*J. Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 2 (11):1129-1139, 2011*

# MAIZE RESPONSE TO NITROGEN RATE AND SPLITTING IN SANDY CLAY LOAM SOIL

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## ABSTRACT

Two field experiments were conducted at a private farm at El-Salhiea City; Sharkia Governorate during two summer seasons of 2006-2007 and 2007-2008 to investigate the effect of nitrogen fertilizer rates and splitting application on maize plant (*Zea mays L.)* grown on sandy clay loam soil.

Ten treatments were arranged in a split plot design with three replicates; which were the simple possible combination between five treatments of N-fertilization, (30, 60, 90, 120 and 150 kg N fed$^{-1}$). Each N rate was divided to 1- two equal doses 50 and 50% which added after 14 and 48 day after sowing (DAS) and 2- four doses 40, 20, 20 and 20% added after 14, 28, 48, 56 DAS.

The maize plant growth parameter increased with increasing the nitrogen fertilizer rate and the superiority of fresh and dry weight of leaves ear and chlorophyll observed with 120 kgN fed$^{-1}$.

100 grain weight, grain yield and straw yield increased with increasing the rate of N fertilizer up to 120 kg N fed$^{-1}$. Treatment of 120 kg N fed$^{-1}$ in four doses as 40, 20, 20 and 20% added after 14, 28, 48, and 56 DAS, recorded higher values of 100 grain weight, straw and grain yield of wheat.

Significant difference in N, P and K concentration in leaves and grain of maize plant were observed due to different levels and splitting of N application. In general, N, P and K% were increased with increasing the N fertilizers levels up to 120 kg N fed$^{-1}$ with split to 2 doses, and 150 kg N fed$^{-1}$ with split to 4 doses.

Under the same conditions of the experiment, it can be recommended to add the nitrogen fertilizer at 120 kg N fed$^{-1}$ in four doses as 40, 20, 20 and 20% after 14, 28, 48, 56 DAS, which gave the best result of quantity and quality of the maize cultivated on sandy clay loam soil.

## INTRODUCTION

Maize (*Zea mays*, L) is a great important crop for both human and animal feeding. It ranks the third position among cereal crops. In Egypt, it is very important to increase production of maize to cover gab between production and consumption. The highest maize yield production depended on many factors i.e. cultivars, nitrogen fertilization (EL-Bana and Gomaa, 2000).

Nitrogen is an integral component of many compounds essential for plant growth processes including chlorophyll, many enzymes and mediates the utilization of potassium, phosphorus and other elements in plants (Brady, 1984).

The optimum amounts of elements in the soil cannot be utilized efficiency if nitrogen is deficient in plants. Therefore, nitrogen deficiency or excess can result in reduce maize yields. Maize nitrogen requirement can be as high as 150 to 200 kg hec$^{-1}$. However, nitrogen requirement and utilization by maize also depend on environmental factors like irrigation, varieties and expected yield. Application of nitrogen fertilizer has also been reported to have significant effect on grain yield and quality of maize (Sanjeev and Bangarwa, 1997).

Plant fresh and dry weights, weight of ear leaf, ear weight, 100 grain weight, yield and yield components of N, P and K of maize plants were increased significantly by increasing the level of nitrogen up to 140 kg N fed$^{-1}$ (Siam *et al*., 2008), In order to study the effects of nitrogen levels on yield and yield components in maize cultivars, Sharifi and Taghizadeh (2009) indicated that nitrogen levels had significant effects on yield and yield components in maize hybrids. The level of nitrogen fertilization differentiated the chlorophyll content expressed in SPAD units (Szulc and Hubert, 2010).

The high prices of nitrogen fertilizer have forced corn producers to consider strategies to increase nitrogen use efficiency. Plant N use efficiency can be improved by matching application rate and timing with plant demands (Ferguson *et al*., 2002). Russelle *et al*. (1983) showed that corn N uptake is affected by time of fertilizer application. Split application of N may help growers make better decision on N application (Feinerman *et al*., 1990). Yield may increase using split application method when using irrigation (Randall *et al*., 2003 and Gehl *et al*., 2005). Randall *et al*., (2003), demonstrated that the lowest grain yield was achieved by fall N application versus the highest grain yield with split N fertilization. The fertilizer with three split doses resulted in highest agronomic efficiency as compared to no split and two splits (Khan *et al*., 2006).

