J. Agric. Sci. Mansoura Univ., 34 (3): 2477 - 2489, 2009

COMBINED EFFECT OF CROP TYPES, MICROBIAL INOCULANTS AND N FERTILIZER RATES ON AVAILABILITY OF NITROGEN

El-Hamdi, Kh. H.[1]; E. M. Selim [2] and Huda I. Hussien[1]
1- Soil Sci. Dept., Fac. of Agric., Mansoura Univ., Egypt.
2- Soil & Water use Dept., National Research Centre, Dokki, Cairo. Egypt

ABSTRACT

The present study was done in a pot experiment at Faculty of Agriculture, Monsoura University during summer 2007 to study the combined effect of crop types, microbial inoculants and N fertilizer rates on availability and uptake of nitrogen at different days after planting (DAP). Randomized complete block design with three replicates was performed. The first factor was arranged for 3 crops i.e; rice (*Oryza sativa*) cv. Sakha 101, tomato (*Lycopersicon esculentum., mill*) cv. Super Merry Mand and cowpea (*Vigna unguiculata* L. Walp) cv. Karim seeds, The second factor (Microbial inoculants); (Non-inoculated – Inoculated with blue green algae) with the rice; non-inoculated – Inoculated with nitrobin for tomato crop and non-inoculated – inoculated with rhizobium for cowpea crop and the pollinating of the seeds before planting. Finally, the third factor was occupied with 3 nitrogen fertilizer rates (control, half and all recommended dose of N according recommended doses for cultivated crops.

The obtained results show as the following;

- Data illustrate that except 35 DAP for dry shoot and 70 and 105 DAP for dry root there are significant differences between average of dry shoots g pot^{-1} at 70 and 105 DAP and as affected by affected by crop types i.e. (rice, cowpea and tomato crops), inoculations and N rates at different plant growth.
- Statistical analysis reveal that there are no significant differences between average of N concentration in shoots at 35and 105DAP except 70 DAP meanwhile, there are no significant differences between average of N concentrations % in roots at 35 and 70 DAP except at 105 DAP as affected by crop types i.e.(rice, cowpea and tomato crops), inoculations and N rates at different plant growth. Generally, the highest mean values of dry shoot, roots and yield and N concentration (%) were obtained from all nitrogen dose + inoculated with Rhizobia + cowpea. Meanwhile, the lowest mean values of fresh shoots were obtained from untreated with nitrogen + untreated with inoculation + tomato.
- It is evident that the highest mean values of utilization efficiency % of applied of nitrogen readings were attained due to all nitrogen doses + inoculated with Rhizobia + cowpea. On the other hand, the lowest means were obtained from half N doses + untreated with inoculation + rice.

Keywords: Crop types, bioinoculants, N rates

INTRODUCTION

In Egypt, chemical fertilizers are used heavily to maintain to the soil fertility and to ensure crop production. Badiane *et al*. (1994) reported that Egypt's consumption of fertilizers is more than 10 times as much of all nutrients per hectare as dose the average for the whole world.

Important nitrogen fixing organisms present in flooded rice – based system include heterotrophic and autotrophic free–living bacteria, photosynthetic bacteria and cyanobacteria, symbiotic cyanobacteria that associate with *Azolla* and symbiotic bacteria that from root and stem nodules on legumes (Roger and Ladha, 1992; Watanabe and Liu, 1992; Becker, Ladha, and Ali, 1995 , Vessey, 2003 and Vessey *et al.*, 2004). Several investigators reported that microbial inoculation of cereal crops by certain free-living-N_2 fixing bacteria and bacteria solubilizing phosphorus had a great important as a new technology, as it minimize the amount of applied chemical fertilizer and reduce the costs of crop production as well as reducing soil pollution. Several free-living bacteria species can fix atmospheric nitrogen such as *Azotobacter* and Azospirillum which are prepared in commercial packets as biofertilization (Kannaiyan, 2003Aziz and Hashem, 2004; Al-Gusaibi, 2004; El-Zeky, 2005).

Finally, Hauggaard *et al.*, (2001) showed that Barley sole crops accumulated 65 kg soil N ha^{-1}in aboveground plant parts, and significantly greater than 15 kg soil N ha^{-1}in the pea sole crop. The weeds accumulated 57 kg soil N ha^{-1}in aboveground plant parts during the growing season in the pea sole crops. therefore, this study was carried out to evaluate the combined effect of crop types, microbial inoculants and N fertilizer rates on availability and of nitrogen.

