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Influence of treated phosphate rock on growth parameters of Banana seedlings (Grand Naine)

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Abstract: Phosphate rock is a cheap source of P, but cannot be used directly as a soil amendment because of its poor water solubility. However, the bioavailability of PR can be enhanced composting and/or through use of specific bio inoculants. So, greenhouse experiment was conducted to study the effectiveness of bio available phosphorus on growth of Banana seedlings (Grand nane) which was taken as an indicator plant to represent fruit type. Results indicated that, the application of compost treated with Al-Oroba phosphate rock at a rate of 10 and 20% increased the shoot fresh weight to 35.90 and 45.28 g/plant as compared with single superphosphate which gave 17.90 g/plant fresh weight after 75 days of growth. Generally, mixing of different phosphocompost with *mycorrhizae* in sandy soil significantly increased the shoot dry weight of banana seedlings than phosphocompost without *mycorrhizae* in most growth periods of plant. The results revealed that using different phosphocomposts with *mycorrhizae* significantly increased number of leaves than phosphocompost without mycorrhizae in most growth periods of plant. In addition, the use of different phosphocomposts with mycorrhizae (AM) significantly increased plant height compared to phosphocompost free of AM in different growth periods of plant. Results concluded that, phosphocompost 20% El-Sebaiya with bacteria followed by phosphocompost 20% Al-Oroba with bacteria and inoculated with mycorrhizae was the best in promoting growth of Banana seedlings.
Keywords: rock phosphate, compost, mycorrhizae, Banana seedlings

Introduction

Banana is one of the most important and popular fruit crops in Egypt for its high nutritive value; it may be consumed either fresh or processed into juice, banana puree, flour, dried catsup, vinegar and as a good source of vitamin B6, potassium and carbohydrate. In Egypt, the total area of banana increased to 55000 feddan in 2009 season produced 1,100,000 tons with average of 20 tons /feddan according to the latest statistics of , FAO (1). Banana is always referred to as a gross feeder and requires large amounts of nitrogen and potassium followed by phosphorus, calcium and magnesium to maintain high yields. These nutrients must be replenished every year through different nutrient sources including organic manures, mineral fertilizers as well as bio-fertilizers in order to maintain soil fertility and to permit continuous production. A thorough knowledge of the critical levels of different nutrient elements, time and method of application of nutrients is essential to get better growth, yields and also to maintain optimum nutrient balancing, a prerequisite enhancing nutrient use efficiency (2).

In Egypt phosphate ore reserves are present in three main localities namely; Nile valley, new valley in western desert, and the eastern desert along the red sea coast. Currently, newly discovered phosphate ores are being mined from Nile valley areas mainly for exportation and partially for local production of fertilizers (3).

The phosphate deposits in Egypt lie between latitudes 23° 10 – 30° 50′ N, whereas the payable zone lies between latitudes 24° 30′ – 26° 50′ N. They extend longitudinally from the Red Sea Coast to El Dakhla Oases. Egypt has about 4 percent of the world phosphate reserves (2.78 billion tons), and produces about 3 percent of the world phosphate production (about 6 million t/y)(4).

The application of phosphorien resulted in an increase in the mobilizable fraction of phosphorus from the phosphate rock and are important in the rhizosphere and provide many benefits to plants, especially enhanced mineral nutrient acquisition, (5). Concerning the effect of mycorrhizae on enhancing plant growth, the interaction between Abu Tartur PR accompanied with different bacteria, *Mycorrhiza*+ compost or chicken manure, led to highly significant increase in the shoot dry matter, concentration, the uptake and utilization efficiency of phosphorus and rare earth elements by Trifolium Pratense (6). Preparation of PR enriched compost was based on the concept of solubilization of insoluble PR into plant available form (water and citrate soluble forms) during the process of composting. Besides the positive effect of organic fertilizer on soil structure that lead to better root development increasing nutrient uptake. Compost is containing not only slow release nutrients but also prevents the loss of chemical fertilizers through identification, volatilization and leaching by binding to nutrients (7).

