Research Journal of Agriculture and Biological Sciences, 6(4): 453-465, 2010

Integrated Effect of Mineral, Compost and Biofertilizers on Soil Fertility and Tested Crops Productivity

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Abastract: Poor performance of nitrogen and micronutrients availability is one of the major factors related to crop productivity in the calcareous soil. Maize (Individual hybrid 10) and wheat (C.V. Giza 168) cropping sequence grown on a calcareous sandy clay loam soil under field conditions of El Nubaria region, Egypt to evaluate the benefit effect of organic manure (composted rice straw) and bio-fertilizer (bio1: Azotobacter sp. and bio2: *Azotobacter* sp, *Asosprillum* sp.*Bacillus* negatherium and *Pseudomonas* sp.) for improving nitrogen and some micronutrients availability. To achieve this target, two rates of mineral N were applied, i.e., 75% and 100% of recommended N. Both two rates of applied N were obtained equally from mineral N and organic one at ratio of (1:1). The investigated maize and wheat grains were either grown without inoculation or inoculated with separate kind of bio-fertilizers (1 ,2). The results obtained clearly showed that the availability of N,P and K in the soil increased as well as some micronutrients availability in a calcareous soil as compared to the initial soil and consequently increased in grains and straw of maize & wheat. Concerning the nutrients content in plants, data revealed that an increasing trend of nutrients responses for the abovementioned elements in plant tissues of the studied two crops with superiority of mineral fertilizer and compost combined with bio-fertilizer at the first and second season. This is may be due to the addition of organic compost which improved the physical and chemical properties of the soil, as well as the mixture of bio-fertilizer enrich the soil by nitrogen fixation which increase soil fertility. As for, increased the supplying power of available nutrients to plants. The positive effect of bio-fertilizer may also be due to optimum soil pH which facilities maximum utilization of applied micronutrients to crops.

Key words: Biofertilizer, organic manure, calcareous soil, maize , wheat and plant nutrients.

INTRODUCTION

Egypt, adopts a policy of land reclamation to cover the gap between agriculture production and consumption. These reclamation projects were planned to comply with sustainable agriculture production. Increased attention is now being paid to developing an Integrated Plant Nutrition System (IPNS) that maintain or enhances soil productivity through balanced use of all sources of nutrients, including chemical, organic and bio-fertilizer. The basic concept is the adjustment of soil fertility and plant nutrient supply to an optimum level for sustaining desired crop productivity through optimization of the benefits from all possible sources of plant nutrient in an integrated manner. Several researchers have demonstrated the beneficial effect of combined use of chemical and organic fertilizers to mitigate the deficiency of many secondary and micronutrients in fields that continuously received only N, P and K fertilizers for a few years, without micronutrients or organic fertilizer. Afield experiment was conducted by Chand *et al*.[2] for seven years continuously to evaluate the influence of organic and chemical fertility build up and nutrient uptake in a mint and mustard cropping sequences. Results indicated that integrated supply of plant nutrients through FYM and mineral fertilizer (N,P and K) played a significant role in sustaining soil fertility and crop productivity. Dutta *et al*. [4] reported that the use of organic fertilizers together with chemical fertilizers, had a higher positive effect on microbial biomass and hence soil health. As well as, Kaur *et al*.[9] reported that balanced fertilization using both organic and chemical fertilizers is important for maintenance of soil organic matter content and long –term soil productivity in the tropics where soil organic matter content is low.

Bio-fertilizers differ from chemical and organic fertilizers in the sense that they are cultures of special bacteria which do not directly supply any nutrients to crops. The effect of combined treatments of multifunctional bio-fertilizers plus 50% of recomended chemical fertilizer (1/2C.F.+ bio-fertilizer) of lettuce were compared by Young *et al*.[25]. Results showed that there was a 25% increase of lettuce yield for the

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treatments of 1/2C.F.+biofertilizer compared to that of C.F. alone indicating that at least 50% of chemical fertilizer can be saved as multifunctional bio-fertilizer. As well as Young *et al*.[24] evaluated the effects of multifunctional bio-fertilizer on rhizosphere microbial activity and the growth of water celery in a field experiments. Results showed that the dry weight of water celery in the treatment with 50% compound fertilizer with bio-fertilizer was increased by 34% compared to the treatment with 100% organic compound fertilizer.

The main objective of this work is to investigate the ability to substitute partly (one half) of the traditional recommended mineral N rate with organic one as a primary step towards the clean entirely organic farming. However, the used compost (as organic source) was enriched with some types of N fixers or acid dissolving microbes.

MATERIALS AND METHODS

A field experiment was carried out at Nubaria, agriculture research station in Egypt for two successive seasons, maize (Individual hybrid10) followed by wheat(C.V.Giza168) to study the effect of organic and biofertilizers on improving the fertility status of calcareous soil under surface irrigation water system. Three sources of mineral fertilizer, compost and bio-fertilizers were used. Two rates of mineral N source were applied at 75% and 100% of recommended dose, which obtained equally from mineral N source and organic one at ratio of (1:1). Maize and wheat) grains were either grown without inoculation or inoculated with separate kind of biofertilizers. Biogen (*Azotobacter* sp.) and microbin (*Azotobacte*r sp, *Asosprillum* sp., *Bacillu*s *negatherium* and *Pseudomonas* sp.). Coating grains with the gum media carrying the bacteria strain on the same day of sowing.

The recommended N P K for maize were 120 N, 45 P_2O_5 and 24 K_2O kg fed^{-1}, while dose of wheat was 100 N, 45 P_2O_5 and 45 K_20 kg fed^{-1}.The following treatments were applied: Control (T0), Mineral fertilizer M.F.(T1), Compost(T2) and Compost +M.F. Some characteristics of the investigated soil and compost and mineral fertilizer are presented in Table (1). Soil samples at a depth of 0-30 cm were collected from different treatments at harvest time, were air dried, crushed, passed through 2mm sieve and kept for analysis. Plant samples were oven dried at $70C^0$ ground and kept for analysis. The design of this experiment is randomized complete block with three replicates.

Analytical Procedures: Soil pH, soil calcium carbonate, electrical conductivity, organic matter were determined according to Walkley & Black methods, were all done as described by page *et al*.[13].

Available Nitrogen was extracted by KCL solution (2M) according to Markous *et al*.[10] and determined by using Technician Auto analyzer.

Available P, Fe, Mn, Zn and Cu were extracted by ammonium bicarbonate AB-DTPA according to Saltanpour [20] and determined by (ICP-Plasma JY).

