Effect of Mycorrhizal Fungi and Promot on Beans

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Mycorrhizal fungi have been extensively studied for their effects on nutrient uptake and growth of plants. They have been reported to improve phosphorus and micronutrient uptake and to increase desiccation tolerance of colonized plants. Colonization of plant roots by vesicular - arbuscular mycorrhizal fungi can also reduce adverse effects of plant stresses and hence increases crop yields.

Trichoderma spp. has been reported to show growth promotion effects on plants. This growth promotion effect was reported to be associated with the production of growth regulating factors by the Trichoderma spp.

The purpose of this experiment was to compare Promot, a product containing Trichoderma spp., and VAM on their effect on bean growth.

Material and Methods

Greenhouse experiment was conducted in Ventura, California in 1993. Promot Powder containing Trichoderma harzianum at 2.0×10^8 conidia/g and Trichoderma koningii 3.0×10^8 was obtained from JH Biotech, Inc and Mycorrhizal fungi sample obtained from Dr. Ted St. John, of Tree of Life Nursery. Randomized Complete Block design was employed with 7 treatments and 4 replications. Soils obtained from a vegetable farm were air dried and crushed to pass a 2 mm screen. Twenty eight 20 cm pots were filled with the air dried soil at 3 kilograms of soil per pot. The treatments include the following:

Treatment	Mycorrhizal Fungi (g/pot)	Promot (g/pot)
M1	3	-
M2	6	-
M1P1	3	3
M2P2	6	6
P1	-	3
Vermiculite	-	-
Control	-	-

Mycorrhizal fungi were applied at a depth of 4 cm below soil surface to increase colonization of VAM on roots. Promot Powder was mixed with seeds previously moistened with distilled water. Since the sample of Mycorrhizal fungi contained vermiculite a treatment using vermiculite was employed as a reference. Vermiculite was applied as the same procedures as the Mycorrhizal fungi. Eight bush bean seeds were planted in each pot. After germination, the seedlings were thinned to 4 plants per pot.

Seeds were planted on August 28, 1993. Plant heights were measured at 25 and 48 days after germination. At 48 days after germination plants were cut at the soil surface, weighed for fresh weight, dried in an oven at 75°C for 24 hours and the weight was recorded as dry matter yield.

Results and Discussion

Plant heights measured at 25 and 48 days after germination for each pots and the average height for each treatment are shown in Tables 1 and 2, respectively. Analysis of variance of the plant heights are shown in Tables 3 and 4. There is no significant difference on plant heights among the treatments measured on both 25 and 48 days after germination.

Table 5 shows the fresh weights of plants measured at 48 days after germination and Table 6 shows the analysis of variance for the fresh weight. There is no significant difference among the treatments of M1, M2, M1P1, M2P2 and P1. Treatment of Promot (P1) alone significantly increased the fresh weight of bean plants over control. There is no significant increase in fresh weight with treatments of M1, M2, M1P1 and M2P2. Vermiculite alone does not significantly increase the fresh weight of bean plants.

The dry matter yields for all the treatments are shown in Table 7 and the correspondent analysis of variance is shown in Table 8. The results are similar to those of the fresh weight.

The results indicate that Trichoderma spp. in the form of Promot may exert similar growth promotion effect as of Mycorrhizal fungi. Combination of Mycorrhizae fungi and Promot does not result in additive growth promotion effect.

Table 1. Plant heights of bean plants measured at 25 days after germination.

	Plant Height (cm)				
Treatment	1	2	3	4	Average*
M1	20.0	18.8	19.5	16.8	18.8 ns
M2	18.8	20.1	20.1	14.7	18.4 ns
M1P1	18.1	18.8	20.8	16.8	18.6 ns
M2P2	19.0	21.0	19.1	19.0	19.5 ns
P1	20.3	17.0	18.3	18.5	18.5 ns
V	20.0	22.3	18.3	12.0	18.2 ns
Control	17.8	19.1	16.6	17.3	17.7 ns

* ns: Not statistically significant

Table 2. Plant heights of bean plants measured at 48 days after germination.

Treatment	Plant Height (cm) 1	2	3	4	Average*
M1	30.6	30.4	32.3	28.6	30.5 ns
M2	30.1	30.4	33.2	34.8	32.1 ns
M1P1	29.0	35.1	31.6	31.2	31.7 ns
M2P2	26.4	36.0	29.8	27.3	29.9 ns
P1	30.0	30.3	31.3	29.1	30.2 ns
V	29.5	31.5	27.8	24.3	28.3 ns
Control	29.1	26.8	29.8	25.7	27.9 ns

* ns: Not statistically significant

Table 3. Analysis of variance for plant heights measured at 25 days after germination.

Source of Variation	df	SS	MS	F
Block	4-1=3	42.20	14.07	4.09 *
Treatment	7-1=6	7.61	1.27	0.37 ns
Error	18	61.99	3.44	
Total	27	111.80		

* Significant at $P \leq 0.05$.

Table 4. Analysis of variance for plant heights measured at 48 days after germination.

Source of Variation	df	SS	MS	F
Block	4-1=3	36.20	12.00	2.09 ns
Treatment	7-1=6	61.31	10.22	1.78 ns
Error	18	103.07	5.73	
Total	27	200.38		

Table 5. Fresh weights of bean plants measured at 48 days after germination.

Treatment	Fresh Weight (g/plant) 1	2	3	4	Average*
M1	16.7	18.1	20.6	18.4	18.5 abc
M2	16.4	17.8	16.8	16.8	17.0 abc
M1P1	23.6	21.6	18.5	12.7	19.1 ab
M2P2	19.1	23.7	13.7	16.6	18.3 abc
P1	21.3	23.4	17.8	18.8	20.3 a
V	16.8	14.0	16.0	10.9	14.4 c
Control	14.8	18.2	16.4	12.9	15.6 bc

* Means in a column not followed by a common letter differ significantly ($p \leq 0.05$) as determined by DMRT.

Table 6. Analysis of variance of bean fresh weight.

Source of Variation	df	SS	MS	F
Block	4-1=3	69.42	23.14	3.58 *
Treatment	7-1=6	101.82	16.97	2.63 *
Error	18	116.29	6.46	
Total	27	287.53		

* Significant at ($p \leq 0.05$)

Table 7. Dry matter yields of bean plants measured at 48 days after germination.

Treatment	Dry Matter Yield (g/plant) 1	2	3	4	Average*
M1	2.61	2.86	3.50	2.94	2.98 ab
M2	2.75	2.76	2.68	2.68	2.72 ab
M1P1	3.70	3.60	2.88	1.90	3.02 ab
M2P2	3.34	3.83	2.80	2.20	3.04 ab
P1	3.78	3.63	2.83	3.00	3.31 a
V	2.06	3.12	2.69	1.47	2.34 b
Control	2.30	2.76	2.66	1.89	2.40 b

* Means in a column not followed by a common letter differ significantly ($p \leq 0.05$) as determined by DMRT.

Table 8. Analysis of variance of bean dry matter yield.

Source of Variation	df	SS	MS	F
Block	4-1=3	3.15	1.050	5.39 *
Treatment	7-1=6	3.09	0.515	2.64 *
Error	18	2.51	0.195	
Total	27	9.75		

* Significant at ($p \leq 0.05$)