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LAND AND WATER EXPLOITATION FOR MAXIMIZING PRODUCTIVITY OF TOMATO INTERCROPPED WITH FABA BEAN CROP UNDER STRESS ECOLOGICAL CONDITIONS AT TOSHKY

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Abstract

The optimistic Toshky National Project is representing strong challenge to cultivate new reclaimed lands under stress ecological situation. The aim of this research is to compare competition between natural rock phosphate and super phosphate fertilizers on single crop as well as intercropping tomato with faba bean, most important legume food crop; for utilizing land equivalent per water unit an experiment was carried out for two years during 2001/2002 and 2002/2003 seasons, at the South Valley Agriculture Research Station, Toshky, in a randomized complete block design. The treatments included phosphate sources (natural rock phosphate and super phosphate) as well as doses. Transplanting dates for tomato hybrid (castle rock) were on 1st and 7th September in 2001/2002 and 2002/2003 seasons, respectively. Sowing dates of faba bean (variety Giza 40) were 15th and 22nd October in two seasons, respectively. Tomato seedlings were transplanted on one side for each lateral 50 cm between drippers. Faba bean seeds were planted in hills spaced 10 cm between hills, one plant per hill.

The obtained results indicated that yield and yield components of faba bean were decreased by intercropping faba bean with tomato as compared with faba bean grown alone, in both seasons. The response of seed yield/fd and yield components to phosphate levels was linear between zero and 60 Kg P_2O_5/fd. Intercropping tomato with faba bean compared with grown tomato separated in both seasons decreased tomato fruits yield and marketable fruits yield. Also, results indicated that in all studies of tomato characters improved with increasing phosphate fertilizer, except culls percentage which decreased with increasing phosphate fertilizer compared to control in both seasons. Total yield and marketable yield increased with increasing mixed phosphate from [15 Kg P_2O_5 (NP) + 15 Kg P_2O_5 (SP)] to [45 Kg P_2O_5 (NP) + 45 Kg P_2O_5 (SP)] compare to control in both seasons. The highest value for Land Equivalent Ratio (LER) was 1.91 and 1.99 for the treatment using mixed phosphate [45 Kg P_2O_5 NP) + 45 Kg P_2O_5 (SP)] in the first and second seasons, respectively. It may be worth mentioning that intercropping tomato with faba bean has maximized utility of irrigation water by saving 31 % compared to separate treatments.

INTRODUCTION

Agricultural development of large desert areas in the extreme southern part of Egypt is continuing. An Agricultural Research Station is establishment near Lake Nasser in 1998. It aims to conduct research on soil and water management, on different crops, and cultivation techniques under the local climatic conditions. Meteorological data indicated that the maximum air temperature is 28 ℃ in winter (December – January) and 48 ℃ in summer (July – August), while the average air temperature is 19 ℃ and 36 ℃, respectively. The averages for soil temperatures are 39 ℃ and 26 ℃ in summer and winter, respectively. Average relative humidity is 17% in summer and 42% in winter, (Abdel-Aal, 2003). Taxonomically, soils could be classified as Typic xerofluvants, Sand Loam Mixed, Hyper thermic (according to soil survey staff, 1994) on the basis of soil physio chemical properties and morphological features (Abdel-Aal, 2003). The main features of the studied soils resulted from physical weathering sandy rock soil that is slight affected by chemical weathering, to some extent. Soil surface is covered with a thin alluvial layer as a result of erosion process. It is characterized by slight undulating topography, with presence of many fragments of various rocks and gravels. These fragments differ in shape, size and colour. The proportion of coarse gravel differs from 5 to 15 percent. In general, the soil color ranges from yellow to yellowish brown and, sometimes, brownish-red. Most of soil particles are single grain of loose to friable consistency. The particles get hard when dry and very soft when moist (Abdel-Aal, 2003).