Available potassium was determined by using Flame photometer according to Jackson [8].

Plant Analysis: Dried plant materials (grain &straw of wheat and maize plants) were digested by using a mixture of concentrated sulphuric- perchloric acids according to the procedure of Chapman and Pratt [3] and the above elements were determined by (ICP-Plasma JY)

Total N was done using the Kjeldahl method described by Jackson [8].

RESULTS AND DISCUSSION

1. The Effect of Using Bio-fertilizer and Organic Compost under Different Levels of Mineral Nitrogen On:

1.1. Availability of Some Macronutrient (NPK) of the Investigated Soil after Harvesting: The obtained data presented in Tables (2 & 3) manifest the impact of mineral fertilizer, compost, bio-fertilizer or their combination on the availability of NH_4^+,NO_3^-,P and K^+ in soil after harvesting of maize and wheat. Available NPK in soil after maize were more affected by combined treatment of (bio-fertilizers (1,2) + 75%M.F. from recommended dose) than each one when applied alone. Interestingly, the higher available NPK were obtained when the soil treated with bio2 + 75%M.F.. On the other hand, after wheat harvesting in the second season where the residual effect of different nitrogen sources, would occur, NH_4^+ was greater but P and K were lower, while NO_3^- -N was very much lower in comparison with after maize harvesting. The higher available NH_4^+ was obtained when the soil treated with (bio2 + compost at the rate of 75%from recommended dose).While, the highest mean values of NO_3 and P were close to or lower than that of (bio2 + compost at the rate of 100% N from recommended dose). However, the highest mean value of K was observed at the combined treatment of (bio2 + compost at the rate of 100%from recommended dose), showing the benefits of bio-fertilizer and compost as a supplying and enhancing the release of N, P and K in the second season. This behavior may be attributed to net immobilization of N at the first season followed by net mineralization at the second one by the microbial action. Adding mixture of bio-fertilizer and compost not only enrich the soil by nitrogen fixation which

Table 1: Some characteristics of the investigated soil, compost and mineral fertilizers.

Items	Soil	Compost	Mineral Fertilizers		
			Nitrogen	Phosphorus	Potassium
C. sand %	42.00	-	-	-	-
F. sand %	12.00	-	-	-	-
Silt %	16.00	-	-	-	-
Clay %	30.00	-	-	-	-
Texture class	S. C. L***	-	-	-	-
S.P %	45.0	100	-	-	-
$CaCO_3$ %	32.0	3.31	-	-	-
pH **	8.10	7.20	-	-	-
EC dS/m*	3.44	24.3	-	-	-
Ca^{2+} meq.100g $soil^{-1}$	0.40	9.90	-	-	-
Mg^{2+} meq.100g $soil^{-1}$	0.32	7.70	-	-	-
Na^{+} meq.100g $soil^{-1}$	0.61	11.25	-	-	-
K^{+} meq.100g $soil^{-1}$	0.40	8.00	-	-	-
$CO_3^{=}$ meq.100g $soil^{-1}$	0.00	0.00	-	-	-
HCO_3^{-} meq.100g $soil^{-1}$	0.16	2.74	-	-	-
CL^{-} meq.100g $soil^{-1}$	0.36	19.60	-	-	-
$SO_4^{=}$ meq.100g $soil^{-1}$	1.21	14.51	-	-	-
(CEC) meq.100 g $soil^{-1}$	15.29	78.40	-	-	-
O.M %	1.11	32.75	-	-	-
O.C %	0.645	18.99	-	-	-
C:N ratio	6 : 1	18:1	-	-	-
T.N %	0.12	1.05	-	-	-
N mg.kg^{-1}	23.07	2179	-	-	-
P mg.kg^{-1}	9.79	22.23	-	-	-
K mg.kg^{-1}	480.46	6452	-	-	-
Fe mg.kg^{-1}	4.29	111.8	2.08(1)	8002.9	99.10
Mn mg.kg^{-1}	8.29	82.75	1.30	454.73	1.83
Zn mg.kg^{-1}	0.85	28.99	28.05	174.85	5.30
Cu mg.kg^{-1}	1.42	4.358	1.20	7.95	1.60

* In paste ** In suspension (1:2.5) ***S.C.L=sandy clay soil

(1): Total of elements in mineral fertilizer (mg.kg^{-1}).

Table 2: Effect of mineral, compost and bio-fertilizers on available N, P and K in soil after harvesting maize.

Bio-Fert. (A)	Nitrogen (75%) Treatments (B)					Nitrogen (100%) Treatments (B)				
	T0	T1	T2	T3	Mean	T0	T1	T2	T3	Mean
					NH_4					
Bio (0)	11.63	24.7	14.83	19.3	17.6c	12.63	38.8	17.93	26.20	23.9c
Bio (1)	20.13	43.2	31.23	37.7	33.1b	13.03	43.20	25.97	31.70	28.5b
Bio (2)	26.2	67.2	40.47	47.00	45.2a	17.53	43.10	18.73	36.70	29.0a
Mean	19.3d	45.0a	28.8c	34.7b		14.4d	41.7a	20.88c	31.53b	
$LSD_{0.05}$	A=0.019	B=0.125	AxB=0.2158			A= 0.019	B=0.127	AxB=0.2201		
					NO_3					
Bio (0)	6.2	87.9	10.33	11.80	29.1b	3.43	45.17	9.43	16.70	18.68b
Bio (1)	1.93	2.20	13.53	2.7	5.1c	4.83	73.0	10.63	22.30	27.69a
Bio (2)	26.13	76.6	35.13	40.70	44.6a	3.73	14.30	7.87	11.20	9.27c
Mean	11.4d	55.6a	19.7b	18.4c		1.00d	44.16a	9.31c	16.73b	
$LSD_{0.05}$	A=0.17	B= 0.119	AxB=0.2226			A=0.023	B=0.124	AxB=0.2183		
					P					
Bio (0)	5.73	12.67	10.13	12.50	10.3c	9.00	24.57	13.73	22.40	17.43c
Bio (1)	10.50	41.57	26.37	38.90	29.3b	10.13	73.10	18.37	19.40	30.25b
Bio (2)	11.23	73.10	45.33	56.10	48.7a	11.43	67.57	26.53	38.40	35.98a
Mean	9.16d	42.44a	27.27c	38.83b		10.19d	55.08a	19.54c	26.73b	
$LSD_{0.05}$	A=0.019	B= 0.122	AxB=0.2054			A=0.029	B=0.121	AxB=0.2151		
					K					
Bio (0)	367.3	680.0	477.0	398.8	480.8c	371.3	727.3	539.3	543.3	545.3c
Bio (1)	461.4	907.1	762.5	782.0	728.2b	406.3	729.3	547.3	629.3	578.1b
Bio (2)	536.9	954.0	825.0	931.8	811.9a	438.0	762.3	589.3	641.3	607.8a
Mean	455.2d	847.1a	688.2c	704.1b		405.2d	739.7a	558.7c	604.7b	
$LSD_{0.05}$	A=0.92	B=0.578	AxB=0.2027			A= 0.189	B= 0.165	AxB= 0.2014		

