SUGAR BEET RESPONSE TO NITROGEN FORMS AND RATES UNDER DIFFERENT TILLAGE PRACTICES EXPRESSED BY POLYNOMIAL QUADRATIC EQUATIONS

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Abstract

A field experiment was conducted during the winter season 2002/2003 at Sakha Agric. Res. Station Farm, Kafr El-Sheikh Governorate to study the effect of nitrogen fertilizer forms and rates on sugar beet yield and their net return under different tillage practices.

Split split plot design was used with four replicates. The main plots were assigned with three tillage practices (T_1, T_2 and T_3). The sub plots were assigned with three nitrogen forms, i.e. anhydrous ammonia 82 % N (AA), ammonium nitrate 33 % N (AN) and urea ammonium nitrate liquid 32 % N (UANL). The sub-sub plots were assigned with four nitrogen rates N_0, N_{30}, N_{60} and N_{90} kg N/fed

Nine polynomial quadratic equations were established and showed the following results:

1. The maximum yield (Y_m) increased as tillage practices changed under the three nitrogen forms used.
2. The highest maximum yield (30.803 ton/fed) was obtained under T_2 treatment and use of AA application.
3. The highest total value of the yield (6159.8 L.E./fed) and the highest net return value of fertilizer (3658.9 L.E./fed) were obtained under T_2 treatment and use of AA application.
4. The net return of N-forms can be arranged according to the following order AA > AN > UANL.
5. The efficiency of fertilizer decreased as N rates increased but it increased as tillage practices changed under the different N-forms.
6. The soil nitrogen content (X_s) increased as tillage practices changed with using the three N forms.
7. The contribution of N fertilizer increased as N rates increased.
8. The contribution of soil N decreased as N rates increased.
9. The contribution of soil N increased as tillage practices changed.

INTRODUCTION

The importance of sugar beet as a source of white sugar continues to expand. Sugar beet recently provides about 40 % of the world's sugar production (Abd El-Hadi *et al.,* 2002). It ranks the second sugar crop in the world. The importance of sugar beet crop to agriculture is not confined only to sugar production, but also it is adapted to grow best under the saline and sodic soils. Thus it can be economically grown in the newly reclaimed areas of the northern parts of Egypt, as it is one of the most tolerant crops to salinity (Hassanein and El-Shebiny, 2000).

Preparation of seedbed is one of the major factors affecting crop production. Tillage is the first step to prepare suitable conditions for seed germination. It improves soil aeration, maintain and improve soil fertility and soil moisture, and create favourable conditions for activity of useful microorganisms (Mengel and Kirkby, 1987; Thabet, 1993; Thabet and Balba, 1994 and Knany *et al.*, 2005).

Nitrogen added to soil in the form of NO^{-}_{3} or NH^{+}_{4} ions is directly available to plants. Using several forms of N fertilizer to increase the utilization efficiency or decrease ammonia volatilization losses are the important goals (Sommer and Christensen, 1992 and El-Shebiny and Badr, 1998).

Adequate nitrogen is required to ensure early maximum vegetative growth, while an excessive amount or application of N late during the growing season reduced sugar content (Abd El-Hadi *et al.*, 2002). Hassanein and El-Shebiny (2000) reported that sugar beet yield decreased with N levels beyond a certain maximum addition.

The objective of the present study is to elucidate the economically effective N fertilizer forms and rates that give the highest sugar beet yield and net return under different tillage practices using the polynomial equation and its derivatives.

MATERIALS AND METHODS

A field experiment was conducted during the winter season 2002/2003 at Kafr El-Sheikh Governorate, Sakha Agric. Res. Station Farm. Sugar beet (*Beta vulgaris*, var. Shems) seeds were sown at 19th November, after corn, on ridges (20 cm between the hills and 60 cm between the ridges). Some physical and chemical properties of the experimental soil are presented in Table 1.

Split split plot design was used with four replicates. The plot area was 14 m^2.

The main plots were assigned with three tillage practices of chisel plow, one pass, and land leveler (T_1), chisel plow, two vertically passes, and land leveler between them (T_2), and chisel plow, four vertically passes, and land leveler between the different passes (T_3).

