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# EFFECT OF CLIPPING DATE AND PLANT DENSITY ON SOME TRAITS OF FOUR *SORGHUM BICOLOR* L. VARIETIES

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## Abstract

A field experiment was conducted at the Agriculture Research and Experimental Station, the College of Agriculture, Al-Muthanna University during the autumn agricultural season 2018. The experiment included the study of three factors, the first factor, which included three clipping dates (booting, Head beginning and end-flowering stages), the second factor included two distances for agriculture (10 cm and 20 cm), the third factor includes four varieties (Bohoth 70, Inkath, Hymax and Cravy Grass). The experiment was applied using the Randomized Complete Block *Design* (RCBD), divided according to Split-Split-plot design with three replicates. The clipping phases occupied the main plots, the distances between plants, the sub-plots and the sub-plots, with three replications. The results showed the significant superiority of the Head beginning phase in stem diameter, branches and leaves number in the first and second clipped, the end-flowering stage outperformed the first clipped in plant height, the plant height was significantly higher in the distance of 10 cm, as for the varieties, the variety of Gravy Grass was superior in plant height, branches and leaves number for the second and third clipped, while Bohoth 70 variety exceeded in the leaves number and plant height and Hymax variety in the stem diameter in the first clipped.

***Key words:*** clipping date, plant density, plant traits, *Sorghum bicolor* L. varieties.

## Introduction

*Sorghum bicolor* L. follows the Poceae family, ranking fifth among cereal crops after wheat, barley, rice and maize. (D.A.S., 2016), the global area planted with white maize is about 44.442 million hectares, a total world production is about 463.63 million. Metric tons, with a productivity rate of about 1.428 tons$^{h-1}$, Africa occupies the first place in the world in cultivated area, then the continent of Asia and America, in the Arab world, Sudan occupies the first place for growing white maize, followed by Egypt and Yemen, in Iraq, the area planted with white maize crop is estimated at about 34038 hectares (C.S.O.I.T., 2007). White maize grains are used in human and animal nutrition, in poor countries, it is used as food for humans when mixed with wheat flour by 50%, in developed countries such as the United States of America, about 90% of its grains were used in human food industries such as starch, because they contain high nutrients, where the proportion of protein is estimated at about 10-12%, fat 3% and carbohydrates 70% (Rana *et al*., 2013). In addition, it is introduced as a feedstock in the poultry feed for high protein content, which is 12% (Willson, 2011). Perhaps its importance in Iraq is that it is tolerant of harsh conditions such as drought, soil salinity and high temperatures, especially in the southern region (Al-Taher *et al*., 2012). There is a wide gap between the amount of green fodder produced in Iraq and the needs of livestock, this shortage is mainly due to the lack of areas planted with forage crops, especially summer crops, overall, the total area planted with fodder crops in Iraq does not exceed 2% of the total arable land (Alk, 2001). In addition to the high prices of feed with the decline of pasture areas due to drought, which made livestock in Iraq suffer from lack of green fodder, white maize crop can provide a large amount of cheap green food feed during the summer months, the clipping stages are factors affecting the green fodder yield of the white maize crop (Rehman *et al*., 2003). Agricultural distance also affects the yield of sorghum feed (Al-Rawi, 2005). The selection of varieties that respond to the environmental conditions and agricultural processes for the production of green fodder for the sorghum crop must be characterized by specifications different from those used for seed production. Therefore, this experiment aims to know the potential of varieties of sorghum and determine the optimal plant density to produce feed at different stages of plant life.

**Table 1:** Some physical and chemical properties of soil before planting*.

| Properties | Unit | Value |
|---|---|---|
| Electrical Conductivity (EC) | $ds.m^{-1}$ | 4.2 |
| pH | | 7.84 |
| Available nitrogen | Mg. $kg^{-1}$ | 22.76 |
| Available phosphorus | | 10.98 |
| Available potassium | | 127.49 |
| Organic Matter | g/ $kg^{-1}$ | 9.63 |
| Total salts | g/ $L^{-1}$ | 3.5 |
| **Soil types** | | |
| Clay soil | g/ $kg^{-1}$ | 389.00 |
| Sandy soil | | 128.00 |
| Silt soil | | 483.00 |
| Soil Texture | Silt Clay mixed | |

* Analysis was carried out in Soil Science Department Laboratory, Agriculture College, Al-Muthanna University.

## Materials and Methods

### Location and treatments of experiment

A field experiment was conducted at the Agriculture Research and Experimental Station, the College of Agriculture, Al-Muthanna University during the autumn agricultural season 2018. The experiment included the study of three factors, the first factor, which included three clipping dates (booting, Head beginning and end-flowering stages), the second factor included two distances for agriculture (10 cm and 20 cm), the third factor includes four varieties (Bohoth 70, Inkath, Hymax and Cravy Grass).

