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MACRONUTRIENT UPTAKE BY MAIZE PLANT AND THEIR AVAILABLITY IN THE SOIL AS AFFECTED BY ORGANIC FERTILIZATION UNDER DIFFERENT SOURCES AND LEVELS OF NITROGEN

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ABSTRACT: A pot experiment was conducted in a greenhouse at the Faculty of Agriculture, Zagazig University during the season of 2004. The effect of applying three organic manures town refuse, rabbit manure and farmyard manure combined with two nitrogen fertilizers applied at three levels on the dry matter yield of (Zea mays), hybrid tripartite 310, macronutrient (N,P and K) uptake and its availability in soil at harvest was investigated. The obtained results could be summarized as follows: a) the highest value of dry matter yield (11.4 g plant-1) was achieved with the application of 1.5 % rabbit manure combined with 150 kg N fed^{-1} as urea. b) The highest NPK uptake was obtained under the addition of urea fertilizer; while the organic manures resulted in non-significant increase in nitrogen uptake. c) The addition of organic manures individually or in combination with mineral fertilizers resulted in an increase in the availability of NPK in soil as compared to the control.

Keywords: Organic manures, mineral fertilizers, maize plant, macronutrients.

INTRODUCTION

Organic manures are regaining popularity and increased interest. This change in policy has been brought up in an international scale in order to reduce environmental pollution, which resulted from using excessive amounts of mineral fertilizers. Using town refuse for increasing crop production instead of accumulating in sanitary heaps around cities for example, is an attractive alternative.

The application of organic manures as town refuse compost,

rabbit manure and farmyard manure with the recommended doses increased the dry matter yield of maize plants (Chandrakumar *et al.*, 2004 and Morsy, 2004), and significantly increased the uptake of NPK by maize plant (Sakr *et al.*, 1992; Kotb, 1994 and Saleem, 1994).

Urea and ammonium sulphate applications were significantly decreased pH, increased electrical conductivity, increased available phosphorus and potassium and increased organic carbon (Sharma *et al.*, 1993).

The NPK fertilizers appeared to be more efficient than the organic manures (sewage sludge, swine, rabbit and poultry manures) in supplying N, P and K, at least in the short run, while the organic manures had an advantage in the supply of other macro- and micro-nutrient elements under no application of NPK fertilizers (Asiegbu and Oikeh 1995 and Zhang *et al.*, 2004).

Thus, the aim of this study was to evaluate the effect of some organic manures and different N fertilizers and their combinations on maize dry matter yield and NPK uptake and availability in soil.

MATERIALS AND METHODS

A pot experiment was carried out to study the effect of applying some organic manures with two sources of mineral nitrogen at three levels (1, 1.5 and 2%) on the dry matter yield of maize and NPK uptake and its availability in soil after harvest.

Soil sample (0-30cm depth) was collected from El-Nakhaz village Zagazig, Sharkia Governorate. The soil samples were dried, crushed and passed through 2 mm sieve before being placed in plastic pots with a capacity of 10 kg. Some physical and chemical properties of the soil used are presented in Table 1.

Assessment of composted town refuse as an organic manure produced from Zagazig town refuse factory comparing with two other organic fertilizers was achieved. The experimental design was randomized complete blocks with a three replicates. The organic fertilizer viz town refuse, rabbit manure and farmyard manure were applied at three levels of (1, 1.5 and 2%) by weight and well mixed with the soil in each pot. The chemical analyses of the organic fertilizers are recorded in Table 2.

Table 1. Some physical and chemical properties of the soil used.

Physical properties		Chemical properties			Available macronutrients (mg kg^{-1} soil)	
Sand %	37.00	pH (1:2.5)		7.70		
Silt %	18.00	EC. dS m^{-1}		2.64	N	62.2
Clay %	45.00		Na^{+}	15.0		
O.M. %	01.81	Cations	K^{+}	0.52		
$CaCO_3$ %	02.45	(meq l^{-1})	Ca^{++}	7.38		
SP %	61.00		Mg^{++}	4.20	P	19.6
			CO_3^{--}	0.00		
FC %	30.50	Anions	HCO_3^{-}	10.0		
		(meq l^{-1})	Cl^{-}	12.3		
			SO_4^{--}	4.80	K	355
PWP %	15.25	SAR		6.2		

* in soil saturation extract

Table 2. Some properties of the organic fertilizers used.