The sub-plots were assigned with three nitrogen forms: anhydrous ammonia 82 % N (AA), ammonium nitrate 33 % N (AN), and urea ammonium nitrate liquid 32 % N (UANL).

The sub-sub plots were assigned to four nitrogen rates of 0 kg (N_0), 30 kg (N_1), 60 kg (N_2) and 90 kg (N_3) N/fed. The anhydrous ammonia was injected into the soil seven days before planting as one dose, while urea ammonium nitrate and ammonium nitrate were splitted on two equal doses with the first and second irrigation. 30 kg P_2O_5/fed as super phosphate (15 % P_2O_5) and 48 kg K_2O/fed as potassium sulphate (48 % K_2O) were applied as one dose with the first irrigation. The other recommended agricultural operations were followed.

A soil sample was taken before planting for the determination of pH, EC, organic matter, available nutrients (N, P and K) and soil texture according to Black (1983), the data are shown in Table 1. The yield of sugar beet roots was weighted (ton/fed). The obtained data were statistically analyzed according to Gomez and Gomez (1984).

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

Properties	EC dS/m 1: 5	pH 1: 2.5	O.M. %	Available nutrients ppm			Sand %	Silt %	Clay %	Texture
				N	P	K				
Value	0.53	8.00	1.87	21	5.5	200	5	33	62	Clay

Quantitative analysis:

The quadratic polynomial equation has been used to describe the sugar beet yield response to nitrogen levels, where its general form is:

$Y = B_0 + B_1 X_i \pm B_2 X_i^2$

Where:

The term "Y" is the yield corresponding to nutrient rates X_i.

The constants B_0, B_1 and B_2 were calculated using the least squares method.

The maximum addition of fertilizer (X_m), the maximum yield (Y_m), the optimum addition of fertilizer (X_{opt}), the optimum yield (Y_{opt}), the average efficiency ($e\overline{X}$) of the fertilizer application rate (X) along the range from X = 0 to X = i, the efficiency of fertilizer (eX) increment (X_i), the relative efficiency (EX), the efficiency of soil nitrogen (eXs) and the soil nitrogen content (X_s) can be calculated from the following equations, , respectively,.

1. $X_m = -\frac{B_1}{2B_2}$ Balba (1961)

2. $Y_m = B_0 - \frac{B_1^2}{4B_2}$ Capurro and Voss (1981).

3. $X_{opt} = \frac{P_r - B_1}{2B_2}$ Balba (1964)

4. $Y_{opt} = B_0 + \frac{P_r^2 - B_1^2}{4B_2}$ Balba (1964)

Where the price ratio (P_r) = $\frac{\text{Price of fertilizer unit}}{\text{Price of one ton of crop}}$

5. $e\overline{X} = B_1 + B_2 X$ ... at X = 3 units Thabet and Balba (1994).

6. $eX = B_1 + 2 B_2 X$ Thabet and Balba (1994).

7. $EX = 0.1 \sqrt{B_1^2 - 4B_0 B_2}$ Capurro and Voss (1981)

8. $eX_s = \frac{B_0}{X_s}$ Thabet and Balba (1994).

9. $X_s = \frac{-B_1 \pm \sqrt{B_1^2 - 4B_0B_2}}{2B_2}$ at Y = 0 Thabet and Balba (1994)

10. The contribution of soil N = $\frac{X_s}{X_f + X_s}$ x calculated yield (Balba and Bray (1957).

11. The contribution of fertilizer = $\frac{X_f}{X_f + X_s}$ x calculated yield (Balba and Bray (1957).

12. SE = $\sqrt{\frac{(observed - calculated)^2}{n-2}}$

RESULTS AND DISCUSSION

The experimental and calculated values of sugar beet yield are presented in Table 2. The values show that the calculated yields are approximately close to the experimental yields. This is evident from both the values of standard error of estimate (SE) and determination coefficient (R^2). The Chi square test showed that the calculated yield values from each equation do not significantly differ from the experimental values for each treatment.