Tomato crop takes comparatively long time in the field, about six months. Intensive cropping requires farmers to look for suitable crops to grow with tomato without reducing its final yield in order to avoid risks of bad yield and/or severe fluctuations prices. Higher monetary return and more stable income also give additional advantages of the associated cropping system (intercropping) as compared to mono-crop cultures. However, several researchers have conducted trials on the effect of growing some field crops intercropped with faba bean. Adelana-Bo (1984) reported that maize and tomatoes were grown in mixed pure stands at 3 sites in Nigeria. The single crops gave higher yields than the mixtures, but the reduction in yield in mixed – cropping was lower in maize than in tomatoes. The input/output analysis showed that it was more profitable to grow the two crops together than either of them separately. Salem and El–Massri (1986) found that the response of seed yields/ha to phosphorus levels was linear be-

tween zero and 107.14 Kg P_2O_5 / ha. Generally, phosphorus application increased the average seed yield per plant and several traits (as number of seeds per pod) averaged over the two seasons. Hassan *et al.* (1992) found the highest LER under mixed cropping of lentil and faba bean. Pino *et al.* (1994) found that three rows of tomatoes alternated with one of maize resulted in the highest tomato yields, 24.88 and 21.20 T/ ha, and in corn-cob (for fodder) yields of 51.8 and 49.61 Kg/ha in 1991 and 1992, respectively. This was equivalent to a 54 % increase in economic value (pesos/ha) compared with the separate tomato controls in 1991 and a 25.50 % increase in 1992. Hussein and El-Deeb (1999) found that the highest seed yield was obtained when intercropping faba bean with sugar beet at a density of 6 or 8 plants / m^2. Intercropped faba bean at 4 plants / m^2 with sugar beet increased profitability by L.E 12.5 % than that of solid sugar beet. Abdel_Aal and Zohry (2003) gained more benefit when intercropped tomato with maize. They found that marketable tomato increased as a result of maize shadow and indicated also saving water and increased land use productivity per unit area.

The aim of this investigation is to study the fertilizing value of natural rock phosphate and super phosphate fertilizers on single as well as intercropping tomato with faba bean, most important public food crop under stress environmental conditions. Agronomic components, traits and yield are investigated. Also, studies included land use efficiency, profit increase, and saving of irrigation water.

MATERIALS AND METHODS

Two field trials were carried out at South Valley Agriculture Research Station, Toshky. Water requirements (WR) is calculated from meteorological data obtained from station at Toshky using Penman Montieth methods (Smith, 1991 and Ainer *et al.* 1999). The experiment was carried out during 2001/2002 and 2002/2003 seasons in randomized complete block design including twelve treatments with four replicates. The treatments include different phosphate sources and doses and crop system; as shown in Table 1.

Table 1. Phosphate treatments.

Symbol	Treatments*	Crop System
T_1	T_1 control (no phosphate)	Tomato & Faba bean
Phosphate source & dose and crop intercropping		
T_2	30 Kg P_2O_5 (NP)	Tomato & Faba bean
T_3	60 Kg P_2O_5 (NP)	Tomato & Faba bean
T_4	30 Kg P_2O_5 (SP)	Tomato & Faba bean
T_5	60 Kg P_2O_5 (SP)	Tomato & Faba bean
Mixed phosphate source &dose and Crop intercropping		
T_6	15 Kg P_2O_5 (NP)+ 15 Kg P_2O_5 (SP)	Tomato & Faba bean
T_7	30 Kg P_2O_5 (NP)+ 30 Kg P_2O_5 (SP)	Tomato & Faba bean
T_8	45 Kg P_2O_5 (NP)+ 45 Kg P_2O_5 (SP)	Tomato & Faba bean
Phosphate source and separate crop (faba bean)		
T_9	60 Kg P_2O_5 (NP)	Faba bean (alone)
T_{10}	60 Kg P_2O_5 (SP)	Faba bean (alone)
Phosphate source and separate crop (Tomato)		
T_{11}	60 Kg P_2O_5 (NP)	Tomato (alone)
T_{12}	60 Kg P_2O_5 (SP)	Tomato (alone)

