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STEPWISE ANALYSIS OF MAIZE UNDER DIFFERENT HUMIC ACID TREATMENTS AND NITROGEN RATES

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ABSTRACT

Two field trials were conducted in Ismailia Research Station representing the sandy soil, with split plot design in four replicates during two successive summer seasons of 2012 and 2013 to find out the effect of four humic acid (HA) treatments (i.e. soaking, spraying, soaking+ spraying and control) and three nitrogen fertilizer levels (60, 90 and 120 Kg/fed) on maize yield and yield attributes. Simple correlation and stepwise regression analysis were used to find out the relationship between yield and its components and to predict their relative contributions to the grain yield.

Differences among humic acid treatments were significant for all traits except plant height and weight of 1000 kernels, while nitrogen levels exhibited significant effect for all traits. The H_3 treatment (Soaking + Spraying) recorded the best values for all traits except the number of ears per plot and the number of rows per ear. Increasing nitrogen levels enhanced the grain yield of maize. In general, it could be noticed that the combination of chemical fertilizer with the application of humic substances improved growth, yield and its attributes (grain yield, ear length, ear diameter, number of kernels per ear and weight of 1000 kernels), especially for the (Soaking + Spraying) treatment, that received 120 kg N per fed.

Grain yield had a positive and significant correlation with all traits except the number of days from planting to 50% tasseling and silking. Meanwhile, stepwise multiple regression linear analysis for maize yield showed that ear length and diameter, no. of days to 50% silking and no. of kernels per row were the most important contributing traits to grain yield (R^2=69.9%). Hence, the selection among these traits would be accompanied by high yielding and more effective for the improvement of maize grain yield in the same conditions.

Keywords: *correlation ,humic acid, maize,nitrogen levels, stepwise and yield components, Zea mays L.*

1. INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal crops grown in Egypt. Maize grain is used for both human consumption and animal feeding. It has a great utility in agro-industrial production. This crop has much higher grain protein content than our staple food rice. Based on area and production, maize is the 3rd most important cereal crop after wheat and rice in the world (Tollenaar and Dwyer, 1999). Increasing maize production became one of the most important goals of the world to face human and animal demands. Intensive farming practices that aim to produce high yields, require extensive use of agro-chemicals which are costly and create environmental pollutions (Kozdro *et al*.,2004). Nitrogen is required in large quantities for plants to grow and is mainly provided in the form of synthetic chemical fertilizers.

To manage agriculture production in unfavorable soil conditions by enriching their organic matter, various options are found in the literature for example, crop rotation, green manures, residue or animal manures incorporation … etc and humic acid application (Delfine *et al.*, 2005; Selim *et al*., 2009; Johnson *et al*., 2012). All these options basically aim to improve soil conditions for growth and quality of the crop. Keeping in consideration the magnitude for shipment and universal availability humic acid seems a choice amongst the various options.

Humic acid is a commercial product containing many elements which improve the soil fertility and increase the availability of nutrients and consequently increase plant growth and yield. Many studies have demonstrated the practical importance of humic acid on plant growth, mineral nutrition, seed germination, seedling growth, root initiation, root growth, shoot development and the uptake of macro and microelements, in addition to the claim that 1 kg of HA can substitute for 1 ton of manure (Nardi *et al*., 2002, Çelik *et al*., 2011, Tahir *et al*., 2011 and Humintech 2012). However, Hartz and Bottoms (2010) reported that HA neither improves crop nutrient uptake nor productivity. Also, no comprehensive study is available on the optimization of HA for any crop especially for maize fodder production.

Estimation of a simple correlation between various agronomic characters will provide necessary information of the more important characters under consideration (Sadek *et al*., 2006). In a study using simple correlations and stepwise regression under normal conditions, grain depth, grain number per row and plant height were considered useful selection criteria of increasing in grain yield, stepwise regression indicated that row number per ear and 1000-grain weight were the most suitable inputs to the statistical model (Shoae Hosseini *et al.* ,2008).