MATERIALS AND METHODS

A pot experiment was performed out at Faculty of Agriculture, Monsoura University during summer 2007 to study the combined effect of crop types, microbial inoculants and N fertilizer rates on availability and uptake of nitrogen.

The experiment was conducted out in plastic containers measuring 60 cm in height and 18 cm in diameter. Each container was filled with 6 kg of soil. Soil samples were collected from the surface layer (0-30 cm) and soil is considered a clay loam in texture (alluvial soil). Some physical and chemical properties were shown in Table 1 as described by Rabbeca (2004).

Table 1: Some physical and chemical properties of the studied soil.

Property		Value	Property	Value
Coarse sand	%	1.71	O.M.%	1.59
Fine sand	%	32.59	ECe (soil paste extract) dSm^{-1}	2.83
Silt	%	27.31	pH (1:2.5 soil: water suspension)	7.6
Clay	%	38.39	Nutrient status in soil (mg kg $soil^{-1}$)	
Texture		Clay loam	Total N	456.2
			Available P	17.5
			Available K	380

Randomized complete block design with three replicates was performed. The first factor was arranged for 3 crops i.e; rice (*Oryza sativa*) cv. Sakha 101, tomato (*Lycopersicon esculentum., mill*) cv. Super Merry Mand and cowpea (*Vigna unguiculata* L. Walp) cv. Karim seeds, The second factor (Microbial inoculants); (Non-inoculated – Inoculated with blue green algae) with the rice; non-inoculated – Inoculated with nitrobin) for tomato crop and non-inoculated – inoculated with rhizobia for cowpea crop and the pollinating of the seeds before planting. Finally, the third factor was occupied with 3 nitrogen fertilizer rates (control, half and all recommended dose of N according recommended doses for cultivated crops. The total of treatments were (3 crops x 2 inoculalation x 3 N rates x 3 replicates = 54 experimental units). Fertilizer of potassium sulphate (40 % K) was used as a source of K (0.72 g pot^{-1} to tomato, 0.45 g pot^{-1} to cowpea and calcium super – phosphate (6.8 % P) was used as a source of P (0.6 g pot^{-1} to rice, 0.6 g pot^{-1} to tomato, 0.6 g pot^{-1} to cowpea).

Five seeds of cowpea and rice were presoaked in distilled water for 24 hours, and were placed 2.5 cm below the soil surface in the centre of each pot and covered with soil. Also, three tomato seedlings were placed in the centre of each pot. Water was applied to the pots to maintain the soil water potential near FC available moisture. After 35, 70 and 105 days after planting, 3 plants were randomly chosen from each plot and taken for fresh and dry weights of shoot (g pot^{-1}) and roots (mg pot^{-1}).

To analyze nitrogen in crop organs, samples were taken from each plot, and dried at 70°, finally it grounded using stainless steel equipments. From each sample 0.2 g was digested using 5 cm^3 from the mixture of sulfuric (H_2SO_4) and perchloric ($HCLO_4$) as described by Cottenie (1982). Total nitrogen (%) was determined by Kjeldahl method as aforementioned by (Hesse, 1971).

After harvesting, soil samples from surface down to 30 cm at 15 cm intervals were collected. Available nitrogen in the soil was extracted using 2.0 M KCl and determined by using macro-Kjeldahl method as described by Hesse (1971). The utilization efficiency (U.E. %) of applied N fertilizer by crop types i.e. (rice, cowpea and tomato) which was calculated from the following formula according to Finck, (1982):

$$\textbf{U.E.\%} = \frac{\text{N uptake by whole plants at specific treatment} - \text{N uptake at control}}{\text{Applied N fertilizer (g pot}^{-1}\text{)}} \times 100$$

All data were statistically analyzed according to the technique of analysis of variance (ANOVA) and the least significant differences between the treatment means as published by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1. Available nitrogen contents (mg kg soil^{-1}) in soil:-

Data in Table 2 reveal that there are significant differences between average Available nitrogen contents mg kg soil^{-1} in soil as affected by crop types i.e. (rice, cowpea and tomato crops), inoculations and N rates.

Table 2 shows also that the highest mean values of available nitrogen contents (mg kg soil^{-1}) in soil readings were 112.33 mg kg soil^{-1} attained due all nitrogen doses + inoculated with nitrobin + tomato. On the other hand, the lowest means of Available nitrogen contents mg kg soil^{-1} in soil were 49.00 mg kg $soil^{-1}$ obtained from untreated with nitrogen + untreated with inoculation+ rice. These results could be enhanced with Hammouda *et al*. (2001) observed that application of biofertilizer improved available soil nitrogen and phosphorus as compared to initial amounts before planting.