* P_2O_5 in natural rock phosphate (NP), (Rokaz) 29.5 %

P_2O_5 in super phosphate (SP) 37.5 %

Recommended fertilizer application of 300 Kg ammonium sulfate, 200 Kg potassium sulfate, 200 Kg/fd agriculture sulfur as well as 10 m^3 chicken manure were added together with phosphate treatments to soil before cultivation. It should be mentioned that for rock phosphate the efficiency of phosphate increased with addition of organic manure and sulfur application. The plot size was 90 m^2 (10 m length and 9 ridge); the distance between each two lines was 1.0 m. Irrigation water was applied using drip irrigation system. Transplanting dates for tomato (castle rock) hybrid were 1st and 7th September in both 2001/2002 and 2001/2002 seasons, respectively, while sowing dates of faba bean (variety Giza 40) were 15th and 22nd October in the two seasons, respectively. Tomatoes were transplanted on one side for each lateral; 50 cm between drippers. Faba bean seeds were planted in hills spaced 10 cm between hills, one plant per hill on the other side of the drip line. Faba-bean crop was harvested after 150 days from sowing. Ten plants were chosen randomly to determine yield parameters, while

the yield / fd was determined on the whole plot. For tomato, number of fruits/plant, weight of fruits (Kg/plant), total fruit yield (ton/fd), total culls percentage and marketable yield (ton/fd) were determined. For faba bean, plant height (cm) number of branches, number of pods / plant, number of seeds/plant, seed yield/plant (g), straw yield (ton/fd) and seed yield (Ardab/fd) were determined. Intercropping advantages were evaluated by calculating the Land Equivalent Ratio (LER); (Willey, 1985):

$$\{ \quad LER = \frac{Y_{tf}}{Y_{tt}} + \frac{Y_{ft}}{Y_{ff}} \quad \}$$

where, y_{tf} and y_{ft} are the intercrop yields of tomato and faba bean, respectively, in the intercropping treatments and y_{tt} and y_{ff} are pure stand yields of tomato and faba bean, respectively. Statistical analysis was applied to data according to Snedecor and Cochran (1967). Soil samples were taken and analyzed for soil texture, salinity, pH, calcium carbonate, organic matter and macro-micro-nutrients (Page, 1982).

RESULTS AND DISCUSSION

Main Soil Features

The main features for the soil under study were described judiciously by Abdel-Aal (2003). During 2001/2002 and 2002/2003 seasons, soil salinity showed very low values ranging from 0.5 and 1.2 dS/m. Organic matter is very low as it ranges between 0.1% and 0.3%.; and soil is very poor in levels of nutrients. Average pH values 8.8. Soil texture is sandy loam. The soil profile is shallow. Its depth varies from 50 cm to 100 cm to the bedrock. The average total calcium carbonate is 12%. Permeability rates range from 9.0 to 15.2 cm/hr, which could be classified as very rapid.

Agronomic Components Traits

Faba bean crop

Data presented in Table 2 indicate agronomic components traits for separated single and intercropped faba bean combined with tomatoes, as affected by phosphate fertilizers (source and dose). Generally, all characters study; plant height, number of branches, number of pods/plant, number of seeds/plant, seed yield/plant, straw yield/fd and seed yield/fd were significantly increased with phosphate fertilizers either

Table 2. Agronomic components and yield of faba bean as affected with intercropping and phosphate sources and doses in the seasons of 2001/2002 and 2002/ 2003.