The inoculation with bacteria *Bacillus amyloliquefaciens*+ *Mycorrhiza*as well as with the combination of compost has a beneficial role for increasing the shoots dry weight of wheat plants and their uptake and utilization efficiency of phosphorus (8). Furthermore, the using of phosphorus fertilization and/or effective microorganisms as a bio-fertilizer increased all studied vegetative growth characters including plant height. In field trials performed in southern Egypt, the highest significant effect on wheat (*Triticum aestivum* L.) yield and phosphorus content was observed when seeds were inoculated with a mixture of the AM fungus Glomuscon strictum with two Egyptian fungal isolates Aspergillus niger and Penicillium citrinum that solubilize phosphate rock, (9). This research work aimed to provide sound guidelines for direct application of phosphate rock as compared to bio available P and its effects on growth of banana seedlings.

Materials and Methods

a) Phosphate rock samples

The phosphate rock samples used in this study were collected from El Sebaiya, Nile Valley (East and West) and Al-Oroba (Western Desert). These PR types represent the most dominant commercial phosphate used in agricultural lands in Egypt. Single superphosphate fertilizer was obtained from Abu Zabal Chemical and Fertilizers Company, represents the control treatment applied in this work. The chemical properties of these phosphate types were analyzed and presented in Table (1).

Table 1: Main chemical composition of rock phosphate samples (wt, %) used in the experiment

PR Location	P_2O_5	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	SrO	TiO_2
El Sebaiya	22.6	9.58	0.72	2.47	47.6	0.23	0.61	0.06	0.24	0.04
Al-Oroba	24.2	14.9	0.98	3.17	43.7	0.33	1.13	0.08	0.22	0.07

b) Biofertilizer

The strains (*Bacillus megaterium*) as phosphate solubilizing bacteria obtained from microbial culture collection of the Agricultural Microbiology Dept. NRC, Cairo, Egypt. The applied *mycorrhizal* inocula consisted of root, hyphae, spores and growth media from a pot culture of onion plants colonization with Glomusmosseae NRC31 and G. fasciculatum NRC15 were originally isolated from Egyptian soils and multiply on peat: vermicolite: perlit, (10). The inculum material contained 275 spores g^{-1} on oven dry bases in addition to the infected roots pieces.

c) Soil sampling

A surface soil sample (0-30 cm) was collected from El-Katta Giza to represent sandy soil. The physicochemical properties of the soil were determined as shown in Table (2).

d) Organic media preparation

Peanut shells (PS) and chicken manure which were collected from Kerdasaa, Giza governorate and imported peat, were air dried and crushed. The peanut was composted with El-Oroba and El-Sebaiya phosphate rock (PR) at 10, 20 and 30%, as rates of application based on weight of peanut shells, well incorporated and incubated for 4 months under aerobic conditions to be decomposed. Distilled water was added daily to maintain the moisture level at 50% of water holding capacities. The main chemical analysis of the organic media is shown in Table (2).

Table 2. Some chemical characteristics of soil and organic media used in the experiment

Sand %	Silt %	Clay %	Tex. Class	pH 1:2.5	EC dS/m	CaCO3 %
79.8	5.85	14.32	Sandy	7.61	1.22	0.93
Available nutrients in soil (ppm)			DTPA-extractable micronutrients in soil (ppm)			
N	P	K	Fe	Mn	Zn	Cu
0.04	2.1	88	1.6	0.82	0.88	0.45
Organic media used		OC %	Total N %	C/N ratio	pH 1:10	EC dS/m
Peanut shells		35.15	0.75	46.86	6.95	0.22
Chicken manure		51.90	2.73	19.00	5.50	1.00

e) Greenhouse experiment

Greenhouse work was conducted during (2012-2013). Banana (Grand nane) was taken as an indicator plant to represent fruit type. Plastic pots with 25 cm diameter and 35 cm height were filled with five kg 1:2 (media: soil). Pots were arranged in split plot design with three replicates for each treatment. The treatments involved in the green house experiment presented in Table (3). The applied to the experiment with and without Mycrrohyzae The pots were planted with banana seedlings and irrigated daily for 15 minutes by using drip irrigation system with discharge emitter 2L/h (0.5L/pot/day) for 5 days per week. After 75 and 150 days, plant samples were taken from each pot and washed with tap and distilled water and oven dried at 70^{0} C. Fresh and dry weight, plant height (cm), stem diameter (cm), number of leaves/ plant, in all plants were recorded and prepared for statistical analysis. The treatments involved in the green house experiment as follows in Table (3).