Table 2: Available nitrogen contents (mg kg $soil^{-1}$) in soil after harvesting as affected by the interactive effect of crop types, inoculation and nitrogen fertilizer rates during 2007/2008 season.

Bioinoculants	N-rates (g pot^{-1})	Crop types		
		Rice	Cowpea	Tomato
Non-inoculated	N0	49.00	49.69	51.00
	N1	69.34	53.59	72.59
	N2	81.00	66.97	91.33
Inoculated	N0	55.26	59.56	58.00
	N1	78.00	71.59	80.67
	N2	93.67	82.50	112.33
F Test		*		
LSD 0.05		0.59		

2. Dry shoots (g pot^{-1}):-

Data in Table 3 illustrate that except 35 DAP there are significant differences between average of dry shoots g pot^{-1} at 70 and 105 DAP as affected by affected by crop types i.e. (rice, cowpea and tomato crops), inoculations and N rates at different plant growth.

Data presented in Table 3 indicate also that the best mean values of dry shoots g pot^{-1} were 1.55 and 2.57 g pot^{-1} obtained from all nitrogen dose + inoculated with Rhizobia + cowpea at 35 and 70 DAP except at 105 DAP were 4.01 obtained from all nitrogen dose + inoculated with nitrobin + tomato. On the other hand the lowest mean values of dry shoots g pot^{-1} were 0.44, 0.95 and 1.00 g pot^{-1} obtained from untreated with nitrogen + untreated with inoculation + tomato. These results could be confirmed with Singh, *et al*. (2004) found that the integrated use inorganic sources of nutrients and biofertilizers significantly increased shoot dry matter yield of tomato.

Table 3: Means of dry shoots (g pot^{-1}) at different plant growth stages as affected by the interactive effect of crop types, inoculation and nitrogen fertilizer rates during 2007/2008 season.

Treatments			Days after planting (DAP)		
			35	**70**	**105**
Rice	**Non-inoculated**	**N0**	0.53	1.12	1.17
		N1	0.61	1.29	1.70
		N2	0.72	1.35	1.97
	Mean		**0.62**	**1.25**	**1.61**
	Inoculated	**N0**	0.85	1.46	2.08
		N1	1.03	1.52	2.31
		N2	1.24	2.15	3.08
	Mean		**1.04**	**1.71**	**2.49**
Average			**0.84**	**1.49**	**2.05**
Cowpea	**Non-inoculated**	**N0**	0.57	1.19	1.59
		N1	0.67	1.30	1.87
		N2	0.81	1.55	2.24
	Mean		**0.68**	**1.35**	**1.9**
	Inoculated	**N0**	1.09	1.85	2.60
		N1	1.50	2.22	3.76
		N2	1.55	2.57	3.98
	Mean		**1.38**	**2.21**	**3.45**
Average			**1.03**	**1.78**	**2.68**
Tomato	**Non-inoculated**	**N0**	0.44	0.95	1.00
		N1	0.54	1.1	1.32
		N2	0.64	1.27	1.77
	Mean		**0.54**	**1.11**	**1.36**
	Inoculated	**N0**	0.75	1.42	2.10
		N1	0.92	1.69	2.48
		N2	1.44	2.32	4.01
	Mean		**1.04**	**1.81**	**2.86**
Average			**0.79**	**1.46**	**2.11**
LSD at 0.05			**--**	**0.80**	**0.98**

3. Dry roots (mg pot^{-1}):-

Reading data in Table 4 it is clear that except 35 DAP there are no significant differences between average of dry roots mg pot^{-1}at 70 and 105 DAP as affected by crop types i.e. (rice, cowpea and tomato crops), inoculations and N rates at different plant growth.

As seen from data in the same Table that the highest mean values of dry roots mg pot^{-1} readings were 91.56, 190.15 and 208.73 mg pot^{-1} attained due to the all nitrogen dose + inoculated with Rhizobia + cowpea. At 35, 70 and 105 DAP. On the other hand, the lowest means of dry roots mg pot^{-1} were 25.61 mg pot^{-1} obtained from untreated with nitrogen + untreated with inoculation + rice at 35 DAP also 39.26 and 41.07 mg pot^{-1} obtained from untreated with nitrogen + untreated with inoculation + tomato at 70 and 105 DAP. These results are in-accordance with those obtained by Al – Karaki (2000) and Amer, *et al*. (2003).