parameters / Organic fertilizers	EC dS/m	pH	N	P	K	OM	OC	C/N Ratio
			(g kg-1)					
Town refuse	0.80	7.40	12.0	2.8	4.1	86.0	153.0	12.8
Rabbit manure	1.80	7.10	28.4	1.4	2.5	183	106.0	3.74
Farmyard manure	1.20	8.10	8.50	5.5	13.5	110.0	64.1	2.23

The sources of mineral N were ammonium sulfate 21%N, and urea 46%N. The mineral fertilizers were added to pots at three levels of 100, 150 and 200 Kg N fed^{-1}. in addition to the control. Each treatment was replicated 3 times. Twenty seeds of maize (Hybrid tripartite 310) were sown in each pot. All pots were irrigated and the soil moisture content was kept at FC continuously.

Phosphorus and potassium fertilizers were added at recommended dose as ordinary superphosphate (15% P_2O_5 at a rate of 2.2 g pot^{-1} equivalent to 40 kg P_2O_5 fed^{-1} and potassium sulphate (48% K_2O) at a rate of 0.32 g pot^{-1} equivalent to 20 kg K_2O fed^{-1} Maize seedlings were thinned to be 5 plants per pot. Plant samples were taken after 50 days from sowing and dried at 70 °C. The dry weight was recorded for each pot. Dried shoots were ground and prepared for some chemical measurements

Dry samples of maize plants were wet digested with H_2SO_4-$HClO_4$ mixture as described by Jackson (1973). N%, P% and K% were determined according to Black, (1982) and the nutrient uptake was calculated.

RESULTS AND DISCUSSION

Dry Matter Yield

Table. 3 reveals that the dry matter yield of maize shoots was increased due to the application of organic manures combined with mineral fertilizers. In general, the higher the application rate of organic fertilizer the higher was the dry matter yield, especially when urea was combined with rabbit manure. Moreover, the highest value of dry matter yield (11.4 g pot^{-1}) was achieved obtained due to the application of 1.5 % rabbit manure combined with 150 kg N fed^{-1} as urea. The increase in dry matter yield may be due to the ability of organic and mineral fertilizers in making soil nutrients more available for plant through the decomposition of organic matter by soil microorganisms (Abou Hussien and Faiyad, 1996 and Mohammed, 2002). These results are in agreement with those results reported by Mostafa and El-Garhi, (1995) and Ismail *et al.* (1996).

Macronutrient Uptake by Plant

Nitrogen

As shown in Table 4 the uptake of nitrogen by maize plants was significantly increased with increasing the application rate of mineral fertilizer. And this was pronounced under the addition of urea fertilizer. However, the organic fertilizer application resulted in some significant increases in nitrogen uptake. The highest value of nitrogen uptake (260 mg plant-1) was observed due to the application of 1.5% rabbit manure when combined with 150

kg N fed-1 as urea. Generally, the application of organic whith mineral fertilizers resulted in significant increases in nitrogen uptake by maize plants. Similar results were obtained by El-Gala and Amberger (1988), and Zaki (1999). This may be due to the ability of organic matter in making soil nutrients more available and chelate these nutrients by humic substances, which help to increase the growth of plants, causing the plant to absorb more nutrients from soil and the fertilizers (Abou hussien and Faiyad, 1996).

Table 3. Dry matter yield (g plant^{-1}) of maize plant shoots as affected by application of some organic and nitrogen fertilizers.

N- fertilizers / Organic- fertilizers	Control	Ammonium sulphate (kg N fed^{-1})			Mean	Urea (kg N fed^{-1})			Mean
		100	150	200		100	150	200	
Control	6.2	6.6	7.6	7.4	7.2	6.8	8.1	8.8	7.9
Town refuse 1%	6.3	7.1	8.1	8.7	8.0	8.6	8.5	7.7	8.3
Town refuse 1.5%	7.4	7.8	8.3	8.3	8.1	7.6	9.1	8.5	8.4
Town refuse 2%	7.7	7.2	8.3	9.6	8.3	7.8	9.1	9.1	8.7
Mean	7.1	7.4	8.2	8.9	8.2	8.0	8.9	8.5	8.5
Rabbit manure 1%	7.7	7.9	7.3	9.6	8.3	9.3	8.8	8.7	8.9
Rabbit manure 1.5%	8.9	7.3	8.2	9.1	8.2	10.0	11.4	9.5	10.3
Rabbit manure2%	8.9	6.2	9.0	7.6	7.6	9.2	11.0	8.5	9.6
Mean	8.5	7.1	8.1	8.8	8.0	9.5	10.4	8.9	9.6
Farmyard manure 1%	6.5	7.8	9.4	9.8	9.0	7.2	8.2	8.2	7.9
Farmyard manure 1.5%	7.3	8.0	10.7	10.0	9.6	7.6	9.9	8.5	8.7
Farmyard manure 2%	7.9	9.2	9.7	9.7	9.5	8.0	8.7	8.9	8.6
Mean	7.2	8.3	9.9	9.8	9.4	7.6	8.9	8.6	8.4