Table 3: The phosphate rock treatments involved in this experiment

Code	Contents
CO 10%	10 Kg Al-Oroba PR + 10 Kg Chicken manure + 80 kg Peanut shell
CO 20%	20 Kg Al-Oroba PR + 10 Kg Chicken manure + 70 kg Peanut shell
CO 30%	30 Kg Al-Oroba PR + 10 Kg Chicken manure + 60 kg Peanut shell
CO 20%+B	20 Kg Al-Oroba PR + 10 Kg Chicken manure + 70 kg Peanut shell + PSB
Al-Oroba	10 Kg Al-Oroba PR
CS 10%	10 Kg El-Sebaiya PR + 10 Kg Chicken manure + 80 kg Peanut shell
CS 20%	20 Kg El-Sebaiya PR + 10 Kg Chicken manure + 70 kg Peanut shell
CS 30%	30 Kg El-Sebaiya PR + 10 Kg Chicken manure + 60 kg Peanut shell
CS 20%+B	20 Kg El-Sebaiya PR + 10 Kg Chicken manure + 70 kg Peanut shell + PSB
El-Sebaiya	10 Kg Al-Oroba PR
CSSP+B	20 Kg SSP + 10 Kg Chicken manure + 70 kg Peanut shell + PSB
CSSP	20 Kg SSP + 10 Kg Chicken manure + 70 kg Peanut shell
SSp	20 Kg single super phosphate (SSP)
CPS	Compost Peanut shell
Petmos	Petmos

PR: phosphate rocks, PSB: phosphate solubilizing bacteria

f) Statistical analysis

Split plot design with three replicates for each treatment was used. The statistical analysis for data was done using analysis of variance as described by (11).

Results and Discussion

1) Shoot and root fresh and dry weight

The effects of different treatments of phosphocompost on shoot and root fresh weight of banana seedlings are presented in Table (4 and 5). As shown in the Table 4, the application of phosphocompost with different doses resulted in a significant increase in shoot fresh weight of banana seedlings at different growth stages; however its effect depends on the type of PR. The application of compost treated with Al-Oroba phosphate rock at rate 10 and 20% increased the shoot fresh weight to 35.90 and 45.28 g/plant as compared with single superphosphate which gave 17.90 g/plant fresh weight after 75 days of growth. Increasing the rate of phosphate rock up to 30%, led to decrease the shoot fresh weight to 40.37 g/plant, it should be mention that the trend was also observed with El-Sebaiya phosphate rock treated compost, the averages of this type were 40.42, 58.20 and 45.65 g/plant at the rates of 10%, 20% and 30%, respectively. The phosphocompost fortified with bacteria enhanced the shoot fresh weight (SFW) of banana seedlings. The averages of increase compared with single superphosphate were 59.97, 61.36 and 45.24 g/plant for compost enriched with 20% of Al-Oroba inoculated bacteria, phosphocompost enriched with 20% El-Sebaiya and also inoculated with bacteria, phosphocompost 20% single superphosphate with bacteria, respectively, at 1st growth stage (75 days). Generally, mixing of different phosphocompost with mycorrhizae is used in sandy soil; there are significant increases in the fresh weight of banana seedlings than phosphocompost mixed without mycorrhizae through the different growth periods of plant studied.