B0=without inoculation B1=inoculation with biogen B2=inoculation with microbin
T0=control T1=mineral fertilizer(MF) T2=compost T3= compost +MF

Table 3: Effect of mineral, compost and bio-fertilizers on available N, P and K in soil after harvesting wheat.

Bio-Fert. (A)	Nitrogen (75%) Treatments (B)					Nitrogen (100%) Treatments (B)				
	T0	T1	T2	T3	Mean	T0	T1	T2	T3	Mean
	NH_4									
Bio (0)	11.9	13.5	39.03	20.5	21.2c	16.03	21.67	29.73	23.50	22.73c
Bio (1)	12.23	27.0	40.13	28.5	26.9b	20.83	25.70	36.23	29.40	28.04b
Bio (2)	106.1	108.8	118.8	111.0	111.2a	22.23	28.20	46.63	31.10	32.04a
Mean	43.42d	49.77c	66.00a	53.33b		19.7d	25.19c	37.53a	28.0b	
$LSD_{0.05}$	A= 0.019	B=0.129	AxB=1.3543			A=0.019	B=0.126	AxB=0.2151		
					NO_3					
Bio (0)	0.20	1.40	4.23	1.80	1.9c	0.00	0.00	5.77	0.10	1.47c
Bio (1)	1.93	2.20	13.53	2.70	5.1b	1.13	3.10	15.33	3.80	5.84b
Bio (2)	5.13	6.23	18.63	9.90	9.9a	8.13	8.80	18.73	9.30	11.24a

Table 3: Continue

Mean	2.4d	3.3c	12.1a	4.8b		3.09d	3.97c	13.28a	4.40b	
LSD $_{0.05}$	A=0.164	B=0.117	AxB=0.2151			A=0.149	B=0.006	AxB= 0.2132		
					P					
Bio (0)	7.33	8.40	10.67	12.50	9.73c	8.20	9.87	12.13	14.0	11.05c
Bio (1)	8.33	9.27	11.56	13.60	10.69b	9.40	10.40	16.03	21.80	14.41b
Bio (2)	9.33	9.80	12.93	13.70	11.44a	10.23	10.60	24.13	36.00	20.24a
Mean	8.33d	9.16c	11.72b	13.27a		9.28d	10.29c	17.43b	23.93a	
LSD $_{0.05}$	A=0.029	B=0.122	AxB=0.2192			A=0.116	B=0.128	AxB=0.2201		
					K					
Bio (0)	277.9	281.8	493.0	461.7	378.6c	321.3	383.2	563.7	477.0	436.3c
Bio (1)	395.2	438.2	653.7	571.6	514.7b	407.3	430.1	638.6	628.2	526.0b
Bio (2)	430.4	428.2	628.4	653.0	534.9a	422.6	433.0	837.7	676.4	592.4a
Mean	367.9d	382.7c	591.7a	562.1b		383.7d	415.4c	679.9a	593.9b	
LSD $_{0.05}$	A=3.31	B=3.247	AxB= 0.2099			A=0.499	B=0.711	AxB=0.2101		

* NS = Not significant.

increase soil fertility, but also to the production of plant growth promoting substances, production of amino acids, vitamins and antimicrobial substances as well, which increase soil fertility, microbial community which in turn improve the cultivated plant growth [14,18].

As well as the absolute value of NO_3^--N values content were recorded lower than that of NH_4^+-N content especially in the second season, which might be attributed to anaerobic condition prevailing in the soil due to maintenance of moisture regime to the level of field capacity.

Concerning, the concentration of P and K after maize harvest, the best results for such traits were obtained with combined fertilization. These treatments gave higher percentage of available P and K than the untreated one (control). This may be due to the decomposition of organic manure which supplied more available nutrients and formation of organic and inorganic acids during decomposition which slightly reduce soil PH which in turn affected the solubility and availability of P and K. This beneficial effect is in agreement with those reported by El-Kouny *et al.*[6]. However, decreases in the second season (wheat) may be due to the plant consumption or movement to the deeper layer or precipitation with $CaCO_3$ or ion acids in the soil. These results are in agreement with those obtained by Sims [19] and Bar-Tal *et al.*[1].

1.2. Availability of Some Micronutrients in Soil after Harvesting: In general, pronounced response had been obtained in the solubility of Fe, Mn, Zn and Cu when bio-fertilizer was accompanied with organic compost than inoculation or organic compost added alone. Tables (4, 5) reveal that the interaction between different N fertilizers (M.F & compost) and bio-fertilizers were significantly increase the availability of (Fe, Mn, Zn and Cu) in the investigated soil after maize harvest. For, the highest concentrations of Fe, Zn and Cu were significantly increased in cases of inoculation with bio2 + compost at the rate of 75% N from recommended dose. This may be due to the addition of organic compost which improve the physical properties of the soil, and increased the supplying power of available nutrients to plants. The positive effect of bio-fertilizer may also due to optimum soil pH which facilities maximum utilization of applied micronutrients to crops [21]. While, the highest value of Mn was observed in the mixture of (Bio2 + M.F. at the rate of 75% N. from recommended dose) compared to the other treatments. This is may be due to the high amount of Mn in the used mineral fertilizers (Triple super phosphate) compared to the investigated compost as shown in Table (1).Concerning, such nutrients in the investigated soil after wheat harvest, it is clear from the obtained data (Table 4,5) that the concentrations of Fe, Mn, Zn and Cu were significantly increased when bio2 and organic manure applied under the rate of 100%N. This may be due to the decomposition of compost in the first season as well as the consumption of the investigated micronutrients by maize plant and the rest of compost in the second season was equal or less than 75% of N from recommended dose but its enough with bio-fertilizer for plant growth.

