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**EFFECT OF NITRIFICATION INHIBITOR (NITRAPYRIN) AND  
NITROGEN LEVEL ON GROWTH AND YIELD OF MAIZE**  
**(*Zea mays* L.)**

**BY**

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**ABSTRACT**

Field trials were conducted during 1991 and 1992 seasons, at the Agricultural Research and Experiment Center, Faculty of Agriculture, Moshtohor, Zagazig University to evaluate the effect of different N levels (15, 30, 45, 60, 75, 90 and 105 kg N/fed.) and nitrapyrin as a nitrification inhibitor on growth and yield of maize.

Results showed that growth, yield and yield components as well as protein content in grains of maize were significantly increased by increasing N rates up to 105 kg N/fed.

Addition of nitrapyrin with urea produced the highest values of growth, yield and yield components of maize. Using nitrapyrin with urea, increased maize grain yield/fed. by 12.6 and 10.3% in 1991 and 1992 seasons, respectively, as compared with urea alone.

Plant height in 1991 and 100-kernel weight, shelling percentage, grain yield/fed. and protein content in grain in the two seasons were significantly influenced by the interaction between N levels and nitrapyrin. Maize grain was significantly increased with increasing N levels up to 105 kg N/fed. when nitrapyrine was not used. However, combination of nitrapyrin with urea significantly increased grain yield of maize with increasing N levels up to 75 kg N/fed.

Under the conditions of this study it can be concluded that using nitrapyrin as nitrification inhibitor combined with 75 kg N/fed (urea) produced the highest grain yield of maize and saved 40 kg N/fed



## INTRODUCTION

Nitrogen fertilizer is critical for economic maize grain yields to be achieved. Nutrient loss from the rhizosphere is greater with N than any other plant nutrient. Many investigators reported that N recovery by crops under field conditions is often less than 50% (York and Tucker, 1985). N applied in the ammonical form undergoes a biological oxidation to nitrate, which is subject to both leaching and denitrification. This oxidation process, known as nitrification, is carried out in soil mainly by *Nitrosomonas* bacteria. Such losses of N result in loss of fertilizer, energy and contaminate ground water by the accumulation of  $\text{NO}_3$ .

Nitrification inhibitors retard the oxidation of fertilizer  $\text{NH}_4$  to  $\text{NO}_3$ , and this should reduce N losses from leaching and denitrification and consequently increase N use efficiency with corresponding improvement in corn growth, yield and quality (Frye *et al.*, 1989). Recently, nitrapyrin is commercially available synthetic nitrification inhibitors and became common and widely used in many agricultural production systems in USA and Europe. Huber *et al.* (1977) reported that nitrification inhibitors (especially nitrapyrin) is a new tool for food production. Walters and Malzer (1990) showed that nitrification inhibitors are recommended for use with ammoniacal fertilizer in corn production to improve fertilizer N use efficiency. They concluded that nitrification inhibitor (NI) with moderate N rates coupled with conservation irrigation management should reduce the risk of corn yield loss and minimize  $\text{NO}_3$  movement to groundwater. They also added that urea + NI increased corn yield and fertilizer N use efficiency at 90 kg N/ha, when leaching was high. Huber *et al.* (1977) and Frye *et al.* (1981) reported that surface application of nitrapyrin have been effective in increasing corn grain yield. Chancy and Kamprath (1982) found that nitrapyrin with urea decreased soil N losses, and significantly increased leaf N concentration, grain yields, plant N accumulation and N fertilizer recovery. Also, Martin *et al.* (1993) recorded that nitrapyrin may reduce loss of fertilizer N from the root zone by reducing leaching and denitrification, this reduced N loss should be reflected in increased crop yields.

Yield and yield components of maize were increased as the N fertilizer application level increased (Shafshak *et al.*, 1981; Faisal, 1983; Kamel *et al.*, 1986; Khedr, 1986; Mahgoub, 1987; Gouda, 1989 and Younis *et al.*, 1990).