Table 4: Means of dry root (mg pot^{-1}) at different plant growth stages as affected by the interactive effect of crop types, inoculation and nitrogen fertilizer rates during 2007/2008 season.

Treatments			Days after planting (DAP)		
			35	**70**	**105**
Rice	**Without**	**N0**	25.61	55.30	51.36
		N1	34.26	73.60	79.42
		N2	47.11	101.04	108.35
	Mean		**35.66**	**76.65**	**79.71**
	With	**N0**	28.79	61.48	66.39
		N1	50.79	100.73	118.51
		N2	63.31	121.97	147.72
	Mean		**47.63**	**94.73**	**110.87**
Average			**41.65**	**85.69**	**95.30**
Cowpea	**Without**	**N0**	28.12	71.24	75.61
		N1	46.88	100.95	107.95
		N2	64.68	137.33	142.24
	Mean		**46.56**	**103.17**	**108.6**
	With	**N0**	66.95	144.73	147.61
		N1	85.13	183.31	188.92
		N2	91.56	190.15	208.73
	Mean		**81.21**	**172.73**	**181.75**
Average			**63.89**	**137.95**	**145.18**
Tomato	**Without**	**N0**	22.88	39.26	41.07
		N1	28.80	49.96	54.13
		N2	30.86	62.27	67.2
	Mean		**81.21**	**50.50**	**54.13**
	With	**N0**	33.6	72.35	78.4
		N1	42.1	90.65	98.23
		N2	50.4	103.99	125.76
	Mean		**42.03**	**89.00**	**100.80**
Average			**34.77**	**69.75**	**77.47**
LSD at 0.05			**3.00**	--	--

5. Dry yield (g pot^{-1}):-

Data presen1ted in Table 5, indicate clearly that there are significant differences between average of dry yield g pot^{-1} as affected by crop types i.e. (rice, cowpea and tomato crops), inoculations and N rates at different plant growth respectively under experimental conditions. It is evident from Table 5 that the highest mean values of dry yield g pot^{-1} readings were 6.27 g pot^{-1} attained due to all nitrogen dose + inoculated with nitrobin + tomato. On the other hand, the lowest means of dry yield g pot^{-1} were 0.31g pot^{-1} obtained from untreated with nitrogen + untreated with inoculation + rice. These results conceded with those reported by Al–Karaki and Hammad (2001); Bhat, *et al*.(2005); Carreres, *et al*.(2000), Channabasavanna, *et al*. (2001), Singh, *et al*. (2004) and Rane , *et al*. (2007) stated that the combined application of inorganic fertilizer and biofertilizer increased yield of tomato.

Table 5: Means of dry yield (g pot^{-1}) as affected by the interactive effect of crop types, inoculation and nitrogen fertilizer rates during 2007/2008 season.

Bioinoculants	N-rates (g pot^{-1})	Crop types		
		Rice	Cowpea	Tomato
Non-inoculated	N0	0.31	0.32	1.77
	N1	0.46	0.47	2.64
	N2	0.58	0.53	2.99
Inoculated	N0	0.46	0.36	3.20
	N1	0.72	0.55	4.42
	N2	0.87	0.96	6.27
F Test		--		
LSD 0.05		NS		

6. N concentrations % in shoots:-

Data in Table 6 reveal that there are no significant differences between average of N concentration in shoots at 35and 105 DAP except 70 DAP. As affected by crop types i.e. (rice, cowpea and tomato crops), inoculations and N rates at different plant growth.

Table 6: Means of N concentrations (%) in shoot at different plant growth stages as affected by the interactive effect of crop types, inoculation and nitrogen fertilizer rates during 2007/2008 season.

