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Biofertilizers and Phosphorus Foliar Application Technique in Relation to Growth and Yield of Two Sweet Sorghum Varieties

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BECAUSE of the shortage and high costs of chemical fertilizers as well as the pollution factor attentions have been focused on bio-fertilizers and foliar spray technique. So a field trial was conducted during the two successive summer seasons, 2004 and 2005 at Sabahia Agric. Res. Station at Alexandria Governorate to illustrate the effect of the tested variables (varieties, number of foliar application of phosphorus combined with some bio-fertilizers) on sweet sorghum yield and its quality.

The results showed almost significant differences in plant growth, yield and its components between the two varieties. The highest gross stalk, forage, stripped stalk, bagasse, juice and syrup weights as well as plant height, stalk diameter and P content in juice and the extraction % of juice and syrup as well as purity % were obtained for clear variety. While quality of juice (sucrose and T.S.S., percentages) and number of internodes were higher in Mn 4490 variety.

Data also found that triple sprays with phosphorus was more effective than twice sprays for the above mentioned characters and the increases were generally significant.

Also data showed that all tested biofertilizers (phosphate dissolving bacteria (PDB) or mycorrhizal inoculation (VAM) or mixture of them) induced increases in growth, yield components and quality of juice compared with the control (untreated seeds) or seeds received the recommended doses of NPK (soil treatment). The combination of PDB + VAM was the most superior treatments followed by VAM then PDB while uninoculated and soil treatment came the last.

Statistically, the double or triple interactions reached sometimes the significancy. Using biofertelizers combined with 3 sprays with mineral phosphorus in clear plants was more superior for growth, yield and extraction % of juice and syrup as well as purity % and P content of juice. When Mn 4490 plants treated with the same treatments gave more improve in juice quality (sucrose and T.S.S. percentages).

Keywords : Sweet sorghum, Varieties, Phosphorus, Mycorrhiza.

unfertilized one. Also, Nassar *et al.* (2005) concluded that, foliar spraying with single superphosphate at level of 2% raise the efficiency of the added fertilizers, save the use amounts comparing with soil application, give the highest resultant and attain the best quantity and quality of yields.

The present study was carried out to examine the effect of seed inoculation with mycorrhiza or phosphate dissolving bacteria in the presence of foliar spray of P fertilization on improving growth and yield of two sweet sorghum varieties. Moreover, investigating if we can use these bio-fertilizer combination as a biological technique to reduce the mineral fertilizers dose in order to reduce the production cost and reduce the environmental pollution.

Material and Methods

The materials consisted of two sweet sorghum varieties, Clear and Mn 4490 which were grown in two successive summer seasons, *i.e.*, 2004 and 2005 at Sabahia Agric. Res., Station at Alexandria Governorate to study the ability of some bio-fertilizers (vascular arbuscular mycorrhiza (VAM) and/or phosphate dissolving bacteria (PDB) and combined with twice or triple sprays of phosphorus to improve sweet sorghum yield. Soil of experimental site has sandy clay loam texture with pH 7.80 and 7.90 EC, 3.92 and 4.15.dSm^{-1}, total nitrogen 0.10 and 0.17%, available P 16.8 and 15.4 ppm , available K 335 and 318 ppm, organic matter 1.30 and 1.45 % as well as $CaCO_3$ 8.00 and 9.50 % in 2004 and 2005, respectively.

A split-split plot design with three replicates was used. Varieties were in the main plots, number of spraying of phosphourus in the sub- plots, while bio-fertilizers were distributed randomly in the sub-sub plots. Each sub-sub plot size was 10.5 m^2 which consists of 5 rows, 0.6 m wide and 3.5 m long. The mycorrhizal inoculation (VAM) was propagated on maize plant in a glasshouse for 3 months. The seed inoculation with (VAM) was done before sowing (150 g mixture of maize root with adhering soil / hill) (Menge & Timmer, 1982). Seed inoculation by phosphate dissolving bacteria (PDB) was also done before sowing.

