Estimation of productivity in some of maize cultivars under the influence of different level of nitrogen

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Abstract

A field experiment was carried out in the fields of the College of Agricultural Engineering Sciences - University of Baghdad during the fall season of 2021, with the aim of knowing which cultivated varieties are more tolerant of a decrease or increase in nitrogen fertilization of the yellow corn crop. The main plots included nitrogen levels and secondary cultivars with three replications and using three cultivars (Baghdad, 5018, Sarah) and adding three levels of nitrogen fertilizer, which are N1 (100 kg.N/ha^{-1}), N2 (200 kg.N/ha^{-1}) and N3 (300 kg.N/ha^{-1}). The results of the statistical analysis are showed the superiority of the cultivar (Sarah) in the characteristic of leaf area and chlorophyll index, as its averages were (6756.6 cm^2) and (590.27 mg. m^2), respectively. There were no significant differences between the cultivars in grain yield and nitrogen utilization efficiency. The two cultivars (5018) and (Sarah) superior in the characteristic of plant height, as they gave an average of (197 cm). In addition to , the results of the statistical analysis are showed that the nitrogen level N3 was superior in the plant height, leaf area, chlorophyll icontent , and grain yield, as its averages were (207 cm, 7268.8 cm 2, 690.72 mg m 2, 14880 kg ha^{-1}), respectively, while the nitrogen level N1 was superior in the nitrogen use efficiency. It gave an average of (91.5).

-key words: maize , Nitrogen , productivity

Introduction

Maize is one of the most widespread cereals in the world and has great importance as human food, animal feed and raw materials for industrial products, including edible oil. In most developing countries, about 50% to 55% of the total maize production is consumed as food (Arun Kunar et al., 2007 ; Khaliq et al,2008). Providing nutrients in an appropriate amount is always necessary to improve the)growth and development of maize. However, productivity and quality parameters are greatly affected by insufficient plant nutrients (NPK). Low maize production is due to many limitations, such as nitogen , potassium , phosphor (Witt et al., 2008). Nitrogen is play a vital role in protoplasm ,protiens ,nucleic acids ,chlorophyll molecule in plant cell to inctresing of crop growth rate (CGR) . The increasing of nitrogen quantity will be increase of ATP , NADPH and antioxidant enzymes : superoxide dismutase (SOD), catalase (CAT), perioxdase (pox), glutathione peroxidase (GPX),glutathione reductase (GR) (Abed et al,2018). The increasing of enzyme activity in cells will be increasing of biochemical pathways and lead to increase of plant height, stem thickness, leaf area, dry matter accumulation, chlorophyll content, and productivity per hectare (Cheema et al., 2010 ; Jessup et al ,2020). Almodares et al. (2009) showed that biomass and crude protein increase with increasing nitrogen content in photosynthesis enzymes of cereal crop (Luque ,2006 ; Abed et al,2018). The nitrogen supplied in eduate quantity will be expandied of leaves with improving of photosynthetic apparatus to do the varieties (species and subspecies (Al-Behadili and Abed ,2019) reached into yield potential (Nduwimana et al. 2020; Jat et al., 2013). Nitrogen is one of the essential mineral nutrients for plant growth, and the high level of nitrogen leads to the rapid development of leaf area and to the prolongation of the leave age and also increased the leaf area after flowering with enhances the final yield

production (Khaliq et al., 2008;Thakur et al., 2015).

Materials and methods

A field experiment was carried out during the fall season of 2021 in the field of experiments - College of Agricultural Engineering Sciences - University of Baghdad, to study the effect of nitrogen fertilization on the growth and yield of some maize . The nfield was plowed in the plow at 7/15/2021, and soil samples were taken for analysis (available N in the soil= 1.9%, total nitrogen=29 mg/kg of soil , soil pH=7.14 and EC=5.4 dsm^{-1}) . The field is divided into experimental units (3×9 m). Three varieties of maize were used (Baghdad, 5018, Sarah) according to the RCBD split plot design. The main plots were nitrogen levels (N1=100, N2=200 ,N3=300 Kg .h-1) and the subplots were cultivars. The grains are sown by plant density (53.333 thousand of plants per hector).

Plant height (cm):

The average height of five plants of each cultivar was measured in each experimental unit, from the soil to node of flag leaf.

Leaf area (cm^2):

It was measured according to the equation: the square of the length of the leaf under the ear × 0.75 (El- Sahookie , 1985).

Chlorophyll index (mg. m2):

The chlorophyll content was measured by the SPAD device for the leaves of the ear of five plants randomly from each experimental unit and according to the chlorophyll index according to the following equation:

Ch= - (80.05)+(10.40×SPAD reading) ……(Monje و Bugbee ،1992).