### Soil analysis

Random samples were taken from different places of the experiment field, (0-30 cm) soil layers, from different locations. Chemical and physical before performing the experiment (Table 1).

### Field operations

The land of experiment 2 plowed perpendicular tillage with mulching plow, the harrowing and leveling process was then carried out, the field is divided into experimental units of 3 × 2, each experimental unit contained 3 lines, a distance of 75 cm from one line to another, the experiment land was planted manually on the 1st of August on 1/8/2018, put 3 seeds in one hole, in the lower third of the line, thinned to only two plants per hole after 20 days of planting after the process of thinning to one plant a week after the first thinned. Phosphate fertilizer was added at a rate of 100 kg/ $h^{-1}$ in the form of triple superphosphate fertilizer when planting (Jadou, 1995). Nitrogen fertilizer was added by 250 kg/$h^{-1}$ in three batches. The first batch was added two weeks after planting (Hamdan, 2006). Granular diazinon (10% active ingredient) was used to control *Sesamia critica* L. sorghum borer (6 kg/$h^{-1}$) in twice, the experiment land was watered throughout the growing season and whenever needed, the replanting was done two weeks after planting on 28/9/2018, weeding was also carried out to eliminate the bush.

### The traits studied

Ten plants were taken from the midline and according to the following traits and for each cutting stage, branches number per plant (branch/ $plant^{-1}$), leaves number per plant (leaf/ $plant^{-1}$), plant height (cm) and stem diameter (mm).

### Statistical analysis

The experiment was applied using the Randomized Complete Block *Design* (RCBD), divided according to Split-Spplit-plot design with three replicates. The clipping

**Table 2:** Effect of Clipping Phase, Planting Distance and Varieties on Branches Number of Plant (Branch.$Plant^{-1}$).

| Clipping date | Distances (cm) | Varieties | | | | Clip.×Dis. mean |
|---|---|---|---|---|---|---|
| | | Bohoth 70 | Inkath | Hymax | Cravy Grass | |
| booting | 10 | 2.17 | 2.37 | 5.27 | 5.83 | 3.91 |
| | 20 | 3.40 | 2.07 | 3.63 | 6.50 | 3.90 |
| Head beginning | 10 | 2.07 | 3.23 | 8.30 | 6.57 | 5.04 |
| | 20 | 2.97 | 3.50 | 6.40 | 10.87 | 5.93 |
| end-flowering | 10 | 0.20 | 0.00 | 1.70 | 11.13 | 3.26 |
| | 20 | 1.53 | 2.90 | 0.00 | 14.30 | 4.68 |
| **Varieties mean** | | 2.06 | 2.34 | 2.56 | 9.20 | **Dis. mean** |
| Dis.×Var. mean | 10 | 1.48 | 1.87 | 5.09 | 7.84 | 4.07 |
| | 20 | 2.63 | 2.82 | 3.34 | 10.56 | 4.84 |
| Clip×Var.mean | booting | 2.78 | 2.22 | 4.45 | 6.17 | 3.90 |
| | Head beginning | 2.52 | 3.37 | 7.35 | 8.72 | 5.49 |
| | end-flowering | 0.87 | 1.45 | 0.85 | 12.72 | 3.47 |
| $L.S.D_{0.05}$ | Clip. 0.88 | | Var. 0.83 | | Dis. 0.72 | |
| | Clip.×Dis. 1.07 | | Dis.×Var 1.18 | | Clip×Var. 1.40 | |
| | Clip.×Dis.×Var. 2.00 | | | | | |

phases occupied the main plots, the distances between plants, the sub-plots and the sub-plots, with three replications. The data were analyzed statistically using the Genstat statistical program, the least significant difference test (L.S.D) was used to compare the mean averages of the coefficients at the level 0.05 (Al-Rawi and Khalaf Allah, 1980).

## Results and Discussions

**Branches number per plant (branch/plant$^{-1}$)**

The results of table 2, showed a distance exceeding 20 cm for the branches number in the three clippes by giving them the highest averages of 1.99, 4.84 and 3.78 branches.plant$^{-1}$ respectively, the distance of 10 cm gave the lowest averages of 1.34, 0.07 and 3.19 branches. Plants$^{-1}$ respectively, may be due to the fact that the increased distance between plants has led to the expansion and spread of roots and the lack of competition between plants, increase plant efficiency in water absorption and nutrients, improve the efficiency of photosynthesis in the vegetative parts thus increasing the number of branches of the plant (Hassan, 2010).