Soil treatment with p fertilizer was performed by addition of 100 kg/fed calcium superphosphate, while, nitrogen and potassium fertilizations at the recommended dose (80 Kg N/fed. as urea and 24 Kg K_2O/fed as potassium sulphate) were added in each sub-sub plot. Sweet sorghum varieties received two sprays of 2% superphosphate after 35 and 50 days from sowing (corresponding to 16 Kg superphosphate/fed.) or three sprays of the same solution after 35, 50 and 65 days from sowing (corresponding to 24 Kg superph-osphate/fed). Irrigation and other cultural practices procedures were pereformed as usual. At plant maturity, samples were taken for analysis of some agronomic and growth characters, *i.e.*, plant height (m), number of internodes and stalk diameter (m.m), yield (ton/fed), total soluble solids (TSS) using the hand refractometer, Sucrose and P percentages were determined according to the procedure out lined by A.O.A.C.(1990). The purity of sugar was calculated as: Purity % = (sucrose % /TSS) x 100.

Extraction percentage of juice and syrup were calculated according to the following formula:

Juice extraction percentage (J.E.) % = juice yield (ton/fed) x100 / fresh weight of stalks (ton/fed).

Syrup extraction percentage (S.E.) % = syrup yield (ton/fed)x 100 / fresh weight of stalks (ton/fed).

Stripped stalks were squeezed in single press sorghum mill to obtain the juice.

The combined statistically analysis of the two successive seasons was carried according to Gomez & Gomez (1984) was performed and the treatments were compared by using LSD at 5% level probability.

Results

In general, the obtained data reflected that, the response of sweet sorghum varieties to phosphorus as foliar application or bio-fertilizer was greater than soil NPK treatment at the recommended dose.

Yield attributes, juice and syrup extractions

Yield and its compounds

Data in Tables 1 and 2 show the effect of the three factors (varieties, number of sprays with mineral phosphorus and bio-fertilizers) on yield and its components of sweet sorghum. The results illustrated that the individual three factors increased gross stalk, forage, stripped stalk, baggas, juice and syrup yields (ton/ fed) as compared to soil treatment.

a-Effect of varieties (V): Data collected in Tables 1 and 2 show that there was significant variation between Clear and Mn4490 varieties for yield and its components under study. Clear variety recorded the higher yield of gross stalk, forage, stripped stalk, bagasse, juice and syrup (ton/ fed) than Mn 4490 variety.

b-Effect of number of phosphorus sprays (N): Triple foliar sprays with mineral phosphorus at triple sprays was significantly effective in increasing gross stalk, forage, stripped stalk, bagasse, juice and syrup yields (ton/ fed) as compared with application of twice sprays.

c-Effect of bio-fertilizers (B): Inoculation with PDB or VAM individually or in mixture together increased all yield and yield components as shown in Tables 1 and 2. These increases were significant for juice and syrup yields only as compared with control (no bio-fertilizers). Inoculation with VAM was more effective than PDB for juice yield, but its effect on syrup yield was not great enough to reach the 5% level of significance. The best treatment which gave the highest values of juice and syrup yields were PDB+ VAM as compared with PDB or VAM alone.

TABLE 1*. Yield and its components (ton/fed.) of sorghum varieties as affected by bio and mineral fertilizer.

