plants (without VAM) were also maintained for each cultivar.

Growth studies were performed by measuring the following parameters: plant height, leaf size, grain number, plant dry weight and grain dry weight. Parts of the rootsystem of each plant was cleared and stained³, and the percentage of root colonization was calculated. Standard deviation was calculated for each parameter and Relative Mycorrhizal dependency (RMD) was also estimated, which is defined as the degree to which a plant is dependent on the Mycorrhizal condition to produce its maximum growth at a given level of fertility.

Results and Discussion

All the four wheat cultivars inoculated with *G. caledonium* were found to be well colonized but showed different receptivity to mycorrhizal infection and varied in percentage of root length colonization, plant growth and dry weight (Tables 1-3). All cultivars tested showed the characteristic morphological structure of VAM. Extraradical hyphal association with the roots and formation of appressoria was also noted. Aseptate hyphae were common in the intermediate layer of the root cortex and were in parallel alignment (Fig. 1 C.). Arbuscules occurred in the inner layer of the root cortex and were similar in all the cultivars (Fig. 1 b). Vesicles were of variable shapes ranging from round, oval to obovoid and also inter and intra cellular (Fig. 1 c,d).

To start with all the seedlings were of same size. After fifteen days of inoculations there was not much difference in height of all the cultivars (Table 1). Non-inoculated plants (VAM) showed slightly more growth than the VAM inoculated ones in cultivar NI 8629, Raj 1777 and CPAN 2005, while plant height was almost the same in both inoculated and non-inoculated plants of cultivar CC 464. This could be attributed to the fact that VAM fungi take time to get established and initially has parasitic life⁴.

Significant difference in height of plants and leaf size among cultivars was observed after thirty days of inoculation. Plants of cultivar NI 8629 were of maximum height followed by CC 464, Raj 1777 and CPAN 2005 in both inoculated and non-inoculated treatment. Plant growth of all the four cultivars was much more over their

non-inoculated plants (Table 1). At initial stage of infection there was not much difference in height of inoculated and non-inoculated plants of cultivar NI 8629 but at later growth stages this difference increased and was maximum followed by cultivar CC 464. While in the case of cultivar Raj 1777 difference was much more at initial stages and less at later in comparison to NI 8629 and CC 464 (Table 1). Cultivar CPAN 2005 maintain the least difference throughout the experiment. Percentage of root length colonization varied among cultivars (Table 2), even though the density of inoculum (i.e. 25 spores) used was the same for all. Percentage of root length colonization in all the cultivars was related to the height (growth) of the plants. As percentage of infection increased with time, plant height also increased in all the cultivars (Table 1,2). However effectiveness in growth stimulation due to VAM inoculation among different cultivars was not related to the degree of VAM infection (Table 1-3). Percentage of infection of NI 8629 and CC 464 was same after 60 days of inoculations, but varied in their effect on plant growth (Table 1). Height of CPAN was lowest amongst all the cultivars even though its dry weight was more than Raj but less than NI 8629 and CC 464 (Table 3).

The response of various cultivars may be regulated by the specific compounds of the exudates⁵. VA mycorrhizal association in wheat cultivars improved their dry weight production over that of non inoculated ones (Table 3).

Cultivar NI 8629 benefited best in association with *Glomus* in comparison to other three cultivars as it grows maximum in