The superiority of the combination (Head beginning phase × the variety Crave Grass) was also observed in the first and third clippes, the combination (end-flowering stage × variety of Crave Grass) in the second loop gave the highest averages of 3.98, 19.22 and 12.72 branches/ Leaf$^{-1}$ in comparison with the rest of the combinations, while the synthesis (booting phase × Bohoth 70) was recorded in the first clipp and the combination (end-flowering phase × hymax class) was recorded in the second clipp, while the combinations (end-flowering stage × all varieties), (Head beginning stage × Bohoth 70, Hymax and Inkath) and the (booting phase × Bohoth 70 and Inkath) in the third clipp gave the lowest averages of 0.00, 0.85 and 0.00 branches/Plant$^{-1}$ respectively.

**Leaves number per plant (leaf/ plant$^{-1}$)**

Table 3, showed the distance exceeded 20 cm for the number of leaves in the three clippes by giving the highest averages of 14.36, 29.22 and 14.01 Leaves/ Plant$^{-1}$ respectively, the distance was 10 cm and the three clippes had the lowest averages of 14.00, 22.85 and 13.97 Leaves/ Plant$^{-1}$ respectively, the increase in the number of leaves per plant may be due to an increase in the number of branches per plant (Table 2), this finding was consistent with Al-Dulaimi and Al-Nimrawi, (2014), the number of leaves increases with the distance between plants.

The results showed that the distance of 20 cm × Bohoth 70 exceeded the first clippes, the distance 20 cm × Cravy Grass for the second and third clippes which gave the highest averages as 17.02, 6.10 and 45.76 Leaves/ Plant$^{-1}$ respectively, while the distance (20 cm × Cravi Grass) was recorded in the first, (the distance 10 cm × Inkath) in the second and third clippes, (distance 20 cm × rescue) for the third clippes, that amounted to 11.86 and 12.51 and 0.00 Leaves/ Plant$^{-1}$, respectively.

**Plant height (cm)**

Table 4, showed a distance exceeding 10 cm in the first clipp, 20 cm in the second and third clipp of the height of the plant, which gave averages of 152.9, 87.4 and 23.05 cm, respectively, while the distance was 20 cm in the first and the distance 10 cm for the second and third clipp, lowest averages of 137.6, 77.0 and 21.99 cm, respectively. The reason the distance of 10 cm in the first bush to the limited distance available to the plant and

**Table 3:** Effect of Clipping Phase, Planting Distance and Varieties on Leaves Number of Plant (Leaves.Plant $^{-1}$).

| Clipping date | Distances (cm) | Varieties | | | | Clip.×Dis. mean |
|---|---|---|---|---|---|---|
| | | Bohoth 70 | Inkath | Hymax | Cravy Grass | |
| booting | 10 | 16.53 | 14.63 | 34.50 | 35.50 | 25.29 |
| | 20 | 22.00 | 11.13 | 30.67 | 34.93 | 24.68 |
| Head beginning | 10 | 17.20 | 22.90 | 31.10 | 44.13 | 28.83 |
| | 20 | 22.37 | 22.63 | 30.70 | 72.43 | 37.03 |
| end-flowering | 10 | 4.90 | 0.00 | 2.87 | 49.97 | 14.43 |
| | 20 | 11.50 | 16.30 | 0.00 | 75.93 | 25.93 |
| **Varieties mean** | | 15.75 | 14.60 | 21.64 | 52.15 | **Dis. mean** |
| Dis.×Var. mean | 10 | 12.88 | 12.51 | 22.82 | 43.20 | 22.85 |
| | 20 | 18.62 | 16.69 | 20.46 | 61.10 | 29.22 |
| Clip×Var.mean | booting | 19.27 | 12.88 | 32.58 | 35.22 | 24.99 |
| | Head beginning | 19.78 | 22.77 | 30.90 | 58.28 | 32.93 |
| | end-flowering | 8.20 | 8.15 | 1.43 | 62.95 | 20.18 |
| $L.S.D_{0.05}$ | Clip. 4.79 | | Var. 3.46 | | Dis. 3.87 | |
| | Clip.×Dis. 5.79 | | Dis.×Var 5.36 | | Clip×Var. 6.34 | |
| | Clip.×Dis.×Var. 9.00 | | | | | |