Table 4: Effect of treated phosphate rock on shoot fresh wt (g/plant)

Treatments	75 days			150 days		
	Without M	With M	Mean	Without M	With M	Mean
CO 10%	32.65	39.14	35.9	164	236.6	200.3
CO 20%	38.73	51.83	45.28	184.2	283.5	233.9
CO 30%	36.82	43.92	40.37	158.3	264.7	211.5
CO 20%+B	51.12	68.23	59.97	216	322.2	269.1
Al-Oroba	9.71	13.2	11.45	80.49	195.6	138
CS 10%	34.23	46.62	40.42	184	246.1	215.1
CS 20%	49.08	67.33	58.2	242.1	318.7	280.4
CS 30%	41.17	50.13	45.65	171.3	242.7	207
CS 20%+B	51.7	71.62	61.36	244	387.2	315.6
El-Sebaiya	8.32	12.17	10.24	37.54	202.5	120
CSSP+B	40.17	50.32	45.24	194.7	266.8	230.7
CSSP	36.72	44.17	40.44	189.1	250.2	219.7
SSp	13.2	22.6	17.9	91.61	188.6	140.1
CPS	30.82	37.52	34.17	129.9	212.6	171.3
Petmos	39.23	42.13	40.68	202.3	267.9	235.1
Mean	34.24	44.06		166	259.1	
LSD M	0.06414			2.315		
LSD T	0.1097			2.58		
LSD Inter	0.1552			3.649		

M:Mycorrhizae

Results in Table (5) indicated that application of composts treated with different doses of phosphate rock during the composting processes, resulted in a significant increase in the root fresh weight of banana seedlings at different growth stages.The application of compost treated with Al-Oroba phosphate rock at rates 10 and 20%, increased the root fresh weight to 12.34 and 14.99 g/plant compared with single superphosphate which gave 5.78 g/plant. Increasing the rate of phosphate rock up to 30% decreased the root fresh weight to 13.78 g/plant. Again, it should be documented that the same trend was also observed with El-Sebaiya phosphate rock. After 75 days of growth, the averages of root weight of this type were 20.99, 22.58 and 21.04g/plant at rates of 10, 20 and 30%, respectively. Phosphocompost fortified with bacteria without AM enhanced the root fresh weight of banana seedlings. As shown in the Table (5), at first growth stage (75 days) the averages value for all treatments enhanced with bacteria i.e. phosphocompost 20% Al-Oroba, phosphocompost 20% El-Sebaiya and phosphocompost 20% single superphosphate was 17.54, 23.42 and 12.83 g/plant as compared with single superphosphate which gave only 5.78 g/plant. In the second growth stage (150 days), application of compost treated with Al-Oroba and El-Sebaiya PR at rate 20%, was effective on the root fresh weight, the average of weight was 22.57 and 31.76 g/plant as compared with single superphosphate which gave 16.65g/plant. After 150 days of plantation, the root fresh weight RFW of banana seedlings in soil amended with 20% El-Sebaiya PR with bacteria and 20% Al-Oroba phosphate rock with bacteria were increased to 35.17 and 24.09 g/plant, respectively as compared to single superphosphate (16.65 g/plant). These data were in agreement with (12) who reported that the highest values of growth parameters were recorded in the case of phosphate ore combined with FYM + phosphate dissolving bacteria. Increasing the cultivation time to 150 days significantly increased both shoot fresh weight (SFW) and root fresh weight (RFW) in cultivated banana seedlings. In the compost enriched with El-Sebaiya and fortified with bacteria, SFW after 75 days of cultivation was 61.36 g, this value increased to 315.60 g after 150 days of cultivation. RFW after 75 days of cultivation was 23.42 g, this value increased to 35.17 g after 150 days of cultivation.This significant increase may due to solubulization of PR in the soil with decreasing of pH value, both parameters enhanced P uptake and promote growth of cultivated banana and subsequently increased both SFW and RFW. The solubilization of insoluble phosphate by microorganisms is mainly preceded by production of organic acid, chelating substance and other products of microbial activity affect of phosphate (13).

Table 5: Effect of treated phosphate rock on root fresh wt (g/plant)