2. Availability of Some Macronutrients in Maize & Wheat Yields:

2.1. Straw: Tables (6 & 7) showed N,P and K content in maize and wheat straw as affected by two rates of mineral N source i.e., 75% and 100% from recommended N dose. Both two rates of applied N were derived equally from mineral N source and

Table 4: Effect of mineral, compost and bio-fertilizers on available micronutrients in soil after harvesting maize.

Bio-Fert. (A)	Nitrogen (75%) Treatments (B)					Nitrogen (100%) Treatments (B)				
	T0	T1	T2	T3	Mean	T0	T1	T2	T3	Mean
					Fe					
Bio (0)	9.83	9.20	18.23	10.80	12.0c	10.13	10.70	19.07	11.20	12.78c
Bio (1)	10.53	11.60	37.47	12.50	18.0b	10.13	11.47	22.07	11.8	13.87b
Bio (2)	13.83	15.03	54.57	17.00	25.1a	10.40	11.80	28.63	11.50	15.58a
Mean	11.4d	11.9c	36.8a	13.4b		10.22d	11.32c	23.26a	11.50b	
$LSD_{0.05}$	A=0.023	B=0.124	AxB=0.2106			A=0.046	B=0.122	AxB=0.2100		
					Mn					
Bio (0)	2.43	8.60	5.37	5.40	5.45c	2.43	7.70	5.13	6.00	5.32c
Bio (1)	2.63	9.43	5.83	6.20	6.02b	2.60	10.67	6.63	8.00	6.98b
Bio (2)	2.63	16.03	9.93	11.90	10.13a	2.83	11.03	6.77	8.40	7.26a
Mean	2.57d	11.36a	7.04c	7.83b		2.62d	9.80a	6.18c	7.46b	
$LSD_{0.05}$	A=0.033	B=0.124	AxB=0.2797			A=0.023	B=0.123	AxB=0.2214		
					Zn					
Bio (0)	0.78	0.74	1.00	1.13	0.91c	0.77	0.81	1.87	1.47	1.23b
Bio (1)	1.05	1.47	2.90	2.58	2.0b	0.79	0.94	1.40	1.23	1.09c
Bio (2)	1.08	1.88	3.87	3.11	2.48a	0.89	0.96	2.07	1.69	1.40a
Mean	0.97d	1.36b	2.59a	2.27b		0.82c	0.90c	1.78a	1.46b	
$LSD_{0.05}$	A=0.002	B=0.121	AxB=0.4392			A=83E-9	B=0.121	AxB= 0.2858		
					Cu					
Bio (0)	1.09	1.19	1.26	1.40	1.24c	1.09	1.12	1.20	1.15	1.14b
Bio (1)	1.12	1.26	1.43	1.25	1.26b	1.10	1.12	1.22	1.18	1.16ab
Bio (2)	1.17	1.51	1.57	1.54	1.45a	1.14	1.16	1.23	1.19	1.18a
Mean	1.13b	1.32a	1.42a	1.39a		1.11a	1.13a	1.22a	1.17a	
$LSD_{0.05}$	A=0.002	B=0.121	AxB= 5.6210			A=0.034	B=0.125	AxB=1.2307		

Table 5: Effect of mineral, compost and bio-fertilizers on available micronutrients in soil after harvesting wheat.

Bio-Fert. (A)	Nitrogen (75%) Treatments (B)					Nitrogen (100%) Treatments (B)				
	T0	T1	T2	T3	Mean	T0	T1	T2	T3	Mean
					Fe					
Bio (0)	7.80	8.30	9.16	8.83	8.53c	7.73	8.80	11.56	9.80	9.47c
Bio (1)	8.66	9.80	10.77	10.17	9.85b	8.93	8.70	15.23	9.90	10.69b
Bio (2)	9.50	10.10	11.27	10.77	10.41a	9.93	9.97	16.53	10.00	11.6a
Mean	8.656c	9.4bc	10.4a	9.9ab		8.87d	9.16c	14.4a	9.9b	
$LSD_{0.05}$	A=0.356	B=0.782	AxB=0.0392			A=0.023	B=0.124	AxB=0.0537		
					Mn					
Bio (0)	7.23	8.00	8.73	8.50	8.12c	8.33	9.30	10.26	9.70	9.40c
Bio (1)	8.93	8.80	10.07	9.90	9.43a	8.53	9.90	11.03	10.3	9.94b
Bio (2)	7.60	9.00	10.43	10.20	9.31b	9.63	10.90	11.43	10.80	10.61a
Mean	7.92b	8.60c	9.74a	9.53b		8.83d	9.97c	10.91a	10.27b	
$LSD_{0.05}$	A=0.033	B= 0.127	AxB=0.2099			A=0.0189	B=0.127	AxB=0.2166		

Table 5: Continue

				Zn						
Bio (0)	0.64	0.67	1.21	1.04	0.89c	0.72	0.72	1.55	1.33	1.08c
Bio (1)	0.76	0.79	1.73	1.17	1.11b	0.83	0.86	1.83	1.39	1.23b
Bio (2)	0.79	0.82	1.73	1.39	1.86a	0.96	1.06	1.93	1.52	1.37a
Mean	0.73d	0.76c	1.56a	1.20b		0.84d	0.88c	1.77a	1.42b	
$LSD_{0.05}$	A=0.032		B=0.023	AxB=0.0189		A=0.033		B=0.031		AxB=0.0636
				Cu						
Bio (0)	0.96	0.96	1.11	1.00	1.01c	1.08	1.10	1.22	1.13	1.14c
Bio (1)	1.04	1.06	1.15	1.05	1.07b	1.86	1.90	2.02	1.93	1.93b
Bio (2)	1.09	1.06	1.09	1.18	1.11a	2.02	2.05	2.09	2.07	2.06a
Mean	1.03c	1.03c	1.12a	1.08b		1.65c	1.68b	1.78a	1.71b	
$LSD_{0.05}$	A= 0.003	B=0.011	AxB=0.3744			A=0.027	B=0.031	AxB=0.2099		

Table 6: Effect of mineral, compost and bio-fertilizers on the Content of N P K in maize (straw and grains).