Characters / Treatments	Plant height (cm)	No. of branches/ plant	No.of pods / plant	No.of seeds/ plant	Seed yield/plant (gm)	Straw yield / Ton/fd	Seed yield / Ardab/fd
	2001 / 2002 Season						
T_1 Control	124.5	2.75	13.50	31.25	19.18	1.040	4.43
T_2 30 Kg P_2O_5 (NP)	140.5	3.00	12.75	33.00	20.38	1.140	5.03
T_3 60 Kg P_2O_5 (NP)	140.8	3.25	14.50	40.75	25.88	1.235	5.98
T_4 30 Kg P_2O_5 (SP)	138.8	3.50	13.75	34.50	24.40	1.170	5.58
T_5 60 Kg P_2O_5 (SP)	153..8	3.75	15.25	43.75	27.13	1.235	6.28
T_6 15 Kg P_2O_5 (NP)+15 Kg P_2O_5 (SP)	128.8	3.75	14.00	38.50	21.83	0.942	4.98
T_7 30 Kg P_2O_5 (NP)+30 Kg P_2O_5 (SP)	156.3	4.00	14.75	45.00	26.13	1.223	6.73
T_8 45 Kg P_2O_5 (NP)+45 Kg P_2O_5 (SP)	155.0	4.25	16.00	45.25	28.13	1.258	6.73
T_9 60 Kg P_2O_5 (NP)	156.0	4.00	15.50	45.50	29.13	1.513	8.23
T_{10} 60 Kg P_2O_5(SP)	154.8	4.25	16.00	46.00	30.13	1.655	9.58
L.S.D at 5 %	9.8	0.90	1.36	2.35	1.16	0.09	0.52
	2002 / 2003 Season						
T_1 Control	122.5	2.25	12.00	30.75	20.45	0.825	4.75
T_2 30 Kg P_2O_5 (NP)	122.5	2.50	12.75	32.50	23.18	1.070	5.30
T_3 60 Kg P_2O_5 (NP)	138.8	2.75	14.00	34.00	25.73	1.215	6.00
T_4 30 Kg P_2O_5 (SP)	130.0	2.75	13.00	33.50	24.85	1.150	5.85
T_5 60 Kg P_2O_5 (SP)	141.3	3.25	14.25	34.75	26.20	1.223	6.90
T_6 15 Kg P_2O_5 (NP)+15 Kg P_2O_5 (SP)	123.8	3.00	12.75	32.00	22.80	0.942	5.00
T_7 30 Kg P_2O_5 (NP)+30 Kg P_2O_5 (SP)	136.3	3.25	14.50	36.00	24.43	1.253	6.15
T_8 45 Kg P_2O_5 (NP)+45 Kg P_2O_5 (SP)	142.5	3.50	16.25	39.00	27.78	1.260	7.23
T_9 60 Kg P_2O_5 (NP)	145.8	3.50	16.50	40.50	28.85	1.550	7.90
T_{10} 60 Kg P_2O_5(SP)	144.3	4.00	17.25	45.50	30.13	1.660	8.23
L.S.D at 5 %	5.9	0.80	1.01	1.85	1.09	0.09	0.53

source or doses, except treatment T_6 [mixed fertilizers of 15 Kg P_2O_5 (Rokaz) + 15 Kg P_2O_5 (super phosphate)], compared with control. On the other hand, intercropping faba bean with tomato compared with pure stand of faba bean in both seasons showed negative effects in all treatments. However, natural rock phosphate (Rokaz) and super phosphate fertilizer treatments significantly affected faba bean plants in all agronomic components in both seasons compared with control treatment.

Most of agronomic components such as plant height, branches number, pods number per plant, seeds number per plant and seeds weight per plant did not show significant effect by source of phosphate; either natural phosphate or super phosphate in both seasons except seed weight per plant in the second season for pure stand. Generally, similar trend was achieved for intercropping faba bean with tomatoes except for plant height, seeds number and weight per plants in the first season. For mixed phosphate fertilizers (Rokaz with super phosphate), results indicated that all agronomic traits were significantly affected by increasing phosphate rate. Total yield including straw and grain, they behaved similarly to growth and yield components in both seasons. Generally, the response of seed yield/fd to phosphorus levels was linear between zero and 60 Kg P_2O_5/fd. The serious reduction in intercropped faba bean yield intercropped treatments compared with faba bean yield alone (for 30 and 60 kg P_2O_5/fd treatments) can be due to crop competition (Adelana-Bo, 1984 and Salem and El-Massri, 1986).