In general, we think that the usage of humic acid in addition to enhancement in maize performance, gives better results by reducing the usage of chemical fertilizers because of its variant physiological effects. It is also used as a substance with natural sources that stabilizes and increases agricultural production (Ghorbani *et al*., 2010). Magdi *et al.* (2011) studied the effects of mineral fertilizers and humic substances on growth and yield of cowpea, and concluded that, the combinations of chemical fertilizers with the application of humic substances improve growth and yield.

The objective of the current work was to study the effects of applied humic acid with different methods and different nitrogen fertilizer levels on maize yield and its attributes.

2.MATERIALS AND METHODS

Two field trials were conducted in Ismailia Agricultural Research Station, Agricultural Research Center (ARC), Egypt, during the 2*nd* week of May in the two successive summer seasons of 2012 and 2013 on maize crop hybrid single cross 166 (SC166) which was kindly provided by Maize Research Department, Field Crops Research Institute, Agricultural Research Center (ARC), Giza, Egypt. This search was conducted to study the effect of humic acid and nitrogen levels on yield and yield components of maize.

2.1.The experiment procedure

Experimental treatments were arranged in split plot design with four replications, where humic treatments were assigned to main plots and nitrogen rates in the sub plots. Plot size was 4 rows, 6 m in length, 80 cm in width, and 21cm between hills (29 plants / row). One blank row was left between plots. All plants in the 2*nd* and 3rd rows were harvested and adjusted to 15.5% moisture. Phosphorus, at a rate of 30 Kg P_2O_5 fed^{-1} in the form of superphosphate (15 % P_2O_5) and Potassium, at a rate of 24 Kg K_2O per fed. in the form of potassium, sulphate (48 % K_2O) were added before planting. Soil samples at (0-30cm depth), were taken from the experimental site before planting for physical and chemical analysis according to Page *et al.* (1982). This study was performed in Ismailia (sandy soil), the soil properties are illustrated in Table (1). Moreover, all other cultural practices were applied as recommended.

Table (1): Some physical and chemical analysis of the Ismailia experimental soil.

Soil characters	Physical analysis	**Soil characters**	Chemic al nalysis
Corse sand%	**13.2**	**PH(1-2.5 suspension)**	**7.9**
Fine sand	**51.2**	**Ec (m mohs cn^{-1})**	**0.132**
Silt%	**20.0**	**OM%**	**0.512**
Clay%	**14.3**	**Available N ppm**	**17.3**
Soil texture	Sandy	**Available P ppm**	**2.3**
		Available K ppm	**80.2**

2.2.The experimental treatments comprise the following

2.2.1. Humic acid treatments

1) Soaking seeds 24 h before planting.
2) Spraying at 21 days from planting.
3) Soaking seeds 24 h before planting+ Spraying at 21 days from planting.
4) Control untreated.

2.2.2. Nitrogen treatments

1)60 kg N fed^{-1}.
2)90 kg N fed^{-1}.
3)120 kg N fed^{-1}.

2.3.Procedure for data recording

Data recorded for maize crop for both seasons were the number of days from planting to 50% tasseling and to 50% silking, plant height (cm), ear height (cm), the number of rows per ear, ear length (cm), ear diameter (cm), ear per plot (two guarded rows), cob diameter (cm), the number of kernels per row, weight of 1000 kernels (gm), the number of kernels per ear and grain yield in ardab per fed (ardab = 140 Kg).

2.4.Statistical analysis

At first, the analysis of variance was applied, then a combined analysis of variance was computed over two seasons according to Snedecor and Cochran (1981). Before running the combined analysis, Levene (1960) test was used to satisfy the assumption of homogeneity of variances. Mean comparison was done using Least significant differences test at 5% level of probability. Correlations among different maize traits and stepwise multiple linear regression procedure were used according to Draper and Smith (1966) to determine the variable accounting for the majority of total yield variability.