Timing of application is important to help assure that applied N remains in the soil for crop use. Also, risk of N loss and thus potential for reduced yield becomes more important when refining to optimal or perhaps less than optimal rates. Therefore, practices should be avoided that enhance buildup of soil nitrate at times when losses are more probable.

The aim of the present study is to determine the effects of N fertilizer rate and splitting on plant growth, yield and yield components and chemical composition of maize cultivated on sandy clay loam soil.

## MATERIALS AND METHODS

Two field experiments were conducted at a private farm El-Salhiea City; Sharkia Governorate during two summer seasons of 2007 and 2008 to investigate the effect of nitrogen fertilizer rates and splitting application on maize plant (*zea mayz L.).*

**Experimental soil and cultivation:** Composite surface soil samples (0-30 cm) were collected from experimental area before sowing and analyzed for some chemical and physical characteristics as shown in Table 1.

The area of each sup plot was 10.5 m$^2$ (0.7 m wide and 3 m in length) comprised 5 ridges. Seeds of corn cv. (3- way cross hybrid), were sown at the rate of 60 Kg fed$^{-1}$. On 15 May during the two successive seasons in hills (one plant/hill) spaced at 30 cm. The agricultural practices and irrigation were done according to the recommendations of the ministry of Agriculture for corn plant. However, irrigation management levels were maintained to soil moisture dose not drop below 70% from water holding capacity of soil during the growing seasons.

**Table 1: The mean values of some chemical and physical properties of the experimental soil:**

| Season | pH * | EC ** dS/m | Ions conc. meq/100g soil | | | | | | | | SP% |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | $Ca^{++}$ | $Mg^{++}$ | $Na^{+}$ | $K^{+}$ | $CO_3^{--}$ | $HCO_3^{-}$ | $Cl^{-}$ | $SO_4^{--}$ | |
| 1st | 7.9 | 3.64 | 0.59 | 0.49 | 0.91 | 0.04 | 0.00 | 0.27 | 0.68 | 1.08 | 47.0 |
| 2nd | 8.1 | 3.59 | 0.56 | 0.51 | 0.89 | 0.07 | 0.00 | 0.33 | 0.71 | 0.99 | 44.0 |
| | **Mechanical Analysis %** | | | | **Tex. Class** | | **OM%** | **$CaCO_3$ %** | **Avail. ppm** | | |
| | **C. sand** | **F. sand** | **Silt** | **Clay** | | | | | **N** | **P** | **K** |
| 1st | 13.32 | 38.56 | 21.15 | 26.97 | Sandy clay loam | | 0.89 | 9.72 | 37.0 | 6.9 | 420 |
| 2nd | 11.93 | 37.42 | 25.16 | 25.49 | | | 0.77 | 7.88 | 41.0 | 4.3 | 375 |

*** pH (1:2.5 soil suspension) ** EC (soil paste extract)**

**Experimental design and treatments:** Ten treatments were arranged in a split plot design with three replicates; which were the simple possible combination between five treatments of N-fertilization, (30, 60, 90, 120 and 150 kg $fed^{-1}$) and two splitting way of each N rates (1st splitting was divided to two equal doses 50 and 50% added at 14 and 48 days after sowing (DAS) and 2nd splitting was divided to four doses 40, 20, 20 and 20% added at 14, 28, 48, 56 DAS). Thus, the total numbers of treatments were conducted in 30 plots.

**Fertilizers used and agricultural practices:** Ammonium nitrate (33.5% N), super phosphate (15.5% $P_2O_5$) and potassium sulphate (48% $K_2O$) fertilizers, were used as sources for N, P and K, respectively. The agricultural practices and irrigation were done according to the recommendations of the Ministry of Agriculture for corn plant. However, irrigations were attained after soil moisture dose not drop below 70% from field capacity of soil during the growing seasons.