Tomato crop

The obtained results are shown in Table 3. Except for culls percentage, all tomato traits were, in general, significantly affected with increasing doses of phosphate fertilizers rates either natural rock phosphate or super-phosphate. Also, tomato agronomic components were significantly affected by intercropping tomato with faba bean, expect for culls percentage, in both seasons.

Statistical analysis indicated that either natural rock phosphate (Rokaz) or super phosphate fertilizer treatment significantly affected tomatoes yield. Branches number of fruits/plant increased with increasing phosphate fertilizer doses compared to the control. Regarding weight of fruits/plant, data indicate that separate tomato treatment gave fruit number/plant similar intercropping treatment. The means differences be-

Table 3. Agronomic components and yield of tomato as affected by intercropping and phosphate sources and doses in the seasons of 2001/2002 and 2002/2003.

Characters / Treatments	Number of fruits/ Plant	Weight of fruits (Kg/plant)	Total fruit yield (ton/fd)	Culls %	Marketable yield (Ton/fd)
	2001 / 2002 Season				
T_1 Control	39.00	5.300	24.675	4.0	23.675
T_2 30 Kg P_2O_5 (NP)	41.00	6.300	25.250	3.6	24.350
T_3 60 Kg P_2O_5 (NP)	42.50	6.300	28.950	3.9	27.825
T_4 30 Kg P_2O_5 (SP)	44.25	6.500	25.600	4.0	24.575
T_5 60 Kg P_2O_5 (SP	45.75	7.225	29.725	4.0	28.525
T_6 15 Kg P_2O_5 (NP)+15 Kg $_2O_5$ (SP)	40.00	5.975	27.525	3.6	26.525
T_7 30 Kg P_2O_5 (NP)+30 Kg P_2O_5 (SP)	40.75	6.450	28.325	2.8	27.525
T_8 45 Kg P_2O_5 (NP)+45 Kg P_2O_5 (SP)	45.50	7.125	31.050	3.2	30.050
T_{11} 60 Kg P_2O_5 (NP)	42.25	6.325	28.700	3.6	27.675
T_{12} 60 Kg P_2O_5(SP)	46.25	6.800	31.925	4.0	30.650
L.S.D at 5 %	4.61	0.65	1.68	N.S.	1.71
	2002 / 2003 Season				
T_1 Control	40.25	5.400	24.675	4.0	23.675
T_2 30 Kg P_2O_5 (NP)	48.25	5.820	25.600	4.0	24.575
T_3 60 Kg P_2O_5 (NP)	45.50	6.087	29.725	4.0	28.525
T_4 30 Kg P_2O_5 (SP)	48.75	6.505	27.525	4.0	26.400
T_5 60 Kg P_2O_5 (SP)	50.75	6.800	28.350	3.5	27.350
T_6 15 Kg P_2O_5 (NP)+15 Kg P_2O_5 (SP)	43.75	5.833	25.000	3.6	24.100
T_7 30 Kg P_2O_5 (NP)+30 Kg P_2O_5 (SP)	43.75	5.975	28.950	4.7	27.600
T_8 45 Kg P_2O_5 (NP)+45 Kg P_2O_5 (SP)	50.75	7.100	31.050	2.6	30.250
T_{11} 60 Kg P_2O_5 (NP)	43.00	6.600	28.850	3.6	27.825
T_{12} 60 Kg P_2O_5(SP)	46.00	7.263	30.850	4.2	29.575
L.S.D at 5 %	5.59	0.60	1.99	N.S.	1.84