L.S.D (0.01) Organic-fertilizers = 0.9394** N- fertilizers = 0.786 ** Organic- fertilizers X N- fertilizers = 2.554 *

Table 4. Nitrogen uptake (mg N plant^{-1}) by maize plant as affected by the application of some organic and nitrogen fertilizers.

N- fertilizers / Organic- fertilizers	Control	Ammonium sulphate (kg N fed^{-1})			Mean	Urea (kg N fed^{-1})			Mean
		100	150	200		100	150	200	
Control	64.0	94.0	141	162.0	132	100	173	207	160
Town refuse 1%	76.8	120	179	157.4	152	146	163	174	161
Town refuse 1.5%	62.0	146	159	208.6	171	113	159	164	145
Town refuse 2%	68.0	111	155	247.2	171	130	188	194	171
Mean	68.9	126	164	204.4	165	130	170	178	159
Rabbit manure 1%	72.6	188	173	229.8	197	171	116	118	135
Rabbit manure 1.5%	91.6	81.2	98.2	130.8	103	118	259	256	211
Rabbit manure2%	106	86.6	145	136.4	123	227	183	184	198
Mean	90.0	119	139	165.7	141	172	186	186	181
Farmyard manure 1%	60.8	114	173	173.6	154	98	103	106	102
Farmyard manure 1.5%	66.6	86.0	127	153.2	122	108	130	138	125
Farmyard manure 2%	72.4	125	136	163.4	146	138	167	206	170
Mean	66.6	108	145	163.4	139	115	133	150	133

L.S.D (0.05) Organic-fertilizers =03.86 N- fertilizers = 19.94 ** Organic-fertilizers X N- fertilizers = 62.6**

Phosphorus

Phosphorus uptake by plant, it was increased significantly as a result of urea application except for the low rates, while organic fertilizers caused no significant effect on phosphorus uptake Table 5. However, the interaction effect between mineral and organic fertilizers resulted in non-significant increase in phosphorus uptake. However, the highest value of phosphorus uptake (32.6 mg plant^{-1}) was observed under the application of 2% rabbit manure combined with 150 kg N fed^{-1} as urea. The application of organic fertilizers at their high rates increased the P-uptake by maize plants. This may be due to that phosphate ions being replaced by humete ion on the active sites of adsorbing surfaces. Solving action of humic substances on insoluble phosphates was also suggested the mechanism in this respect. Products of organic decay such as organic acids are thought to be effective in decreasing soil pH which are mainly responsible for P solubility in soils. Mikaeel *et al.* (1997) noticed that the application of organic manure such town refuse or sewage sludge increased P uptake by wheat plants in sandy

soils. These results were similarly obtained by Baruzzini *et al.* (1992), Hassan *et al.* (1994), Abd El-Moez (1996) and Vadivel *et al.* (2000) whose pointed out that the percentage and uptake of phosphorus for plant were slightly increased by increasing the application rate of farmyard manure.

Potassium

Table 6 displays that the application of mineral fertilizers showed increases in potassium uptake and this was significantly true except for the low rates of application especially with urea. The high rates of the organic fertilizer cased the potassium uptake to be significantly increased and this was more pronounced with rabbit manure. Moreover, the interaction effect of nitrogen and organic fertilizers resulted in significant increases in potassium uptake by maize plants. The highest value for potassium uptake (662 mg plant^{-1}) was due to the application of 2% rabbit manure combined with 150 kg N fed^{-1} as urea. Such different response might reflect the different nutritional status of the added organic manures under study due to the difference rate of decomposition and the subsequent release of included nutrients throughout the growth season.

Table 5. Phosphorus uptake (mg P plant^{-1}) by maize plant as affected by the application of some organic and nitrogen fertilizers.