Table 3 shows the polynomial quadratic equations that were established to express sugar beet response to nitrogen forms and rates under tillage practices.

Maximum and optimum N rates

Data presented in Table 4 show that the maximum (X_m) and optimum (X_{opt}) N rates increased as tillage practices changed from T_1 to T_2 and T_3, respectively, under the three nitrogen forms used.

The maximum N rates (X_m) increased from 1.73 N unit/fed to 2.74 and 3.40 N unit/fed (fertilizer unit = 30 kg N/fed) with changing tillage practices from T_1 to T_2 and T_3, respectively, under anhydrous ammonia (AA).

Table 2. Experimental and calculated sugar beet yield (ton/fed) as affected by tillage practices, nitrogen forms and nitrogen rates.

Treatment*		AA		AN		UANL	
		Experimental	Calculated	Experimental	Calculated	Experimental	Calculated
T_1	N_0	11.480	11.584	11.480	10.548	11.480	11.380
	N_1	19.100	18.788	16.330	19.126	21.000	21.302
	N_2	19.830	20.142	24.940	22.144	23.630	23.329
	N_3	15.750	15.646	18.670	19.602	17.360	17.461
	SE	0.329		2.947		0.318	
	R^2	0.995		0.815		0.998	
T_2	N_0	11.550	11.978	11.550	11.673	11.550	11.992
	N_1	24.500	23.216	20.270	19.903	22.140	20.814
	N_2	28.150	29.434	23.770	24.138	23.210	24.536
	N_3	31.060	30.632	24.500	24.378	23.600	23.158
	SE	1.353		0.387		1.398	
	R^2	0.984		0.997		0.961	
T_3	N_0	12.830	12.898	12.830	12.142	12.830	12.437
	N_1	20.520	20.318	16.630	18.694	17.850	19.029
	N_2	24.980	25.182	25.300	23.236	24.750	23.571
	N_3	27.560	27.493	25.080	25.768	25.670	26.063
	SE	0.213		2.176		1.243	
	R^2	0.999		0.919		0.972	

* N_0 = Zero N/fed, N_1=30 kg N/fed, N_2 = 60 kg N/fed, N_3 = 90 kg N/fed

Table 3. The polynomial equations expressing sugar beet yields under tillage practices, nitrogen forms and nitrogen rates.

Treatment		The polynomial equations	Equation No.
AA	T_1	$Y = 11.584 + 10.128 X - 2.925 X^2$	1
	T_2	$Y = 11.978 + 13.748 X - 2.510 X^2$	2
	T_3	$Y = 12.898 + 8.698 X - 1.278 X^2$	3
AN	T_1	$Y = 10.548 + 11.358 X - 2.780 X^2$	4
	T_2	$Y = 11.673 + 10.228 X - 1.998 X^2$	5
	T_3	$Y = 12.142 + 7.557 X - 1.005 X^2$	6
UANL	T_1	$Y = 11.380 + 13.870 X - 3.948 X^2$	7
	T_2	$Y = 11.992 + 11.372 X - 2.550 X^2$	8
	T_3	$Y = 12.437 + 7.617 X - 1.025 X^2$	9

Results in Table 4 also show the same trend as ammonium nitrate (AN) and UANL were used. The increase of X_m was associated with increasing of the maximum yield (Y_m).

The values of X_{opt} show the same trend of X_m and it was less than the values of X_m, where the X_{opt} was calculated by differentiating "Y" in the polynomial equation with regard to "X" and equating with the ratio (Pr) of the price of fertilizer unit (30 kg N/fed) and the price of sugar beet unit (ton).

Table 4. The maximum N rate (X_m), optimum N rate (Y_{opt}), maximum yield (Y_m), optimum yield (Y_{opt}) and the returns of sugar beet under tillage practices, nitrogen forms and nitrogen rates (One fertilizer unit of N/fed = 30 kg N/fed) .

