

Effect of Different Nitrogen and Weeding Levels on Vegetative Growth of Five Cultivars of Corn (*Zea mays* L.)

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Abstract Field experiments were conducted in the Demonstration Farm of Mohammed Osman Salih (Blue Nile North of Gezira state / ElBagair area) for the two consecutive seasons (summer 2007 /2008 and 2008 /2009) to study the effect of different Nitrogen and Weeding Levels on Vegetative growth of Five Cultivars of *Zea mays*. The treatments used consisted of three levels of nitrogen control (N0) , 86 kg N/ha (N1), 129 kg N/ha (N2), two levels of weeding non-weed control (W0) , weeding (W1) and five cultivars, open pollinated Giza-2 (V1) , Var113 (V2), Hudiba-1 (V3) and Hybrid cultivars, Hycorn-90 (V4) and Hycorn-675 (V5). The 30 factorial treatments were executed in randomized complete block design, with four replications. The results obtained showed that nitrogen fertilizer had a significant effect on growth of maize cultivars, particularly plant height, leaves number and dry weight of plant. The results from these experiments showed that hybrid cultivars maize efficiently utilized nitrogen without weeding better than the open cultivars except Giza-2. The results obtained showed negligible differences between the two seasons for vegetative growth. This justifies growing maize in summer with 129 kg/ha nitrogen and good cultivation.

Keyword Cultivar, Growth, Nitrogen, Weeding

1. Introduction

Maize (*Zea mays* L.) or Corn, is the most important cereal crop in sub-Saharan Africa and with rice and wheat, comprise the three most important cereal crops in the world. Maize is high yielding, easy to process, readily digested. It is also a versatile crop, growing across a range of agroecological zone. Every part of maize plant has economic value: the grain, leaves, stalk, tassel, and cob can all be used to produce a large variety of food and non-food products. In industrialized countries, maize is largely used as livestock

feed and as a raw material for industrial products, while in developing countries it is mainly used for human consumption. In sub-Saharan Africa, maize is a staple food for 50% of the population. It is important source of carbohydrate, protein, vitamin B, and minerals. Green maize (fresh on the cob) is eaten boiled, playing an important role in filling the hunger gap (CIMMYT, 1994 and USDA, 2009). Maize (*Zea mays* L.) is grown on approximately 140 million hectares (M/ha) worldwide: 97 M/ha in developing countries, 34 M/ha in the high income countries, and 9 M/ha in the Eastern Europe and the former Soviet Union (<http://www.c.1994>). Maize is a staple food for several hundred million people in the developing world. The average inhabitant of Eastern and Southern Africa consumes about 80 kg of maize each year; while in Mexico, Central America, and the Caribbean he consumes about 170 kg. Annual per capita maize utilization averages 100kg in East Asia and more than 190 kg in the southern cone of South America, largely as animal feed in both cases. Unfortunately, developing countries do not produce enough maize to meet their needs and must therefore import approximately 30 million tons of maize annually. Use of improved cultivars and management practices should help increase maize yield and reduce imports in developing countries. (<http://www.c.2009>). Maize or corn as a world Crop is grown in various countries. The crop is widely used as a food crop in many parts of the world especially in the tropical and subtropical countries. Maize is rich in starch (carbohydrates) with an average of about 70%, but low in protein (about 9.5%). The oil is concentrated mainly in the germ with an average of 4% of kernel weight. The composition of other components of the kernel is 1.4% sugars, 2.3 crude fiber and 1.4% ash. Maize seed enters also in livestock feeds, and in other industrial purposes as in the case of glucose, starch and edible oil industries. One of the causes of low production could be attributed to high infestation of weeds. Because of acute shortage of labor and frequent monsoon rain during the early growth period of maize, hand weeding or mechanical

weeding operations are usually delayed or left altogether. In such situations, herbicides offer the most practical, effective and economical method of weed control and increase crop yield. Weeds are one of the most important factors in maize production. They cause significantly yield losses worldwide with an average of 12.8% despite weed control application and 29.2% in case of no weed control (Oerke and Steiner, 1996). Therefore, weed control is an important management practice for maize production and should be carried out to ensure optimum grain yield. Weed control in maize is carried out by mechanical and/ or chemical methods. Weed between plants rows are removed generally by mechanical cultivation. While weeds on the rows are controlled by hand hoeing or by herbicides, and both methods are effective in controlling weeds. In Sudan, Maize utilization as a human food for making bread was limited, where most of the produce is consumed as roasted kernels or in mixing with wheat to make bread. The environmental conditions in the Sudan are generally favorable for maize production. Old statistics showed that the crop used to be produced in various ecological zones (Arab, O. 2006 and AOAD, 1986). The main objective of this research is to study the effects of the nitrogen and weeding on vegetative growth of a number of maize genotypes and to select the best cultivar for the prevailing conditions.