Grain yield ($kg.h^{-1}$): It was determined by the average yield of five plants and then converted to $kg.h^{-1}$.

Nitrogen Use Efficiency(NUE):

It was calculated by dividing the grain dry weight by the quantity of nitrogen(Moll et al., 1988) et al.)

Results and discussion

Plant height(cm)

Plant height is one of the important characteristics that play an important role in increasing-of yield due to elongation of meristematic tissues for plant growth, and their auxin content (Shahid et al., 2016). The results of table (1) showed that there were significant differences between the cultivated cultivars in the plant height characteristic, as the cultivar (5018) and Sara gave the highest plant (197 cm) compared to the cultivar (Baghdad), which gave an average of (193 cm). It is noted that there is a significant effect of the levels of nitrogen fertilization on the characteristic of plant height, as the level of nitrogen fertilization N3 gave the highest height of (207 cm) compared to the nitrogen fertilization N1, which gave (184.0 cm). Increasing the level of nitrogen increases the activity of cytokinins as well as strigolactones that act on hormonal regulation and inhibit secondary branches, thus triggering an increase in meristematic cell division (Dun et al., 2009). and (Bevaridge and kyozzuka, 2010). There was a significant effect of the interaction between cultivars and nitrogen levels, as the cultivar (Baghdad and 5018 at the level of nitrogen fertilization N3 gave the highest rate of (210 cm) compared to the cultivar (Sarah) at the level of nitrogen fertilization N1, which gave the lowest rate of (183 cm). Increasing nitrogen fertilization increases plant height, because the nitrogen element is included in the composition of the plant cell protoplast and chlorophyll molecule, as well as enhancing enzymatic activity in the cell, which encourages cell division and expansion, which leads to an increase in their size, which causes an increase in plant height ((Bubert , 2014)

Table (1): Effect of nitrogen fertilization levels and the intraction between of them on the plant height (cm) of cultivars in maize for season 2021

Cultivars	Nitrogen level			Mean Cultivars
	N1	N2	N3	
Baghdad	184	196	210	193
5018	185	195	210	197
Sarah	183	197	201	197
L.S.D 0.05	2.2			1.4
Mean N	184	196	207	
L.S.D 0.05	1.2			

Leaf area (cm^2):

Leaf area is an important trait to the yield of maize ,because of it is resposible of light capture and synthesis metabolites (Richards et al., 2002; Jessup et al,2020). The results of table (2) showed that there were significant differences between cultivars in the characteristic of leaf area, as the cultivar (Sara) gave the highest leaf area about (6756.6 cm^2), compared to the cultivar (Baghdad) which is gave the lowest value (6291.1 cm^2). The difference in the leaf area of the different genotypes is attributed to the cultivar of the nitrogen uptake efficiency of each cultivar , as well as to the low nitrogen tolerance ratio (Azeez, 2009). There was a significant effect of nitrogen levels on the leaf area characteristic, the N3 level gave the highest value of the leaf area n (7268.8 cm 2), compared to the level of nitrogen fertilization N1, which gave the lowest value of (5626.1 cm^2). The increase of leaf area because of the level of nitrogen that which is plays an important role during the growth phase of the maizesuch as cell division activity and cell size (cellular expansion) (Gruzska et al., 2016; Abed et al,2018) and (Seadh et al., 2013) and (Abebe and feyisa, 2017). It is noted that there is a significant effect of the between cultivar and nitrogen levels, if the cultivar (Sarah) at the level of nitrogen fertilization N3 gave the highest value of leaf area amounting to (7726.4 cm^2), compared to cultivar (5018) at of N1 nitrogen level , as it gave the lowest value of (5428.2 cm^2) . The Increasing the level of nitrogen supplied caused the activity of the meristematic tissue, the development of leaf growth, cell division and expansion of leaf (Valadabadi and Farahani, 2010; Al-Temimi and Abed,2016).

Chlorophyll content (mg. m^2):

The results of table (3) showed that there were significant differences between the cultivars in the characteristic of chlorophyll index, as cultivar (Sara) gave the highest rate of (590.27) mg. m 2 ,compared to the cultivar (5018) which is gave the lowest rate of (555.09) mg. m 2. This may be due to a variation of the NADP Malic enzyme (pathway) closely associated with increased stay green, which increases the number of chlorophyll molecules formed in maize (Naidu et al., 2003;). The results of Table (3) indicated that there was a significant effect of nitrogen fertilization levels on the characteristic of chlorophyll content , as N3level of nitrogen gave the highest rate of chlorophyll content amounted to (690.72) mg .m 2 , compared to the level of nitrogen N1, which is gave the lowest rate of (469.02) mg .m 2because of the increasing of N molecule

in chlorophyll pigment , the fact that the nitrogen is the largest element of the chlorophyll molecule of chloroplast (Guo et al., 2006; Al-Behadili and Abed,2019). The results of table (3) showed that there is a significant interaction between cultivars and levels of nitrogen fertilization, as the cultivar (Sara) at the fertilizer level N3 gave the highest rate in the chlorophyll content , reaching (719.88) mg. m2, compared with the cultivar (Baghdad), at the N1 level, which is gave (454.37) mg. m2. The increasing of chlorophyll content because of nitrogen leaf concentration , (Lucas et al., 2019) and (Elos et al. 2016; Abed et al,2018).

