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RESPONSE OF POPCORN (*ZEA MAYS SSP. EVERTA* L.) TO UREA AND SULFUR FERTILIZER AS WELL AS FOLIAR UREA APPLICATION

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ABSTRACT
A field experiment was carried out in private field (Abu-Garaq, 10 km west of Hilla city) during the autumn season of 2014 in silt clay loam soil, to study the response of popcorn to spraying urea under different soil fertilization levels of urea and agricultural sulfur. Split – split blot design in randomized complete blocks design (RCBD) in three replications was used. The factors were: soil fertilizer with urea (0, 100 and 200 kg ha^{-1}) which were given symbols (U0, U100 and U200) respectively, and three agricultural sulfur levels (0, 10 and 20 kg ha^{-1}) which were given symbols (S0, S10, S20) respectively, and two levels of spraying urea (spraying and control). The spraying was done twice (at 12 leaves stage and silk appearance stage at concentration of %0.05 even full wet) which were given symbols (A0, A1) respectively. The results showed that 200 kg ha^{-1} (U200) was superior significantly in ear rows number, grain number per row, the weight of 300 grain (19.42 , 45.5 , 45,2 g) . U100 and U200 caused a significant effect in plant yield (160.11 g and 157.98 g) and total grain yield (7.63 and 7.43 ton.ha^{-1}) compared to control. Sulfur level 10 and 20 kg ha^{-1} (S10 and S20) was superior and gave the highest average of: ear rows number (18.97 and 18.77), weight of 300 grain (43.48 and 42.88g), respectively compared to control. Spraying urea (A1) was superior in ear row number (19.17). The interaction caused a significant effect in most of the studied traits.
KEY WORDS: *popcorn, Agricultural sulfur, N fertilizer, Urea foliar fertilizer*

INTRODUCTION

Popcorn is one kind of maize which is economically important and occupies third place after wheat and rice crops. Popcorn seeds either needle elongated seeds resemble rice grains like or spherical pearly shaped like contain little protein and endosperm predominantly starch hyperkeratosis and containing little water that causes burst when exposed to high temperatures and the seed coat thick except models Argentine where the thin seed casing. Its importance comes as a result of the global demand for seeds for consumption immediately after exposure to heat as well as for use in a lot of crossover unchanged industries if maize. Maize is soil stressful crop which absorb large amounts of nutrients in various stages of growth, especially nitrogen. Nitrogen enters in the composition of cells and is a basic element in the formation of amino acids that make up protein (Kole, 2010; Adelusi & Oseni, 2015). Therefore, studies have shown that maize plants highly respond to nitrogen fertilizer (Shaban *et al.,* 2011; Bashir *et al*, 2012; Sarma *et al,* 2015). One of the important things that make consuming more nitrogen component compared to rest elements by maize plant returns to its needed through all

stages of growth (Lomer *et al,* 2012; Jasim, 2015). Sulfur is an essential nutrient for all forms of animal and plant life. Plant absorbs sulfur comparable amounts with the amounts of phosphorus absorbed (Tandon, 1991). Ongoing planting soil without the addition of sulfur made the symptoms of deficiency and clear in many regions of the world. Because of sulfur needed ant its important, the farmers ranking sulfur as fourth element nutritious (Imran *et al,* 2014). Sulfur is a composition of some amino acids, one of the components of vitamin A as well as its importance in increasing the effectiveness of plant enzyme systems (Havlin *et al.,* 2004). Studies have indicated that the addition of sulfur causes an increase of hydrogen concentration in the soil solution and increase its acidity, which causes increase the solubility and the readiness of some other nutrient compounds. Acidic soil interaction ensure the absorption of nutrients by the plant, as it was clear that the additions of sulfur fertilizer cause an increase in the growth and production of field crops (Dawood & Kadban, 1989). Foliar fertilizer is important in reducing the amount of fertilizer added and reducing the energy needed to transfer ions within the plant, and processing plant with nutrients requirement when roots did not provide it during critical and sensitive stages of growth. Spraying their solutions on the vegetative parts is quick and faster compared to soil fertilization (EL-Emam & EL-Ahmar, 2003). This study aims to study the addition of urea and sulfur levels as soil fertilizer and determining the effectiveness of foliar fertilizer with urea solution and their interaction on popcorn yield.