2. Materials and Methods

The experiment was conducted for two consecutive summer seasons of 2007/2008 and 2008/2009. they were conducted in the farms of Osman Salih ElBagir area (North of Gezira state. Sudan) latitude 15-22N and longitude 32-46 E. on sandy clay loam soil. The seeds consisted of open-pollinated cultivars (Geza-2, Hudeiba-1 and var-113) and hybrid cultivars (Hycorn-90 and Hycorn-675). The experiment was factorial in a randomized complete block design, with four replications. The treatments consisted of the five cultivars of maize (V1 = Geza-2, V2 = var-113, V3 = Hudiba -1, V4 = Hycorn-90, V5 = Hycorn-675). The three levels of nitrogen are:- N0 = (control) with no nitrogen, N1 (86kg N/ha), N2 (129 kg N/ha); and the two levels of weed are : W0 (control) with no weed, W1 = weeding. Measurements of growth attributes were taken approximately every two weeks, starting 30 days from sowing-from each plot, six plants were selected at random from the two inner ridges and after leaving one meter at each end of the plot. The selected plants were tagged and the observations were made on them. The plant height was measured at 30, 45 and 60 days from sowing in each subplot. The measurements were made from the base of the youngest leaf to the top of the young leaf. Then the mean plant height was recorded for each plot. The six plants used for the measurement of plant height were also used for the count of number of leaves per plant where the average numbers of leaves were recorded. The six plants of each plot were cut at 120 days from sowing and sun-dried then weighed and the

average dry weight per plant was recorded. The six plants of each plot were cut at 120 days from sowing and sun-dried then weighed and the average dry weight per plant was recorded. Data collected from the different treatment were subjected to analysis of variance (ANOVA) appropriate for randomized complete block design (Gomez and Gomez, 1984). The means were separated using the least significant difference (LSD) and Duncan Multiple Range Test (DMRT).

3. Results

From the analysis of variance (table 1,2), after 30 days it was clear that there were significant ($P= 0.01$) differences in number of leaves per plant between the levels of nitrogen and also between the two levels of weed. The differences between the cultivars and all interaction were not significant in the first and second seasons. After 45 days, it was clear that there were significant ($P= 0.01$) differences in number of leaves per plant between the different levels of nitrogen. The application of 86 kg N/ha gave 25%, 8% significantly higher number of leaves over control respectively, whereas the application of 129 kg N/ha increased the number of leaves over control by 42%. On the other hand, there were no significant differences in the leaf number between the application of 86 and 129 kg N/ha. Also, in the first one there were significant differences between cultivars, where cultivar Giza-2, HyCorn90 and HyCorn-675 gave significantly higher leaf Number per plant than the cultivars var-113 and Hudiba-1, which were not significantly different from each other. The difference between the two weeding treatments was significant. While in the second season there were significant differences between the cultivars, where Hycorn 90 gave significantly higher leaf number per plant than the cultivars Giza-2, var-113, Hudiba-1 and Hycorn 675, which were not significantly different from each other. The difference between the two levels of weeding was significant and weeding gave 20% higher leaf number over control which were not significantly different from each other. On the other hand the interaction of all treatment levels had significant effect. After 60 days, completely different pattern in the application of 86 kg N/ha which gave 29%, 27% significantly higher leaf number over the control, whereas the application of 129kg N/ha increased the number of leaves over the control by 36%, 40% respectively. On the other hand, there were significant differences in leaf number per plant between the application of 86 and 129kg N/ha. In the first season there was significant effect of cultivars, and weeding on interaction number of leaves but in the second there was no significant differences. From the statistical analysis (table 1,2), after 30 days it was clear that there were significant differences in plant height between the levels of nitrogen. The application of 86kg N/ha gave 21%, 17% significantly greater plant height over control, whereas the application of 129 kg N/ha increased plant height over control by 29%, 37% respectively. There were significant differences between cultivars, where HyCorn-675 and