**Plant Sampling:** After 75 days from sowing (DAS), total chlorophyll (SPAD value) of the fourth maize leaf from the plant top was determined and fresh and dry weight of the leaf was determined. Also, N, P: K contents were determined in the digested plant material. The samples of leaves materials were subjected to clean by a cotton peace wetted by distilled water and dried in a forced-air oven at 70 $^{o}C$ tell constant the weight. The oven-dried leaves were ground and stored for chemical analysis (N, P and K).

At harvest, whole plants of each experimental unit were harvested to estimate 100 grain weight, cob yield, grain yield and straw yield $fed^{-1}$. Also, N, P, K contents in grains of corn was estimated.

**Statistical analysis:** Data of the present study were statistically analyzed and the differences between the means of the treatments were considered significantly when they were more than least significant differences (LSD) at the confidence level of 5% using CoStat (Version 6.303, CoHort, USA, 1998–2004).

**Methods of analysis**

**Soil analysis:** The electrical conductivity of the soil paste extract was measured by EC meter according to the method of Richard (1954), soil reaction (pH) was measured in 1:2.5 soil-water suspension as described by Jackson (1967), mechanical analysis was determined following the international pipette method of Dewis and Fertias (1970) , using $NH_4OH$ as a dispersing agent, calcium carbonate was determined using Collin's calcemeter method (Piper, 1950), organic matter content was determined using walkely's rapid titration method (Jackson, 1967). Soil available nitrogen was extracted using KCl (2.0 M) and determined by using macro-Kjeldahl method according to Hesse (1971). Soil available phosphorus was extracted with $NaHCO_3$ (0.5 M) at pH 8.5 and determined colorimetrically after treating with ammonium molybdate and stannous chloride at a wavelength of 660 nm, according to Jackson (1967). Available potassium was determined by extracting soil with ammonium acetate (1.0 M) at pH 7.0 using a flame photometer as described by Hesse (1971).

**Plant analysis:** Total nitrogen was determined by micro-Kjeldahl method as explained by Hesse (1971). Total phosphorus was determined colorimetrically at wavelength 680 nm using spectrophotometer (Spekol) as described by Cottenie *et al*., (1982). Total potassium was determined by using Gallen Kamp flame photometer as mentioned by Cottenie *et al*. (1982). Total chlorophyll in leaves was measured using Minolta SPAD chlorophyll-meter (Yadava, 1986).

## RESULTS AND DISCUSSION

### Maize plant growth:

### Fresh and dry weight of ear leaf:

Data on fresh and dry weight of ear leaf are presented in Table 2. The fresh and dry weight of ear leaf was influenced by the treatments in both seasons. Different levels and time of N application exhibited significant differences in fresh and dry weight. At treatment (120 kg N per ha in four splits as 40, 20, 20 and 20% after 14, 28, 48, 56 DAS) accounted for significantly higher fresh weight of ear leaf (22.20, 22.79 g) and dry weight (6.77, 6.91 g) in both seasons.

**Table 2: Effect of nitrogen fertilizer rates and splitting on maize plant growth**

| Splitting | N rates | F.W Ear leaf (g) | | D.W Ear leaf (g) | | Chlorophyll | |
|---|---|---|---|---|---|---|---|
| | | 1st season | 2nd season | 1st season | 2nd season | 1st season | 2nd season |
| 2 doses | 30 | 12.77 | 13.00 | 3.87 | 3.94 | 40.76 | 41.48 |
| | 60 | 15.00 | 15.33 | 4.55 | 4.65 | 47.88 | 48.91 |
| | 90 | 17.34 | 17.67 | 5.26 | 5.36 | 55.32 | 56.38 |
| | 120 | 20.85 | 21.37 | 6.34 | 6.48 | 66.68 | 68.20 |
| | 150 | 19.42 | 19.59 | 5.89 | 5.94 | 61.95 | 62.51 |
| 4 doses | 30 | 13.62 | 13.86 | 4.13 | 4.20 | 43.46 | 44.22 |
| | 60 | 16.00 | 16.34 | 4.85 | 4.96 | 51.05 | 52.15 |
| | 90 | 18.48 | 18.84 | 5.61 | 5.71 | 58.98 | 60.11 |
| | 120 | 22.20 | 22.79 | 6.77 | 6.91 | 71.22 | 72.71 |
| | 150 | 20.70 | 20.89 | 6.28 | 6.34 | 66.05 | 66.64 |
| LSD 5% | | **1.83** | **1.54** | **0.43** | **0.51** | **3.21** | **3.67** |

The next best treatment was (120 kg N fed$^{-1}$ in two doses as 50 and 50% after 14 and 48 DAS) (20.85, 21.37g) for fresh weight and (6.34, 6.48 g) for dry weight in both seasons, respectively. The least fresh and dry weight of ear leaf recorded in treatment (30 kg N fed$^{-1}$ either with two or four splits).