Table (2): The effect of nitrogen fertilization levels and intraction of them on the leaf area((cm^2) of maize cultivars in the season 2021

Cultivars	Nitrogen level ((kg. ha^{-1})			Mean Cultivars
	N1	N2	N3	
Baghdad	5534.1	6378.7	6960.4	6291.1
5018	5428.2	6444.2	7119.5	6330.6
Sarah	5915.9	6627.4	7726.4	6756.6
L.S.D 0.05	315.08			190.58
Mean N	5626.1	6483.4	7268.8	
L.S.D 0.05	227.76			

Table (3): The effect of nitrogen fertilization levels and the interaction between of them on the chlorophyll content(mg.m^2) of maize cultivars in season 2021.

Cultivars	Nitrogen level (kg. ha^{-1})			Mean Cultivars
	N1	N2	N3	
Baghdad	454.37	578.76	708.96	580.70
5018	468.10	553.87	643.30	555.09
Sarah	484.60	566.34	719.88	590.27
L.S.D 0.05	41.023			23.955
Mean N	469.02	566.32	690.72	
L.S.D 0.05	31.600			

Grain yield (kg. ha^{-1})

The results of table (4) indicated that there were significant differences between the levels of nitrogen fertilization for the yield trait, as the nitrogen level N3 gave the highest value amounting to (14880 kg ha^{-1}) compared to the level N1 that gave the lowest value for the trait amounted to (9150 kg ha^{-1}). The reason behind the increase in the plant yield with the increase in the level of nitrogen fertilization is due to the plant's ability to use nitrogen with high

efficiency during the stages of growth and formation of the components of the crop, and that the increase in plant yield is associated with the highest absorbed nitrogen and the highest ability to benefit from this element and its representation in the plant to produce a higher yield (Luque et al. 2006). The results of table (4) also showed that there is a significant effect of the interaction between the cultivars and the levels of nitrogen fertilization, as the cultivar (5018) at the level of nitrogen fertilization N3 gave the highest value for the trait amounted to (15530 kg.ha^{-1}) compared to the same variety at the level of nitrogen fertilization 1N, which gave the lowest value For the recipe, it amounted to (8900 kg .ha^{-1}). This increase is explained by the fact that the high nitrogen level helped to increase the dry matter during the plant growth stages (Al-Mehemdi and Abed,2016 ; Dhoot et al., 2017).

Table (4): The effect of nitrogen fertilization levels and the intraction of them on grain yield(kg.ha^{-1})of maize cultivar in season 2021.

Cultivars	Nitrogen level (kg. ha^{-}			Mean Cultivars
	N1	N2	N3	
Baghdad	9070	12700	14350	12040
5018	8900	12890	15530	12440
Sarah	9490	12710	14750	12316
L.S.D 0.05	1.095			n.s
Mean N	9150	12770	14880	
L.S.D 0.05	6.94			

Nitrogen Use Efficiency (NUE)

The results of table (5) indicated that there were significant differences between the nitrogen levels, as the fertilizer level N1 gave the highest rate for the trait amounted to (91.5) compared to the high fertilizer level N3, which gave the lowest rate for the trait amounted to (49.6), because of the nitrogen plays a respectable role in photosynthesis and whole part of chlorophyll molecule . The chlorophyll molecule acts as photosynthetic machinery in cell of plants and convert light energy into chemical energy , and the nitrogen use efficiency will be increasing with N concentration in the soil (Chakwizira et al., 2016). Several studies confirmed the existence of an inverse relationship between increasing the level of nitrogen fertilizer addition and use efficiency, which is mainly due to the variation in the amount absorbed due to the increase in nitrogen levels. Less than the variation of supplied of nitrogen quantity (Haile et al., 2012).

Table 5: The effect of nitrogen fertilization levels and the intraction between of them on the nitrogen use efficiency of maize cultivars in the season 2021.

Cultivars	Nitrogen level ((kg. ha^{-1})			Mean Cultivars
	N1	N2	N3	
Baghdad	90.7	63.5	47.8	67.3
5018	89	64.45	51.7	68.4
Sarah	94.9	63.5	49.1	69.2
L.S.D 0.05	10.95			n.s
Mean N	91.5	63.8	49.6	
L.S.D 0.05	6.94			

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