Bio-fert. (A)	Nitrogen (75%)					Nitrogen (100%)					Nitrogen (75%)					Nitrogen (100%)				
	Treatment (B)					Treatment (B)					Treatment (B)					Treatment (B)				
	T0	T1	T2	T3	Mean	T0	T1	T2	T3	Mean	T0	T1	T2	T3	Mean	T0	T1	T2	T3	Mean
					Maize straw N (mg/kg)										Maize grains N (mg/kg)					
Bio (0)	0.56	1.29	0.46	0.94	0.81c	0.56	1.42	0.72	1.06	0.94c	0.49	1.35	0.81	1.03	0.92c	0.50	1.49	0.83	1.08	0.98c
Bio (1)	0.64	1.78	1.17	1.64	1.34a	0.63	1.41	.97	1.28	1.07b	0.52	1.91	1.00	1.30	1.29a	0.54	1.78	0.95	1.22	1.13a
Bio (2)	0.77	1.92	1.16	1.42	1.28b	0.74	1.75	1.34	1.52	1.33a	0.53	2.36	1.02	1.29	1.19b	0.58	1.76	0.95	1.10	1.1b
Mean	0.66d	1.66a	0.93c	1.33b		0.64d	1.53a	1.01c	1.29b		0.51d	1.88a	0.95c	1.21b		0.54d	1.68a	0.91c	1.13b	
$LSD_{0.05}$	A=0.002	B=0.004	A*B=0.083			A=0.0	B=0.0	A*B=00038			A=0.002	B=0.0023	A*B= 0.209			A=0.002	B=0.0023	A*B= 0.209		
					P (mg/kg)										P (mg/kg)					
Bio (0)	0.024	0.044	0.042	0.046	0.04c	0.023	0.046	0.054	0.06	0.05c	0.16	0.45	0.34	0.41	0.34c	0.16	0.46	0.34	0.44	0.35c
Bio (1)	0.024	0.16	0.069	0.096	0.09b	0.024	0.11	0.057	0.07	0.06b	0.18	0.53	0.42	0.49	0.41b	0.18	0.5	0.37	0.44	0.38b
Bio (2)	0.025	0.28	0.095	0.24	0.16a	0.027	0.11	0.06	0.089	0.07a	0.2	0.64	0.48	0.59	0.48a	0.2	0.58	0.39	0.46	0.41a
Mean	0.03d	0.17a	0.07c	0.13b		0.03d	0.09a	0.06c	0.07b		0.18d	0.54a	0.41c	0.49b		0.18d	0.37c	0.51a	0.45b	
$LSD_{0.05}$	A=0.0002	B=0.004	A*B=0.0077			A=0.003	B=0.003	A*B=0.000			A=0.0038	B=0.005	A*B=0.21			A=0.005	B=0.005	A*B=0.288		
					K (mg/kg)										K (mg/kg)					
Bio (0)	0.031	0.06	0.049	0.051	0.05c	0.034	0.065	0.057	0.060	0.05b	0.007	0.016	0.013	0.015	0.013c	0.007	0.016	0.014	0.015	0.01c
Bio (1)	0.036	0.067	0.059	0.062	0.06b	0.035	0.066	0.051	0.054	0.05b	0.008	0.019	0.018	0.018	0.02b	0.009	0.018	0.015	0.015	0.02b
Bio (2)	0.035	0.075	0.06	0.069	0.06a	0.034	0.071	0.057	0.070	0.06a	0.01	0.025	0.02	0.022	0.02a	0.009	0.015	0.016	0.018	0.02a
Mean	0.03d	0.09a	0.06c	0.05b		0.03d	0.07a	0.06c	0.07b		0.01d	0.02a	0.02c	0.02b		0.01d	0.02a	0.015c	0.02b	
$LSD_{0.05}$	A= 0.0003	B= 0.0003	A*B=0.0077			A=0.0002	B=0.0002	AxB=0.0077			A= 0.00	B= 0. 003	A*B=0.21			A=0.001	B=0.0002	AxB=0.209		

NS = Not significant.

Table 7: Effect of mineral, compost and bio-fertilizers on the Content of N P K in wheat (straw and grains).

Bio-fert. (A)	Nitrogen (75%)					Nitrogen (100%)					Nitrogen (75%)					Nitrogen (100%)				
	Treatment (B)					Treatment (B)					Treatment (B)					Treatment (B)				
	T0	T1	T2	T3	Mean	T0	T1	T2	T3	Mean	T0	T1	T2	T3	Mean	T0	T1	T2	T3	Mean
					Maize straw N (mg/kg)										Maize grains N (mg/kg)					
Bio (0)	0.17	0.17	0.42	0.28	0.21c	0.17	0.20	0.25	0.22	2.6c	0.64	1.18	1.62	1.30	1.19c	0.64	1.01	1.26	1.48	1.09c
Bio (1)	0.17	0.20	0.51	0.34	0.24b	0.18	0.28	0.34	0.26	0.33b	0.66	1.34	1.88	1.54	1.36b	0.66	1.12	1.26	1.51	1.13b
Bio (2)	0.18	0.28	0.65	0.50	0.38a	0.18	0.44	0.49	0.31	0.44a	0.65	1.40	1.90	1.68	1.41a	0.65	1.20	1.40	1.60	1.21a
Mean	0.17d	0.22c	0.53a	0.37b		0.18d	0.31c	0.36a	0.26b		0.65d	1.31c	1.80a	1.51b		0.65d	1.11c	1.30b	1.53a	
$LSD_{0.05}$	A=0.002	B=0.002	A*B=0.2176			A=0.004	B=0.003	A*B=0.2100			A= 0.0033	B=0.0055	A*B=0.0095			A= 0.002	B= 0.0023	A*B=0.0041		
					P (mg/kg)										P (mg/kg)					
Bio (0)	0.26	0.26	0.35	0.33	0.299c	0.27	0.28	0.33	0.36	0.31c	0.013	0.016	0.046	0.030	0.027c	0.13	0.200	0.033	0.430	0.028c
Bio (1)	0.28	0.29	0.36	0.34	0.32b	0.27	0.31	0.35	0.38	0.33b	0.017	0.020	0.050	0.033	0.030b	0.02	0.023	0.043	0.046	0.033b
Bio (2)	0.28	0.29	0.38	0.35	0.33a	0.26	0.31	0.38	0.39	0.34a	0.020	0.023	0.060	0.046	0.037a	0.02	0.023	0.073	0.103	0.055a
Mean	0.27d	0.28c	0.37a	0.34b		0.26d	0.3c	0.35b	0.38a		0.02c	0.02c	0.05a	0.040b		0.018d	0.022c	0.05b	0.06a	
$LSD_{0.05}$	A= 0.003	B=0.003	A*B=0.2100			A= 0.0038	B=0.003	A*B=0.2100			A= 0.002	B=0.004	A*B=0.0029			A= 0.002	B=0.003	A*B=0.0015		