Treatments		X_m N unit/fed	X_{opt} N unit/fed	Y_m ton/fed	Y_{opt} ton/fed	price of sugar beet. L.E./ton.	Price of fert. Unit L.E./fed	Total values Of yield L.E./ ton.	Total values of Control yield L.E./fed	Return of fert. L.E./ fed	Fert. cost L.E./fed	Net return of fert. L.E./ fed	L.E. /1 L.E.
AA	T_1	1.73	1.70	20.353	20.350	200	39.0	4070.0	2316.8	1753.2	66.3	1686.9	25.44
	T_2	2.74	2.70	30.803	30.799	200	39.0	6159.8	2395.6	3764.2	105.3	3658.9	34.75
	T_3	3.40	3.32	27.698	27.698	200	39.0	5538.0	2579.6	2958.4	129.5	2828.9	21.84
AN	T_1	2.04	1.99	22.149	22.142	200	56.0	4428.4	2109.6	2318.8	111.4	2207.4	19.82
	T_2	2.25	2.49	24.763	24.763	200	56.0	4950.6	2334.6	2616.0	139.4	2476.6	17.77
	T_3	3.76	3.62	26.348	26.562	200	56.0	5265.8	2428.4	2837.4	202.7	2634.7	13.00
UANL	T_1	1.76	1.72	23.562	23.560	200	56.0	4712.0	2276.0	2436.0	96.3	2339.7	24.30
	T_2	2.23	2.17	24.671	24.671	200	56.0	4928.6	2398.4	2530.2	121.5	2408.7	19.82
	T_3	3.72	3.57	26.588	26.569	200	56.0	5313.8	2487.4	2826.4	199.9	2626.5	13.14

Maximum and optimum yields

Data presented in Table 4 show that the Y_m increased as tillage practices changed under the three nitrogen forms used. The Y_m increased from 20.353 ton/fed to 30.803 and 27.698 ton/fed as tillage practices changed from T_1 to T_2 and T_3 , respectively, when AA was used. The highest Y_m value (30.803 ton/fed) was obtained when T_2 was used. The increase of Y_m was more than 51 % as two passes and land leveler between them (T_2) was used. The increasing percentage was 36.1 when T_3 was used. The differences between T_2 and T_3 may be attributed to ammonia escape to the lower layer far from the roots zone.

The values of Y_m also increased as tillage practices changed from T_1 to T_2, T_3, respectively, under AN and UANL. The highest Y_m values obtained when T_3 was used.

The results in Table 4 show that the Y_m was 20.353 ton/fed for T_1 with using AA and increased to 22.149 and 23.562 ton/fed as AN and UANL were used, respectively. This difference reflects the importance of ammonia injection depth, where the shallow injection causes ammonia loss by ammonia volatilization and the deeper injection causes ammonia loss by escaping below the root zone. These results are encouraged by those reported by Sommer and Christensen (1992) who reported that ammonia injected by knives penetrates only 500 - 100 mm into the soil.

As shown in Table 4, the values of Y_{opt} was less than the values of Y_m, where the values of Y_{opt} was obtained by substitution of "X" by corresponding values of X_{opt} in equations 1 - 9 (Table 3). The values of Y_{opt} show the same trend of Y_m as different treatments used.

The returns from applied optimum rates

The return from applied optimum N rates are found in Table 4. The total values of the yield increased from 4070.0 L.E./fed to 6159.8 and 5538.0 L.E./fed as tillage practices changed from T_1 to T_2 and T_3, respectively, under AA. The net return of fertilizer also increased as tillage practices increased. The highest total value of the yield (6159.8 L.E./fed) and the highest net return value of fertilizer (3658.9 L.E./fed) were obtained as T_2 used. Data in Table 4 also show the return per each Egyptian pound (L.E.) spent for each of the applied optimum rate of N fertilizer. The highest value of 1 L.E. was 34.75 L.E. when using T_2 and AA was applied.

It has been observed that addition of AN and UANL increased the total value of the yield and the net return of fertilizer as tillage practices changed from T_1 to T_2 and T_3, respectively,. The highest total value of the yield and the highest net return value of yield and the highest net return value of the fertilizer were obtained under T_3 treatment.