Treatments		Yield and its component (ton/fed.)											
		Gross plant			Forage			Stripped stalk			Bagasse		
Variety (V)		V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean
Soil treatment		19.3	18.2	18.8	7.75	7.51	7.63	10.5	9.6	10.1	8.17	7.91	8.04
No of sprays (N)	Biofertilizers(B)												
2	0	20.6	19.3	19.9	8.80	8.54	8.67	11.7	11.0	11.3	9.25	8.89	9.07
	PDB	21.1	20.0	20.6	8.80	8.72	8.76	12.2	11.4	11.8	9.25	9.03	9.14
	VAM	20.7	20.1	20.4	8.75	8.70	8.72	12.0	11.5	11.7	9.22	9.13	9.17
	PDB+VAM	21.6	20.6	21.1	9.21	8.89	9.05	12.4	11.5	11.9	9.62	9.10	9.36
Mean		21.0	20.0	20.5	8.89	8.71	8.80	12.1	11.3	11.7	9.34	9.03	9.19
3	0	20.6	19.7	20.1	9.04	8.71	8.87	12.0	11.3	11.6	9.41	9.08	9.25
	PDB	21.9	20.9	21.4	9.21	8.90	9.05	12.9	12.1	12.5	9.99	9.41	9.70
	VAM	22.5	21.9	22.2	9.45	9.51	9.48	13.1	12.2	12.6	9.95	9.66	9.80
	PDB+VAM	23.5	22.4	22.9	9.90	9.82	9.86	13.5	12.4	13.0	10.3	10.0	10.2
Mean		22.1	21.2	21.7	9.40	9.23	9.32	12.9	12.0	12.4	9.91	9.55	9.73
Mean of (B)	0	20.6	19.5	20.0	8.92	8.63	8.77	11.8	11.1	11.5	9.33	8.98	9.16
	PDB	21.5	20.5	21.0	9.01	8.81	8.91	12.5	11.8	12.1	9.62	9.22	9.42
	VAM	21.6	21.0	21.3	9.10	9.10	9.10	12.5	11.8	12.2	9.59	9.39	9.49
	PDB+VAM	22.6	21.5	22.0	9.56	9.35	9.46	13.0	11.9	12.4	9.95	9.57	9.76
Mean		21.6	20.6	21.1	9.15	8.97	9.06	12.5	11.7	12.1	9.62	9.29	9.46
LSD at 0.05													
Variety (V)				0.32			0.05			0.16			0.10
No of sprays (N)				0.18			0.04			0.15			0.07
Bio-fertilizers (B)				0.40			0.05			0.19			0.07
VXN				N.S			N.S			N.S			N.S
VXB				N.S			0.08			N.S			N.S
NXB				0.57			0.08			0.27			0.10
VXNXB				N.S			0.15			N.S			0.14

PDB = phosphate dissolving bacteria. V1=Clear. * Average of 2004 and 2005 growing seasons.
VAM=inoculation with mycorrhiza. V2=Mn4490.

TABLE 2*. Juice and syrup yields (ton/fed.) and extraction of juice and syrup percentages of sorghum varieties as affected by bio and mineral fertilizer.

Treatments		Yield (ton/fed.)						Extraction %					
		Juice			Syrup			Juice			Syrup		
Variety (V)		V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean
Soil treatment		2.64	2.03	2.09	0.52	0.47	0.50	20.0	20.7	20.4	4.25	4.34	4.30
No of sprays (N)	Biofertilizers (B)												
2	0	2.44	2.25	2.35	0.52	0.50	0.51	20.8	20.6	20.7	4.42	4.59	4.51
	PDB	2.66	2.44	2.55	0.55	0.51	0.53	21.8	21.4	21.6	4.54	4.49	4.52
	VAM	2.54	2.52	2.53	0.54	0.53	0.54	21.3	22.0	21.6	4.53	4.63	4.58
	PDB+VAM	2.78	2.56	2.67	0.57	0.54	0.56	22.5	22.3	22.4	4.61	4.70	4.66
Mean		2.61	2.44	2.52	0.55	0.52	0.53	21.6	21.6	21.6	4.52	4.60	4.56
3	0	2.47	2.38	2.43	0.53	0.50	0.52	20.7	21.2	20.9	4.44	4.46	4.45
	PDB	2.88	2.71	2.81	0.58	0.54	0.56	22.5	22.4	22.4	4.54	4.45	4.51
	VAM	3.16	2.78	2.97	0.61	0.56	0.59	24.2	22.8	23.6	4.68	4.60	4.64
	PDB+VAM	3.21	2.81	3.00	0.64	0.58	0.61	23.7	22.6	23.2	4.75	4.70	4.72
Mean		2.93	2.67	2.80	0.59	0.55	0.57	22.8	22.3	22.5	4.60	4.55	4.58
Mean of (B)	0	2.46	2.32	2.39	0.52	0.50	0.51	20.8	20.9	20.8	4.43	4.53	4.48
	PDB	2.77	2.58	2.67	0.57	0.53	0.55	22.2	21.9	22.0	4.54	4.47	4.51
	VAM	2.85	2.65	2.75	0.58	0.55	0.56	22.7	22.4	22.6	4.61	4.62	4.61
	PDB+VAM	3.00	2.68	2.84	0.61	0.56	0.58	23.1	22.4	22.8	4.68	4.70	4.69
Mean		2.77	2.56	2.66	0.57	0.53	0.55	22.2	21.9	22.1	4.56	4.58	4.57
LSD at 0.05													
Variety (V)				0.03			0.01			N.S			N.S
No of sprays (N)				0.03			0.01			0.33			N.S
Bio-fertilizers (B)				0.04			0.02			0.50			N.S
VXN				0.04			N.S			N.S			N.S
VXB				0.05			N.S			N.S			N.S
NXB				0.05			N.S			N.S			N.S
VXNXB				0.07			N.S			N.S			N.S