Table 7: Continue

	K (mg/kg)										K (mg/kg)									
Bio (0)	0.007	0.005	0.009	0.009	0.007c	0.006	0.007	0.009	0.009	0.008c	0.034	0.034	0.052	0.048	0.04c	0.032	0.038	0.064	0.052	0.147c
Bio (1)	0.006	0.008	0.010	0.007	0.009b	0.007	0.009	0.012	0.011	0.009b	0.034	0.034	0.053	0.052	0.04b	0.034	0.039	0.074	0.061	0.052b
Bio (2)	0.007	0.009	0.013	0.011	0.010a	0.007	0.009	0.015	0.011	0.010a	0.034	0.034	0.075	0.069	0.05a	0.033	0.042	0.088	0.066	0.057a
Mean	0.006d	0.007c	0.011a	0.009b		0.006d	0.008c	0.010b	0.01a		0.034c	0.034c	0.06a	0.057b		0.033d	0.040c	0.06b	0.08a	
$LSD_{0.05}$	A=0.0004	B=0.0003	A*B=0.0383			A= 0.00	B=0.0003	A*B=0.0536			A= 0.0003	B= 0.0004	A*B=0.0064		A= 0.0004	B= 0.0003	A*B=0.0054			

* NS = Not significant.

Table 8: Content of micronutrients in maize straw as affected by mineral fertilizer, compost and bio-fertilizers under two N levels.

Bio-Fert. (A)	Nitrogen (75%) Treatments (B)					Nitrogen (100%) Treatments (B)				
	T0	T1	T2	T3	Mean	T0	T1	T2	T3	Mean
	Fe									
Bio (0)	268.00	317.0	621.0	319.0	381.25c	264.0	380.33	825.0	414.33	470.92c
Bio (1)	316.0	455.0	1029.0	500.66	575.17b	325.0	396.0	926.33	502.0	537.33b
Bio (2)	314.0	830.33	3863.67	1155.0	1540.75a	319.0	460.0	1009.33	490.67	569.75a
Mean	299.33d	534.11c	1837.89a	658.22b		302.67d	412.11c	920.22a	469.0b	
$LSD_{0.05}$	A= 0.38	B=0.27	A*B=0.0064			A=0.23	B= 0.33	A*B=0.0059		
					Mn					
Bio (0)	23.28	35.3	26.67	21.3	26.64c	23.75	37.17	31.18	24.60	29.18c
Bio (1)	23.9	55.1	37.17	33.1	37.32b	23.77	39.97	31.83	29.00	31.14b
Bio (2)	26.87	61.27	44.47	62.7	48.83a	25.42	50.27	33.79	30.83	35.08a
Mean	24.68d	50.56a	36.1c	39.03b		24.32d	42.47a	32.27b	28.14c	
$LSD_{0.05}$	A=0.0019	B=0.12	A*B=0.0005			A= 0.12	B= 0.17	A*B=0.0013		
					Zn					
Bio (0)	11.53	12.4	20.4	18.1	15.61c	1.27	13.8	20.7	19.77	16.38c
Bio (1)	12.02	16.27	28.1	25.37	20.44b	11.9	14.6	23.1	19.97	17.39b
Bio (2)	12.96	21.37	31.1	27.1	23.14a	112.9	17.7	26.87	24.8	20.57a
Mean	12.17d	16.68c	26.53a	23.52b		12.02d	15.37c	23.56a	21.51b	
$LSD_{0.05}$	A=0.002	B=0.12	A*B=0.0013			A=0.002	B= 0.12	A*B=0.00041		
	Cu									
Bio (0)	1.23	1.87	2.35	2.47	1.98c	1.2	2.47	2.57	3.0	2.31c
Bio (1)	2.10	4.07	5.87	5.00	4.26b	2.2	2.27	3.67	3.26	2.85b
Bio (2)	2.84	4.10	6.87	5.68	4.87a	2.77	2.97	4.47	3.27	3.37a
Mean	2.06d	3.35c	5.03a	4.38b		2.06d	2.57c	3.57a	3.18b	
$LSD_{0.05}$	A=0.03	B=0.12	A*B=0.2169	A= 0.002	B=0.12	A*B=0.2142.				

organic one at ratio of (1:1). Data indicated that the combined effect of bio-fertilizer with inorganic N fertilizer up to rate of 75% from recommended N dose gave a significant increase in N, P and K concentration in maize straw yield. The highest values of N, P and K content in maize straw were (1.92, 0.28 and 0.08 mg/kg) respectively at M.F combined with Bio2 under 75% from recommended dose. However, for wheat straw, a significant increase was noticed for N and P by using combination of B2+compost under the same level of N to reach 0.65 and 0.38 mg/kg, respectively. These increases mainly attributed to the effect of microorganisms which can play a very significant role in the availability of the nutrients for plants [16]. They reported that the application of combined chemical fertilizer and bio-fertilizer gave the highest values of NPK uptake by wheat plant. Whereas, Potassium content in the straw showing no significant increment due to application of compost and inoculation, probably due to low K conc. in the composted paddy straw. This result was in agreement with those of Tran *et al*.[23].

2.2. Grains: Regarding the effect of the abovementioned treatments on N,P and K content of maize and wheat grains, data presented in Tables (6and7) revealed that, bio-fertilizer application caused a significant increase in N,P and K concentration in comparison with control treatment. Meanwhile, the combination of bio-fertilizer with inorganic N fertilizer up to 75% from recommended dose gave a higher increase. Since it surpassed the untreated soil by about 5,4,4 folds for maize grains for N,P and K respectively whereas it was 3,5 and 2 folds for N,P and K of wheat grains as a results of applied B2+ compost under 75% N from recommended dose.

Generally, the relative N, P and K content in wheat grains were higher than that of mineral fertilizer, indicating the residual effect of applied compost as well as the combined treatments, showing the benefits of bio fertilizer and compost for improving not only the supplying power of available nutrients to plants but also the over all soil fertility. These finding are in harmony with those of Mohamed *et al*. [12].