Treatments			Days after planting (DAP)		
			35	70	105
Rice	Non-inoculated	N0	2.15	2.34	1.95
		N1	2.17	2.43	2.03
		N2	2.56	2.80	2.33
	Mean		**2.29**	**2.52**	**2.10**
	Inoculated	N0	2.24	2.44	2.03
		N1	3.06	3.34	2.78
		N2	3.31	3.61	3.01
	Mean		**2.87**	**3.13**	**2.61**
Average			**2.58**	**2.83**	**2.35**
Cowpea	Non-inoculated	N0	2.34	2.51	2.17
		N1	3.39	3.70	3.08
		N2	3.85	4.20	3.5
	Mean		**3.19**	**3.47**	**2.92**
	Inoculated	N0	2.86	3.32	2.6
		N1	3.67	4.01	3.34
		N2	4.37	4.90	4.08
	Mean		**3.63**	**4.08**	**3.34**
Average			**3.41**	**3.77**	**3.12**
Tomato	Non-inoculated	N0	2.80	3.06	2.55
		N1	3.15	3.53	2.94
		N2	3.44	3.75	3.12
	Mean		**3.13**	**3.45**	**2.87**
	Inoculated	N0	2.81	3.05	2.54
		N1	3.67	3.93	3.34
		N2	4.02	4.38	3.65
	Mean		**3.5**	**3.79**	**3.18**
Average			**3.31**	**3.62**	**3.02**
LSD at 0.05			--	0.56	--

Concerning to the effect of inoculations, the same Table reveals that mean values of N concentration in shoots tend to increase significantly with inoculated plants as compared with non inoculated plants at (35, 70 and 105DAP respectively. Table 6 indicates also that the higher the rate of N the higher the means of N concentration in shoots (%) at 35, 70and 105 DAP respectively. Finelly, Table 6 shows also that the highest mean values of N concentration in shoots readings were 4.37, 4.90 and 4.08% attained due to all nitrogen doses + inoculated with Rhizobia +cowpea at 35, 70 and 105 DAP. On the other hand, the lowest means of N concentration in shoots % were 2.15, 2.34 and 1.95% at 35, 70 and 105 DAP, obtained from untreated with nitrogen + untreated with inoculation + rice. these results are in a line with those reported by El–Robae (2003) found that N, P and K % in leaves of tomato plants increased with increasing nitrogen application up to the highest used level (160 kg N/fed) under sandy soil condition.

7. N concentrations in roots %:-

As show in Table 7 there are no significant differences between average of N concentrations % in roots at 35 and 70 DAP except at 105 DAP as affected by crop types i.e.(rice, cowpea and tomato crops) , inoculations and N rates at different plant growth.

It is worthy to point out that the effect of inoculations in the same Table reveal that mean values of N concentrations % in roots tend to increase with inoculated plants as compared with non inoculated plants at 35, 70 and 105 DAP respectively. Generally, data in Table 7 show that application of N fertilizer rates positively increased the N concentrations % in roots at 35, 70 and 105DAP respectively.

Table 7 shows also that the highest mean values of N concentration in roots readings were 0.200% attained due to all nitrogen doses + inoculated with Rhizobia +cowpea at 35DAP and 0.230 and 0.147 % attained due to all nitrogen dose + inoculated with nitrobin + tomato at 70 and 105 DAP. On the other hand, the lowest means of N concentrations % in roots were 0.067 % obtained from untreated with nitrogen + inoculation with blue green algae + rice at 35 DAP and 0.090 and 0.068 % obtained from untreated with nitrogen + untreated with inoculation + rice at 70 and 105 DAP. as mentioned by Rasco, *et al.* (1992) showed that N, P and K concentration in roots increased by inoculation as compared with control.

Table 7: Means of N concentrations (%) in root at different plant growth stages as affected by the interactive effect of crop types, inoculation and nitrogen fertilizer rates during 2007/2008 season.

Treatments			Days after planting (DAP)		
			35	**70**	**105**
Rice	**Non-inoculated**	**N0**	0.083	0.090	0.068
		N1	0.100	0.113	0.079
		N2	0.120	0.1237	0.086
	Mean		**0.101**	**0.109**	**0.078**
	Inoculated	**N0**	0.067	0.107	0.074
		N1	0.100	0.127	0.091
		N2	0.120	0.1337	0.094
	Mean		**0.096**	**0.123**	**0.086**
Average			**0.098**	**0.116**	**0.082**
Cowpea	**Non-inoculated**	**N0**	0.160	0.100	0.070
		N1	0.180	0.150	0.105
		N2	0.193	0.167	0.118
	Mean		**0.178**	**0.139**	**0.098**
	Inoculated	**N0**	0.170	0.103	0.073
		N1	0.183	0.157	0.113
		N2	0.200	0.183	0.129
	Mean		**0.184**	**0.148**	**0.105**
Average			**0.181**	**0.143**	**0.101**
Tomato	**Non-inoculated**	**N0**	0.103	0.160	0.112
		N1	0.123	0.190	0.134
		N2	0.133	0.196	0.138
	Mean		**0.120**	**0.182**	**0.128**
	Inoculated	**N0**	0.14	0.180	0.130
		N1	0.123	0.190	0.136
		N2	0.143	0.230	0.147
	Mean		**0.135**	**0.2**	**0.138**
Average			**0.128**	**0.191**	**0.133**
LSD at 0.05			**--**	**--**	**0.005**

8. N concentrations % in yield:-

Data in Table 8 reveal that there are no significant differences between average of N concentrations % in crop yield as affected by crop types i.e.(rice, cowpea and tomato crops), inoculations and N rates at yield.