3.RESULTS AND DISCUSSION

3.1.Combined analysis of the variance

The results of Levene test (1960) confirmed the homogeneity of variances for all the studied traits which allowed the combined analysis.

Results of combined analysis of variance **(**Table 2) showed significant differences among the different humic acid treatments for all traits except plant height and weight of 1000 kernels. Our results are in harmony with Çelik *et al*. (2011) and Daur and Bakhashwaln (2013) who reported that HA increased crop growth and productivity. In respect to nitrogen levels, significant differences were detected for all traits, which demonstrated an existence of high effect of different treatments. The results in this experiment are in agreement with the results of other researchers such as Sadeghi and Bahrani (2002) and Ghasemi pirbalouti *et al*., (2002), who indicated that applying more nitrogen rate in sweet corn, some characters as ear length and grain row number per ear were increased. In terms of the interaction between humic acid treatments and nitrogen levels, there were significant differences for all the traits except days from planting to 50% tasseling, plant height, grain yield, ear diameter, the number of kernels per ear and weight of 1000 kernels.

3.2. Effect of humic acid

Data in Table 3 show the effect of humic acid treatments on the studied traits of maize over two seasons at Ismailia. The mean data showed that the minimum value of the number of days from planting to 50% tasseling and to 50% silking were (61.29 and 62.50 day), respectively for H_3 treatment of humic acid. The highest value of plant height 249.04 cm, ear height 124.79 cm, grain yield 25.19 ardab per fed., ear length 19.32 cm., ear diameter 4.48 cm., cob diameter 2.90 cm., the number of kernels per row 38.38, weight of 1000 kernels 284.51g and the number of kernels per ear 575.21 were obtained by use the same H_3 treatment of humic acid. Meanwhile, the H_2 treatment showed the highest number of ear per plot 48.38 and the highest number of row per ear 14.18.

From the above results, the 3rd treatment (Soaking + Spraying) recorded the best values for all traits except number of ear per plot and number of row per ear.

3.3.Effect of Nitrogen

Data in Table (4) represent the mean values of the studied traits under three Nitrogen levels over two seasons. Mean performances were significantly increased by increasing N levels in most traits. These results are in harmony with those obtained by (Sadeghi and Bahrani, 2002 and Ghasemi pirbalouti, 2002). The 3rd N level recorded the highest values for all studied traits except for number of ear per plot and number of row per ear. The minimum values of number of days from planting to 50% tasseling and to 50% silking were (61.19 and 62.70 day) for N_2 level of Nitrogen, respectively.

There were significant responses to N with asserting the vital need for N application to maize production. The results obtained showed that elevating nitrogen level enhanced the grain yield of maize. These results agreed with Hokmalipour and Darbandi, 2011 ; Ghazal *et al.* 2013.

-Interaction effect of humic acid and nitrogen:

Data in Table(5) represent significant effects of the interaction between humic acid treatments and Nitrogen fertilizer levels on most traits. It could be noticed that the combination of chemical fertilizer with the application of humic substances improved maize growth, yield and most its attributes, which are in agreement with Gazal *et al.*, (2013).

From the results in Table 5, it could be concluded that, the lowest nitrogen level (60 kg N/ fed.) under the different humic acid treatments recorded the minimum values of plant height, ear height, the number of ears/ plant, grain yield, ear length, ear diameter, cob diameter, the number of kernels, 1000 kernel weight and the number of kernels / ear. On the

Table (2): Mean squares of combined analysis of variance for different traits under different humic treatments and nitrogen levels.