In Egypt, experimental results for evaluating the effect of nitrification inhibitor (nitrapyrin) on field crops are indeed limited. Zaid and Doss (1993) found that urea or ammonium sulphate mixed with nitrification inhibitor (N-serve) improved the quality and yield of carrot. Thus, the objectives of this study were directed to evaluate the effect of nitrapyrin as nitrification inhibitor under different N levels on growth and yield of maize.



## MATERIALS AND METHODS

Two field experiments were carried out during 1991 and 1992 seasons at the Agriculture Research and Experiment Center, Faculty of Agriculture at Moshtohor, Zagazig University to evaluate the effect of nitrapyrin as a nitrification inhibitor applied under different N levels on growth, yield and yield components, as well as protein content in grain of maize

The composite maize variety Giza 2 was used in this study. Normal cultural practices were applied properly. Planting dates were 20<sup>th</sup> and 26<sup>th</sup> June in 1991 and 1992 season, respectively. The preceding crop was wheat in the two seasons.

Soil was clay textured with pH value of 7.9, 2.55% (organic matter) and  $\text{CaCO}_3$  contents of 3.65%.

Each experiment included 14 treatments which were the combination of 7 N levels as urea 46% N: 15, 30, 45, 60, 75, 90 and 105 kg N/fed. with and without nitrapyrin. Nitrapyrin [2-chloro-6-(trichloromethyl) pyridine] used as a nitrification inhibitor (NI) applied at a rate of 0.5% of N in the fertilizer (Dow Chemical Co., Midland, MI, USA). For urea + nitrapyrin treatments; urea was thoroughly mixed with nitrapyrin, to ensure uniform distribution, just prior to field application according to Walters and Malzer (1990). N or N + NI were applied in hills (about 15 cm from the base of the plants) and incorporated directly by shallow cultivation, then 1<sup>st</sup> irrigation followed at the same day.

The treatments were laid out in a randomized complete block design with four replications. The size of each plot was  $10.5 \text{ m}^2$  (3 x 3.5 m) or 1/400 fed and contained 5 ridges.

At harvest, 10 plants and 10 ears were taken randomly from each plot to determine: plant height (cm), ear height (cm), stem diameter (mm) of the internode below the ear, number of rows/ear, number of kernels/row, ear weight (gm), 100-kernel weight (gm), shelling percentage, and protein percentage in grains (using procedure of Micro-Keldahl's as outlined by A.O.A.C., 1970). Grain yield (kg/fed), adjusted to 15.5% moisture content, was estimated from the middle 3 rows of each plot.

Statistical analysis for the studied characters were conducted according to Steel and Torrie (1981).

## RESULTS AND DISCUSSION

### 1. Effect of N fertilizer level:

Results in Table (1) show the significant effect of N level on some growth characters of maize plant height, ear height and stem diameter in 1991



and 1992 seasons. Plant height, ear height and stem diameter were significantly increased with the increase in N level from 15 to 105 kg N/fed. in both seasons. It is quite evident that N fertilizer had a great effect on maize growth. These results indicate clearly the vital role of N in plant growth as it is necessary for protoplasm formation, photosynthesis activity in all plants, and necessary for cell division and meristematic activity in plant organs. The present results are in agreement with those reported by Shafshak *et al.* (1981), Faisal (1983) and Khedr (1986).

Data in Table (1) indicated the significant effect of N level on yield components of maize in the two seasons. Ear length, ear diameter, number of kernels/row, ear weight, 100-kernel weight and shelling percentage significantly increased as the N level increased from 15 to 105 Kg N/fed. Similar results were reported by Shafshak *et al.* (1981), Faisal (1983) and Khedr (1986).