tween treatments were not significant. Also, statistical analysis did not show any significant difference on tomato weights per plant between both treatments mean of natural rock phosphate and super phosphate. For total yields of tomato fruits, they were significantly affected by intercropping with faba bean and phosphate fertilizers. It was noticed that both phosphate fertilizer natural rock phosphate and super phosphate have significant effect on total yield, which increased with increasing phosphate fertilizer compared with control. The important parameter for tomato aspect is marketable yield. Results show that both main treatments of phosphate fertilizers and intercropping tomato with faba bean significantly decreased marketable fruits yield expect treatment (T_8) in the second season, compared with separate tomato in both seasons. On the other hand, there was no significant effect either by using natural rock phosphate or super phosphate on marketable fruits yields between T_2 and T_4 or between T_3 and T_5. In addition, results indicate that there was no significant difference between separate tomato treatment (T_{11}) and intercropping tomato with faba bean T_4 or T_7 by using natural rock phosphate (Rockas) in both seasons. Also, results indicate that there was no significant difference between separate tomato (T_{12}) and intercropping tomato with faba bean T_8 by using super phosphate fertilizer treatments, in both seasons.

In general, phosphate treatments increased marketable yield which ranged from 23.675 to 30.113 ton/fd in both seasons. The response of marketable yield to phosphorus levels was linear between zero and 60 Kg P_2O_5/fd. Similar results were obtained by Adelana-Bo (1984).

Land Exploitation

Land Equivalent Ratio, L.E.R. (Land exploitation of total land productivity) is presented fractions of tomato (RY_{tf}) and faba bean (RY_{ft}) are presented in Table 4. It might be said that many scientists calculate the L.E.R. to evaluate over yielding. It is the total land required by a separate crop to produce the yield achieved in intercropping. L.E.R. values were greater than 1.0, which means directly these all treatments of phosphate fertilizer as well as intercropping tomato with faba bean through the first and second seasons were positively effective on increasing Land Equivalent Ratio. These yield advantages could be attributed to the relative yield of tomato, which was relatively higher than that of faba bean. Regarding source of phosphate, there was a

relative increase in the values of L.E.R. by using natural rock phosphate (Rokaz) compared with super phosphate in both seasons. The highest value for L.E.R. was 1.91 and 1.99 for the treatment using natural rock phosphate (Rokaz) in the first and second seasons, respectively.

Table 4. Data on Relative yields (RY), Land Equivalent Ratio (LER) for faba bean with tomatoes and phosphate source as well as doses during 2001/2002 and 2002/2003 seasons.

Treatments	Natural rock phosphate (NP)			Super phosphate (SP)		
	Ry_{ft}	Ry_{tf}	L.E.R.	Ry_{ft}	Ry_{tf}	L.E.R.
	2000 / 2001 Season					
T_1 Control	0.54	0.86	1.4	0.46	0.77	1.23
T_2 30 Kg (NP)	0.61	0.88	1.49	0.52	0.79	1.31
T_3 60 Kg (NP)	0.73	1.01	1.74	0.62	0.91	1.53
T_4 30 Kg (SP)	0.68	0.89	1.57	0.58	0.8	1.38
T_5 60 Kg (SP)	0.76	1.03	1.79	0.66	0.93	1.59
T_6 15 Kg (NP&SP)	0.6	0.96	1.59	0.52	0.87	1.39
T_7 30 Kg (NP&SP)	0.82	0.99	1.81	0.78	0.9	1.68
T_8 45 Kg (NP&SP)	0.82	1.09	1.91	0.7	0.98	1.68
T_9 60 Kg (NP)	1	-	1	-	-	-
T_{10} 60 Kg (SP)	-	-	-	1	-	1
T_{11} 60 Kg(NP)	-	1	1	-	-	-
T_{12} 60 Kg (SP)	-	-	-	-	1	1
	2001 / 2002 Season					
T_1 Control	0.6	0.85	1.45	0.58	0.8	1.38
T_2 30 Kg (NP)	0.67	0.88	1.55	0.64	0.83	1.47
T_3 60 Kg (NP)	0.76	1.03	1.79	0.73	0.96	1.69
T_4 30 Kg (SP)	0.74	0.95	1.69	0.71	0.89	1.6
T_5 60 Kg (SP)	0.87	0.98	1.85	0.84	0.92	1.76
T_6 15 Kg (NP&SP)	0.63	0.87	1.5	0.6	0.81	1.41
T_7 30 Kg (NP&SP)	0.78	0.99	1.77	0.75	0.93	1.68
T_8 45 Kg (NP&SP)	0.91	1.08	1.99	0.88	1.02	1.9
T_9 60 Kg (NP)	1	-	1	-	-	-
T_{10} 60 Kg (SP)	-	-	-	1	-	1
T_{11} 60 Kg(NP)	-	1	1	-	-	-
T_{12} 60 Kg (SP)	-	-	-	-	1	1