**Chlorophyll:**

Data pertaining to chlorophyll (SPAD) in leaf are presented in Table 2. Among the levels and time of N application, treatment 120 kg N per ha in four doses as 40, 20, 20 and 20% after 14, 28, 48, 56 DAS recorded significantly higher values of chlorophyll (71.22, 72.71) in 1$^{st}$ and 2$^{nd}$ seasons, respectively, followed by treatment (120 kg N fed$^{-1}$ in two doses as 50 and 50% after 14 and 48 DAS) which recorded (66.68, 68.20) in both season, respectively, over other treatments including N fertilizer rate 150 kg N fed$^{-1}$ either with splitting to 2 or 4 doses. However, the lowest values of chlorophyll (40.76, 41.48 and 43.46, 44.22) were recorded in treatment of 30 kg N fed$^{-1}$ in two and four doses in both seasons, respectively.

The data of corn plant growth may be related to that splitting of N fertilizer applications is an important factor affecting the efficiency of fertilizer N because of the interval between application and crop uptake determines the length of exposure of fertilizer N to loss processes such as leaching and denitrification. Timing N applications to reduce the chance of N losses through these processes can increase the efficiency of fertilizer N use. Vetsch and Randall (2004) found a significant difference in N recovery: 87% for spring N application compared with only 45% when N was applied in fall. Relative leaf chlorophyll measurements taken at different growth stages were not significantly different for fall and spring applied N.

**Maize yield and yield components:**

**100 grain weight:**

Data on 100 grain weight recorded at different rates, and splitting of N fertilizer in both seasons are presented in Table 3. 100 grain weight increased with increasing the rate of N fertilizer up to 120 kg N fed$^{-1}$ and there after it showed decreasing trend.

It is found from Table 3 that treatment of120 kg N fed$^{-1}$ in four doses as 40, 20, 20 and 20% added after 14, 28, 48, 56 DAS gave the values of 43.74, 44.75 g and treatment of 120 kg N fed$^{-1}$ in two doses as 50 and 50% added after 14 and 48 DAS gave the values of 41.05, 41.97 g which recorded the higher values of 100 grain weight. The least 100 grain weight (25.08, 25.52 and 26.75, 27.22 g) recorded in treatment of 30 kg N fed$^{-1}$ in two and four doses in both seasons, respectively.

**Grain yield:**

The values of grain yield as influenced by different levels and time of N application are shown in Table 3. Nitrogen application in different levels and doses produced significant variation in grain yield at different seasons.

Among the levels and time of N application, treatment (120 kg N fed$^{-1}$ in four doses as 40, 20, 20 and 20% added after 14, 28, 48, 56 DAS) recorded (4.63, 4.72 ton fed$^{-1}$) and treatment of 120 kg N fed$^{-1}$ in two doses as 50 and 50% added after 14 and 48 DAS accounted for significantly higher grain yield recorded (4.34, 4.43 ton fed$^{-1}$) in both seasons, respectively over the rest of treatments. The lowest grain yield (2.65, 2.69 and 2.82, 2.87 ton fed$^{-1}$) was recorded in treatment (30 kg N fed$^{-1}$ in two and four doses) as compared to other treatments.

**Straw yield:**

The straw yield as influenced by different levels and time of N application are presented in Table 3. Straw yield significantly influenced by the treatments in both seasons.

Significantly higher straw yield (6.63, 6.77 and 7.06, 7.20 ton fed$^{-1}$) was recorded in treatment (150 kg N per fed in two doses as 50 and 50% added after 14 and 48 DAS) and treatment (150 kg N fed$^{-1}$ in four doses as 40, 20, 20 and 20% added after 14, 28, 48, 56 DAS) than other treatments. However, it was on par with other treatments. Treatment (30 kg N fed$^{-1}$ in two and four doses in both seasons) recorded lowest straw yield (4.05, 4.12 and 4.30, 4.38 ton fed$^{-1}$).