Maize grain yield responded significantly to N level in the two seasons. Applying N at 30, 45, 60, 75, 90 and 105 kg N/fed. increased grain yield by 25.9, 82.2, 112.9, 134.1, 148.3 and 153.8% over 15 kg N/fed. in 1991 season, corresponding to 5.5, 14.4, 29.8, 49.5, 58.1 and 60.8% in 1992 season, respectively. The effect of N fertilizer on maize grain yield is due to its effect on vegetative growth and yield components. A better vegetative growth caused to intercept and trap more light energy through photosynthetic products accumulation and source/sink relation which is reflected on the yield and yield components. The present results are in agreement with those reported by Shafshak *et al.* (1981), Faisal (1983), Kamel *et al.* (1986), Gouda (1989) and Younis (1990).

The increase in N level significantly increased protein content in maize grain in both seasons. Protein percentage increased by 16 and 17.9% as the result of increasing N level from 15 to 105 kg N/fed in 1991 and 1992, respectively. This result indicates the vital role of N in forming amino acids which are condensed in turn to form proteins. Similar results were obtained by Faisal (1983), Mahgoub (1987) and Gouda (1989) who found that the increase in N level significantly increased protein content in grain.

## II. Effect of nitrapyrin:

Results in Table (2) show that growth characters and yield components of maize were significantly affected by using nitrapyrin in the two seasons. Plant height, ear height and stem diameter were significantly increased by mixing nitrapyrin with urea fertilizer. The present results confirmed the findings of Touchton and Kabana (1985). They found that nitrification inhibitor (EDB) resulted in greater plant height and plant weight of corn.

Nitrapyrin increased ear characters and yield components in both seasons. This may be attributed to reducing N losses and increasing N fertilizer use efficiency.



Table (1): Effect of nitrogen levels on growth, yield components, yield and protein percent of maize in 1991 and 1992 seasons.

N-rates	Plant height [cm]	Ear height [cm]	Stem diameter [mm]	Ear length [cm]	Ear diameter [mm]	No. of rows/ear	No. of kernels/row	Ear weight gm	100-kernel weight gm	Shelling %	Grain yield kg/fed.	Protein %
kg/fed.												
<b>1991 season</b>												
15	211.9	105.6	18.4	13.9	40.9	11.5	19.4	140.1	31.5	77.1	1235	7.5
30	220.1	110.1	19.6	14.9	43.3	11.8	23.4	144.0	32.2	77.1	155	7.6
45	233.5	116.1	19.8	16.6	45.3	12.5	31.4	178.8	32.6	77.6	2250	7.8
60	239.6	117.9	20.4	18.8	47.3	12.5	36.4	197.6	33.3	77.9	2630	8.2
75	249.1	126.4	20.7	19.8	49.5	12.0	38.5	215.5	34.1	78.2	2891	8.3
90	252.9	127.4	21.1	19.9	49.5	12.3	39.9	236.4	35.1	78.4	3067	8.4
105	255.9	132.9	21.3	20.1	50.4	11.8	42.5	244.8	35.9	79.2	3135	8.7
L.S.D.	14.0	7.4	1.0	0.9	1.7	N.S.	3.3	18.3	0.5	0.1	129	0.1
<b>1992 season</b>												
15	292.9	168.0	16.5	15.1	38.6	11.5	24.3	169.3	34.6	77.2	1696	7.8
30	284.6	168.5	17.0	16.3	40.4	11.5	27.1	172.6	35.2	77.3	1790	7.9
45	303.6	174.4	17.6	18.0	43.0	12.3	32.1	177.3	36.2	77.5	1940	8.0
60	310.1	180.1	18.1	19.5	46.3	12.5	34.4	185.5	36.9	77.9	2202	8.4
75	312.9	185.4	18.4	21.1	50.1	12.0	36.5	189.8	38.1	78.4	2536	8.7
90	317.6	188.1	18.5	21.4	49.6	12.5	38.3	194.6	38.7	78.8	2682	9.0
105	325.4	193.5	18.9	21.8	51.1	12.3	40.3	196.0	39.4	79.3	2728	9.2
L.S.D.	9.1	6.5	0.7	1.2	2.5	N.S.	3.3	10.5	0.3	0.1	138	0.1



Table (2): Effect of nitrification inhibitors on growth, yield components, yield and protein percent of maize in 1991 and 1992 seasons.