Maximizing Utilization of Irrigation Water

An important advantage of using intercropping system is to maximize use of unit land and irrigation water to produce maximum yield. The current work found that the water requirements were 3749 m^3/fd for separate tomato crop and 2170 m^3/fd for separate faba bean crop using drip irrigation system. In the intercropping treatments, tomato with faba bean, the irrigation water requirement amounted to 4114 m^3/fd for other treatments to produce maximum yield for tomato and faba bean compared to separate tomato and faba bean treatments. It may be worth mentioning that intercropping tomato with faba bean has maximized irrigation water use efficiency by saving 31 % of irrigation water compared with separate treatments.

REFERENCES

1. Abdel-Aal, A. I. N. 2003. The Optimal Use of Land and Water at Toshky for Crop Production. Second Annual Report. Regional Council for Research & Extension, ARC. Ministry of Agriculture & Land Reclamation.

2. Abdel-Aal, A. I. N. and A. A. Zohry. 2003. Natural phosphate affecting on maize as a protective crop for tomato under environmental stress conditions at Toshky. Egyptian J. Agric. Res., ARC 81.

3. Adelana – Bo. 1984. Evaluation of maize – tomato mixed cropping in South Western Nigeria. Indian J. Agric.Sci. 54: 7, 564-569.

4. Ainer, N. G., W. I. Miseha, F. A. Abbas and H. M. Eid. 1999. A new concept of rationalization of irrigation water use in Egypt. Third Conference of On-Farm Irrigation and Agronotology. Volume 1 (No. 2). Soil water & Environment Research Institute ARC, Giza, Egypt. Jan. 25-27, 1999.

5. Hassan, M. W., M. I. Amer and H. A. Saber. 1992. Investigation into the effect of lentil and faba bean mixed cropping. Egypt. J. Appl. Sci. 7 (12): 556-566.

6. Hussein, A. H. A. and M. A. El-Deeb. 1999. Evaluation of intercropping faba bean, chickpea and lentil with sugar beet in middle Egypt. J. Agric. Sci., Ain-Shams Univ., Cairo. 7 (2), 475-482.

7. Page, A. L. 1982. Methods of Soil Analysis. Second Edition Part II Chemical and Microbiological Properties., Madison, Wisconsin, USA.

8. Pino, M-de-los-A, M. E. Domini, E. Terry, M. Bertoli and R. Espinosa. 1994. Maize as a protective crop for tomato in conditions of environmental stress. Cultivos – Tropicales. 15: 2, 60-63.

9. Salem, S. A. and M. F. El-Massri. 1986. Effect of cultivars, plant densities and phosphatic fertilizer levels on seed yield and other agronomic characters in faba bean (*Vicia faba L.*). Alex. J. Agric. Res. 31 (3): 127-137.

10. Smith, N. 1991. CROPWAT model for Et_o calculation using Penman Monteith method. FAO. Irrigation and Drainage paper 46.

11. Snedecor, G. W. and W. G. Cochran. 1967. Statistical Methods, 6^{th} edition. Iowa state Univ. Press, Ames, Iowa, USA.