**Table 4:** Effect of Clipping Phase, Planting Distance and Varieties on plant height (cm).

| Clipping date | Distances (cm) | Varieties | | | | Clip.×Dis. mean |
|---|---|---|---|---|---|---|
| | | Bohoth 70 | Inkath | Hymax | Cravy Grass | |
| booting | 10 | 180.3 | 71.8 | 68.1 | 128.2 | 112.1 |
| | 20 | 111.6 | 77.1 | 70.5 | 86.0 | 86.3 |
| Head beginning | 10 | 238.0 | 132.3 | 142.7 | 156.2 | 167.3 |
| | 20 | 219.7 | 120.5 | 142.3 | 146.8 | 157.3 |
| end-flowering | 10 | 235.2 | 124.3 | 183.0 | 174.7 | 179.3 |
| | 20 | 219.4 | 128.1 | 181.2 | 174.7 | 169.1 |
| **Varieties mean** | | 200.7 | 109.0 | 131.3 | 139.9 | **Dis. mean** |
| Dis.×Var. mean | 10 | 217.8 | 109.5 | 131.3 | 153.0 | 152.9 |
| | 20 | 183.6 | 108.5 | 131.4 | 126.8 | 137.6 |
| Clip×Var.mean | booting | 145.9 | 74.4 | 69.3 | 107.1 | 99.2 |
| | Head beginning | 228.8 | 126.4 | 142.5 | 151.5 | 162.3 |
| | end-flowering | 227.3 | 126.2 | 182.1 | 161.2 | 174.2 |
| $L.S.D_{0.05}$ | Clip. 16.37 | | Var. 12.55 | | Dis. 20.79 | |
| | Clip.×Dis. 27.03 | | Dis.×Var 23.97 | | Clip×Var. 22.50 | |
| | Clip.×Dis.×Var. 36.16 | | | | | |

the occurrence of misleading, which prompted the plant towards increasing altitude in search of light. As for the superiority of the distance 20 cm in the second and third sorts can be attributed to the increase in the number of lateral branches after the mowing due to high plant density, which leads to misleading pushes the plant towards increasing rates of elevation in search of light (Bisht *et al*., 2012).

The superiority of the (Head beginning × Bohoth 70) was observed for the first and second clippes, (Head beginning × Cravy Grass), which gave the highest averages of 228.8, 126.0 and 75.53 cm, respectively. While (booting × Hymax) and (end-flowering × Inkath) were recorded in the second mole while the third mole had the lowest plant height (69.3, 39.4 and 0.00 cm, respectively).

**Stem diameter (mm)**

Table 5, show a distance of 20 cm for the first and second clippes and the distance of 10 cm in the third ring, which averaged 22.33, 11.79 and 2.46 mm respectively. While the distance of 10 cm for the first and second clippes, 20 cm distance for the third clipp recorded the lowest averages of 21.07, 9.67 and 2.59 mm respectively. The reason may exceed the distance of 20 cm in the first and second clippes to the size allocated to the plant area, which means a good absorption of water and nutrients and then grow well reflected on the increase in stem diameter. The reason for exceeding the distance of 10

**Table 5:** Effect of Clipping Phase, Planting Distance and Varieties on stem diameter (mm).

| Clipping date | Distances (cm) | Varieties | | | | Clip.×Dis. mean |
|---|---|---|---|---|---|---|
| | | Bohoth 70 | Inkath | Hymax | Cravy Grass | |
| booting | 10 | 11.00 | 9.21 | 12.12 | 10.71 | 10.76 |
| | 20 | 11.97 | 14.51 | 14.19 | 12.13 | 13.20 |
| Head beginning | 10 | 10.92 | 13.67 | 14.33 | 10.92 | 12.46 |
| | 20 | 11.28 | 13.97 | 15.61 | 10.15 | 12.75 |
| end-flowering | 10 | 4.82 | 0.00 | 5.28 | 13.01 | 5.78 |
| | 20 | 12.96 | 14.75 | 0.00 | 9.91 | 9.41 |
| **Varieties mean** | | 10.49 | 11.02 | 10.26 | 11.14 | **Dis. mean** |
| Dis.×Var. mean | 10 | 8.91 | 7.63 | 10.58 | 11.55 | 9.69 |
| | 20 | 12.07 | 14.41 | 9.94 | 10.73 | 11.79 |
| Clip×Var.mean | booting | 11.48 | 11.86 | 13.15 | 11.42 | 11.98 |
| | Head beginning | 11.10 | 13.82 | 14.97 | 10.53 | 12.61 |
| | end-flowering | 8.89 | 7.38 | 2.64 | 11.46 | 7.59 |
| $L.S.D_{0.05}$ | Clip. 2.11 | | Var. 1.52 | | Dis. 2.66 | |
| | Clip.×Dis. 3.46 | | Dis.×Var 3.01 | | Clip×Var. 2.79 | |
| | Clip.×Dis.×Var. 4.51 | | | | | |

cm in the third clipp may be due to the frequency of the mow has weakened the cultivated plants from the distance of 20 cm and the attrition of plants as a result of good growth of plants during the first and second marshes (Abdullah *et al*., 2010). Output (Head beginning × Hymax) for the first and second clippes, (Head beginning × Hymax) in the second clipp and (Head beginning × Cravy Grass) for the third clipp, which gave the highest averages of 25.03, 14.97 and 8.29 mm respectively. While the (booting × Cravy Grass) in the first and the (end-flowering × Haymax) in the second clippes recorded the lowest averages of 18.14, 2.64 and 0.00 mm, respectively.

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