The role of effect of inoculations, in Table 8 observed that means values of N concentrations % in crop yield tend to increase with inoculated plants more than non inoculated plants.

Table 8 shows also that the highest mean values of N concentrations % in crop yield readings were 3.75% attained due all nitrogen doses + inoculated with Rhizobia + cowpea. On the other hand, the lowest means of N concentrations % in crop yield were 1.12% obtained from untreated with nitrogen + untreated with inoculation + rice.

Table 8 : Means of N concentrations (%) in crop yield as affected by the interactive effect of crop types, inoculation and nitrogen fertilizer rates during 2007/2008 season.

Bioinoculants	N-rates (g pot^{-1})	Crop types		
		Rice	Cowpea	Tomato
Non-inoculated	N0	1.12	3.14	2.97
	N1	1.34	3.47	3.13
	N2	1.50	3.54	3.29
Inoculated	N0	1.29	3.14	2.92
	N1	1.40	3.40	3.21
	N2	1.61	3.75	3.42
F Test		--		
LSD 0.05		NS		

9. Utilization efficiency % of applied of nitrogen:-

Results with the effect of inoculations, in table 9 observed that mean values of Utilization efficiency % of applied of nitrogen tend to increase with inoculation treatments.

Table 9 : Means of N concentrations (%) in crop yield as affected by the interactive effect of crop types, inoculation and nitrogen fertilizer rates during 2007/2008 season.

Bioinoculants	N-rates (g pot^{-1})	Crop types		
		Rice	Cowpea	Tomato
Non-inoculated	N0	--	--	--
	N1	2.40	9.86	4.15
	N2	4.74	17.81	7.22
Inoculated	N0	--	--	--
	N1	4.37	21.92	7.41
	N2	9.69	39.92	20.37

Regarding the effect of N fertilizer, data in Table 9 reveal that application of N fertilizer rates positively increased utilization efficiency % of applied of nitrogen.

It is evident from table 9 that the highest mean values of Utilization efficiency % of applied of nitrogen readings were 39.92 % attained due to all nitrogen doses + inoculated with Rhizobia + cowpea. On the other hand, the lowest means were 2.40 % obtained from half N doses + untreated with inoculation + rice. These results were accordance with those reported by Li *et al*. (1991a).

Conclusion

It could be concluded that the highest mean values of dry shoot, roots and yield and its N concentration (%) were obtained from all nitrogen dose + inoculated with Rhizobia + cowpea. Meanwhile, the lowest mean values of fresh shoots were obtained from untreated with nitrogen +

untreated with inoculation + tomato. Moreover, the highest utilization efficiency % of N applied was attained due to all nitrogen doses + inoculated with Rhizobia + cowpea over the others.

REFERENCES

Al – Karaki, G. N. and M. R. Hammad (2001). Response of two tomato cultivars differing in salt tolerance to inoculation with mycorrhizal fungi under salt stress. Mycorrhiza 11:43-47.

Al-Gusaibi,-A-M (2004) Seston and nitrogen effects on yield and N, P uptake of rice (Oryza sativa L. cv. Hassawi), Scientific-Journal-of-King-Faisal-University-Basic-and-Applied-Sciences. 2004; 5(1): 93-101.

Al-Karaki, G. N. (2000) Growth of mycorrhizal tomato and mineral acquisition under salt stress. Mycorriza, 10 (2):51-54.

Amer,-A-H; El-Shimi,-I-Z; Zayed,-G-A (2003) Response of tomato plants grown in newly reclaimed sandy soils to bio and mineral fertilization.Annals-of-Agricultural-Science,-Moshtohor.2003; 41(2): 925-938.

Aziz, M. A and M. A. Hashem 2004. Role of cyanobacteria on yield of rice in saline soil. Pakistan J. of Biol. Sci. 7 (3): 309-311.