Treatments	75 days			150 days		
	Without M	**With M**	**Mean**	**Without M**	**With M**	**Mean**
CO 10%	11.75	12.93	12.34	12.37	23.75	18.06
CO 20%	13.66	16.33	14.99	15.68	29.46	22.57
CO 30%	12.73	14.83	13.78	13.88	27.73	20.81
CO 20%+B	14.73	20.35	17.54	18.61	29.57	24.09
Al-Oroba	4.4	6.133	5.267	12.72	19.5	16.11
CS 10%	20.17	21.82	20.99	18	29.77	23.89
CS 20%	20.3	24.86	22.58	22.21	41.32	31.76
CS 30%	18.94	23.14	21.04	21.83	33.8	27.81
CS 20%+B	22.23	24.61	23.42	26.14	44.2	35.17
El-Sebaiya	2.133	4.14	3.137	8.8	21	14.9
CSSP+B	12.23	13.43	12.83	18	24.72	21.36
CSSP	7.3	11.62	9.462	16	23.16	19.58
SSp	5.427	6.133	5.78	11.5	21.8	16.65
CPS	6.1	12.23	9.167	14.22	17.16	15.69
Petmos	12.92	14.14	13.53	19.23	22.2	20.72
Mean	12.33	15.11		16.61	27.28	
LSD M	0.06414			1.402		
LSD T	0.01157			1.24		
LSD Inter	0.1636			1.753		

M:Mycorrhizae

The effects of the investigated treatments on shoot dry weight of banana seedlings are presented in Fig. (1). It was noticed that application of composts treated with different doses of phosphate rock during the composting processes resulted in a remarkable increase in the shoot dry weight of banana seedlings at different growth stages. Results indicated that application of compost treated with Al-Oroba phosphate rock at rate 10% and 20% increased the shoot dry weight to 3.26 and 4 g/plant as compared with single superphosphate 1.55

g/plant. Increasing rate of phosphate rock up to 30% decreased the shoot dry weight to 3.69 g/plant, the trend goes the same with El-Sebaiya phosphate rock and the averages were 3.73, 4.83 and 4.12 g/plant at rate 10%, 20% and 30% with El-Sebaiya phosphate rock, respectively. The application of composts treated with different doses of phosphate rock during the composting processes resulted in a remarkable increase in the root dry weight, of banana seedlings at different growth stages. Results indicated that application of compost treated with Al-Oroba phosphate rock at rate 10% and 20% increased the root dry weight to 0.6 and 0.84 g/plant as compared with single superphosphate 0.56 after 75 days. Increasing rate of phosphate rock up to 30% decreased the root dry weight to 0.75, the trend goes the same with El-Sebaiya phosphate rock. The averages were 0.93, 1.28 and 1.17 g/plant at rate 10%, 20% and 30% with El-Sebaiya phosphate rock, respectively. Phosphocompost enriched with FYM was most effective in increasing phosphorus availability in red soil and increasing dry matter yield of maize plants (14).