SOV	df	Tas	Silk	Ph	Eh	Epp	Y	El	Ed	Cd	Rpe	Kpr	Kwt	Kpe
Humic (H)	3	5.58**	8.68**	208.82	233.09*	6.37**	73.05**	16.6**	0.19**	0.01**	0.52**	14.19*	909.56	14301.47**
Error	18	0.97	0.8	154.26	55.33	0.74	1.97	0.27	0.02	0.003	0.04	4.36	766.75	443.93
Nitrogen (N)	2	6.64**	2.07*	2457.82**	1630.2**	59.14**	442.09**	57.56**	0.38**	0.28**	0.95**	459.51**	5160.67**	112119.76**
H*N	6	0.8	1.66*	123.5	107.78*	6.71**	4.11*	2.48**	0.02	0.05**	0.83**	3.91	466.52	2250.79**
Error	48	0.45	0.6	67.51	45.15	1.55	1.92	0.18	0.01	0.002	0.15	3.13	345.68	450.69

Number of days from planting to 50% tasseling (Tas) and to 50% silking(Silk), plant height(Ph), ear height (Eh), number of ear per plot (Epp), grain yield (Y), ear length (El), ear diameter (Ed), cob diameter (Cd), number of row per ear (Rpe), number of kernels per row(Kpr), weight of 1000 kernels (Kwt) and number of kernels per ear (Kpe).

ns, * and **: no significant, significant at 5 and 1% probability levels, respectively.

Table (3): Effect of humic acid treatments on maize traits (Combined data over 2012 and 2013 seasons).

Trait	Tas	Silk	Ph	Eh	Epp	Y	El	Ed	Cd	Rpe	Kpr	Kwt	Kpe
H_1	62.29	63.67	243.13	117.33	47.83	22.46	18.36	4.32	2.87	14.17	37.64	269.94	565.30
H_2	61.33	62.50	246.63	119.67	48.38	21.35	17.98	4.34	2.85	14.18	37.17	279.19	560.96
H_3	61.29	62.50	249.04	124.79	48.08	25.19	19.32	4.48	2.90	14.12	38.38	284.51	575.21
H_4	61.92	63.38	242.92	120.42	47.17	21.67	17.33	4.27	2.85	13.87	36.56	275.31	519.81
LSD	0.59	0.53	NS	4.42	0.51	0.84	0.31	0.07	0.03	0.13	1.24	NS	12.53

Number of days from planting to 50% tasseling (Tas) and to 50% silking (Silk), plant height (Ph), ear height (Eh), number of ear per plot (Epp), grain yield (Y), ear length (El), ear diameter (Ed), cob diameter (Cd), number of row per ear (Rpe), number of kernels per row (Kpr), weight of 1000 kernels (Kwt) and number of kernels per ear (Kpe). H_1: Soaking, H_2: Spraying, H_3: Soaking + Spraying and H_4: control.

, * and **: no significant, significant at 5 and 1% probability levels, respectively.

Table (4): Effect of Nitrogen treatments on maize traits (Combined data over 2012 and 2013 seasons).

Trait	Tas	Silk	Ph	Eh	Epp	Y	El	Ed	Cd	Rpe	Kpr	Kwt	Kpe
N_1	61.91	63.13	231.13	112.81	46.31	19.00	16.93	4.26	2.81	13.89	34.03	264.15	504.98
N_2	61.19	62.72	248.44	121.97	48.84	22.56	18.21	4.33	2.82	14.21	36.77	278.05	540.44
N_3	62.03	63.19	256.72	126.88	48.43	26.44	19.61	4.47	2.98	14.15	41.52	289.51	620.53
LSD	0.34	0.39	4.19	3.43	0.64	0.71	0.21	0.05	0.02	0.20	0.90	9.49	10.84

Number of days from planting to 50% tasseling (Tas) and to 50% silking (Silk), plant height (Ph), ear height (Eh), number of ear per plot (Epp), grain yield (Y), ear length (El), ear diameter (Ed), cob diameter (Cd), number of row per ear (Rpe), number of kernels per row (Kpr), weight of 1000 kernels (Kwt) and number of kernels per ear (Kpe). N_1: 60Kg, N_2: 90Kg and N_3: 120Kg. , * and **: no significant, significant at 5 and 1% probability levels, respectively.

Table (5): Mean performance of studied traits under interaction between humic acid (H) and Nitrogen (N) treatments (Combined).