Nitrification inhibitor (NI)	Plant height (cm)	Ear height (cm)	Stem diameter (mm)	Ear length (cm)	Ear diameter (mm)	No. of rows/ear	No. of kernels/row	Ear weight (gm)	100-kernel weight (gm)	Shelling %	Grain yield (kg/fed.)	Protein %
<b>1991 season</b>												
None	228.9	116.9	19.4	17.2	45.4	11.9	31.3	174.0	32.7	77.8	2253	8.06
Nitrapyrin	246.0	122.1	20.9	18.2	47.8	12.1	34.9	213.8	34.3	78.0	2537	8.08
L.S.D.	7.5	3.9	0.5	0.5	0.9	N.S.	1.8	9.8	0.2	0.1	69	N.S.
<b>1992 season</b>												
Non	303.8	177.9	17.5	18.5	44.4	11.9	30.5	178.9	36.1	77.9	2116	8.35
Nitrapyrin	312.8	181.8	18.2	19.5	46.8	12.2	36.0	188.2	37.9	78.1	2334	8.46
L.S.D.	4.9	3.5	0.4	0.7	1.4	N.S.	1.8	5.6	0.2	0.1	74	0.06



Maize grain yield/fed. increased markedly by using nitrapyrin. Nitrapyrin significantly increased maize grain yield by 12.6 and 10.3% as compared with the check treatments in the first and second season, respectively. Protein content in maize grain was influenced by nitrapyrin with significant difference in the second season only.

Generally, results indicated that, increases in growth, yield and yield components of maize have been obtained by using nitrapyrin. These increases are mainly attributed to nitrapyrin, as a nitrification inhibitor, minimized fertilizer N losses associated with  $\text{NO}_3$  by maintaining the  $\text{NH}_4$  form (Touchton *et al.*, 1979), delayed nitrification process (Boswell and Anderson, 1974 and Chancy and Kamprath, 1982) and thus prolonged the availability of  $\text{NH}_4$ -N for plant use (Huffman, 1989) and this should reduce N losses from leaching and denitrification and consequently increase N use efficiency with corresponding improvement in maize production (Huber *et al.*, 1977; Touchton *et al.*, 1979; Frye *et al.*, 1981; Frye *et al.*, 1989 and Walters and Malzer, 1990). Also, Martin *et al.* (1993) found that nitrapyrin, as a nitrification inhibitor, may reduce loss of N fertilizer from the root zone by leaching and denitrification. Such reduce in N loss should be reflected in increasing corn yields. Also, Chancy and Kamprath (1982) showed that nitrapyrin with urea decreased soil N losses and significantly increased leaf N concentration, grain yields, plant N accumulation and fertilizer N recovery.

### III. Interaction effects:

Plant height in 1992 and 100-kernel weight, shelling percentage, grain yield/fed. and protein content in grain in the two seasons were significantly influenced by the interaction between N level and nitrapyrin (Tables 3 and 4).

The highest values of plant height, 100-kernel weight and shelling percentage were achieved at the highest N level (105 kg N/fed.) combined with nitrapyrin, while the lowest values of these traits were obtained by adding the lowest N level (15 kg N/fed.).

Grain protein content was significantly increased when nitrapyrin was used at 105 kg N, indicating late-season N uptake. The same effect was observed by Walters and Malzer (1990), also Jung *et al.* (1972) and Russelle *et al.* (1981) who found the same result when N fertilizer was applied late in the vegetative growth period of corn.