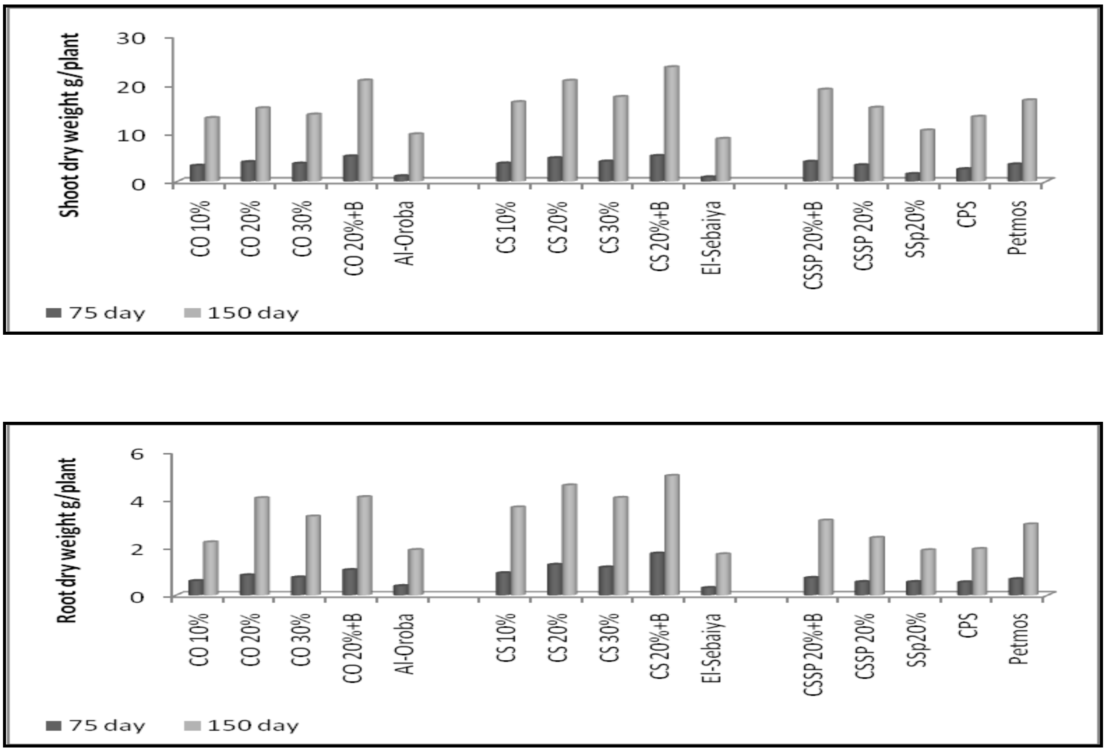

Fig.1. Effect of treated phosphate rock on shoot and root dry weight (g/plant)

The comparison between compost enrich with PR weather El-Sebaiya or Al-Oroba applied to soil and single super phosphate applied individually to soil or incorporated with compost and fortified with bacteria, results showed that in all cases shoot dry weight (SDW) of both phosphocompost 20% Al-Oroba with bacteria and phosphocompost 20% El-Sebaiya with bacteria gave the highest values than SSP. Numerically the almost the same weight i.e. 5.19 and 5.27 g were obtained in both Al-Oroba and El-Sebaiya PR, meanwhile only 4.07 g was observed in phosphocompost single super phosphate with bacteria at 75 days, worth to mention that according to LSD the difference between PR types and SSP is quite significant. Although the same trend was observed in SDW, the results indicated the significance of application the AM on SDW regardless the time of cultivation. After 150 days SDW was 20.80g in phosphocompost 20% Al-Oroba with bacteria, the same treatment gave only 13.2 g without AM, the effect of AM in El-Sebaiya type was also observed with significant variations compared to single superphosphate. Generally, mixing of different phosphocompost with mycorrhizae in sandy soil significantly increased the shoot dry weight of banana seedlings than phosphocompost without mycorrhizae in most growth periods of plant. These results are in agreement with those of (15) who explained the increase in uptake of nutrients by Mycorrhiza occurs in two mechanisms. The first enhanced the uptake by enlarging the absorption area of root system with extra radical hyphae. The second mechanism increased the uptake of nutrient due to the increase uptake of water. (8), found that mycorrhiza increased percent of root infected up to 40 % and 50 % with Bacillus licheniformis and Mycorrhiza, bacteria Bacillus amyloliquefaciens and mycorrhiza, respectively. The effect of AM fungi on dry matter was more pronounced in aerial biomass than root biomass because of arbuscularmycorrhizae colonization can cause a proportionally greater allocation of carbohydrates to the shoot than root tissues, (16). The interaction among PR, micro-organisms and chicken manure or compost decreased the percent of root infected by AM., this result agreed with those obtained by (17) who demonstrated that plant response to organic amendment was strongly correlated to changes in mycorrhizae colonization level and specific population of species, thus suggesting that the differential response to organic manure is related to the specific isolates of AM fungus.

2) Number of leaves

The effects of different phosphocompost on the number of leaves at different growth periods of Banana seedlings are shown in Fig. (2). Results revealed that using different phosphocomposts with mycorrhizae significantly increased number of leaves than phosphocompost without mycorrhizae in most growth periods of plant. Non significant increase in number of leaves was observed between different phosphocompost (10, 20 and 30% Al-Oroba rock and 10, 20 and 30% El-Sebaiya rock) at 75 and 150 days. The increase in number of leaves might be due to the higher vegetative growth of VAM treated plants which may be due to the growth promontory effect of VAM that improves the phosphorus availability and thereby causing higher protein synthesis resulting in more morphological growth. The VAM compensations at reduced P application were very much effective in increasing the number of leaves per plant, (18) and (19).