H	N	Tas	Silk	Ph	Eh	Epp	Y	El	Ed	Cd	Rpe	Kpr	Kwt	Kpe
H_1	N_1	62.88	64.00	226.88	109.00	46.50	18.80	16.37	4.27	2.90	14.25	34.05	256.33	513.29
	N_2	61.50	63.00	243.75	115.50	47.75	22.41	18.55	4.26	2.70	13.85	36.59	266.19	532.61
	N_3	62.50	64.00	258.75	127.50	49.25	26.17	20.18	4.43	3.00	14.40	42.28	287.30	649.99
H_2	N_1	61.38	62.50	229.25	111.13	46.75	18.55	17.51	4.24	2.78	14.05	33.65	262.86	523.41
	N_2	60.75	62.38	250.63	119.50	49.25	20.86	17.56	4.32	2.86	14.35	36.85	291.71	540.41
	N_3	61.88	62.63	260.00	128.38	49.13	24.64	18.88	4.47	2.93	14.15	41.00	283.00	619.06
H_3	N_1	61.63	63.13	239.00	117.50	47.00	20.45	17.93	4.40	2.83	13.55	35.23	276.39	509.03
	N_2	60.88	62.00	253.13	130.63	49.88	25.39	19.26	4.49	2.90	14.65	36.95	282.26	578.86
	N_3	61.38	62.38	255.00	126.25	47.38	29.73	20.77	4.55	2.98	14.15	42.98	294.88	637.74
H_4	N_1	61.75	62.88	229.38	113.63	45.00	18.23	15.90	4.14	2.74	13.70	33.18	261.03	474.21
	N_2	61.63	63.50	246.25	122.25	48.50	21.59	17.48	4.24	2.82	14.00	36.70	272.04	509.89
	N_3	62.38	63.75	253.13	125.38	48.00	25.20	18.60	4.45	2.99	13.90	39.81	292.86	575.34
LSD		NS	0.89	NS	7.75	1.44	NS	0.48	NS	0.06	0.44	NS	NS	24.50

Number of days from planting to 50% tasseling (Tas) and to 50% silking (Silk), plant height (Ph), ear height (Eh), number of ear per plot (Epp), grain yield ardab/fed. (Y), ear length (El), ear diameter (Ed), cob diameter (Cd), number of row per ear (Rpe), number of kernels per row (Kpr), weight of 1000 kernels (Kwt) and number of kernels per ear (Kpe). H_1: Soaking, H_2: Spraying, H_3: Soaking + Spraying and H_4: control. N_1: 60Kg, N_2: 90Kg and N_3: 120Kg. , * and **: no significant, significant at 5 and 1% probability levels, respectively.

other hand the highest nitrogen level (120 kg N/fed.) showed the maximum values of plant height, ear height, the number of ears/ plot, grain yield, ear length, ear diameter, cob diameter, number of kernels/ row, 1000 kernels weight and number of kernels/ ear under the four humic acid treatments.

In conclusion, it could be noticed that the combination of chemical fertilizer with the application of humic substances improve growth and positively affect maize yield and most its attributes (grain yield, ear length, ear diameter, number of kernels per ear and weight of 1000 kernels), especially for the H_3N_3 treatment, that received 120 kg N per fed + (HA soaking + HA spray).

3.4.Correlation studies

The estimates of simple correlation coefficients for all comparisons among the studied traits are presented in Table (6).

Grain yield had a positive and significant correlation with all traits except the number of days from planting to 50% tasseling and to 50% silking. The maximum correlation coefficient value was detected between silking and tasseling (0.98^{**}). In the same context, grain yield exhibited high correlation coefficient values with each of ear length (0.79^{**}), number of kernel per ear (0.74^{**}), number of kernel per row (0.65^{**}) and ear diameter (0.63^{**}). Meanwhile, high correlation was detected between ear length and each of number of kernel per ear (0.85^{**}) and number of kernel per row (0.72^{**}). These results are in line with those confirmed by Khazaei *et al.* (2010), Khodarahmpour and Hamidi (2012) and Zamaninejad *et al.* (2013).