Maize grain yield was significantly increased with increasing N rates up to 105 kg N/fed when nitrapyrin was not included (Table 4). However, combination of nitrapyrin with urea significantly increased grain yield with increasing N rates up to 75 kg N/fed but the inhibiting effect of nitrapyrin was not evident with increasing N rates from 75 to 105 Kg N because the yield at 90 and 105 kg N with nitrapyrin was not different than that at 75 kg N/fed. The



Table (3): Effect of interaction between N level and nitrification inhibitor on plant height, 100-kernel weight and shelling percentage in 1991 and 1992 seasons.

N-rates kg/fed.	Plant height (cm)		100-kernel weight (gm)				Shelling percentage			
	1991 season		1992 season		1991 season		1992 season		1991 season	
	NI	Nitrapyrin	NI	Nitrapyrin	NI	Nitrapyrin	NI	Nitrapyrin	NI	Nitrapyrin
15	210.5	213.3	297.3	288.5	31.05	32.00	34.00	35.10	77.15	77.05
30	225.3	225.0	294.3	295.0	31.25	33.10	34.60	35.70	77.15	77.10
45	225.5	241.5	298.0	309.3	31.55	33.70	35.35	37.10	77.50	77.65
60	229.8	249.5	302.3	318.0	32.20	34.40	35.40	37.80	77.85	77.85
75	238.3	260.0	305.5	320.3	33.20	34.95	36.55	39.65	78.00	78.40
90	239.5	266.3	308.3	327.0	34.55	35.60	37.50	39.80	78.15	78.70
105	243.5	266.8	319.5	331.3	35.40	36.30	38.75	39.95	78.85	79.45
L.S.D. 5%	N.S.		12.9		0.64		0.49		0.16	
									0.14	



Table (4): Effect of interaction between N level and nitrification inhibitor (NI) on grain yield/fed. and protein percentage in maize grain in 1991 and 1992 seasons.

N-rates kg/fed.	Grain yield kg/fad.				Protein percentage			
	1991 season		1992 season		1991 season		1992 season	
	NI		NI		NI		NI	
	None	Nitrapyrin	None	Nitrapyrin	None	Nitrapyrin	None	Nitrapyrin
15	1268	1203	1704	1688	7.60	7.38	7.75	7.85
30	1567	1543	1788	1792	7.60	7.55	7.85	7.85
45	2038	2463	1864	2016	7.85	7.70	8.00	7.95
60	2442	2817	1984	2420	8.00	8.35	8.25	8.55
75	2540	3243	2270	2800	8.15	8.50	8.65	8.75
90	2887	3248	2524	2840	8.50	8.35	9.00	8.95
105	3025	3245	2676	2780	8.73	8.75	9.00	9.35
L.S.D. 5%	182		196		0.16		0.17	



marked effect of nitrapyrin was due to the effective inhibition of nitrification resulting in a reduction of N loss and reduced N losses by leaching and in turn increased N fertilizer use efficiency (Frye *et al.*, 1981; Chancy and Kamprath, 1982 and Walters and Malzer, 1990). At 15 kg N/fed., nitrapyrin decreased grain yield, probably because of delayed nitrification and movement of fertilizer N into the active root zone. While, the relative abundance of N at the higher N rate when nitrapyrin was used could have resulted in sufficient N supply to sustain a higher yield and yield components than at the lower N rate.

Generally, addition of nitrapyrin with urea could result in the lowest risk of yield loss on this heavy irrigated soils, which induce N losses by leaching, if N rate is below that which is recommended for maize production. The recommended N rate was 105 kg N/fed., the use of nitrapyrin at this rate did not result in any yield advantage or improvement in growth and yield components more than using it at 75 kg N/fed. This means that, using nitrapyrin with urea saved about 40% of N fertilizer. Similar results were reported by Walters and Malze (1990) who found that the yield increases usually occurred when nitrapyrin was applied with limited N levels. Similar results were also reported by Touchton *et al.* (1979) and Frye *et al.* (1981).

Under the conditions of this study, it can be concluded that, using nitrapyrin (as a nitrification inhibitor) combined with 75 kg N/fed. gave higher or the same values of yield and yield components of maize at the highest N level (105 kg N/fed.) without nitrapyrin. Thus the highest economical grain yield of maize can be obtained by using 75 kg N/fed. mixed with nitrapyrin.