PDB = phosphate dissolving bacteria. V1=Clear . * Average of 2004 and 2005 growing seasons.
VAM=inoculation with mycorrhiza. V2=Mn4490.

d-Effect of interactions: There were no significant effects for the interaction between varieties and number of sprays of phosphorus (V x N) for yield and its components except juice yield which showed significant effect due to NxV interaction and Clear variety sprayed three times with phosphorus gave the highest juice yield. On the other hand, the interactions between number of phosphorus sprays and bio-fertilizers (N x B) were significant for yield and its components except syrup yield. From these results, it is important to mentioned that plants sprayed with P three times and grown from seeds inoculated with mixture (PDB+VAM) gave the highest values of gross stalk, forage, stripped stalk, bagasse and juice yields (ton/fed).

In addition, the interactions between varieties and bio-fertilizers (V x B) gave insignificant effects for yield and yield components except forage and juice yields. Clear variety inoculated with the mixture (PDB+VAM) was the best treatment than other (V x B) interactions. Data also, indicated that the triple interaction (VxNxB) exhibited significant effect on forage, bagasse and juice yields (ton/fed). Spraying Clear variety with mineral phosphorus three times and inoculation with (PDB + VAM) gave the highest values.

Juice and syrup extraction

Data in Table 2 show that varieties treated with foliar phosphorus and bio-fertilizers as well as their interactions insignificantly increased juice and syrup extractions with the exception of number of phosphorus sprays or bio-fertilizers for juice extraction, where the increase of juice extraction was significant for plants given triple sprays of phosphorus compared to double sprays, also when inoculated with VAM alone or mixed with PDB as compared with control (no bio-fertilizers).

Growth parameters

Data in Table 3 show the effect of individual or combined treatments or when used together on growth parameters such as plant height, stalk diameter and number of internodes. The lowest studied parameters were obtained by normal plants grown on soil application of NPK than plants sprayed with phosphorus or inoculated with bio-fertilizers.

a- Effect of varieties (V)

There were significant difference between clear and Mn 4490 varieties where, clear had higher values of plant height and stalk diameter than Mn 4490, the opposite was found for number of internodes.

b- Effect of number of phosphorus sprays (N)

Data also, indicate that plant height, stalk diameter and number of internodes showed significant difference between twice and triple sprays with phosphorus. Triple sprays had better results than twice on all parameters mentioned above.

TABLE 3*.Growth characters of sorghum varieties as affected by bio and mineral fertilizer.

Treatments		Growth characters								
		Plant height (m)			Stalk diameter (m.m)			No of internodes		
Variety (V)		V1	V2	Mean	V1	V2	Mean	V1	V2	Mean
Soil treatment		2.02	1.82	1.92	2.56	2.44	2.50	12.7	14.3	13.5
No of sprays(N)	Biofertilizers(B)									
2	0	2.08	1.95	2.02	2.65	2.54	2.59	13.5	15.8	14.6
	PDB	2.30	2.16	2.23	2.75	2.60	2.67	14.4	17.1	15.7
	VAM	2.24	2.19	2.21	2.70	2.62	2.66	14.8	16.5	15.7
	PDB+VAM	2.33	2.23	2.28	2.77	2.64	2.71	15.2	17.4	16.3
Mean		2.24	2.13	2.18	2.72	2.60	2.66	14.5	16.7	15.6
3	0	2.19	2.06	2.12	2.69	2.57	2.63	14.1	16.1	15.1
	PDB	2.38	2.28	2.33	2.81	2.67	2.73	15.4	18.5	17.0
	VAM	2.44	2.34	2.39	2.80	2.68	2.74	16.5	18.3	17.4
	PDB+VAM	2.46	2.41	2.43	2.83	2.68	2.76	16.3	18.7	17.5
Mean		2.37	2.27	2.32	2.78	2.65	2.72	15.6	17.9	16.7
Mean of (B)	0	2.13	2.00	2.07	2.67	2.56	2.61	13.8	15.9	14.9
	PDB	2.34	2.22	2.28	2.77	2.63	2.70	14.9	17.8	16.3
	VAM	2.34	2.27	2.30	2.75	2.65	2.70	15.7	17.4	16.5
	PDB+VAM	2.39	2.32	2.36	2.80	2.66	2.71	15.8	18.0	16.9
Mean		2.30	2.20	2.25	2.75	2.63	2.687	15.0	17.3	16.2
LSD at 0.05										
Variety (V)				0.06			0.01			0.14
No of sprays (N)				0.04			0.03			0.21
Bio-fertilizers (B)	VXN			0.05			0.06			0.35
VXB				N.S			N.S			N.S
NXB				N.S			N.S			N.S
VXNXB				N.S			N.S			N.S