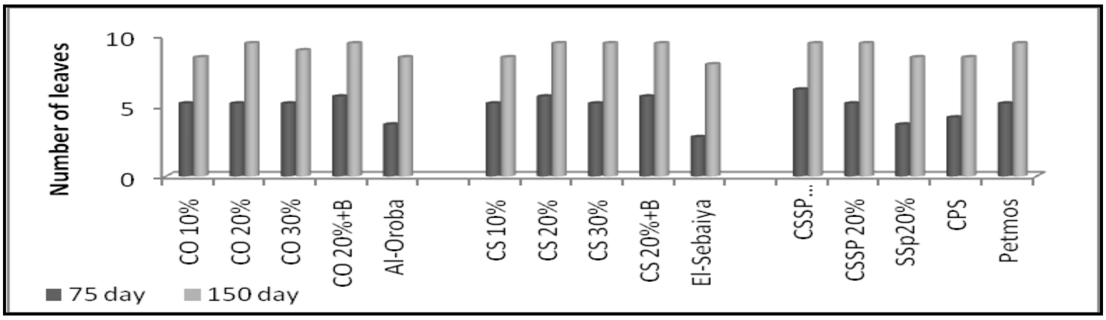

Fig. 2. Effect of treated phosphate rock on number of leaves

3) Plant height (cm)

The effects of phosphocompost on plant height at different growth periods of banana seedlings are shown in Table (6). Data reveal that in general as the plant growth increased, the plant height also increased.

After 75 days results indicated that application of compost treated with Al-Oroba phosphate rock at rate 10% and 20%, increased plant height to about 17 and 19 cm compared with single superphosphate which gave 14 cm. However, increasing rate of PR up to 30% decreased plant height to 18 cm; the same trend was observed in El-Sebaiya phosphate rock with averages values 18, 21 and 18 cm at rate 10%, 20% and 30%, respectively, compared with El-Sebaiya phosphate rock with bacteria which gave 22 cm as a mean value. Phosphocompost incorporated with bacteria enhanced the plant height of banana seedlings plants. Data in the same table showed that at the first growth stage (75days), the average values of increase were 20, 22 and 19 cm for Al-Oroba phosphocompost, El-Sebaiya phosphocompost and SSP phosphocompost, respectively as compared with individual single superphosphate which gave 14 cm. In the second growth stage (150 days), application of compost treated with El-Sebaiya phosphate rock at rate 20% has more pronounced efficient on plant height with average of increase reached to about 48 cm as compared with single superphosphate which gave 24 cm, with 20% El-Sebaiya phosphate rock and 20% Al-Oroba phosphate rock incorporated with bacteria. Phosphocompost with single superphosphate increase again the plant height to about 51, 48 and 41 cm, respectively. These results agreement with (20) who found that application of bio-fertilizers to increase the plant height by promoting plant growth regulators.

Table 6: Effect of treated phosphate rock on plant height (cm) of Banana

Treatments	75 days			150 days		
	Without M	With M	Mean	Without M	With M	Mean
CO 10%	16	17	17	33	36	34
CO 20%	17	20	19	42	46	44
CO 30%	17	19	18	35	38	37
CO 20%+B	18	22	20	43	53	48
Al-Oroba	10	15	12	22	25	24
CS 10%	16	19	18	36	38	37
CS 20%	18	23	21	44	52	48
CS 30%	17	19	18	39	43	41
CS 20%+B	19	25	22	47	55	51
El-Sebaiya	9	11	10	19	22	20
CSSP+B	18	20	19	41	42	41
CSSP	18	18	18	38	40	39
SSp	13	14	14	24	25	24
CPS	16	17	17	13	29	21
Petmos	17	17	17	35	37	36
Mean	16	18		34	39	
LSD M	0.04057			0.4046		
LSD T	0.1319			0.8861		
LSD Inter.	0.1865			1.253		

M:Mycorrhizae

In addition, the use of different phosphocomposts with mycorrhizae (AM) significantly increased plant height compared to phosphocompost free of AM in different growth periods of plant. Again results showed that after 75 days phosphocompost 20% El-Sebaiya with bacteria gave a significant increase in plant height reached to 22 cm compared to other treatments applied in the study. Inoculation with AM, in all cases, increased plant height for all treatments applied. Data in the same table showed that after 150 days, in phosphocompost 20% El-Sebaiya with bacteria treatment plant height was 47 cm without AM application, this value increased to 55 cm with AM application.The same results are in a good harmony with those obtained by (21). Who noticed significant increase in enzyme activities in soil amended with microorganisms, led to increase different plant parameters involving plant height. Moreover, these amendments have been shown to be highly efficient in association with arbuscular mycorrhizae.