MATERIALS AND METHODS

A field experiment was carried out during the autumn season of 2014 in one of private farmers, Abu-Gharaq (10 km west of the Hilla city within 32.31 north latitude and 44.21 east longitude to study the effect of spray urea under different levels of soil fertilizing with urea and agricultural sulfur on popcorn. Field soil was prepared by plowing and landing and then dividing to ridges 75 cm between each to other. Field soil physical and chemical characters was shown in Table 1. Split-split plot arrangement according to randomized complete blocks design (RCBD) with three replications was used as factorial experiment with three factors. The main plot consist of urea (0, 100 and 200) $kg.ha^{-1}$which were given symbols (U0, U100 and U200) respectively, sub plot including sulfur (0, 10, 20 $kg.ha^{-1}$) which were given symbols (S0 and S10 and S20), respectively and the sub-sub plot included urea foliar fertilizer (control and spraying) which were given symbols (A0 and A1), respectively. Urea foliar fertilizer was done twice, in the stage of 12 paper the stage of silk emergence at concentration of 0.05 until the full wet. Seeds of local popcorn variety was planting at 07/15/2014 on ridges 75 cm and 25 cm between hills (53 333 $plant.ha^{-1}$). The experimental unit (3*4 m) contained 4 ridges and left one ridge between each experimental unit and the other. Soil and plant management were done uniformly by the recommendations. Field experiment was fertilized with NPK (20:20:20) at the level of 200 $kg.ha^{-1}$ uniformly to all experimental unit in lines 10 cm down of planting line. Urea and agricultural sulfur soil levels added at 4 leaves stage, and foliar fertilizer with urea spray (%0.5) was done, one day after irrigation at stage of 12 leaves and at silk emergence by sprinkler dorsal 16-liter in the morning until full wet. Control plants were sprayed with distilled water only in the same way. Average number of rows per ear and grains per row were calculated for ten ears chosen randomly from 10 plants in internal lines. Dry weight of 300 grains was taken randomly from grains of ten ears from each experimental unit were calculated

and correct weight based on the moisture content of 15.5%. Plant yield was measured by dividing the yield of internal lines of each experimental unit on the number of plants in them. Average grain yield ($t.ha^{-1}$) estimated on the basis of plant yield relative to the intensity. Data was analyzed according to the design practice using a statistical program (Genstat) and the means were compared by less significant difference (LSD) test.

TABLE 1. Some chemical and physical characteristics of the field soil

Traits		value
Soil component	sand	179 $g.kg^{-1}$
	silt	481 $g.kg^{-1}$
	clay	340 $g.kg^{-1}$
Soil texture		Silt-clay-loam
pH		7.14
EC		2.72 $dSm.m^{-1}$
N		1.219 $mg.kg^{-1}$
P		4.786 $mg.kg^{-1}$

RESULTS AND DISCUSSIONS

Table (2) indicates that U200 treatment gave the highest average number of rows per ear (19.42 $rows.ear^{-1}$) significantly compared to control (18.08 $rows.ear^{-1}$). Urea spraying led to a significant increase in the average number of $rows.ear^{-1}$, which was increased from 18.04 to 19.16 $rows.ear^{-1}$. The reason may be due to the nitrogen added to the soil or sprayed on the plant led to improve growth and increased food factory thus reducing competition for nutrients and reduce the abortion rate, which leads to increase the proportion of pollination and fertility and then increase the number of $rows.ear^{-1}$. This result is consistent with the findings of Sharifi *et al* (2011) and Moraditochaee *et al* (2012). Adding agricultural sulfur led to a significant increase in the average number of $rows.ear^{-1}$,in which S20 and S10 treatments gave significantly the highest average of 18.97 and 18.77 $rows.ear^{-1}$ respectively, compared to control (18.07).

The interaction between urea spraying and sulfur application gave a significant effect, in which A1S20 and A1S10 were superior (19.43 and 19.36 $rows.ear^{-1}$, respectively) compared to other interactions, while A0S0 gave the lowest average (17:42 $rows.ear^{-1}$). The interaction between spraying of urea and soil levels of urea gave significant effect and A1S200 was superior significantly (19.87) compared to A0U0 (17.39 $rows.ear^{-1}$). The interaction between urea and sulfur levels gave significant effect and all interactions were superior significantly compared to U0S0 (17.37 $rows.ear^{-1}$), and U200S20 and U200S10 gave the highest means (19.62 and 19.50 $rows.ear^{-1}$) significantly compared to others. The triple interaction gave significant effect and all interactions led to significant increase compared to A0S0U0 (16.45 $rows.ear^{-1}$), while A1S20U200 gave the highest average number (20.27 $rows.ear^{-1}$).