N- fertilizers / Organic- fertilizers	Control	Ammonium sulphate (kg N fed^{-1})			Mean	Urea (kg N fed^{-1})			Mean
		100	150	200		100	150	200	
Control	16.0	13.2	17.0	17.2	15.8	14.4	21.8	22.4	19.5
Town refuse 1%	15.0	18.2	22.8	23.4	21.5	20.4	21.8	26.2	22.8
Town refuse 1.5%	15.6	22.4	23.2	21.0	22.2	20.6	27.4	24.2	24.1
Town refuse 2%	16.8	17.4	21.4	25.8	21.5	22.0	25.2	25.0	24.1
Mean	15.8	19.3	22.5	23.4	21.7	21.0	24.8	25.1	23.6
Rabbit manure 1%	17.0	23.6	20.8	28.0	24.1	30.0	24.6	23.6	26.1
Rabbit manure 1.5%	19.0	22.6	26.4	31.2	26.7	26.2	30.8	29.6	28.9
Rabbit manure2%	20.4	18.2	30.4	25.0	24.5	26.8	32.6	25.0	28.1
Mean	18.8	21.5	25.9	28.1	25.1	27.7	29.3	26.1	27.7
Farmyard manure 1%	13.6	26.0	24.2	25.2	25.1	21.8	21.8	22.8	22.1
Farmyard manure 1.5%	16.2	21.4	24.0	28.2	24.5	21.2	22.4	24.4	22.7
Farmyard manure 2%	16.4	24.2	25.0	26.6	25.3	25.2	26.6	29.0	26.9
Mean	15.4	23.9	24.4	26.7	25.0	22.7	23.6	25.4	23.9

L.S.D (0.05) Organic-fertilizers = n.s ** N- fertilizers = 3.228**
Organic- fertilizers X N- fertilizers = ns.

Table 6. Potassium uptake (mg K plant^{-1}) by maize plant as affected by the application of some organic and nitrogen fertilizers.

N- fertilizers / Organic- fertilizers	Control	Ammonium sulphate (kg N fed^{-1})			Mean	Urea (kg N fed^{-1})			Mean
		100	150	200		100	150	200	
Control	276	294	330	336	320	288	388	372	349
Town refuse 1%	292	304	436	488	409	400	414	354	389
Town refuse 1.5%	306	438	460	438	445	326	400	382	369
Town refuse 2%	328	362	382	478	407	434	394	438	422
Mean	309	368	426	468	421	387	403	391	394
Rabbit manure 1%	320	338	366	526	410	440	518	480	479
Rabbit manure 1.5%	382	356	366	416	379	466	576	500	514
Rabbit manure2%	402	300	420	390	370	508	662	454	541
Mean	368	331	384	444	386	471	585	478	512
Farmyard manure 1%	286	414	522	498	478	354	432	442	409
Farmyard manure 1.5%	282	394	538	522	485	386	494	452	444
Farmyard manure 2%	322	480	542	441	488	376	394	450	407
Mean	297	429	534	487	483	372	440	448	420

L.S.D (0.05) Organic-fertilizers =52.360 ** N- fertilizers =43.8 **
Organic- fertilizers X N- fertilizers = 137.4**

In this respect, Rabie *et al.* (1997) and El-Sherbieny *et al.* (1999) reported that the organic manure addition to soil resulted in creating favorable soil physical conditions which must have affected the availability of nutrients and that uptake of nutrients. Similar results were obtained by Mostafa and El-Garhi (1995) who noticed that addition of organic manure caused a significant increase in the potassium uptake in plants. This also was in agreement with the results reported by Abd El-Moez, (1996) and Vadivel *et al.* (2000).

Macronutrient Availability in Soil

Nitrogen

It is evident in Table 7 that addition of organic manures

individually or in combination with nitrogen fertilizers resulted in highly increases in the availability of N in soil compared to the control. Generally, the application of 1.5% of rabbit manure combined with 150 kg N fed^{-1} as urea showed the highest concentration of available nitrogen (30.9 mg kg^{-1} soil). This superiority may be due to beneficial effect of rabbit manure insupplying soil with relatively higher amount of N and improving soil characteristics particularly soil pH (Table 3). Similar concept was suggested by Abd El-Galil *et al.* (1995) Abd El-Fattah *et al.* (1996) and Metwally and Khamis (1998). Also, Mohammed (1998) observed that the application of urea and ammonium sulphate significantly increased the availability of nitrogen in the soil particularly with the addition of 120 kg N fed^{-1}. Nevertheless, the high application doses of nitrogen fertilizers combined with organic fertilizers led to a decrease in available nitrogen in soil.

Table 7. Available nitrogen concentration (mg N kg^{-1} soil) in the soil as affected by the application of some organic and nitrogen fertilizers.