Generally, the net return of AA was higher than of AN and of UANL under the different tillage practices. This may be due to that anhydrous ammonia (AA) was injected into sugar beet soil before the sowing which make a fertile soil from the first day of sugar beet life, this led to healthy plants. On the other hand, ammonium nitrate and urea ammonium nitrate applied to the sugar beet which the first and second irrigation after about twenty days. These results are in agreement with those obtained by Knany *et al.* (2005).

Efficiencies of nitrogen fertilizer and soil nitrogen

The efficiencies of N rates (N_0, N_1, N_2 and N_3), the average efficiencies ($e\overline{X}$), the relative efficiency EX, the efficiency of soil nitrogen (eXs) and soil nitrogen (Xs) are presented in Table 5.

The efficiencies of N rates (eX) decreased as N rates increased from N_0 to N_3 under the different tillage practices used. It can be stated that the eX values change from a maximum at the beginning at N_0 and decrease till it reach zero at the maximum yield and turn to negative at further increments. The values of $e\overline{X}$ increased as tillage practices increased from T_1 to T_2 and T_3. The $e\overline{X}$ values increased from 1.354 ton/unit/fed to 6.218 and 4.864 ton/unit/fed, as AA was used. Similar trend was observed as AN and UANL were used. Thabet (1993), Thabet and Balba (1994) and Thabet (1995) stated that the efficiency of nitrogen fertilizer had increased with increasing levels of tillage due to the improvement of some physical and nutritional properties (enhancing the decomposition of the soil organic matter, decreasing the bulk density and increasing soil aeration and permeability).

Table 5. Efficiencies of N rates (eX), $e\overline{X}$, EX, eXs and Xs under tillage practices, nitrogen forms and nitrogen rates.

Treatment		eX (ton/unit/fed)				$e\overline{X}$	EX	eXs	Xs
		N_0	N_1	N_2	N_3	ton/unit/fed			N unit fed^{-1}
AA	T_1	10.129	4.279	-1.571	-7.421	1.354	1.543	12.786	0.906
	T_2	13.748	8.728	3.708	-1.312	6.218	1.759	15.658	0.765
	T_3	8.698	6.142	3.586	1.030	4.864	1.190	10.302	1.252
AN	T_1	11.358	5.798	0.46	-5.322	3.018	1.569	13.523	0.780
	T_2	10.228	6.232	2.236	-1.760	4.234	1.407	12.147	0.961
	T_3	7.557	5.547	3.537	1.527	4.542	1.029	8.921	1.361
UANL	T_1	13.870	5.974	-1.922	-9.818	2.026	1.929	16.589	0.686
	T_2	11.372	6.272	1.172	-3.928	3.722	1.586	13.612	0.881
	T_3	7.617	5.567	3.517	1.467	4.542	1.044	9032	1.377

The relative efficiency (EX) increased from 1.543 ton/unit/fed to 1.759 as tillage practices changed from T_1 to T_2 and then decreased to 1.190 ton/unit/fed as T_3 was used. On contrast, the EX decreased from T_1 to T_2 and T_3 as AN and UANL were used, as shown in Table 5. The soil nitrogen efficiency eXs shows the same trend of EX where it changed from 12.786 to 15.658 ton/unit/fed as tillage practices changed from T_1 to T_2 and then decreased as T_3 used.

Table 5 shows the soil nitrogen content (Xs). Generally, the value of Xs increased from T_1 to T_2 and T_3 as AA, AN and UANL used.

Contribution of soil and fertilizer N to yield:

In fact, the roots absorb the plant needs of N from two available sources, the soil source and the fertilizer source. Accordingly, the contribution of the soil source in yield $= \frac{X_s}{X_f + X_s}$ x calculated yield, the contribution of fertilizer source = $\frac{X_f}{X_f + X_s}$ x calculated yield.

The results obtained by using this method are presented in Table 6.