var-113 gave significantly higher plants than the cultivars Giza-2, Hudiba -1 and HyCorn -90, which were also significantly different from each other in the first season but in the second, Hycorn -675 gave significantly higher plants than other cultivars. The effect of weeding on plant height was significant. Also, effect of interaction was significant in the all . After 45 days, There were significant differences in plant height between the levels of nitrogen .The application of 86 kg N/ha gave 7%,5% significantly greater plant height over control, whereas the application of 129 kg N/ha increased the plant height over the control by 26%, 13% respectively. On the other hand, in the first one there were no significant differences in plant height between the application of 86 kg N/ha and 129 kg N/ha, and found significant difference in the second. First season, there were significant differences between cultivars, where the cultivars HyCorn-90 and HyCorn -675 gave significantly greater plant height than cultivars Giza-2, var-113 and Hudiba-1, which were significantly different from each other. Also, in the second there were significant differences between cultivars, where Giza-2 gave higher plant than other, which were no significantly different from each other The differences between the levels of weed were highly significant. After 60 days there were significant differences in plant height between the levels of nitrogen. The application of 86 kg N/ha gave 19%,6% significantly higher plants over control, where the application of 129 kg N/ha increased the plant height over the control by 37%,19% respectively. On the other hand, there were significant differences in plant height between the application of 86 kg N/ha and 129 kg N/ha. There were significant differences between cultivars, where cultivars HyCorn-675 gave significantly greater plant height per plant than the cultivars Giza-2, var-113, Hudiba-1 and HyCorn-90, which were not significantly different from each other in both seasons. The differences between the two levels of weeding were significant . Interaction of treatments was also significant.

Analysis of variance(table1,2) show clear significant ($P=0.01$) differences in dry weight between the levels of nitrogen. The application of 86 kg N/ha gave 20%,26% significantly higher dry weight over control, whereas the application of 129 kg N/ha increased the dry weight per plant over the control by 27%, 30% respectively. Also, in the two season there were significant ($P=0.01$) differences between cultivars, where cultivar HyCorn-90 gave significantly higher dry weight than the cultivars Giza-2, var.113, Hudiba-1 and Hycorn-675, which were significantly different from each other. The interaction between treatments and weeding were also significant.

4. Discussions

The present study showed that nitrogen had significant effect on number of leaves per plant and plant height. Both N1 and N2 gave significant increase in plant growth in comparison to the control (N0). From the result obtained for both season it was clear that all vegetative growth parameters increased with increasing levels of nitrogen. Also cultivars showed significant differences in the plant height. In this connection , Turkhede and Jajendra (1978); Mock and Henghin (1976); Peter et al. (1988); Hattab et al. (1980) and Omara (1989) reported similar result on the effects of nitrogen on plant height, where they attributed the result to the fact that nitrogen promotes plant growth. With regards to the number of leaves per plant, Reddy and Hussein (1969); Waston (1952) and Zahir et al. (2007); Arshed et al. (1994); Zahir et al. (2000) found similar result. Also it was reported by Yanusa et al. (1991) that taller cultivars gave greater number of leaves than the dwarf cultivars, which agree with our results where Giza-2 and Hycorn-675 gave taller plants, but Giza-2 and Hycorn -90 gave greater number of leaves. Weed control resulted in significantly higher leaf number and plant height in both seasons than the unweeded control. Similar results were obtained by Kumar (1973); Knezevic et al. (2002); (Rajcan and Swanton, 2001) and Rubin (1996). Also Rai (1965) reported that weed control resulted greater number of leaves when weeds were reduced at different growth stages. This has been also reported for other crops such as potato and maize (Eghtedari Naeini, 1996) ; Javanbakht and Hesar, 1996). Emergence time of weeds influences the critical period for weed control (Zimdahl, 1987; Weaver et al., 1992; Mesbah et al., 1994; Ghadiri, 1996). In this study, maize growth was not significant with nitrogen fertilizer, non-weeding and the interaction in both seasons. Similar results were obtained by Thomas and Allison (1975); Marais (1985); Twomlow et al. (1997). Steel et al. (1997); Akobundu (1987) and Shumb (1988) who showed that the interaction effects of weed distance from the maize row on maize development and grain yield was not significantly affected by the time of weed removal. Weeding had significant effect on dry weight and in general weed control gave higher dry weight in both seasons. This result is confirmed by Teton-Kagho and Gardner (1988). Nitrogen application generally increased dry weight/plant and the increase reached significant levels at later stages of growth in both seasons. Such effects could be attributed to enhancement of vegetative growth and dry weight production by nitrogen. The interaction of N with weeding had significant effect on dry weight (at early stages at over 60 days from sowing) in the second season. It is well known that the combined effect of nitrogen and weeding is greater than individual effect of each treatment by itself.