**Table 3: Effect of nitrogen fertilizer rates and splitting on maize yield and yield components**

| Splitting | N rate | 100 grain W. (g) | | Grain yield ton fed$^{-1}$ | | Straw yield ton fed$^{-1}$ | |
|---|---|---|---|---|---|---|---|
| | | 1st Season | 2nd season | 1st season | 2nd season | 1st season | 2nd season |
| 2 doses | 30 | 25.08 | 25.52 | 2.65 | 2.69 | 4.05 | 4.12 |
| | 60 | 29.46 | 30.10 | 3.11 | 3.18 | 4.75 | 4.86 |
| | 90 | 34.04 | 34.69 | 3.59 | 3.66 | 5.49 | 5.60 |
| | 120 | 41.05 | 41.97 | 4.34 | 4.43 | 6.63 | 6.77 |
| | 150 | 38.12 | 38.46 | 4.02 | 4.06 | 6.15 | 6.21 |
| 4 doses | 30 | 26.75 | 27.22 | 2.82 | 2.87 | 4.30 | 4.38 |
| | 60 | 31.42 | 32.10 | 3.31 | 3.38 | 5.06 | 5.16 |
| | 90 | 36.30 | 37.00 | 3.83 | 3.90 | 5.84 | 5.95 |
| | 120 | 43.74 | 44.75 | 4.63 | 4.72 | 7.06 | 7.20 |
| | 150 | 40.66 | 41.02 | 4.29 | 4.32 | 6.54 | 6.60 |
| LSD 5% | | 2.43 | 2.21 | 0.53 | 0.57 | 0.04 | 0.03 |

As it was predicted, increasing nitrogen application levels increased grain and straw yield in both seasons, These results could be substantiated with those obtained by (Pawel *et al*., 2011). Grain yield was significantly affected by the nitrogen level. The grain yield increased as nitrogen level increased up to 100Kg N ha$^{-1}$. this was in agreement with results reported by Bundy and Carter (1988). According to kamprath *et al*., (1982) the increase in maize grain yield after N application is largely due to an increase in the number of ears per plant, increase in total dry matter distribution to the grain and increase in average ear weight. The increase in number of grains per cob with increased fertilizer application could be attributed to the increased physiological processes in crop plants leading to higher growth and increased photosynthates to silks. This might be due to better utilization of NPK supply (Selvaraju and Iruthayaraj,1994). The increase in yield and its components as well as quality due to nitrogen fertilization may be due to its role in activation of cells division, metabolic and photosynthesis processes and nutritive status of corn plant. Similar results were reported by Atta Allah and Mohammed (2003). The increased in grain yield was probably to the more number of rows per ear, number of grains per row and 1000 grain weight etc. These results are supported by the findings of Jayakunar *et al*., (2008) and Oguzor (2007). Increase yields with N application agree with Idikut *et al*., (2009); however, the maximum yield in their study was obtained at 250 kg N $ha^{-1}$ when compared to treatments with 125 kg N $ha^{-1}$. Some researchers have reported that corn yield increased with split or sidedress N applications (Gehl *et al*., 2005; and Viswakumar *et al*., 2008).

**Maize chemical composition:**

**NPK % in maize leaves:**

Data on nitrogen, phosphorus and potassium concentration in maize ear leaves as influenced by different levels, splitting and time of N application are presented in Table 4.