The results in Table 6 show that the contribution of N fertilizer increased as N rates increased from N_0 to N_1, N_2 and N_3 with the different tillage practices and N forms. For example, the yield mean value of the three tillage practices increased from 0.0 to 10.685, 16.875 and 18.613 ton/fed as N rates increased from N_0 to N_1, N_2 and N_3, respectively, with AA application. On contrast, the contribution of soil N decreased as N rate increased from N_0 to N_1, N_2 and N_3, respectively. The mean values of the three tillage practices decreased from 12.153 ton/fed to 10.089, 8.044 and 5.977 ton/fed as N rate increased from N_0 to N_1, N_2 and N_3, respectively, with AA application.

Table 6. Contribution of soil N and added fertilizer to sugar beet yield at different treatments.

Treatment		Contributions of N fertilizer (ton/fed)					Contributions of soil N (ton/fed)				
		N_0	N_1	N_2	N_3	Mean	N_0	N_1	N_2	N_3	Mean
AA	T_1	0.0	9.864	13.858	12.016	8.935	11.584	8.924	6.284	3.630	7.606
	T_2	0.0	13.163	21.281	24.414	14.715	11.978	10.053	8.153	6.218	9.101
	T_3	0.0	9.029	15.487	19.410	10.982	12.898	11.289	9.695	8.083	10.491
Mean		0.0	10.685	16.875	18.613	11.544	12.153	10.089	8.044	5.977	9.066
AN	T_1	0.0	10.749	15.922	15.564	10.559	10.548	8.377	6.222	4.038	7.296
	T_2	0.0	10.151	16.293	18.454	11.225	11.673	9.752	7.485	5.924	8.799
	T_3	0.0	7.926	13.825	17.728	9.870	12.142	10.768	9.411	8.040	10.090
Mean		0.0	9.609	15.347	17.249	10.551	11.454	9.632	7.826	6.001	8.728
UANL	T_1	0.0	12.632	17.380	14.213	11.056	11.380	8.670	5.949	3.248	7.312
	T_2	0.0	11.073	17.028	17.901	11.503	11.992	9.741	7.508	5.257	8.625
	T_3	0.0	8.011	13.954	17.384	9.837	12.437	11.018	9.617	8.679	10.438
Mean		0.0	10.572	16.499	16.499	10.799	11.936	9.810	7.691	5.728	8.791

Table 6 shows a similar trend as AN and UANL were used. Thabet (1995) obtained similar results where he stated that the contribution of N fertilizer to the rice grain yields increased with the increase of fertilizer N application under different levels of tillage and the contribution of soil N to the rice grain yield decreased with the increase in the fertilizer N application under different levels of tillage.

Results in Table 6 show also that the contribution of soil N increased with changing tillage practices as the three N forms used. For example, the yield increased from 7.606 ton/fed to 9.101 and 10.491 ton/fed as tillage practices changed from T_1 to T_2 and T_3, respectively, with AA applications.

Table 7. Contribution fraction of soil N and added fertilizer to sugar beet yield at different treatments.

Treatment		Contributions of N fertilizer (ton/fed)					Contributions of soil N (ton/fed)				
		N_0	N_1	N_2	N_3	Mean	N_0	N_1	N_2	N_3	Mean
AA	T_1	0.0	0.525	0.688	0.768	0.495	1.00	0.475	0.312	0.232	0.505
	T_2	0.0	0.567	0.723	0.797	0.522	1.00	0.433	0.277	0.203	0.478
	T_3	0.0	0.444	0.615	0.706	0.441	1.00	0.556	0.385	0.294	0.559
Mean		0.0	0.512	0.675	0.757	0.486	1.00	0.488	0.325	0.243	0.514
AN	T_1	0.0	0.562	0.719	0.794	0.519	1.00	0.438	0.281	0.206	0.481
	T_2	0.0	0.510	0.675	0.757	0.486	1.00	0.490	0.325	0.243	0.515
	T_3	0.0	0.424	0.595	0.688	0.427	1.00	0.576	0.405	0.312	0.573
Mean		0.0	0499	0.663	0.746	0.477	1.00	0.501	0.337	0.254	0.523
UANL	T_1	0.0	0.593	0.745	0.814	0.538	1.00	0.407	0.255	0.186	0.462
	T_2	0.0	0.532	0.694	0.773	0.500	1.00	0.468	0.306	0.227	0.500
	T_3	0.0	0.421	0.592	0.667	0.420	1.00	0.579	0.408	0.333	0.580
Mean		0.0	0.515	0.677	0.751	0.486	1.00	0.485	0.323	0.249	0.514

Data presented in Table 7 show that the contribution fraction of N fertilizer increased as N rates increased with tillage practices and N forms. In the same time, the contribution fraction of N fertilizer decreased as the tillage practices changed from T_1 to T_2 and T_3 with AN and UANL applications.