Table (3) shows that the addition of urea to the soil led to a significant increase in the number of $grain.row^{-1}$ compared to control treatment (U0), which gave the lowest average (40.1). The treatment U200 was superior significantly (45.5) compared to U100 (43.4). This results was due to nitrogen role in improving the qualities of growth (Jasim & Ghani 2015) which led to increase the rate of photosynthesis and increase the proportion of fertility. This is consistent with the findings of Laekemariam & Gidago (2012) and Ali *et al,* (2013), who found an increase in the number of $grains.row^{-1}$at increasing levels of nitrogen fertilization. Spraying

urea and sulfur treatment had no significant effect in this trait, but tend to increase. The interaction between sulfur levels and urea had no significant effect, while the interaction between urea levels and spraying urea had significant effect in increasing this trait.

TABLE 2. Effect of urea and sulfur levels and foliar urea on rows number.ear^{-1}

Urea spray	sulfur	Urea levels			Sulfur x Urea
		U0	U100	U200	
A0	S0	16.45	17.71	18.12	17.41
	S10	17.69	17.94	19.11	18.25
	S20	18.23	18.44	18.99	18.55
A1	S0	18.28	18.41	19.45	18.71
	S10	18.78	19.45	19.89	19.36
	S20	19.11	18.79	20.27	19.43
Urea average		18.08	18.46	19.42	
$LSD_{0.05}$		Urea=0.82 interaction=0.93			0.44
Urea levels x urea spraying					Spraying average
A0		17.36	18.03	18.74	18.04
A1		18.71	18.89	19.87	19.16
$LSD_{0.05}$		0.80			0.21
Urea levels x sulfur levels					Sulfur average
S0		17.37	18.04	18.79	18.07
S10		18.21	18.59	19.50	18.77
S20		18.67	18.61	19.62	18.97
$LSD_{0.05}$		0.85			0.37

TABLE 3. Effect of urea and sulfur levels and foliar urea on grain number.row^{-1}

Urea spray	sulfur	Urea levels			Sulfur x Urea
		U0	U100	U200	
A0	S0	38.6	42.8	44.4	41.9
	S10	39.4	40.8	46.2	42.1
	S20	41.4	44.2	45.7	43.8
A1	S0	38.5	43.9	45.5	42.2
	S10	42.4	44.4	46.7	43.8
	S20	42.4	44.1	45.6	44.0
Urea average		40.1	43.4	45.5	
$LSD_{0.05}$		Urea=0.29 interaction=3.15			n.s.
Urea levels x urea spraying					Spraying average
A0		39.8	42.6	45.4	42.6
A1		41.1	44.1	45. 9	43.7
$LSD_{0.05}$		1.34			n.s.
Urea levels x sulfur levels					Sulfur average
S0		38.6	43.4	44.5	42.2
S10		39.9	42.6	46.5	43.0
S20		41.9	44.2	45.7	43.9
$LSD_{0.05}$		2.36			n.s.

The interaction between urea levels and sulfur levels showed significant effect in increasing the number of grain.row^{-1}, and U200S10 gave the highest average (46.5) compared to U0S0. The interaction between urea, sulfur levels and spraying urea had a significant effect

in increasing the number of grain.row^{-1} and A1S10U200 gave the highest average (46.7), while A0S0U0 gave the lowest average (38.6).