3.5.Stepwise regression analysis

Data presented in Table (7) shows stepwise multiple regression analysis of the estimated variables in predicting grain yield. The obtained results showed that 69.9% of total variation in yield, resulted from ear length, ear diameter, number of days to 50% silking and number of kernels per row, indicated that ear length, ear diameter, number of days to 50% silking and number of kernels per row were the most suitable inputs to the model. The obtained results showed that the best prediction equation for yield ($\hat{Y}$) is formulated as follows:

Yield = -14.72 + 1.26^{**} Ear length + 5.1^{**} Ear diameter – 0.278^{**} Number of days to 50 % silking + 0.26^{**} Number of kernels per row.

Hence, it could be concluded that selection based on ear length, ear diameter, number of days to 50% silking and number of kernels per

Table (6): Correlation coefficients between all possible pair's combination of the studied traits in *Zea mays* L. under humic acid treatments and nitrogen rates.

Trait	Tas	Silk	Ph	Eh	Epp	El	Ed	Cd	Rpe	Kpr	Kwt	Kpe
Silk	0.98^{**}											
Ph	-0.43^{*}	-0.44^{**}										
Eh	-0.05^{ns}	-0.07^{ns}	0.63^{**}									
Epp	0.23^{*}	0.24^{*}	0.34^{**}	0.51^{**}								
El	0.08^{ns}	0.07^{ns}	0.47^{**}	0.54^{**}	0.50^{**}							
Ed	0.36^{**}	0.34^{**}	0.14^{ns}	0.32^{**}	0.42^{**}	0.65^{**}						
Cd	-0.10^{ns}	0.09^{ns}	0.40^{**}	0.45^{**}	0.41^{**}	0.55^{**}	0.61^{**}					
Rpe	-0.12^{ns}	-0.12^{ns}	0.23^{*}	0.32^{**}	0.48^{**}	0.29^{**}	0.14	0.36^{**}				
Kpr	0.47^{**}	0.46^{**}	0.24^{*}	0.44^{**}	0.48^{**}	0.72^{**}	0.72^{**}	0.60^{**}	0.10^{ns}			
Kwt	0.45^{**}	0.45^{**}	0.10^{ns}	0.35^{**}	0.38^{**}	0.40^{**}	0.54^{**}	0.33^{**}	0.02^{ns}	0.57^{**}		
Kpe	0.03^{ns}	0.10^{ns}	0.47^{**}	0.50^{**}	0.46^{**}	0.84^{**}	0.58^{**}	0.71^{**}	0.49^{**}	0.63^{**}	0.35^{**}	
Y	0.002^{ns}	-0.03^{ns}	0.45^{**}	0.50^{**}	0.40^{**}	0.79^{**}	0.63^{**}	0.57^{**}	0.24^{**}	0.65^{**}	0.33^{**}	0.74^{**}

Number of days from planting to 50% tasseling (Tas) and to 50% silking(Silk), plant height(Ph), ear height (Eh), number of row per ear (Rpe), ear length (El), ear diameter (Ed), number of ear per plot (Epp), cob diameter (Cd), number of kernels per row(Kpr), weight of 1000 kernels(Kwt), number of kernels per ear (Kpe)and grain yield (Y).
***, ** and ns indicates significant, highly significant and insignificant at the 0.05 and 0.01 level of probability.**

Table (7): Stepwise regression between grain yield (dependent) and some studied traits in maize.

Independent variable	intercept	Regression coefficient				Accumulative partial R- Sq%
		b1	b2	b3	b4	
Ear length	- 16.43	2.14				62.56
Ear diameter	- 30.93	1.77	4.9			65.15
No. of days to 50% silking	- 26.07	1.65	6.9	-0.181		67.69
No. of kernels per row	- 14.72	1.26	5.1	-0.278	0.26	69.90

**** Significant at 5% of probability levels.**

row is more appropriate. These findings are in accordance with the results obtained by Khodarahmpour and Hamidi (2012) and Zamaninejad *et al.* (2013) who reported that the traits of the number of kernels per row and ear diameter were useful for the determination of an increase in yield.