PDB = phosphate dissolving bacteria. V1=Clear. * Average of 2004 and 2005 growing seasons.
VAM=inoculation with mycorrhiza. V2=Mn4490.

c- Effect of bio-fertilizers (B)

Inoculation with PDB or VAM separately or in a mixture together significantly increased plant height, stalk diameter and number of internodes as compared with the control. Application of PDB or VAM treatments approximately, had the same effect. The combination between them also gave significant positive effect for plant height, stalk diameter and number of internodes.

d- Effect of interactions

In spite of all parameters, *i.e.*, plant height, stalk diameter and number of internodes, tended to increase by the interactions of the three factors, these increases were insignificant.

3- Juice quality and phosphorus content

Data in Table 4 show that individual factors increased juice quality, *i.e.*, sucrose %, total soluble solids % and purity % as well as P % as compared with soil treatment.

a-Effect of varieties (V)

From the data, it can be noticed that Mn 4490 variety gave significant increase in sucrose % and total soluble solids. as compared with clear variety (Table 4), however, clear variety gave higher P content and purity % but the increase was insignificant for purity.

b- Effect of number of phosphorus sprays (N)

Data also showed that triple sprays with phosphorus induced better effect than twice sprays for sucrose %, TSS % and P % but the increase was insignificant for purity %.

c- Effect of bio-fertilizers (B)

With regard to with bio-fertilizers, it was found that PDB, VAM or the mixture of PDB+VAM treatments significantly increased sucrose %, TSS% and P % as compared with control (no bio-fertilizers). Inoculation with VAM was significantly better than PDB for sucrose % while, it gave the same result of PDB for TSS %. The combination between PDB and VAM was the best treatment for sucrose and TSS percentages. On the other hand, purity was not affected by all bio-fertilizer treatments.

d- Effect of interactions

The interactions of (V x N), (V x B) and (N x B) exhibited significant increases for sucrose %, TSS %, purity % and P%. While (V x N x B) interaction was significant for sucrose % and P%. Mn 4490 variety sprayed three times with phosphorus and inoculated with PDB +VAM gave the maximum sucrose %.

TABLE 4*. Juice quality and content of phosphorus of sorghum varieties as affected by bio and mineral fertilizer.

Treatments		Juice quality									P% in juice		
		Sucrose %			TSS %			Purity%					
Variety (V)		V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean
Soil treatment		8.40	8.30	8.35	17.2	17.0	17.1	48.8	48.8	48.8	0.09	0.11	0.10
No of sprays(N)	Bio-fertilizers(B)												
2	0	9.29	9.58	9.44	18.0	18.7	18.3	51.5	51.4	51.5	0.11	0.13	0.12
	PDB	9.58	9.82	9.70	18.7	19.3	19.0	51.3	51.0	51.1	0.14	0.15	0.15
	VAM	9.73	9.67	9.70	19.0	18.9	19.0	51.2	51.1	51.2	0.15	0.17	0.16
	PDB+VAM	9.76	9.88	9.82	19.1	19.4	19.3	51.1	51.0	51.0	0.17	0.17	0.17
Mean		9.59	9.74	9.67	18.7	19.1	18.9	51.3	51.1	51.2	0.13	0.14	0.14
3	0	9.61	9.61	9.61	18.7	18.9	18.8	51.4	50.9	51.1	0.13	0.14	0.14
	PDB	9.82	9.91	9.87	19.2	19.6	19.4	51.3	50.5	50.9	0.17	0.18	0.17
	VAM	9.88	9.98	9.93	19.3	19.7	19.5	51.1	50.7	50.9	0.18	0.18	0.18
	PDB+VAM	10.1	10.0	10.04	19.7	19.8	19.7	51.1	50.7	50.9	0.18	0.19	0.18
Mean		9.84	9.88	9.86	19.2	19.5	19.4	51.2	50.7	51.0	0.17	0.17	0.17
Mean of (B)	0	9.45	9.60	9.52	18.4	18.8	18.6	51.4	51.1	51.3	0.13	0.14	0.14
	PDB	9.70	9.87	9.78	18.9	19.5	19.2	51.3	50.7	51.0	0.17	0.18	0.17
	VAM	9.81	9.83	9.82	19.2	19.3	19.2	51.2	50.9	51.1	0.18	0.18	0.18
	PDB+VAM	9.91	9.96	9.93	19.4	19.6	19.5	51.1	50.8	51.0	0.18	0.19	0.18
Mean		9.72	9.81	9.76	19.0	19.3	19.1	51.2	50.9	51.1	0.15	0.16	0.16
LSD at 0.05													
Variety (V)				0.05			0.14			N.S			0.002
No of sprays (N)				0.04			0.16			N.S			0.002
Bio-fertilizers (B)				0.04			0.18			N.S			0.003
VXN				N.S			N.S			N.S			N.S
VXB				N.S			N.S			N.S			N.S
NXB				N.S			N.S			N.S			0.004
VXNXB				0.09			N.S			N.S			0.006