2.3. Availability of Micronutrients in Maize & Wheat Yields: Generally, micronutrients availability in soil were affected by biofertilizers, where the inoculation effect was more pronounced in the presence of organic fertilizers. Results in Tables (8-11) revealed that applying of bio-fertilizer and organic manures under the two rates of N application caused markedly increase in the content of Fe, Zn and Cu for maize and wheat (straw and grains). This finding is in harmony with Shawer [17] and Hago *et al*. [7]. They mentioned that such increment may be related to the effect of this treatment on the yield of the investigated crops. On the other hand, the results also showed that, the mixing of bio-fertilizer with inorganic nitrogen up to ratio of 100% from recommended N dose lead to increase Mn concentration especially for maize (straw and grains). This is may be due to the high amount of Mn in the used mineral fertilizers (Triple super phosphate) compared to the investigated compost as shown in Table (1).Increases of such nutrients when applied of mixture (Bio2 + compost) might be due to the availability of soil microorganisms to convert the unavailable forms of nutrients elements to available forms Saber [15] .by generating of carbon dioxide from bio-fertilizers.

2.4. Yield and Yield Attributes: Productivity in an ecosystem is influenced by several factors, such as availability of nutrients and water. Concerning the effect of the treatments under investigation on grains, straw and biological yields of maize and wheat , data presented in table (11) indicated that all the aforementioned parameters were positively affected by the different treatments. In general; the plants treated with bio-fertilizer singly showed the lowest values of grains and straw in both investigated plants. However, the plants treated with dual mixture of (bio2+M.F. at the rate of 75% N from recommended dose) recorded the highest values of (grains and straw) in maize plant The mean value was 40.86%. While the highest values of wheat (grains and straw) were recorded with the combined treatment of (bio2+ compost at the rate of 75% N from recommended dose) and reached to 107.8 and 48% compared to the control treatment. This increases mainly attributed to the effect of microorganisms which can play a very significant role in making available nutrients elements for plants. The biological yield is the summation of grains and straw yields. Hence it can be concluded that it increases as a result of increasing the abovementioned two fractions as shown in table (11). The relative positive effect of bio-fertilizer treatment on some yield criteria may be attributed to their N_2-fixing activity and the production of plant growth promoting substances such as IAA, gibberellins and cytokinine-like substances [5]. It is essential by bring about some microbial transformation of both inorganic and organic compounds in the soil to make available of these elements to plants. These findings were also supported by Mekki and Amal [11] and Tabrizi *et al*.[22].

Recommendation: Under conditions of this experiments it can be recommended that using such a treatments. Moreover, the complete or partial replacement of NPK fertilization by the use of more safe and economical fertilization to prevent not only the waste of the farmers' money but also keep the environment clean.

Table 9: Content of micronutrients in maize grains as affected by mineral , compost and bio-fertilizers under two N levels.

Bio-Fert. (A)	Nitrogen (75%) Treatments (B)					Nitrogen (100%) Treatments (B)				
	T0	T1	T2	T3	Mean	T0	T1	T2	T3	Mean
					Fe					
Bio (0)	36.03	34.87	61.07	44.70	44.2c	35.63	37.6	110.8	46.9	57.79c
Bio (1)	52.83	56.0	149.9	68.3	81.8b	52.33	57.8	146.3	73.4	82.5b
Bio (2)	58.0	88.2	365.4	106.9	154. a	56.73	65.17	288.3	75.1	121. a
Mean	48.9d	59.69c	73.3b	192. a		48.2d	53.59c	181. a	65.1b	
$LSD_{0.05}$	A= 0.045	B= 0.12	A*B =0.21			A=0.033	B= 0.12	A*B=0.209		
					Mn					
Bio (0)	3.70	6.47	4.50	4.80	4.87c	3.77	6.77	4.67	5.30	5.13c
Bio (1)	4.07	7.77	5.66	5.90	5.85b	4.00	7.77	5.53	5.73	5.76b
Bio (2)	4.53	11.13	6.50	7.07	7.31a	4.17	7.90	5.77	6.20	6.01a
Mean	4.1d	8.46a	5.55c	5.92b		3.98d	7.48a	5.32c	5.74b	
	A= 0.0019	B=0.12	A*B= 0.0514			A=0.004	B=0.12	A*B=0.0877		
Bio (0)	11.53	12.07	20.20	17.07	15.22c	11.20	13.8	20.77	15.20	15.24c
Bio (1)	11.27	13.87	20.90	19.70	16.4b	12.06	15.17	22.23	19.63	17.3b
Bio (2)	14.00	20.80	34.77	28.30	24.5a	13.73	15.20	25.70	20.93	18.9a
Mean	12.3d	15.58c	25.3a	21.7b		12.3d	14.72c	22.9a	18.6b	
$LSD_{0.05}$	A=0.0019	B=0.21	A*B=0.2014			A=0.002	B= 0.12	A*B=0.2093		
					Cu					
Bio (0)	1.41	1.40	2.43	1.67	1.73c	1.40	1.90	1.80	2.30	1.85c
Bio (1)	1.57	1.89	2.67	1.97	2.03b	1.56	2.06	2.10	2.37	2.02b
Bio (2)	1.87	1.90	2.93	2.00	2.18a	1.75	2.30	2.27	2.80	2.28a
Mean	1.61d	1.66c	2.74a	1.88b		1.57d	2.09c	2.06a	2.49b	
$LSD_{0.05}$	A=0.08	B= 0.029	A*B=0.111			A=0.09	B=0.05	A*B=0.111		

Table 10: Concentration of micronutrients in wheat straw as affected by mineral, compost and bio-fertilizer under two N levels.

Bio-Fert. (A)	Nitrogen (75%) Treatments (B)					Nitrogen (100%) Treatments (B)				
	T0	T1	T2	T3	Mean	T0	T1	T2	T3	Mean
Bio (0)	33.43	33.40	92.97	37.60	49.35c	33.93	55.90	257.63	72.90	105.1c
Bio (1)	35.63	39.07	123.97	39.30	59.49b	37.73	62.00	388.47	88.11	144.1b
Bio (2)	37.23	73.20	319.77	75.70	126.47a	38.43	101.20	634.13	136.8	227.6a
Mean	35.43d	48.56c	178.9a	50.87b		36.70d	73.03c	426.7a	99.3b	
$LSD_{0.05}$	A= 0.019	B=0.12	A*B=0.0390			A= 0.019	B= 0.13	A*B=0.0541		
					Mn					
Bio (0)	26.23	26.57	27.93	27.80	27.13c	27.13	28.23	29.96	29.90	28.81c
Bio (1)	28.23	28.87	30.53	32.0	29.9b	28.33	29.40	32.66	32.30	30.68b
Bio (2)	30.63	30.80	32.87	30.30	31.15a	29.23	31.47	33.83	32.80	31.83a
Mean	28.37d	28.74c	30.44a	30.03b		28.23d	29.70c	32.16a	31.7b	
$LSD_{0.05}$	A= 0.019	B=0.12	A*B=0.0155			A=0.019	B=0.12	A*B=0.0527		