The contribution fraction of soil N deceased with increasing N rates. The mean values of contribution fraction of soil N decreased from 1.0 to 0.488, 0.325 and 0.243 as N rate increased from N_0 to N_1, N_2 and N_3, respectively, with AA application. The same trend observed as AN and UANL were used. As a general trend, the contribution fraction of soil N increased as tillage practices changed from T_1 to T_2 and T_3 with using the three nitrogen forms. It is clearly from these results that the tillage practices improve the soil condition as well as the utilization of soil N.

It is worthy to mention that the above stated mathematical manipulation is based on a single year experiment. It needs to be verified by using data of several seasons.

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استجابة محصول بنجر السكر للصور والمعدلات النتروجينية تحت معاملات حرث مختلفة معبرا عنها بمعادلات الدرجة الثانية

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معهد بحوث الأراضى والمياه والبيئة ــ مركز البحوث الزراعية ــ الجيزه ــ مصر

أقيمت تجربة حقلية خلال موسم الشتاء ٢٠٠٣/٢٠٠٢ بمزرعة محطة البحوث الزراعية بسخا وذلك بهدف دراسة الصور والمعدلات النيتروجينية التى تحقق أعلى عائد اقتصادى وأعلى محصول من نبات البنجر تحت عمليات الحرث المختلفة.

كان التصميم المستخدم هو تصميم القطع المنشقة مرتين فى أربع مكــررات وكانــت القطــع الرئيسية لثلاثة مستويات خدمة (ح١ ، ح٢ ، ح٣) وكانت القطع الشقية لثلاثة مصادر نيتروجينيــة هى: ١- سماد الأمونيا الغازية ٨٢% نيتروجين ، ٢- سماد نترات الأمونيــوم ٣٣% نيتــروجين وسماد اليوريا امونيوم نترات السائلة ٣٢% نيتروجين. وكانت القطع تحت الشقية لأربعة مســتويات نيتروجين هى: صفر ، ٣٠ ، ٦٠ ، ٩٠كجم نيتروجين كل فدان.

وقد استخدم تسع معادلات من معادلات الدرجة الثانية للحصول على النتائج التالية:

١- ازداد المحصول الأعظم بزيادة عمليات الخدمة مع الصور النيتروجينية الثلاث.

٢- كان أعلى محصول أعظم (٣٠,٨٠٣ طن/فدان) مع المعاملة الثانية للحرث عند استخدام سماد الأمونيا الغازية.

٣- كان أعلى عائد اقتصادى (٦١٥٩,٨ جنيه مصرى/فدان) وأعلى عائد صــافى مــن الســماد (٣٦٥٨,٩ جنيه مصرى/فدان) مع الحرثة الثانية عند استخدام سماد الأمونيا الغازية.

٤- كان ترتيب العائد الصافى كما يلى: الأمونيا السائلة > نترات الأمونيوم > اليوريا السائلة.

٥- تناقصت كفاءة السماد المضاف مع زيادة المعدلات السمادية بينما ازدادت كفاءة الســماد مــع زيادة عمليات الخدمة.

٦- ازداد محتوى الأرض من النيتروجين مع زيادة عمليات الخدمــة مــع اســتخدام المصــادر النيتروجينية الثلاث.

٧- ازدادت مساهمة النتروجين السمادى فى المحصول الناتج مع زيادة معدلات السماد المضاف.

٨- تناقصت مساهمة النتروجين الأرضى فى المحصول الناتج مع زيادة معدلات السماد المضاف.

٩- ازدادت مساهمة النتروجين الأرضى فى المحصول الناتج مع زيادة عمليات الحرث.