Table (4) showed that the addition of urea led to a significant increase in dry weight of 300 grains compared to control treatment (U0) which gave less weight (39.21 g), and the treatments of U200 was superior significantly (45.20 g) compared to U100 (42.52g). This results were due to the role of nitrogen in increasing vegetative growth (Jasim & Ghani 2015) and this means increasing the photosynthesis and the source-sink transport of nutrients, then increasing accumulation of dry matter in grains. This trait was consistent with the results of Tollenear *et al*. (1997), who found that nitrogen fertilizer helps to increase the accumulation of dry matter during grain filling stage. These results are consistent with the results of El-Atawy & Eid, (2010), Rizwan *et al.* (2003) and Ahmed *et al.* (2002). Sulfur treatments led to a significant increase in the weight of 300 grains significantly compared to control (S0), which gave the lowest weight (40.07 g**).** This results were due to sulfur role in the formation of amino acids and assembly of proteins in the grain (Jaliya *et al,* 2013). This is consistent with the findings of Rasheed *et al* (2004) in Pakistan when adding 30 kg.ha^{-1}sulfur to field corn, and the results of Ali *et al* (2013) when adding 25-35 kg.ha^{-1} sulfur that led to a significant increase in the weight of 1000 grains of maize and the results of Sarfaraz *et al* (2014) when adding 60 kg.ha^{-1} sulfur which caused a significant increase in 1000 grain of maize. The interaction between urea spraying and sulfur levels had a significant effect, in which A1S20 and A1S10 were superior significantly (44.91 and 43.91 g, respectively), while A0S0 gave the lowest average weight (40.33 g).The interaction of urea levels and urea spraying had significant effect and A0U0 gave significantly the lowest 300 grain dry weight (37.53 g), while A0U200 and A0U200 were superior (45.24 and 45.15g, respectively). The interaction between sulfur levels, urea levels and urea spraying had significant effect, in which A1S20U200 and A0S10U200 were superior (46.82 and 46.06 g, respectively), while A0S0U0 gave the lowest average (35.68 g).

TABLE 4. Effect of urea and sulfur levels and foliar urea on 300 grain weight (gm)

Urea spray	sulfur	Urea levels			Sulfur x Urea
		U0	U100	U200	
A0	S0	35.68	40.98	44.25	40.33
	S10	37.92	41.57	46.06	41.85
	S20	39.00	41.79	45.42	42.07
A1	S0	38.22	41.26	43.61	41.03
	S10	41.76	44.96	45.02	43.91
	S20	42.35	45.56	46.82	44.91
Urea average		39.21	42.52	45.20	
$LSD_{0.05}$		Urea=0.91 interaction=2.63			1.57
Urea levels x urea spraying					Spraying average
A0		37.53	41.45	45.24	41.41
A1		40.78	43.93	45.15	43.29
$LSD_{0.05}$		1.44			n.s.
Urea levels x sulfur levels					Sulfur average
S0		36.95	41.12	43.93	40.07
S10		39.84	43.27	45.54	42.88
S20		40.68	43.68	46.08	43.48
$LSD_{0.05}$		1.55			1.00

Table (5) shows that urea addition led to increase plant grain yield, and the treatments of U200 and U100 caused a significant increase in plant grain yield (160.11 and 157.98g) compared to control U0 (147.15 g). This result consistent with the findings of Zeidan *et al* (2006) who indicated superiority of corn plant yield when increasing fertilization levels of nitrogen. Studies have shown the presence of highly positive significant correlation between grain weight and yield, which indicates that the increase in yield components lead to increase yield (Ricardo *et al*., 2002). Spraying urea and sulfur levels had no significant effect on the average grain yield per plant. The interaction of urea levels and spraying urea caused a significant effect, and the interaction of U200 and U100 with spraying urea or not (A1 and A0) were superior significantly compared to others, which indicate that the main effect is due to soil application of urea. The interaction between urea levels and sulfur levels caused a significant effect, and the interaction of U200 and U100 with or without sulfur application and urea spraying were superior compared to others, which indicate that soil fertilizer with urea had the main effect on plant grain yield. The interaction between soil application of urea and sulfur levels and urea spraying caused a significant effect, in which A1S20U200 gave the highest average of plant grain yield (163.19 g), while A0S0U0 gave the lowest average (142.45 g).

TABLE 5. Effect of urea and sulfur levels and foliar urea on plant yield

Urea spray	sulfur	Urea levels			Sulfur x Urea
		U0	U100	U200	
A0	S0	142.45	155.71	160.12	152.76
	S10	144.69	157.94	162.11	154.91
	S20	146.23	158.44	163.99	156.22
A1	S0	148.28	157.41	161.75	155.48
	S10	149.75	158.45	162.49	156.56
	S20	152.51	159.89	163.19	157.87
Urea average		147.15	157.98	160.11	
$LSD_{0.05}$		Urea=5.85 interaction=11.47			n.s
Urea levels x urea spraying					Spraying average
A0		144.46	157.36	162.08	154.63
A1		150.15	158.59	162.48	157.07
$LSD_{0.05}$		6.56			n.s
Urea levels x sulfur levels					Sulfur average
S0		145.37	158.06	160.93	154.79
S10		147.21	159.19	162.30	156.24
S20		149.37	159.17	163.59	157.38
$LSD_{0.05}$		8.78			n.s