Table 10: Continue

					Zn					
Bio (0)	17.70	17.97	22.53	20.57	19.69c	17.90	19.80	23.20	21.87	20.69c
Bio (1)	18.57	20.93	25.43	22.50	21.86b	18.36	20.37	25.20	22.47	21.60b
Bio (2)	18.79	21.13	28.70	23.80	23.10a	18.70	20.40	25.57	24.03	22.18a
Mean	18.35d	20.01c	25.55a	22.29b		18.32d	20.19c	24.66a	22.8b	
$LSD_{0.05}$	A=0.27		B= 0.023	A*B=0.0158		A= 0.26		B= 0.031	A*B=0.0545	
					Cu					
Bio (0)	3.17	3.40	3.80	3.43	3.45c	3.05	3.60	4.40	4.17	3.81c
Bio (1)	3.67	4.17	5.4	4.43	1.42b	3.57	4.00	4.87	4.23	4.17b
Bio (2)	3.57	4.20	5.4	4.56	4.43a	3.60	4.10	4.97	4.33	4.25a
Mean	3.47d	3.92c	4.14b	4.87a		3.41d	3.90c	4.75a	4.24b	
$LSD_{0.05}$	A=0.0023		B=0.009	A*B=0.0054		A= 0.022		B=0.032	A*B=0.0155	

Table 11: Content of micronutrients in wheat grains as affected by mineral, compost and bio-fertilizers under two N levels.

	Nitrogen (75%)					Nitrogen (100%)				
Bio-Fert. (A)	Treatments (B)					Treatments (B)				
	T0	T1	T2	T3	Mean	T0	T1	T2	T3	Mean
Bio (0)	85.22	169.0	149.03	161.7	141.24c	87.300	227.40	538.83	290.1	285.9b
Bio (1)	88.63	170.66	310.03	188.0	189.33b	89.00	236.80	451.37	238.8	253.9c
Bio (2)	87.93	224.0	339.03	226.0	219.24a	87.93	266.07	926.07	286.1	391.5a
Mean	87.3d	187.9c	266.0a	191.9b		88.1d	243.4c	638.8a	271.7b	
$LSD_{0.05}$	A=0.019		B=0.13	A*B=0.0059		A= 0.044		B=0.122	A*B=0.0059	
					Mn					
Bio (0)	9.83	11.6	15.93	15.8	13.29c	9.53	13.17	17.33	15.7	13.93c
Bio (1)	10.33	15.27	20.33	19.00	16.23b	9.9.3	16.67	23.03	22.90	18.13b
Bio (2)	10.40	16.90	22.53	21.90	17.93a	10.33	21.50	27.26	25.90	21.25a
Mean	10.19d	14.59c	19.6a	18.9b		9.93d	17.11c	22.54a	21.5b	
$LSD_{0.05}$	A= 0.029		B= 0.13	A*B=0.0006		A= 0.09		B=0.12	A*B=0.0005	
					Zn					
Bio (0)	3.6	2.1	4.2	3.97	3.47c	3.49	2.50	2.87	5.67	1.38c
Bio (1)	3.66	3.87	10.37	8.97	6.72b	3.57	3.67	7.77	5.97	5.24b
Bio (2)	3.50	4.70	23.00	16.30	11.88a	3.65	3.70	13.40	9.50	7.56a
Mean	3.59c	3.56d	12.52a	9.74b		3.57c	3.29d	9.012a	7.04b	
$LSD_{0.05}$	A=0.027		B= 0.022	A*B=0.0005		A= 0.029		B=0.031	A*B=0.0006	
					Cu					
Bio (0)	0.97	1.07	1.79	1.57	1.35c	1.06	1.53	2.40	1.80	1.70c
Bio (1)	1.27	1.57	3.10	1.90	1.96b	1.30	1.60	2.47	1.90	1.81b
Bio (2)	1.67	2.0	4.50	2.87	2.75a	1.57	1.67	3.40	2.00	2.16a
Mean	1.3d	1.54c	3.13a	2.11b		1.31d	1.60c	2.77a	1.90b	
$LSD_{0.05}$	A=0.002		B=0.009	A*B=0.2182		A=0.03		B=0.03	A*B=0.2114	

Table 12: Effect of fertilizer, compost, bio-fertilizers under different N levels on the maize and wheat yields.

Treat.	Wheat (kg/Fed.)						Maize (kg/Fed.)					
	75%N			100%N			75%N			100%N		
	straw	grains	biolog. yield	straw	grains	biolog. yield	straw	grains	biolog. yield	straw	grains	biolog. yield
B0	2173	3118	5291	2334	3349	5683	2619	1139	3758	2185	1126	3311
B1	2400	3668	6068	2563	3445	6008	2984	1137	4121	2174	1089	3263
B2	2728	3914	6642	2586	3711	6297	3086	1232	4318	2251	1121	3372
T0	1383	1985	3368	1384	1986	3370	1348	616	1964	1355	600	1955
T1	2673	4010	6683	2884	3965	6849	1350	629	1979	1402	646	2048
T2	2352	3561	5913	2554	3479	6033	3579	2092	5671	3677	2072	5749
T3	2577	3781	6358	2703	3797	6500	2335	1220	3555	2308	1187	3495
B1T0	1385	1989	3374	1386	1987	3373	1352	617	1969	1351	585	1936
B1T1	2661	4207	6868	2932	3818	6750	1354	630	1984	1447	595	2042
B1T2	2361	3657	6018	2549	3980	6529	3687	2104	5791	3728	2041	5769
B1T3	2627	3913	6540	2727	3770	6497	2409	1200	3609	2173	1137	3310
B2T0	1393	1999	3392	1395	2001	3396	1347	620	1967	1364	577	1941
B2T1	3061	4392	7453	2969	4261	7230	1347	624	1971	1405	649	2054
B2T2	2771	3976	6747	2570	3687	6257	3876	2367	6243	3783	2072	5855
B2T3	2914	4181	7095	2840	4076	6916	2547	1319	3866	2454	1187	3641

* biolog. yield: Biological yield

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