#### REFERENCES

- A.O.A.C. (1970): Association of Official Agricultural Chemists. Official method of analysis. 11th Ed., Washington, D.C.
- Boswell, F.C. and Anderson, O.E. (1974): Nitrification inhibitor studies on soil in field-buried polyethylene bags. Soil Sci. Soc. Am. Proc. 38:851-852
- Chancy, H.F. and Kamprath, E.J. (1982). Effect of nitrapyrin on N response of corn on sandy soil. Agron. J. 74: 565-569.
- Faisal, R.I. (1983). Effect of some agricultural practices on growth and yield of some maize varieties (*Zea mays* L.) M.Sc Thesis. Fac Agric Moshtohor, Zagazig Univ., Egypt
- Frye, W.W., Blevens, R.L., Murdock, L.W., Wells, K.I. and Ellis, J.H. (1981) Effectiveness of nitrapyrin with surface applied nitrogen fertilizer in no-tillage corn. Agron. J. 73: 287-289
- Frye, W.W., Gratz, D.A., Locascio, S.J., Reves, D.W. and Touchton, J.I. (1989) Dicyandiamide as a nitrification inhibitor in crop production in south eastern USA. Common Soil Sci. Plant Anal. 20 (19 & 20) 1969-1999 (C.F. Martin *et al.*, Agron. J. 85: 651-655, 1993)
- Gouda, A.S.A. (1989). Agronomic studies on maize. Ph.D. Thesis. Fac Agric Zagazig Univ., Egypt



- Huber, D.M.; Warren, H.L.; Nelson, D.W. and Tsai, C.Y. (1977). Nitrification inhibitors-new tools for food production. *Bio-Science*, 27: 523-529.
- Huffman, J.R. (1989). Effects of enhanced ammonium nitrogen availability for corn. *J. Agron. Educ.* 18: 93-97. (C.F. Smiciklas, K.D. and F.E. Below, 1992. *Crop Sci.* 32: 1220-1225).
- Jung, P.E.; Jr., Peterson, L.A. and Schrader, L.E. (1972). Response of irrigated corn to time, rate and source of applied N on sandy soils. *Agron. J.* 64: 668-670.
- Kamel, M.S.; Shaban, S.A.; Ashour, N.I. and Abdel-Lateef, E.M. (1986). Soil and foliar fertilization studies on maize. 1. Yield and yield components. *Proc. 2nd Conf. Agron.* 1: 247-261.
- Khedr, E.A.F. (1986). Response of maize plant to irrigation and nitrogen fertilization. Ph.D. Thesis, Fac. Agric., Moshtohor, Zagazig Univ., Egypt.
- Mahgoub, G.A.M. (1987). Response of corn inbreds and their hybrids to different nutrient environments. Ph.D. Diss. Univ. Wisconsin, Madison, USA.
- Martin, H.W.; Graetz, D.A.; Locascio, S.J. and Hensel, D.R. (1993). Nitrification inhibitor influences on potato. *Agron. J.* 85: 651-655.
- Russelle, M.P.; Deibert, F.J.; Hauck, R.D.; Stevanovic, M. and Olson, R.A. (1981). Effect of water and nitrogen management on yield and N-depleted fertilizer use efficiency of irrigated corn. *Soil Sci. Soc. Am. J.* 45: 553-558.
- Shafshak, S.E.; Salem, M.S. and Roshdy, A. (1981). Response of maize to nitrogen and boron. *Ann. Agric. Sci., Moshtohor*, 16: 3-16.
- Steel, R.G.D. and Torrie, J.H. (1981). Principles and procedures of statistics. 2nd Ed. McGraw-Hill Co., New York.
- Touchton, J.T.; Hoeft, R.G.; Welch, L.F.; Mulvaney, D.L.; Oldham, M.G. and Zajicek, F.E. (1979). N uptake and corn yield as affected by applications of nitapyrin with anhydrous ammonia. *Agron. J.* 71: 238-249.
- Touchton, J.T. and Kabana, R.R. (1985). Corn growth and yield response to ethylene dibromide and nitrogen. *Agron. J.* 77: 389-392.
- Walters, D.I. and Malzer, G.L. (1990). Management and nitrification inhibitor effects on nitrogen-15 enriched urea: I. Yield and fertilizer use efficiency. *Soil Sci. Soc. Am. Proc.* 54: 115-122.
- York, A.C. and Tucker, M.R. (1985). Nitrification inhibitor evaluation on cotton. I. Rate and time of application. *Agron. J.* 77: 403-406.
- Younis, M.A.; Mahgoub, G.M.; Khedr, E.A. and El-Demerdash, F.M. (1990). Response of some maize hybrids to plant density and nitrogen fertilizer. *Egypt J Appl Sci* 5: 125-135.
- Zaid, H.A. and Doss, M. (1993). Effect of nitrification inhibitor (N-serve) applied in combination with N-fertilizers on yield and quality of carrot in calcareous soil. *J. Agric. Sci. Mansoura*, 18: 1240-1253.