PDB = phosphate dissolving bacteria. V1=Clear. * Average of 2004 and 2005 growing seasons.

Discussion

From the above mentioned results, important topics could be concluded :

1-The tested varieties showed distinct and significant differences in most traits under study. Clear variety has recorded a distinguished superiority over Mn 4490, while, Mn 4490 variety was higher than clear for sucrose, TSS and purity percentages. The variation in these traits among the two varieties is due to the action of gene make-up which plays an important role in plant structure and morphology (Miller & Creelman, 1982). Or may be due to differing rates of absorption, translocation and utilization between varieties.

2-Foliar spraying with phosphorus three times is considered the suitable procedure for sweet sorghum than twice spraying on all the studied traits. This may be due to that foliar application of P can delay senescence of the leaves and thus, increase the leaf area duration (Marschner, 1998). In addition, a fundamental role of P in raising the efficiency of plants to photosynthetic, metabolic, activating large number of enzymatic reactions depending on phosphorylation (Mohamed, 1998 and Nassar *et al.*, 2005) and increasing the plant meristematic tissues which take much of P in the early stages. As a result, root development as well as macro and micronutrients uptake increase, producing increase in yield quantity and juice quality (El-Koumey *et al.*, 1993 and Nassar *et al.*, 2005). ATP- ase activity increases by P application which uses in vital plant processes such as protein and carbohydrate construction, cell division and expansion, respiration and photosynthesis (Dwivedi & Chaubey, 1995). (Reneau *et al.*, 1983) reported that increasing levels of phosphorus fertilization was associated with increased nutrient mineral contents in plant tissues and thereby subsequent increased plant growth occurred. Nearly all energy translation reactions require phosphorus and it is a constituent of many plant compounds such as lipids and phytin. Similar results were reported by El-Hefnawy *et al.* (1991) and El-Sayed *et al.* (1992).

3-All tested bio-fertilizer treatments, *i.e.*, PDB and VAM separately or in a mixture caused remarkable increases in most traits under study as compared with the control treatment (no bio-fertilizers). The positively and significantly results of PDB may be due to that it produce growth promoting substances such as auxins, gibberellins and cytokinins (Barea *et al.*, 1976), which improve plant growth and stimulate the microbial development (El-Sayed, 1998). In addition , PDB increases the availability of phosphorus and other essential nutrients used for building new tissues (Nijjar, 1985) by secreting organic acids such as formic, acetic, lactic... etc. These acids decrease the pH and bring about the dissolution of bound forms of phosphate (Nassar *et al.*, 2000). This result was in full agreement with those obtained by (Azer *et al.*, 2003). On the other side, inoculation with VAM gave better results than PDB for most traits mentioned before. Such effect may be attributed to that VAM increase plant nutrient supply by extending the volume of soil accessible to plants or by acquiring nutrient forms that would not normally be available to plant (Elwan, 1993). Mycorrhizal can also cause growth form changes to root architecture and vascular tissue. In

addition, mycorrhizal fungi are able to synthesize indole acetic acid (IAA) which is able to metabolize indgenious treptophan to IAA (Gay *et al.*, 1992). These data are in agreement with those reported (Sorial, 2001), (Nafie & Ismail, 2002). Results also showed that, mixture of VAM+PDB attained the highest values for all previous parameters and this result is in agreement to some what with Koreish *et al.* (1998) and Mahmoud & Gebrail (2001).

