EFFECT OF NITROGEN AND SEED RATES ON GROWTH AND YIELD OF FORAGE SORGHUM (*Sorghum bicolor* L *Moench* cv. *Abusabien*)

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ABSTRACT:

A field experiment was conducted to study the effect of nitrogen and seed rates on growth and yield of forage sorghum (*Sorghum bicolor* L *Moench* cv. *Abusabien*) at of Sudan University of Science and Technology, Shambat, Sudan during 2004-05 and 2005-06. The experiment was laid out in randomized complete block design with three replications. There were three seed rates viz. 20 kg/fed (S1), 40 kg/fed (S2) and 60 kg/fed (S3) and two levels of nitrogen 0 kg/fad (N0) and 80 kg/fad (N1). The observations including plant height, number of leaves and leaves area index were recorded periodically at 15 days interval (three cuttings), and then plant population, fresh and dry weight were also obtained for two seasons.

The results showed that increasing doses of nitrogen increased all growth attributed but there were no variation due to seed rate. On the other hand the results revealed significant differences for second cutting and third cutting of first and second seasons respectively for plant height and leaves area index. The number of leaves showed significant differences in the second cutting in the first season only. The results also indicated that there were significant differences for plant population, dry weight for two season but for fresh weight the significant difference was appeared only in the first season only, and also the variation is due to nitrogen nor seed rate.

KEY WORDS: Nitrogen, Seed rate, Growth, Yield and Forage sorghum.
INTRODUCTION

Forage production and consumption in the Sudan is increasing overtime due to the increasing rate of livestock population (140 millions heads) (Ministry of Animals Resources 2007) and the diminishing amount of fodder produced naturally due to the expansion of rain-fed agriculture on the expenses of range land. According to a recent survey conducted by Khair and Salih (2007), the annual forage crops produced in Sudan were estimated at 971 thousand tons of dry matter, which was produced from a cultivated area of 121 thousand hectare. The main forage crops produced in the country was Abusabien (Sorghum bicolor L. Moench cv.) constituting about 43% of the total annual yield and occupying an area 70 thousand hectares. No wonder, if known that, forage sorghum can be produced in all types of soils as it's tolerant to salinity and alkalinity. Other important forage crops in descending orders were alfa alfa and lubia occupying an area of 38 thousand and 13 thousand hectares respectively. Abusabien is the Arabic name of (Sorghum bicolor L. Moench cv.)
bicolor L. Moench cv.) which comes from the periods the crop takes till reach its maturity (70 or sabien) days (Kambal, 2003). Kambal (2003) also reported that, the name Abusabien is used for sorghum grain in the Rubatab and Alyab areas of the northern Sudan.

Taking in mind that, nitrogen is the most limiting nutrient for sorghum forage production on a global basis (Foth and Ellis, 1988), and the improper cultural practices (sowing method, irrigation intervals and nitrogen fertilization properly) used by many farmers in the country, forage sorghum was not reach it s required amount of production both quality and quantity wise. Recent studies were focused on improving sorghum forage quantity and quality. Therefore, the objectives of this study were to investigate the effect of different seed rates and doses of nitrogen on performance of sorghum forage.

MATERIALS AND METHODS
The study was conducted at the Demonstrated Farm, College of Agricultural Studies, Sudan University of Science and Technology, Sudan, Shambat for two consecutive seasons (2004/05 and 2005/06). The study area lies in the central Sudan (latitude 15o 40’ N longitude 32o 32’ E and latitude 230 m asl). The soil of the experimental site is clay (fine montmorillonitic, isohyperthermicentric chromustert), with alkaline pH. The climate of the locality is tropical semi-arid with mean annual rainfall of 100 to 200 mm and maximum temperature of about 42°C in summer and low temperature of 21°C in winter. Three levels of seed rate 20kg/fed (S1), 40 kg/fed (S2) and 60 kg/fed (S3) and two levels of nitrogen 0 kg/fed (N0) and 80 kg/fed (N1) were used in the experiment. Urea (46% N) was applied in the experiment as a source of nitrogen. Urea banded on the side of the ridge and sowing at 5 cm depth. The area of experiment were divided into 18 plots (6x5 meters each), each plot consisted of five ridges 70 cm a part and 6 meter long. The crop was seeded during the last week of October in both seasons by banding the seeds on one side of ridges. The first irrigation was given immediately after sowing and then the crop was watered every 12-14 days. Two hand weeding were carried out during the experiments. After a month from sowing date, plants in an area of 0.7 m2 in each plot were counted to determine plant height in (cm). Leaf area index was measured 15, 45 and 60 days from
sowing. Ten leaves were taken randomly the length (L) and weigh (w) were measured and the leaf area was taken in cm and calculated as follows:

\[ \text{Leaf area} = L \times w \times 0.74 \]

Stem diameter was measured at 45 and 60 days from sowing on the five tagged plants. A vernier was used to measure stem diameter in (cm). Numbers of leaves were also determined. At maturity, plants in an area of 1 meter in the centre of each plot were cut and weighted. The fresh weight was then air-dried to determine the dry weight. The experiment was carried out using a randomized complete block design RCBD with three replications. Data were statistically analyzed according to SAS.

RESULTS AND DISSICUTION

In general all treatments, plant height, stem diameter, and leaves area index increased progressively with advancement of growth. Increasing doses of nitrogen increased all growth attributed. The effect of different doses of nitrogen and seed rates on plant height for two seasons for each three cutting were presented in Fig 1a, 1b, 2a, 2b, 3a, and 3b.

Plant height fig 1a and 1b the results revealed significant difference at (P=0.01) in second reading of the first season and third cutting of second season, and there was no significant difference in the other readings. As a general application of nitrogen in two seasons for three reading increased the plant height.