Table (6) shows that the addition of urea led to a significant increase in grain yield, and the treatment U200 and U100gave highest yield (7.63 and 7.41 $t.ha^{-1}$, respectively) compared to control U0 (6.81 $t.ha^{-1}$). This results is due to the effect of urea in processing of nitrogen, which led to increase growth and photosynthesis levels (Jasim & Ghani, 2015), thereby increasing yield components (number of rows per ear, number of grain per row and grain weight) as shown in tables 2, 3 and 4, resulting in increasing plant yield table 5 and thus grain yield per unit area. This is consistent with the findings of Zeidan *et al* (2006) who indicated corn yield superiority when increasing urea levels. The interaction of urea levels and urea spraying caused a significant effect, and the interaction of A1U200 and A0U200 gave

highest yield of 7.63 and 7.61 t.ha^{-1} , respectively , while A0U0 gave the lowest average of 6.78 t.h^{-1}.

TABLE 6. Effect of urea and sulfur levels and foliar urea on grain yield (t.ha^{-1})

Urea spray	sulfur	Urea levels			Sulfur x Urea
		U0	U100	U200	
A0	S0	6.69	7.31	7.52	7.17
	S10	6.79	7.41	7.61	7.27
	S20	6.86	7.44	7.69	7.33
A1	S0	6.96	7.39	7.59	7.31
	S10	7.03	7.44	7.63	7.36
	S20	7.16	7.50	7.66	7.44
Urea average		6.81	7.41	7.63	
$LSD_{0.05}$		Urea=0.48 interaction=0.19			n.s
Urea levels x urea spraying					Spraying average
A0		6.78	7.39	7.61	7.26
A1		7.05	7.44	7.63	7.37
$LSD_{0.05}$		0.24			n.s
Urea levels x sulfur levels					
S0		6.82	7.35	7.55	7.24
S10		6.88	7.42	7.62	7.31
S20		7.01	7.47	7.68	7.39
$LSD_{0.05}$		0.36			n.s

The interaction between urea levels and sulfur levels caused a significant effect, and the interaction of U200 and U100 with or without sulfur application were superior compared to U0 interactions and U200S20 gave the highest average of 7.68 t.ha^{-1}. The interaction between urea levels, sulfur levels and urea spraying caused a significant effect. The highest average grain yield obtained from U200 at any level of S and urea spraying (7.52-7.69 t.ha^{-1}), while A0S0U0 gave the lowest average (6.69 t.ha^{-1}).

CONCLUSIONS

It will be concluded that soil application of 200 kg.ha^{-1} with silfur 10-20 kg.ha^{-1} were more effective in increasing popcorn yield and yield components which were enough and urea spray did not have a significant impact in promoting greater yield.

REFERENCES

- Ahmad R., Mahmood A., Ikraam M., Hassan B. 2002. Influence of different Irrigation methods and band placement of nitrogen on maize productivity. *Inter. J. Agric. & Biol.,* 4(4): 540-543.
- Adelusi A.A., Oseni O.M. 2015. Effects of nitrogen concentrations on the photosynthetic pigment accumulation and yield of S*olanum lycopersicum. Annals of West University of Timişoara, ser. Biology,* 18 (2:. 131-138
- Ali A., Iqbal Z., Hassan S. W., Khaliq M.Y. T., Ahmad S. 2013. Effect of Nitrogen and Sulphur on Phenology, Growth and yield parameters of maize crop. *Sci.Int.(Lahore),* 25(2),363-366.
- Bashir N. , Malik S., Mahmood S., Ul-Hassan M., Athar H., Athar M. 2012. Influence of urea application on growth, yield and mineral uptake in two corn (*Zea mays* L.) cultivars. *Afr. J. Biotech.,* 11(46): 10494-10503 .
- Cox W.J., Kalonge S., Cherney D.J.R., Reid W.S**.** 1993. Growth, yield ,and quality of forage maize under different nitrogen management practices. *Agro. J.* 85: 341-347.
- Dawood F.A., Kadban M.M. 1989. Sulfur and sorbed phosphorus relationship in calcareous soils. *J. Agric. And water res.,* 8 (1): 83-93.