4) Stem diameter

The effects of phosphocompost on stem diameter at different growth periods of banana seedlings are shown in Table (7). Data reveal that as the plant growth increased, stem diameter increased. Generally, the obtained results indicated that the use of different phosphocomposts with mycorrhizae significantly increased stem diameter than phosphocompost without mycorrhizae in most growth periods of plant. Also the results show significant differences in stem diameter between different phosphocomposts. At 75 days results indicated that application of compost treated with Al- Oroba phosphate rock at rate 10% and 20% increased the stem diameter to 6.8 and 7.7 cm as compared with single superphosphate 4.7 cm. Increasing the rate of phosphate rock up to 30% decreased the stem diameter to 7.3 cm, the trend goes the same with El-Sebaiya phosphate rock and the averages were 6.9, 7.7 and 7.2 cm at rate 10%, 20% and 30% El-Sebaiya phosphate rock, respectively. Phosphocompost incorporated with bacteria enhanced the stem diameter of banana seedlings. Averages of increase were 7.8, 8.1 and 7.4 cm for phosphocompost 20% Al-Oroba with bacteria, phosphocompost 20% El-Sebaiya with bacteria and phosphocompost with single superphosphate as compared with single superphosphate 4.7 cm, respectively, at first growth stage (75 days). Data also revealed that at the second growth stage (150 days), application of compost treated with El-Sebaiya phosphate rock at rate 20% has more pronounced effect on the stem diameter. An average of increase was 15.9 cm as compared which single superphosphate 9.7 cm. The stem diameter showed that compost treated with 20% El-Sebaiya phosphate rock with bacteria and 20%

Al-Oroba phosphate rock with bacteria increase again the stem diameter reached to 15.9 and 15.4 cm, respectively as compared with single superphosphate. Composting of rice straw plus rock phosphate inoculated with aspergillums and FYM can be successfully utilized as alternative organic rich P fertilizer for increasing crop production (22).

Table 7: Effect of treated phosphate rock on stem diameter (cm) of Banana

Treatments	**75 days**			**150 days**		
	Without M	**With M**	**Mean**	**Without M**	**With M**	**Mean**
CO 10%	6.4	7.1	6.8	12.6	13.5	13
CO 20%	7.2	8.2	7.7	14.3	16.3	15.3
CO 30%	7.1	7.5	7.3	10.8	12.8	11.8
CO 20%+B	7.4	8.2	7.8	14.2	16.6	15.4
Al-Oroba	4.1	5.1	4.6	9.5	10.6	10.1
CS 10%	6.7	7.1	6.9	13.1	14.3	13.7
CS 20%	7.2	8.1	7.7	14.2	17.7	15.9
CS 30%	7.1	7.3	7.2	12.7	14	13.4
CS 20%+B	7.7	8.4	8.1	14.3	17.6	15.9
El-Sebaiya	3.4	4.1	3.8	6.6	8.5	7.6
CSSP+B	7.1	7.6	7.4	11.3	13.5	12.4
CSSP	6.1	6.4	6.3	10.5	13.4	12
SSp	4.6	4.7	4.7	8.8	10.5	9.7
CPS	5.4	6.5	6	10.4	12.6	11.5
Petmos	7.1	7.2	7.2	13.2	13.5	13.4
Mean	6.3	6.9		11.8	13.7	
LSD M	0.0907			0.7067		
LSD T	0.1213			0.592		
LSD Inter	0.1715			0.8372		

M:Mycorrhizae

Conclusion

Application of phosphate rock combined with compost and mycrrohyzae were more benefits and has pronounced effects on the growth factors of banana seedlings during the growing periods.

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