**Table 4: Effect of nitrogen fertilizer rates and splitting on chemical composition (NPK%) of maize ear leaves**

| Splitting | N rate | N% | | P% | | K% | |
|---|---|---|---|---|---|---|---|
| | | 1st season | 2nd season | 1st season | 2nd season | 1st season | 2nd season |
| 2 doses | 30 | 2.01 | 2.07 | 0.21 | 0.20 | 1.76 | 1.78 |
| | 60 | 2.40 | 2.42 | 0.27 | 0.26 | 2.23 | 2.25 |
| | 90 | 2.79 | 2.81 | 0.31 | 0.30 | 2.65 | 2.69 |
| | 120 | 3.39 | 3.42 | 0.41 | 0.40 | 3.38 | 3.46 |
| | 150 | 3.10 | 3.12 | 0.36 | 0.36 | 3.03 | 3.07 |
| 4 doses | 30 | 2.24 | 2.27 | 0.23 | 0.24 | 1.92 | 1.95 |
| | 60 | 2.59 | 2.64 | 0.29 | 0.29 | 2.40 | 2.45 |
| | 90 | 2.91 | 2.93 | 0.34 | 0.34 | 2.87 | 2.88 |
| | 120 | 3.27 | 3.32 | 0.39 | 0.39 | 3.32 | 3.35 |
| | 150 | 3.57 | 3.60 | 0.44 | 0.44 | 3.77 | 3.82 |
| LSD 5% | | 0.31 | 0.33 | 0.011 | 0.012 | 0.21 | 0.23 |

Significantly higher nitrogen concentration (3.57, 3.60%), phosphorus concentration (0.44, 0.44%) and potassium concentration (3.77, 3.82%) in leaves were observed in treatment (150 kg N $fed^{-1}$ in four doses as 40, 20, 20 and 20% added after 14, 28, 48, 56 DAS) compared to the rest of treatments. However, it was on par with (120 kg N $fed^{-1}$ in four doses as 40, 20, 20 and 20% added after 14, 28, 48, 56 DAS) which resulted in N% (3.27, 3.32 %), P% (0.39, 0.39%) and K% (3.32, 3.35%) followed by treatment (120 kg N $fed^{-1}$ in two doses as 50 and 50% added after 14 and 48 DAS) which resulted in N% (3.39, 3.42%), P% (0.41, 0.40 %) and K% (3.38, 3.46%). However, treatment (30 kg N $fed^{-1}$ in two and four doses in both seasons) recorded lowest N, P and K% in maize leaves.

These results may be due to the role of nitrogen in stimulating the build of amino acids and growth hormones. This in turn into positively in cell division and enlargement also, nitrogen fertilizer may promote change in mineral composition of plant, (Mengel and Kirkby, 1982).

**NPK% in maize grains:**

It is obvious from the data showed in Table 5 that treatment (150 kg N fed$^{-1}$ in four doses as 40, 20, 20 and 20% added after 14, 28, 48, 56 DAS) accounted for significantly higher nitrogen concentration (2.15, 2.18 %), phosphorus concentration (0.36, 0.36 %) and potassium concentration (1.13, 1.14 %) in maize grain. However, it was on par with (120 kg N fed$^{-1}$ in four doses as 40, 20, 20 and 20% applied after 14, 28, 48, 56 DAS). The lowest nitrogen concentration (2.01, 2.05 %), phosphorus concentration (0.33, 0.34 %) and potassium concentration (1.02, 1.03%) in corn grain recorded in treatment (30 kg N fed$^{-1}$ in two doses in both seasons).

Plant N use efficiency can be improved by matching application rate and timing with plant demands (Ferguson *et al*., 2002). Russelle *et al*., (1983) showed that corn N uptake is affected by time of fertilizer application.

**Table 5: Effect of nitrogen fertilizer rates and splitting on chemical composition (NPK%) of maize grain**

| Splitting | N rate | N% | | P% | | K% | |
|---|---|---|---|---|---|---|---|
| | | 1st season | 2nd season | 1st season | 2nd season | 1st season | 2nd season |
| 2 doses | **30** | 1.23 | 1.25 | 0.17 | 0.17 | 0.52 | 0.53 |
| | **60** | 1.44 | 1.47 | 0.21 | 0.21 | 0.66 | 0.67 |
| | **90** | 1.66 | 1.69 | 0.25 | 0.26 | 0.79 | 0.79 |
| | **120** | 2.01 | 2.05 | 0.33 | 0.34 | 1.02 | 1.03 |
| | **150** | 1.86 | 1.88 | 0.29 | 0.30 | 0.90 | 0.91 |
| 4 doses | **30** | 1.33 | 1.35 | 0.19 | 0.19 | 0.58 | 0.57 |
| | **60** | 1.54 | 1.57 | 0.23 | 0.23 | 0.71 | 0.72 |
| | **90** | 1.74 | 1.77 | 0.27 | 0.27 | 0.85 | 0.87 |
| | **120** | 1.95 | 1.97 | 0.31 | 0.31 | 0.99 | 0.99 |
| | **150** | 2.15 | 2.18 | 0.36 | 0.36 | 1.13 | 1.14 |
| **LSD 5%** | | **0.21** | **0.22** | **0.02** | **0.03** | **0.05** | **0.04** |