- El-Atawy G. S., Eid S.M. 2010. Influence of irrigation water amounts and nitrogen rate on maize productivity and some water relation in WadiElnatroon, region, Egypt . *J. Soil Sci. and agric. Engineering Univ.* 1(8): 75-87.
- El-Emam S.T., El-Ahmar B.A. 2003. Effect of NK levels on some economic characters of sesame and safflowers.*News. Letter.*, 18:101-107.
- Havlin J.L., Samuel L., Tisdale S.L., Nelson W.L., Beaton J.D. 2004. Soil fertility and fertilizers. An introduction to nutrient management. *7th ed. Pearson Education Inc. Singapore.* p. 221.
- Imran U., Parveen S., Ali A., Wahid F., Arifullah, Ali F. 2014. Influence of sulfur rates on phosphorus and sulfur content of maize crop and its utilization in soil. *Int. J. Farm & Allied Sci.,* 3 (11): 1194-1200 .
- Jaliya M.M., Ibrahim A., Babaji B.A., Sani B.M., Aminu D. 2013. Nitrogen and sulfur fertilizers on maize grain protein content of QPM maize. *G.J.B.B.,* .2 (1) 2013: 132-134.
- Jasim A.H. 2015. Effect of soil sulfur fertilizer and some foliar fertilizers on growth and yield of broccoli in saline soil. *Annals of West University of Timişoara, ser. Biology,* 18 (2): 123-130
- Kole S. G. 2010. *Response baby corn (Zea mays L.) to plant density and fertilizer levels*. Master of Agric. Sci., Dharwad Univ.
- Laekemariam F., Gidago G. 2012. Response of maize (*Zea mays* L.) to integrated fertilizer application in Wolaita, South Ethiopia. *Advances in Life Sci. & Tech.,* 5:21-30.
- Lomer A.M. , Ali-zade V. , Chogan R., Amiri E. 2012. Effect of nitrogen on the growth levels and development of maize hybrids in the condition of amino acids application. *Int. J Agric. Crop Sci.,* 4 (14), 984-992
- Moraditochaee M., Motamed M.K., Azarpour E., Danesh R.K., Bozorgi H.R. 2012. Effects of nitrogen fertilizer and plant density management in corn farming. *J. Agric. & Biol. Sci.,* 7(2): 132-137.
- Rasheed M., Ali H., Mahmood T. 2004. Impact of nitrogen and sulfur application on growth and yield of maize (*Zea mays* l.) crop. 15(2): 153-157.
- Ricardo M.J., Larandera J., Camozzim E. 2002. Elemental sulfur as nutrient for crops in the pampeanMollissols of Argentina. *Paper No. 1512 , Symposium* No. 17.
- Rizwan M., Maqsood M., Rafiq M., Saeed M., Ail Z. 2003. Maize *Zea mays* L. Response to split application of nitrogen. *Inter. J. Agric. Biol.,* 5(1):19-21.
- Sarfaraz Q., Perveen S., Shahab Q., Muhammad D., Bashir S., Ahmed N., Ahmed S., Islam M., Asghar I. 2014. Comparative effect of soil and foliar application of sulfur on maize. *J. Agric. and Veter. Sci. (IOSR-JAVS)*, 7(4): 32-37.
- Sarma B., Bhattacharya S. S., Gogoi N. 2015. Impact of n fertilization on c balance and soil quality in maize-dhaincha cropping sequence. *J. Agric. Sci.,* 60 (2): 135-148.
- Shaban K.A., Abd El-Kader M.G., El-Khadrawy S.M. 2011. Evaluation of organic farm and compost combined with urea fertilizers on fertility and maize productivity in newly reclaimed. *Res. J. Agric. and Biol. Sci.,* 7(5): 388-397.
- Sharifi R.S., Seyedi M.N., Zaiefizadeh M. 2011. Influence of various levels of nitrogen fertilizer on grain and nitrogen use efficiency in canola (*Brassica napus* L.) cultivars. *J. Crops Improv.,* 13(21):51-60 .
- Tandon H.L.S. 1991. *Sulphur research and agricultural production in India*. The Sulphur Institute, USA. 140 .
- Tollenear M., Aguilera A., Nissanka S. P. 1997. Grain yield is reduced more by weed interference in an old than in a new maize hybrid. *Agro. J.*, 89(2) :239-246.
- Zeidan M.S., Amany A., El-Kramany B., Ali M. 2006. Effect of N-fertilizer and plant density on yield and quality of maize in sandy soil. *Res. J. Agric. and Biol. Sci.,* 2(4): 156-161.