Conclusions

It can be concluded that, generally, the application of the two kinds of bio-fertilizers increased the main parameters of yield and it also improved the quality and only P content in the plant juice grown under this conditions. The organic production is accomplished by using, where possible, agronomic, biological, and opposed to using synthetic materials, to fulfill any specific function within the system. Moreover, from the foregoing discussion, it could be concluded that under the condition of our soils, application of chemical fertilizer (phosphorus) along with biofertilizer could optimizing the efficiency of the added fertilizer, and save the used amounts by decreasing fixation or nutrient losses , give the highest resultant and attain the best quantity and quality of yields which in turn improved sugar extractability.

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التسميد الحيوي والرش الورقى بالفوسفور وعلاقته بالنمو والمحصول لصنفين من نبات الذرة السكرية

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نظرا لما تسببه الأسمدة المعدنية من مشاكل بيئية وأحيانا حدوث نقص في إنتاجيا وارتفاع أسعارها أدي إلي استخدام المخصبات الحيوية والرش الورقى كبدائل آمنة الاستخدام بهدف تقليل التلوث ولهذا الغرض أقيمت تجربة حقلية فى صيف عامي ٢٠٠٤- ٢٠٠٥ بمحطة بحوث الصباحية بمحافظة الاسكندرية لدراسة تأثير العوامل المختلفة وتداخلاتها (الأصناف – عدد مرات الرش الورقى بالفوسفور مع استخدام المخصبات الحيوية)على محصول وجوده الذرة السكرية وأوضحت النتائج ما يلي : –

أن الفرق بين الأصناف كان في معظم الأحوال معنويا عند دراسة النمو والمحصول ومكوناته وقد أعطى الصنف كليبر تفوقا في كل من الوزن الكلى للنبات ووزن السيقان بعد تقشيرها ووزن الأوراق ووزن كل من العصير والشراب الناتج من السيقان وكذلك طول النبات وقطر الساق ونسبه الفوسفور في العصير والنسبة المئوية لاستخلاص العصير والشراب والنقاوة بينما الصنف م ن ٤٤٩٠ كان متفوقا في جودة العصير (نسبه السكروز والمواد الصلبة الذائبة الكلية) وكذلك في عدد العقل .

وجد أن الرش الورقى بالفوسفور ثلاث مرات كان له تأثير ايجابي معنوي أكثر من إضافته مرتين وذلك بالنسبة لجميع الصفات المذكورة سابقا والإضافة الأرضية كانت اقليم .

وأدى استخدام المخصبات الحيوية (البكتريا المذيبة للفوسفات والميكورهيزا منفردين او الخليط منهم) إلى زيادة في صفات النمو ومكونات المحصول وجودة العصير بمقارنتها مع الكنترول (النباتات النامية من البذور الغير الملقحة بالمخصبات أو النباتات النامية من إضافة العناصر الغذائية الموصى بها من نيتروجين وفوسفور وبوتاسيوم كإضافة أرضي) وكان استخدام الخليط من (البكتريا المذيبة للفوسفات والميكورهيزا) معا أكثر تفوقا يليها التلقيح بالميكورهيزا ثم التلقيح بالبكتريا المذيبة للفوسفوربينما النباتات الغير ملقحة والإضافة الأرضية جاءت الاخيرة.

إحصائيا وجد إن التداخل الثنائي أو الثلاثي يكون معنويا أحيانا ووجد أن صنف كليبر عندما لقح بخليط من المخصبات الحيوية ورش ثلاث مرات بالفوسفور المعدني كان أكثر تفوقا في نمو المحصول ونسبة الاستخلاص لكل من العصير والشراب ومحتوى العصير من الفوسفور والنقاوة وعند معاملة صنف م ن ٤٤٩٠ بنفس المعاملة أعطى تفوقا في جودة العصير (نسبة السكروز والمواد الصلبة الذائبة الكلية).