**Conclusion and recommendation**

Split application of nitrogen (N) is a management strategy for corn that has been practiced on a limited basis for years. Because a greater portion of the N is applied closer to the time of maximum N uptake, split application strategies are often considered as being more efficient and environmentally sound. Additionally, as the price of N increases.

Under the same conditions of the experiment, it can be recommended to add the nitrogen fertilizer at (120 kg N fed$^{-1}$ in four doses as 40, 20, 20 and 20% applied after 14, 28, 48, 56 DAS), which gave the best result of quantity and quality of the maize cultivated on sandy clay loam reclaimed soil.

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# استجابة الذرة إلى معدلات وجرعات إضافة التسميد النيتروجيني في تربة رملية طينية طميية

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أجريت تجربتان حقليتان بمزرعة خاصة بمدينة الصالحية، محافظة الشرقية خلال الموسمين الشتويين 2006-2007 و 2007-2008 لدراسة تأثير معدلات إضافة السماد النيتروجيني وتأثير تقسيم هذه المعدلات وتوقيت إضافتها على نبات الذرة بأرض مستصلحة.

نظمت عشرة معاملات في تصميم قطع منشقة مع ثلاث مكررات، التي تكونت من خمسة معاملات نيتروجين (30، 60، 90، 120 و 150 كجم / فدان) كل معاملة قسمت إما إلى (جرعتين متساوية 50 و 50 ٪ والتي أضيفت بعد 14 و 48 يوم من الزراعة أو أربع جرعات 40، 20، 20 و 20 ٪ والتي أضيفت بعد 14، 28، 48، 56 يوم من الزراعة).

**أوضحت النتائج الآتي:**

لوحظ أن قياسات النمو لنباتات الذرة زادت تدريجيا مع زيادة معدلات السماد النيتروجيني وقد لوحظ أعلى معدلات لقياسات النمو (الوزن الطازج والجاف لأوراق الكوز) والكلوروفيل مع إضافة 120 كجم ن / فدان سواء مع تقسيمها إلى جرعتين أو أربع جرعات مع تفوق تقسيم المعاملة إلى أربع جرعات.

لوحظ أعلى زيادة في وزن الـ 100 حبة ومحصول القش والحبوب مع زيادة معدل التسميد النيتروجيني إلى 120 كجم ن / فدان وكانت أفضل المعاملات هي (120 كجم نيتروجين للفدان في أربعة جرعات هي 40، 20، 20 و 20 ٪ والتي أضيفت بعد 14، 28، 48، 56 يوم من الزراعة).

وقد لوحظ اختلاف كبير في تركيز كل من النيتروجين والفوسفور والبوتاسيوم في أوراق و حبوب الذرة ، بسبب زيادة معدلات الإضافة وطريقة تقسيم الجرعات وميعاد إضافتها. حيث لوحظ أن أعلى قيم لتركيز النيتروجين والفوسفور والبوتاسيوم لوحظت عند إضافة النيتروجين بمعدل 150 كجم نيتروجين / فدان مع تقسيمه إلى 4 جرعات يليه عند إضافته بمعدل 120 كجم ن / فدان مع تقسيمه إلى جرعتين.

تحت نفس ظروف التجربة، يمكن أن يوصى بإضافة السماد النيتروجيني بمعدل (120 كجم نيتروجين للفدان في أربعة جرعات هي 40، 20، 20 و 20 ٪ تضاف عند 14، 28، 48، 56 يوم من الزراعة)، الذي أعطى أفضل نتيجة لكمية ونوعية الذرة المزروعة في تربة طينية طميية.

**قام بتحكيم البحث**

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