In conclusion, the results from the present study indicate that the application of HA and N fertilizers can positively affect maize yield and its attributes, especially under the H_3 treatment (soaking + spraying) and 120 kg N per feddan, which recorded a maize yield (29.73 ard/fed) in sandy soil. Generally grain yield was improved with increasing increment of HA. So it can be considered that the (H_3N_3) were the superior treatment. The results of stepwise regression analysis for grain yield, indicated that ear length, ear diameter, number of days to 50% silking and number of kernels per row contribute about 69.9% of the variation of grain yield. Therefore, these traits provided the most useful input for an increase of grain yield.

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التحليل المرحلى لمحصول الذرة تحت معدلات مختلفة من حامض الهيوميك والتسميد النيتروجينى

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ملخص

أجريت هذه التجربة فى محطة البحوث الزراعية بالاسماعيلية ممثلة للأراضى الرملية خلال الموسم الصيفى ٢٠١٢ و٢٠١٣ لدراسة تأثير أربع معاملات من حامض الهيوميك (نقع البذرة قبل الزراعة - رش ورقى بعد الزراعة – نقع+ رش وكنترول) على محصول الذرة (هجين فردى ١٦٦) تحت ثلاث مستويات مختلفة من التسميد النيتروجينى (٦٠-٩٠-١٢٠ كجم/فدان) باستخدام القطع المنشقة مرة واحدة بتصميم القطاعات كاملة العشوائية فى أربع مكررات. تمت دراسة العلاقة بين المحصول ومكوناته باستخدام تحليل الارتباط البسيط بينما استخدم تحليل الانحدار المرحلى للتنبؤ بالمساهمة النسبية لمكونات المحصول.

أوضحت النتائج وجود تأثيرات معنوية لمعاملات حامض الهيوميك على كل الصفات عدا طول النبات، ووزن-١٠٠٠ حبة، أما تأثيرات مستويات التسميد النيتروجينى فكانت معنوية على كل الصفات. بينما كان تفاعل تأثيرات معاملة الهيوميك مع اضافة النيتروجين معنويا على معظم الصفات . وقد سجلت المعاملة الثالثة (نقع+ رش) أفضل قيم لكل الصفات عدا عدد الكيزان فى القطعة وعددالصفوف فى الكوز، بينما يزداد المحصول بزيادة مستوى التسميد النيتروجينى. عموما وجد تأثير موجب للمعاملة بالهيوميك مع اضافة النيتروجين على محصول الذرة وبعض مكوناته مثل (محصول الحبوب وطول وقطر الكوز، وعددالحبوب فى الكوز، ووزن-١٠٠٠ حبة) وكانت أفضل معاملة التسميد بـ١٢٠كجم/فدان نيتروجين بالاضافة لمعاملة الحبة بالهيوميك (نقع+ رش).

اوضحت نتائج تحليل الارتباط البسيط لبيانات المحصول وجود ارتباط معنوى موجب مع كل الصفات عدا عدد الايام من الزراعة حتى ظهور كلا من النورة المذكرة و المؤنثة. فى حين أوضح تحليل الانحدار المرحلى أن أكثر الصفات تأثيراً على المحصول هى طول وقطر الكوز، وعدد الايام من الزراعة حتى ظهور النورة المؤنثة، وعدد الحبوب بالصف؛ حيث ساهم معامل التحديد (R^2) لهذه الصفات بحوالى٦٩,٩٠% فى تباين محصول الذرة مما يؤكد أن الانتخاب خلال هذه الصفات يكون مصحوباً بزيادة المحصول تحت نفس الظروف من المعاملة.

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