### تأثير إضافة مثبط التآزت مع مستويات مختلفة من التسميد الأزوتى على نمو ومحصول الذرة الشامية

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أقيمت تجربتان حقليتان خلال موسمي ١٩٩١، ١٩٩٢ بمركز البحوث والتجارب الزراعية بكلية الزراعة بمشتر وذلك لدراسة تأثير إضافة مثبط التآزت (Nitrapyrin) مع مستويات مختلفة من التسميد الأزوتى على نمو ومحصول صنف الذرة الشامية جيزة ٢.

تضمن البحث أربعة عشر معاملة وهى التوافق بين سبع مستويات من التسميد الأزوتى (١٥، ٣٠، ٤٥، ٦٠، ٧٥، ٩٠، ١٠٥ كجم/ن/ف) من سماد اليوريا مع أو بدون إضافة مثبط التآزت، وذلك فى تصميم القطاعات الكاملة العشوائية فى أربع مكررات.

- وقد أدى التسميد الأزوتى إلى زيادة معنوية فى كل صفات النمو والمحصول ومكوناته وكذلك نسبة البروتين فى الحبة نتيجة زيادة معدل إضافة السماد الأزوتى من ١٥ إلى ١٠٥ كجم/ن/ف.
- وتشير النتائج إلى أن إضافة مثبط التآزت (Nitrapyrin) مع سماد اليوريا أدى إلى زيادة ملحوظة فى صفات النمو ومكونات المحصول والمحصول وذلك مقارنة باستخدام اليوريا فقط، حيث زاد محصول الحبوب للفدان بنسبة ١٢,٦، ١٠,٣٪ خلال الموسم الأول والثانى على التوالي.
- كان للتفاعل بين التسميد الأزوتى ومثبط التآزت تأثير معنوى على طول النبات فى الموسم الثانى ووزن ١٠٠ حبة ونسبة التقريط ومحصول الحبوب للفدان ومحتوى الحبة من البروتين فى كلا الموسمين.
- أدت إضافة مثبط التآزت مع سماد اليوريا بمعدل ٧٥ كجم/ن/فدان إلى الحصول على أعلى محصول من الحبوب للفدان فى كلا الموسمين وكان هذا المحصول أعلى منه فى حالة إضافة ١٠٥ كجم/ن/فدان بدون استخدام مثبط التآزت.
- وتحت ظروف هذا البحث فإنه يمكن الحصول على أعلى محصول من الذرة الشامية بإضافة مثبط التآزت (Nitrapyrin) مع ٧٥ كجم/ن/فدان من سماد اليوريا وبذلك يمكن توفير ٤٠ كجم/ن/فدان.