Table 1. F-value of the measured variables for interaction of cultivar weeding and fertilizer treatment 2007/08 season

Source of variation	d.f.	No. of leaves at 30 days	No. of leaves at 45 days	No. of leaves at 60 days	Plant height at 30 days (cm)	Plant height at 45 days (cm)	Plant height at 60 days (cm)	Dry weight per plant (gm)
Variety (V)	4	4.73*	16.70**	48.32**	24.80**	152.50**	23.90*	36.28**
Nitrogen (N)	2	155.25**	192.00**	348.70**	566.60**	2314.12**	308.03**	656.70**
Weeding (W)	1	40.91**	301.45**	213.41**	520.30**	354.80**	3553.70**	117.60**
VXN	8	4.29*	0.58NS	1.56NS	13.41**	110.50**	4.75NS	117.62**
VXW	4	6.28**	0.81**	4.94*	24.57**	18.57**	8.59*	27.89*
NXW	2	1.09*	8.02*	6.99*	5.22*	13.60*	4.30NS	20.84*
VXNXW	8	3.59NS	4.32**	6.56**	12.00*	11.14*	3.34NS	98.44**
MS Error	-	1.19	0.90	1.09	2.47	5.90	29.26	43.93
SE (+-)	-	0.32	0.27	0.30	0.45	0.70	1.56	1.91
LSD	-	0.62	0.52	0.69	0.99	0.15	3.44	4.20
CV (%)	-	4.20%	2.10%	0.60%	0.70%	0.60%	7.50%	0.70%

NS = not significant

*Significant (5%)

**Highly significant (1%)

Table 2. F-value of the measured variables for interaction of cultivars weeding and fertilizer treatments 2008 / 09 season

Source of variation	d.f.	No. of leaves at 30 days	No. of leaves at 45 days	No. of leaves at 60 days	Plant height at 30 days (cm)	Plant height at 45 days (cm)	Plant height at 60 days (cm)	Dry weight per plant (gm)
Variety (V)	4	21.33*	28.42**	87.54**	250.20**	744.80*	877.40**	25.22*
Nitrogen (N)	2	174.22**	574.10**	494.80**	2557.40**	655.02**	3266.02**	49.12*
Weeding (W)	1	126.08**	240.83**	418.13**	1620.70**	5880.00**	6134.70**	80.03**
VXN	8	21.62*	17.18*	33.30*	128.76**	114.56**	337.56**	6.38*
VXW	4	14.47*	14.75*	14.12*	165.62**	1203.80**	375.50**	10.21*
NXW	2	6.65*	14.87*	62.06**	154.20**	1.25NS	33.45*	2.11NS
VXNXW	8	14.18*	28.05**	31.93*	167.63**	82.17*	485.50**	19.88*
MS Error	-	1.19	1.19	0.96	21.36	3.57	89.85	2.34
SE (+-)	-	0.32	0.32	0.28	1.02	0.55	2.74	0.44
LSD	-	0.68	0.64	0.62	0.80	1.12	5.99	0.96
CV (%)	-	18.00%	21.20%	17.70%	17.40%	14.10%	19.70%	36.40%

NS = not significant

*Significant (5%)

**Highly significant (1%)

5. Conclusions

In this study, N application to maize tended to improve vegetative growth. The response to N increased as level of N applied increased. Thus it is feasible to recommend N application to maize under similar conditions. This suggests, as mentioned earlier, that maize crop in this area can successfully be grown in the summer season in Northern, Gezira and similar areas in Sudan. The weed control used in this study failed to bring out clear differences in growth of maize. More weeding during crop growth is required in order to determine the optimum weed control for maize. The experiment was conducted during summer in both seasons. Further studies are needed to compare summer growing with winter growing. The results from these experiments showed that hybrid maize (Hycorn-90 and Hycorn-675) efficiently utilized nitrogen better than the open pollinated (Hudiba-1 and Var-113) with the exception of Giza-2.

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