The increased in the plant height due to nitrogen fertilizer may caused by increase in number of nodes or inter nodes elongation or both. Similar result were reported by Abuswar and Mohammed (1997) and Eltelib (2004).

The effect of nitrogen fertilization and seed rate on the number of leaf was showed in Fig 2a and 2b. The number of leaves in all cutting showed no significant different among treatments, while highly significant difference was observed in the second cutting in the first season. On the other hand, in the second season there was slight increase in number of leaves as a result of application of nitrogen but this difference was not significant. In conclusion, the study revealed that the number of leaves per plant increased due to nitrogen fertilization. This results were in agreement with Abuswar and
Mohmmed(1997). Also Abuswar (1981) found that no significant difference was manifested in leaf number as a result of seed rate. Mustafa and Abdemaged (1982) conducted that addition of nitrogen has little effect on number of leaves per plant.

The effect of nitrogen and seed rate on leaf area for two seasons showed in Fig 3a and 3b. In both seasons the leaf area had significant difference in the second and third cutting, but over all means of results showed higher leaf area index for all cuttings as a result of nitrogen application, but there were no variation due to seed rate.

The leaf area index increased due to the fact that nitrogen enhance protein synthesis and consequently vegetative growth which resulted in increasing of photosynthetic surface and stimulated of further growth, the above result was on confirmed by Eltelib(2004).
Legends: S = Seed rate for different doses, N = Nitrogen different doses, C = for three cutting

For each parameters, treatment means followed by a common letter don't differ significantly at P=0.05

Fig 1 a: The effect of nitrogen application and seed rate on the plant height of Sorghum fodder 2004/05
Fig 1b: The effect of nitrogen application and seed rate on the plant height of Sorghum fodder 2005/06.
Fig 2 a: The effect of nitrogen Fertilization and Seed rate on the number of leaves of Sorghum fodder 2004/05).
Fig 2 b: The effect of nitrogen application and Seed rate on the number of leaves of sorghum fodder 2005/06.
Fig 3 a: The effect of nitrogen application and Seed rate on leaf area index Sorghum fodder 2004/05
The effect of seed rate and nitrogen fertilization on plant population, fresh and dry weight of fodder sorghum was presented in (Table 1). The effect of nitrogen and seed rate on the plant population showed highly significant difference for two seasons. For 2004-05 season, S2N1 and S3N1 gave higher values (144.3 and 141.0 respectively. Were in 2005-06 season, S1N1 and S2N1 resulted in higher values 164.3 and 112.8 respectively. These results revealed
that application of nitrogen greater plant population, and there were no clear
evidence due to seed rate and interaction of nitrogen and seed rates. This
finding was in agree with Abuswar and Mohammed (1997) who reported that
nitrogen fertilization had significant effect on plant density and number of
green leaves of fodder sorghum. Plant density is an important factor in forage
production as it influences both fodder quality and quantity special in cereal
forage. Bebawi, (1987) found that tiller density of abusabien has significant
effect on harvesting. On the other hand Bebawi (1987) revealed that nitrogen
application had no effect on plant population

The effect of nitrogen application and seed rate on fresh weight of fodder
sorghum showed significant differences in the two seasons. However, the
dry weight showed highly significant difference at the first season only. In
general the fresh and dry weight increased with application of nitrogen. For
fresh weight the results revealed that S2N1 and S3N1 were gave greater
values (13.9 and 13.2) respectively in the first season. However, in second
season S1N1 and S2N1 were the greatest records (8.5 and 7.9 respectively).
For the dry weight the result in Table 1, showed significant difference in the
first season only. S2N1 and S3N1 give higher records (5.3 and 5.9
respectively. In the second season there were slight increased in all nitrogen
application treatments (S1N1, S2N1 and S3N1) Also the results showed
there were no effect due seed rate and the interaction of nitrogen and seeds
rate. Application of urea increased the fresh and dry weight of abusabien, and
this results was in agreement with Khair and Salih, (2007) and Eltelib(2004).
While, Bebawi, (1987) studied the effect of sowing pattern and seed rate on
the yield of sorghum and found that the yield were greater when traditionally
sown at 35kg seed/ ha. Khair (1999) reported that sorghum bicolar increased
in yield with increase of plant population from 8-15 plants/m². Khair(1999)
found that the higher plant population was advantage on the higher levels of
stored moisture and planting rates had little influence on grain yield, but
heavier planting rates produced the higher yield forage. Hago and
Mohammed (1996) reported that seed rate had significant effects on forage
yield of the ratoon crops only. In addition to that the effect of seed rate was
greater on yield of second ratoon crop.
Table 1: the effect of nitrogen fertilization and seed rate on the plant population, fresh weight and dry weight for two seasons 2004/05 and 2005/06 of sorghum fodder.

<table>
<thead>
<tr>
<th>Plant population</th>
<th>Fresh weight (gm)</th>
<th>Dry weight (gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1 N0</td>
<td>35.7e</td>
<td>35.5e</td>
</tr>
<tr>
<td>S1 N1</td>
<td>64.8d</td>
<td>164.3a</td>
</tr>
<tr>
<td>S2 N0</td>
<td>90.0d</td>
<td>63.0d</td>
</tr>
<tr>
<td>S2 N1</td>
<td>144.3a</td>
<td>139.0a</td>
</tr>
<tr>
<td>S3 N0</td>
<td>115.1b</td>
<td>91.4c</td>
</tr>
<tr>
<td>S3 N1</td>
<td>141.0a</td>
<td>112.8b</td>
</tr>
<tr>
<td>LSD</td>
<td>46.30</td>
<td>20.71</td>
</tr>
</tbody>
</table>

For each parameters, treatment means followed by a common letter don't differ significantly at P=0.05
REFERENCES