12. Willey, R. W. 1985. Evaluation and presentation of intercropping advantages. Experimental Agriculture. 21: 119-133.

إستغلال الأرض والمياه لتعظيم إنتاجية الطماطم المحملة على الفول البلدى تحت ظروف الإجهاد البيئى بتوشكى

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١ معهد بحوث *الأراضي والمياه والبيئة* – مركز *البحوث الزراعية* – دقى – جيزة – مصر
٢ معهد بحوث *المحاصيل الحقلية* – مركز *البحوث الزراعية* – دقى – جيزة – مصر

يمثل المشروع القومى الواعد بتوشكى قوة التحدى لزراعة الأراضى الجديدة تحت ظروف بيئية قاسية. وتستهدف هذه الدراسة مقارنة تنافسية بين صخر الفوسفات الطبيعى والسوبر فوسفات على إنتاجية محصول الطماطم المنفردة والمحملة مع الفول البلدى مع تعظيم الإستفادة من وحدة الأرض والمياه. وقد أجريت تجربتان حقليتان بمحطة البحوث الزراعية في جنوب الوادي (توشكي) خلال موسمي ٢٠٠١/٢٠٠٢، ٢٠٠٢/٢٠٠٣ باستخدام تصميم القطاعات الكاملة العشوائية، وكانت المعاملات مصادر مختلفة من الفوسفات (صخر الفوسفات الطبيعي، سوبر فوسفات) بمعدلات إضافة مختلفة. تم شتل نباتات الطماطم (كاسل روك) في ١ و ٧ سبتمبر لكل موسم على التوالي، بينما تمت زراعة الفول البلدي (جيزة ٤٠) ١٥ و ٢٢ أكتوبر للموسمين ، وتم شتل نباتات الطماطم في خطوط بعرض ١٠٠ سم ، ٥٠ سم بين كل نقاط ري والأخر وكانت زراعة الفول البلدي في جور على مسافة ١٠ سم على الجانب الأخر من خط الري.

وكانت أبرز النتائج المتحصل عليها كما يلى:

(١) أدى تحميل الفول البلدي مع الطماطم إلى انخفاض المحصول ومكوناته مقارنة بالزراعة المنفردة للفول البلدي خلال الموسمين. وزيادة المحصول ومكوناته زيادة خطية بزيادة التسميد الفوسفاتي من صفر إلى ٦٠ كجم فو٢ ا٥ / فدان.

(٢) أدى تحميل الطماطم مع الفول البلدي إلى انخفاض المحصول الكلي للطماطم والمحصول الصالح للتسويق مقارنة بالزراعة المنفردة للطماطم خلال الموسمين.

(٣) أوضحت النتائج أيضا أن زيادة التسميد الفوسفاتي أدى إلى زيادة جميع الصفات تحت الدراسة ما عدا النسبة المئوية للتالف من المحصول فقد انخفض بزيادة التسميد الفوسفاتي مقارنة بالكنترول في خلال الموسمين.

(٤) زيادة المحصول الكلى للطماطم والمحصول الصالح للتسويق بزيادة معدل التسميد الفوسفاتي المكون من مصدري الفوسفات (الفوسفات الطبيعي الروكاز + السوبر فوسفات) من (١٥ كجم فو٢ ا٥ فوسفات طبيعي الروكاز + ١٥ كجم فو٢ ا٥ سوبر فوسفات) إلى (٤٥ كجم فو٢ ا٥ الروكاز + ٤٥ كجم فو٢ ا٥ سوبر فوسفات) مقارنة بالكنترول في خلال الموسمين.

(٥) سجل معدل استغلال الأرض أعلى قيمة وهي ١,٩١ ، ١,٩٩ وذلك عند استخدام خليط من الفوسفات الطبيعي (الروكاز) والسوبر فوسفات بمعدل ٤٥ كجم فو٢ اه الروكاز + ٤٥ كجم فو٢ اه سوبر فوسفات واستخدام التسميد بالفوسفات الطبيعي الروكاز بمعدل ٦٠ كجم فو٢ اه روكاز مع الزراعة المنفردة من الطماطم والفول البلدي.

(٦) أوضحت النتائج أن تحميل الطماطم بالفول البلدى أدى إلى توفير مياه الرى حوالى ٣١٪ بالمقارنة بالمعاملات المنفردة.