Badiane, O., M. Bader, M. R. El-Amir, A. El-Miniawy, F. Goletti and J. Soil. 1994. Agricultural input and output market in Egypt: Initial impact and future policy issues. Paper II. 3. A Report Submitted to the MALR, Egypt and Int. Food Policy Res. Inst./Washington, D. C.

Becker, M., J.K. Ladha, and M. Ali (1995) Green manure technology: potential usage, and limitations. A case study for lowland rice. Plant and soil 174:181-194.

Bhat,-J-A; Chakrabortty,-S; Sharma, D. P. and Tarrence, Thomas (2005) Effect of integrated nutrient management on soil properties, nutrient uptake growth and yield of rice (Oryza sativa L.). Environment-and-Ecology. 2005; 23(2): 390-394.

Carreres, R; J. Sendra; R. Ballesteros and J. G. de. La. Cuadra (2000) Effects of preflood nitrogen rate and midseason nitrogen timing on flooded rice. J. Agric. Sci. 134 (4): 379 – 390.

Channabasavanna, A. S; K. S. Jagadish and D. P. Biradar (2001) Effect of *Aospirillum a*nd N levels on the growth and yield of rice Kamataka J. Agric Sci. India. 14(4): 928-931.

Cottenie, A.; M. Verloo; G. Velghe and R. Camerlynch (1982). Chemical Analysis of Plants and Soil. Laboratory of Analytical and Chemistry. State of Univ. Gent, Belgium.

El - Robae, M. M. (2003) Effect of some agricultural treatments on yield and quality of tomatoes. M. Sc. Thesis, Fac. Agric. Zagazig Univ., Egypt.3

El-Zeky, M. M. (2005): Response of wheat to biofertilizer inoculation under different levels of inorganic nitrogen. J. Agric. Sci. Mansoura Univ., 30 (1): 701-710.

Finck, A. (1982).“Fertilizers and Fertilization”.Weinheim Deerfield Beach, Florida, Basel, Verlage Chemie, pp. 223.

Gomez, K.A. and A. A. Gomez (1984). Statistically Procedures for Agricultural Research. 2nd Ed. John Wiely and Sons, pp. 680.
Hammouda, F. M; F. K. Abd El-Fattah and Dawlat. M. N. Abadi (2001). The potential improvement of some different biofertilizations on rice crop and their residual effect on succeeding wheat crop. J. Agric. Sci. Mansoura Univ. Egypt. 26 (2):1021-1030.
Hauggaard-Nielsena H.; Ambusa P. and Jensenb E. S. (2001). Interspecifc competition, N use and interference with weeds in pea-barley intercropping. Field Crops Research 70 (2001) 101-109.
Hesse, P. R. (1971). A Text Book of Soil Chemical Analysis. John Murry (Publishers) Ltd., 50 Albermarle Street, London.
Kannaiyan, S. (2003) Inoculant production in developing countries–problems, potentials and success. Maximizing the use of biological nitrogen fixation in agriculture – Report of an FAO/IAEA – Technical Expert Meeting held in Rome – 13 – 15 – March – 2001. 187 – 198.
Li, X. l.; H.; Marschner and E.; George (1991a). Acquisition of phosphorus and copper by VA- mycorrhizal hyphae and root – to – shoot tans port in white clover. Plant and Soil. 136: 49-57.
Rane, S. D.; Chavan, S. D. and Ranshur, N. J. (2007) Integrated plant nutrient supply for tomato in inceptisol. Journal-of-Maharashtra-Agricultural-Universities. 2007; 32(1): 168-169.
Rasco, E. T., Amonte, V. D., Orolfo, E. and Catomay, M. (1992). Response of sweet potato to biofertilizers. Special Publication-Taichyng District Agric. Improvement station. 407-417.
Rebecca, B. (2004). Soil Survey Laboratory Methods Manual. Soil Survey Laboratory Investigations Report No. 42.
Roger, P. A. and J. K. Ladha (1992) Biological N_2 fixation in wetland rice fields: estimation and contribution to nitrogen balance. Plant and Soil 141:41-55.
Singh, T. R.; Singh,-S; Singh, S. K; Singh, M. P.; Srivastava, B. K. (2004) Effect of integrated nutrient management on crop nutrient uptake and yield under okra-pea-tomato cropping system in a Mollisol. Indian-Journal-of-Horticulture. 2004; 61(4): 312-314.
Vessey, J. K. (2003): Plant growth promoting rhizobactria as biofertilizers. Plant and soil. 255:517-586.
Watanabe, I. and C.C. Liu. (1992) Improving nitrogen-fixating systems and integrating them into sustainable rice farming. Plant and Soil 141:57-67.