N- fertilizers / Organic- fertilizers	Control	Ammonium sulphate (kg N fed^{-1})			Mean	Urea (kg N fed^{-1})			Mean
		100	150	200		100	150	200	
Control	7.56	18.4	24.9	27.3	23.5	15.4	24.7	28.8	23.0
Town refuse 1%	15.9	12.9	23.8	12.5	16.4	10.5	11.7	13.0	11.7
Town refuse 1.5%	14.2	18.0	15.5	14.6	16.0	15.1	15.5	21.7	17.4
Town refuse 2%	23.8	19.0	18.4	19.2	18.9	17.6	12.1	18.4	16.0
Mean	18.0	16.6	19.2	15.4	17.1	14.4	13.1	17.7	15.1
Rabbit manure 1%	15.4	30.2	11.3	29.3	23.6	18.0	23.8	22.2	21.3
Rabbit manure 1.5%	16.3	21.7	27.2	19.2	22.7	19.6	30.9	22.7	24.4
Rabbit manure2%	19.2	27.6	20.9	16.7	21.7	10.2	15.1	21.5	15.6
Mean	17.0	26.5	19.8	21.7	22.7	15.9	23.3	22.1	20.4
Farmyard manure 1%	16.9	15.5	21.2	19.3	18.6	28.0	26.1	27.9	27.3
Farmyard manure 1.5%	11.3	18.5	19.5	15.1	17.7	23.8	14.7	17.0	18.5
Farmyard manure 2%	21.3	25.3	19.3	26.5	23.7	26.5	15.1	15.5	19.0
Mean	16.5	19.8	20.0	20.3	20.0	26.1	18.6	20.1	21.6

Phosphorus

Table 8 clearly show that the available phosphorus in soil increased with increasing the application rate of organic fertilizers particularly with rabbit manure. However, the combined applications of town refuse, rabbit manure or farmyard manure with ammonium sulphate or urea resulted in increasing the available phosphorus. Moreover, the application of 2% rabbit manure with 100 kg N fed^{-1} as urea was superior in increasing the P availability in soil among the different treatments. This seems to be related to its beneficial effect in lowering the soil pH and consequently increasing the availability of phosphorus. (Soltan *et al.*, 1996; Toor and Bishnoi, 1996; Moustafa, 2001 and Zhang *et al.* (2004) suggested that enhancing rizosphere acidification attributable to applications of NH_4-N fertilizer can increase P availability in the soil. Fan and Mackenzei (1994) reported that addition of organic matter could increase the availability of P and reduce P fixationin soil. In this concern Hussien (1995) concluded that application of organic manure without phosphorus fertilizers increased the available phosphorus in the soil. However, Alexander (1997) reported that organic residues addition to soil not only increase the P content of the soil, but also activate soil biota which considerably increase solubility of the P compounds in the soil. Organic matter decomposition is able to promote the solubilization of inorganic P by formation of carbonic acid and some organic acids which may solublize certain insoluble P compounds.

Potassium

Table 9 shows no clear trend regarding the effect of either organic or nitrogen fertilizers on the available potassium concentration in soil. However, the highest value of available potassium (1.97 mg kg^{-1}soil) was observed due to the application of 2% rabbit manure when combined with 150 kg N fed^{-1}as urea. This was followed by the values obtained farmyard manure combined with 100 kg N fed^{-1} as ammonium sulphate. This result might be due to that farmyard manure contains appreciable amount of K, Table 2. Similar findings were reported by (Tahoun *et al.*, 2000) and Dahdoh *et al.* (2001) in this respect Abdel-Nasser and Hussein (2001) who observed that the most important role of organic manure application is in modifying soil chemical properties including soil fertility.

Table 8. Available phosphorus concentration (mg P kg^{-1} soil) in the soil as affected by the application of some organic and nitrogen fertilizers.