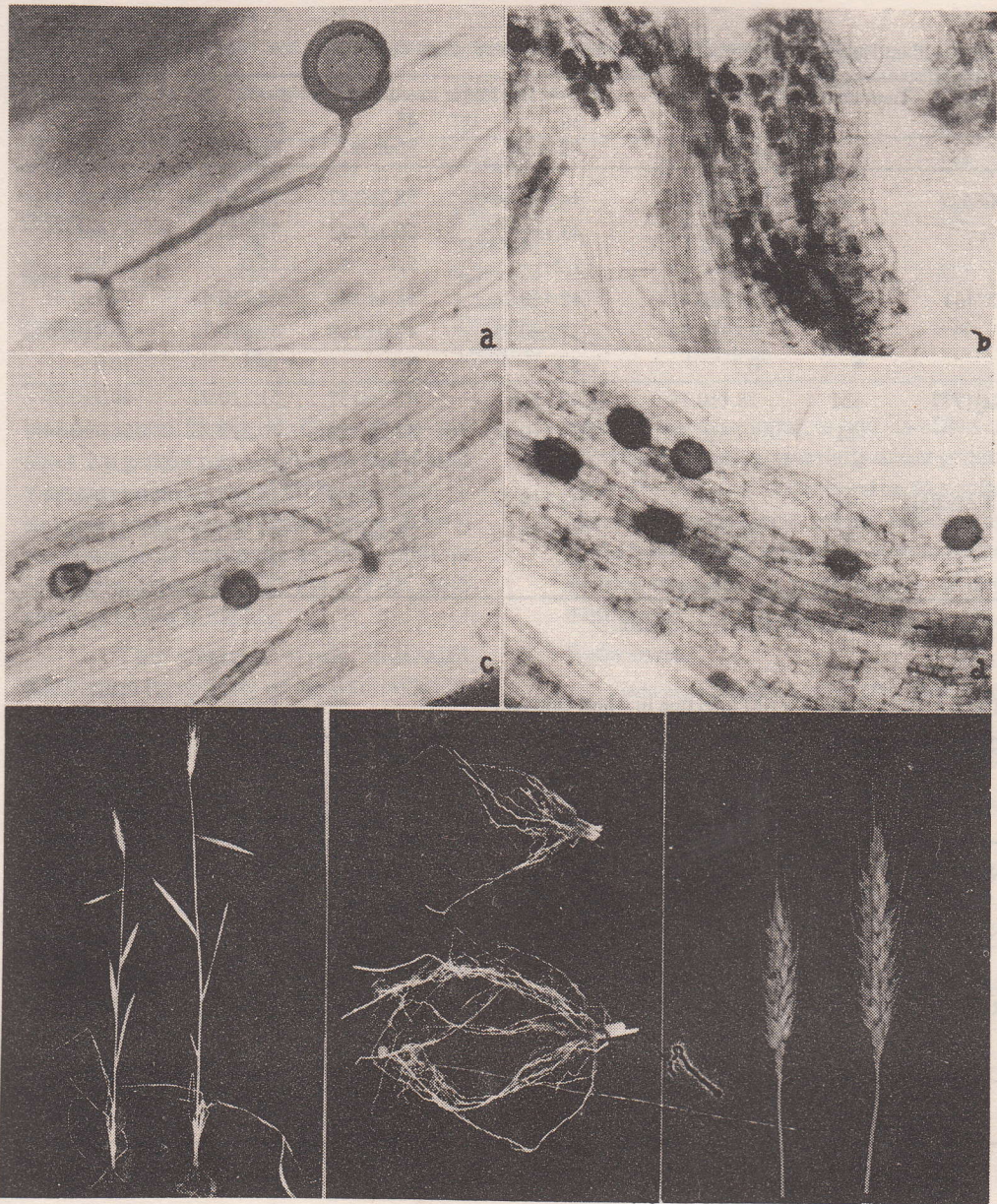


Fig. 1 (a) Spore germinating; (b)Arbuscules; (c) H-connections in parallel hyphae; (d) Vesicles; (e) +M and -M plants; (f) +M and -M roots; (g) +M and -M inflorescence
+M = Mycorrhizal -M = non-mycorrhizal

Table 1. Plant Height (cm) in inoculated and non-inoculated wheat cultivars.