التأثير المشترك لنوع المحصول والتلقيح الميكروبي ومعدلات التسميد النتروجيني على تيسر النيتروجين

خالد حسن الحامدي[1] ، المتولي مصطفي سليم[2] و هدي إبراهيم حسين[1]
١- قسم الأراضي- كلية الزراعة- جامعة المنصورة
٢- قسم الأراضي واستغلال المياه- المركز القومي للبحوث- القاهرة - الدقي

أقيمت تجربة أصص بمحطة الأبحاث الزراعية بكلية الزراعة-جامعة المنصورة من خلال موسم صيف ٢٠٠٧ لدراسة التأثير المشترك لنوعية المحصول (الأرز ، اللوبيا والطماطم)، والتلقيح البكتيري مقارنة بدون التلقيح البكتيري ومعدلات التسميد النتروجيني (كنترول، ٢/١ المعدل الموصى به، وكل المعدل الموصى به في صورة نترات نشادر) طبقاً للتوصيات السمادية لكل محصول على محتوى التربة من النتروجين (ملجم/كجم تربة) بعد الحصاد والوزن الجاف وتركيز النتروجين (%) في كل من المجموع الخضري والجذور والمحصول خلال مراحل النمو المختلفة (٣٥، ٧٠ و ١٠٥ يوم من الزراعة) وكذلك كفاءة الاستفادة من السماد النتروجيني المضاف في قطاعات كاملة العشوائية.

وفيما يلي عرض لملخص النتائج المتحصل عليها:

- أظهرت النتائج أن محتوى للتربة من النيتروجين الصالح كان مع كل النيتروجين الموصى به + التلقيح بالنيتروبين + الطماطم فى حين كان اقل متوسط مع بدون تسميد معدنى + بدون تلقيح + الأرز.
- أشارت النتائج أن أعلى متوسط للوزن الجاف للعرش كان مع الكمية الموصى بها من النيتروجين + التلقيح بالريزوبيا + اللوبيا عند ٣٥ ، ٧٠ يوم من الزراعة ماعدا عند ١٠٥ يوم كانت مع كل النيتروجين الموصى به +التلقيح بالنيتروبين + الطماطم ، وكان اقل متوسط للوزن الجاف للعرش مع بدون تسميد معدنى + بدون تلقيح + الطماطم مراحل النمو المختلفة عند ٣٥،٧٠، ١٠٥ يوم بعد الزراعة.
- أوضح التحليل الإحصائي أعلى متوسط للوزن الجاف للجذور والمحصول كان مع الكمية الموصى بها من النيتروجين + التلقيح بالريزوبيا + اللوبيا وبدون تسميد معدنى + بدون تلقيح + الطماطم أثناء مراحل النمو المختلفة عند ٣٥،٧٠، ١٠٥ يوم بعد الزراعة، فى حين كان أقل متوسط للوزن الجاف للمحصول مع بدون تسميد معدنى + بدون تلقيح + الأرز .
- وجد من التحليل الإحصائي أن أعلى متوسط لتركيز النيتروجين فى العرش والمحصول كان مع كل النيتروجين الموصى به + التلقيح بالريزوبيا + اللوبيا فى حين كان اقل متوسط كان مع الكنترول مع الأرز فى مراحل النمو المختلفة للنبات ٣٥ ، ٧٠ ، ١٠٥ يوم بعد الزراعة.
- تبين من النتائج أن أعلى متوسط لتركيز النيتروجين فى الجذور كان مع كل النيتروجين الموصى به + التلقيح بالريزوبيا + اللوبيا عند ٣٥ يوم بعد الزراعة ومع كل النيتروجين الموصى به + التلقيح بالنيتروبين + الطماطم عند ٧٠ ، ١٠٥ يوم بعد الزراعة فى حين كانت اقل متوسط كان مع بدون تسميد معدنى + التلقيح بالطحالب الخضراء المزرقة + مع الأرز عند ٣٥ يوم بعد الزراعة و مع بدون تسميد معدنى + بدون تلقيح + الأرز عند ٧٠ ، ١٠٥ يوم بعد الزراعة.
- أعلى متوسط لكفاءة الاستفادة من السماد كان مع كل النيتروجين الموصى به + التلقيح بالريزوبيا + اللوبيا فى حين كان أقل متوسط مع نصف النيتروجين الموصى به + بدون تلقيح + الأرز.