N- fertilizers / Organic- fertilizers	Control	Ammonium sulphate (kg N fed^{-1})			Mean	Urea (kg N fed^{-1})			Mean
		100	150	200		100	150	200	
Control	13.4	18.3	17.2	11.2	15.6	16.9	21.0	17.7	18.6
Town refuse 1%	20.7	20.2	26.8	42.6	29.8	22.4	30.3	19.9	24.2
Town refuse 1.5%	19.9	23.8	18.3	37.7	26.6	37.1	17.5	31.1	28.6
Town refuse 2%	21.8	39.6	23.8	29.5	30.9	40.1	26.7	40.5	35.8
Mean	20.8	27.8	22.9	36.6	29.1	33.2	24.8	30.5	29.5
Rabbit manure 1%	40.1	64	50.9	40.1	51.6	59.8	65.6	66.4	63.9
Rabbit manure 1.5%	59.2	115	88.9	93.3	99.0	89.5	61.7	72.6	74.6
Rabbit manure2%	48.3	122	96.6	118	112.1	138	98.5	136	124.0
Mean	49.2	100.2	78.8	83.6	87.5	95.7	75.3	91.6	87.5
Farmyard manure 1%	26.5	33.3	31.8	28.3	31.1	32.5	32.5	29.9	31.6
Farmyard manure 1.5%	25.9	30.7	46.8	48.7	42.1	34.3	30.2	37.5	34.0
Farmyard manure 2%	21.8	41.1	32.9	53.9	42.6	45.7	60.4	47.9	51.3
Mean	24.8	35.0	37.2	43.6	38.6	37.5	41.0	38.4	39.0

Table 9. Available potassium concentration (mg K kg^{-1} soil) in the soil as affected by the application of nitrogen from different sources.

N- fertilizers / Organic- fertilizers	Control	Ammonium sulphate (kg N fed^{-1})			Mean	Urea (kg N fed^{-1})			Mean
		100	150	200		100	150	200	
Control	1.09	1.25	1.07	1.09	1.14	1.09	1.09	1.05	1.08
Town refuse 1%	1.45	1.17	1.26	1.16	1.20	1.16	1.08	1.07	1.10
Town refuse 1.5%	1.15	1.5	1.4	1.09	1.33	1.12	1.08	1.09	1.10
Town refuse 2%	1.31	1.4	1.1	1.17	1.22	1.35	1.08	1.14	1.19
Mean	1.30	1.36	1.25	1.14	1.25	1.21	1.08	1.10	1.13
Rabbit manure 1%	1.25	1.41	0.97	1.5	1.29	1.17	1.13	1.2	1.17
Rabbit manure 1.5%	1.05	1.29	1.57	1.09	1.32	1.16	1.45	1.25	1.29
Rabbit manure2%	1.15	1.45	1.06	1.17	1.23	1.31	1.97	1.3	1.53
Mean	1.15	1.38	1.20	1.25	1.28	1.21	1.52	1.25	1.33
Farmyard manure 1%	1.13	1.49	1.13	1.19	1.27	1.2	1.19	1.25	1.21
Farmyard manure 1.5%	0.95	1.45	1.3	1.45	1.40	1.3	1.09	1.1	1.16
Farmyard manure 2%	1.21	1.5	1.45	1.36	1.44	1.2	1.07	1.45	1.24
Mean	1.10	1.48	1.29	1.33	1.37	1.23	1.12	1.27	1.21

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امتصاص العناصر الكبرى في نبات الذرة وتيسرها في التربة تحت تأثير التسميد العضوي وصور ومعدلات مختلفة من النيتروجين المعدني

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أقيمت تجربة أصص في صوبة كلية الزراعة جامعة الزقازيق خلال موسم النمو ٢٠٠٤ وذلك لدراسة تأثير إضافة بعض الأسمدة العضوية بالإضافة الى نوعين من الأسمدة المعدنية النيتروجينية في ثلاث مستويات على محصول المادة الجافة لنبات الذرة (هجين ثلاثي) وكذلك على امتصاص النيتروجين والفسفور والبوتاسيوم بالإضافة إلى تأثيرها على صلاحية هذه العناصر في التربة وكانت أهم النتائج المتحصل عليها:

- أعلى قيمة لمحصول المادة الجافة كانت (١١,٤ جم/نبات) وذلك عند استخدام سماد الأرانب ١,٥% مخلوطا مع ١٥٠ كجم N في صورة يوريا.
- أعلى قيمة لامتصاص النيتروجين والفسفور والبوتاسيوم كانت عند استخدام سماد اليوريا بينما استخدام السماد العضوي لم يعط زيادة معنوية لامتصاص النيتروجين.
- إضافة السماد العضوي منفردا أو مخلوطا بالسماد النتروجيني أدى إلى زيادة في النيتروجين والفسفور والبوتاسيوم الميسر في التربة مقارنة مع الكنترول.

من خلال النتائج المتحصل عليها يتضح أن استخدام الأسمدة العضوية مع جرعات منخفضة من الأسمدة النيتروجينية يمكن أن يقلل من إضافة الأسمدة النيتروجينية وبالتالي الحد من تلوث التربة.