| Cultivar | Treatment | Days after inoculations | | | | |
|----------|-----------|-------------------------|-----------------|-----------------|-----------------|-----------------|
| | | 15 Plant ht. | 30 Plant ht. | 45 Plant ht. | 60 Plant ht. | 75 Plant ht. |
| NI8629 | +M | 30.0±0.72 | 44.3±0.36 | 58.2±0.67 | 74.3±0.48 | 86.4±0.57 |
| | -M | 31.5±0.34 | 43.1±0.62 | 50.3±0.23 | 59.3±0.53 | 65.4±0.34 |
| | * | -1.5 | 1.2 | 7.9 | 15.0 | 21.0 |
| CC464 | +M | 28.0±0.27 | 42.4±0.91 | 54.1±0.41 | 66.2±0.68 | 77.1±0.61 |
| | -M | 27.3±0.60 | 37.2±0.73 | 47.0±0.39 | 49.3±0.36 | 56.1±0.67 |
| | * | 0.7 | 5.2 | 7.1 | 14.4 | 20.0 |
| Raj1777 | +M | 28.1±0.14 | 40.7±48 | 45.5±0.37 | 51.1±0.91 | 60.3±0.39 |
| | -M | 30.3±0.31 | 34.1±0.14 | 37.2±0.28 | 40.5±0.23 | 56.3±0.34 |
| | * | -2.2 | 6.6 | 8.3 | 10.6 | 8.0 |
| CPAN2005 | +M | 25.2±0.36 | 32.1±0.27 | 38.0±0.53 | 50.5±0.22 | 58.7±0.29 |
| | -M | 26.6±0.32 | 31.6±0.36 | 36.5±0.93 | 44.5±0.43 | 52.8±0.46 |
| | * | -1.4 | 0.5 | 1.5 | 6.0 | 6.9 |

* Net VAM inoculation effect over control.

Table 2. Percentage of VAM infection in wheat cultivars

| Cultivar | Treatment | Days after inoculations | | | | |
|----------|-----------|-------------------------|-----------------|-----------------|-----------------|-----------------|
| | | 15 % of Inf. | 30 % of Inf. | 45 % of Inf. | 60 % of Inf. | 75 % of Inf. |
| NI8629 | +M | 15.0±2.14 | 48.0±3.60 | 75.0±2.54 | 98.0±2.72 | 100.0±0.00 |
| | -M | - | - | - | - | - |
| CC464 | +M | 17.0±1.84 | 42.0±2.54 | 71.0±1.31 | 97.0±1.94 | 100.0±0.00 |
| | -M | - | - | - | - | - |
| Raj1777 | +M | 4.0±1.14 | 27.0±1.27 | 38.0±1.37 | 63.0±1.08 | 85.0±0.48 |
| | -M | - | - | - | - | - |
| CPAN2005 | +M | 5.0±0.57 | 29.0±1.45 | 41.0±1.02 | 61.0±0.84 | 79.0±1.13 |
| | -M | - | - | - | - | - |

Table 3. Plant dry weights and grain weight in inoculated and non inoculated wheat cultivars.

| Cultivar | Treatment | Plant dry weight (g) | Total Grain weight (g) | RMD (%) |
|----------|-----------|----------------------|------------------------|---------|
| N18629 | +M | 5.68±0.81 | 2.43±0.47 | 138 |
| | -M | 4.10±1.01 | 1.56±0.23 | |
| CC464 | +M | 5.13±0.23 | 2.08±0.71 | 130 |
| | -M | 3.90±0.61 | 1.45±0.93 | |
| Raj1777 | +M | 4.21±1.73 | 1.79±0.13 | 127 |
| | -M | 3.30±0.82 | 1.20±0.07 | |
| CPAN2005 | +M | 4.65±0.36 | 1.84±0.61 | 129 |
| | -M | 3.60±0.37 | 1.32±0.43 | |

its association (Table 1). Grain yield and plant dry weight measured were also found to be maximum in case of NI 8629 (Table 3). Relative Mycorrhizal dependency (RMD) was found to be maximum in case of cultivar NI 8629 followed by CC 464, CPAN 2005 and Raj 1777 (Table 3).

The present work indicates differential receptivity of the four cultivars of wheat to mycorrhizal inoculation. Different species and different isolates within species can have different effects on plant growth. One isolate or species may increase fruit set on one plant species and may increase plant height or have no effect on another plant species. Although, they are similar in appearance in root, not every VAM fungus will have the same effects on different hosts. It has also been suggested that VA

mycorrhizal development and its effect on host plants are at least partially under genetic control⁶. The results obtained in this paper also supports this view. Infact, infection by VAM fungi may be related to nutrient content in root exudates or permeability of root membranes.

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