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# Effect of Different Sowing Dates on Growth and Yield of Three Pearl Millet (*Pennisetum glaucum* (L.) R. Br) Cultivars in West Darfur Sudan

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***Authors' contributions***

*This work was carried out in collaboration between three authors. Author MMHB initiated the experiments, collected the data, performed the statistical analysis. Author SOY designed the study, managed the literature review and wrote the first drafts of the manuscript. Author SAAM assisted with statistical analysis and contributed to the final draft. Three authors read and approved the final manuscript.*

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## ABSTRACT

**Aim:** To study the effect of sowing dates on growth and yield of three pearl millet (*Pennisetum glaucum* (L.) R. Br) cultivars.
**Study Design:** The treatments were arranged in split plot design with four replicates.
**Place and Duration of Study:** Field experiments were conducted for two consecutive seasons (2011/12 and 2012/13), in the rain-fed area of ELGeneina, West Darfur State, Sudan.
**Methodology:** Sowings were applied throughout four sowing intervals namely: S1 = first sowing date in July 19th in season one and July 5th in season two, S2 = second sowing date in July 25th in season one and July 10th in season two, S3 = third sowing date in July 31th in season one and July 16th in season two, S4 = fourth sowing date in August 6 in season one and July 22th in season two. The three pearl millet cultivars were; Dembi (V1), Bauoda (V2) and Hariri (V3).

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**Results:** The results obtained showed significant difference for the majority of growth and yield parameters except in stem diameters for two seasons. In general, among cultivars almost (Hariri) showed the weakest growth, mean while, (Dembi) and (Bauoda) had stronger growth and yield. The best sowing dates for all parameters were the S1 first sowing date (first July). while, V1S1 and V2S1 showed the greatest values for two seasons.
**Conclusion:** Under this condition of Sudan early sowing date (first and mid July) is the best optimum dates in term of growth and yield of millet, while Dembi and Bauoda cultivars can be recommended as good yielding cultivars.

*Keywords: Sowing date; growth; yield; pearl millet; cultivars.*

## 1. INTRODUCTION

Following separation from South Sudan in July 2011, Sudan is now 1.8 million $km^2$ – the third-largest country in Africa, with a population of more than 33 million people. Eighty percent of the population derives their livelihood from agriculture. But Sudan's abundant agricultural potential is largely untapped. Decades of conflict, displacement and poverty showed that only around 20 percent of Sudan's arable land is cultivated and the country remains a net importer of food [1].

Pearl millet (*Pennisetum glaucum* L.) R. Br), locally known as "Dukhun", is one of the important cereal crops of the Sudan, coming as the second most-important cereal crop, after sorghum , in both area and total production [2]. It is the preferred staple food crop for the majority of the inhabitants of western Sudan (Kordofan and Darfur States) [2]. The average total area annually planted in the country is about 6 million feddans (2.5 million ha). About 95% of this area is found in Western Sudan [2,3,4]. Millet is considered to be the main food source in West Darfur. It is particularly adapted to nutrient poor soil and low rainfall conditions [5]. Average millet acreage is around 5.4 million feddans, producing some 300,000 tons with low average yields of about 90 kg/fed [1].

A major problem of rain- fed agriculture in semi-arid regions with short rainy seasons is how to determine the optimum sowing date for individual crops, a decision tied to a proper definition of onset of the rains. Managing planting date influence crop growth and development as the interaction between growth, development and stressful periods [6]. A decline in both temperature and length of photoperiod over successive sowing dates from July to September had a drastic effect on phonology and yield potentials of the pearl millet cultivars [7]. Mean while, Mass et al. [8] found that planting dates was significant for yield and height. There are many pearl millet cultivars in Sudan and the most popular and widely grown cultivar in Kordfan is Dembi. It has a light brown to yellowish brown seed color. It is comparatively late in maturity (around 120 days) with a medium or tall plant height. Abulgasim [2] found that Bauoda is the most popular local variety in Darfur State. It is characterized by having a cream colored grain. It has heads of medium size and it is of medium to late maturity [2]. Hariri (Baladi) is local Millet grown mainly the clay soils. The current study was therefore undertaken to determine the effect of different sowing date on growth and yield of three cultivars of millet grown in rain fed conditions of west Darfur.

## 2. MATERIALS AND METHODS

### 2.1 Experimental Site

The experiments were conducted for two consecutive season 2011/12 – 2012/13, to study the effect of different sowing dates on growth and yield of three pearl millet cultivars under rainfall in West Darfur ELGeneina. The experiment site lies at latitude 13 25 41.0 North and longitude 022 27 17.6 East.

### 2.2 Layout of the Experiment

The experiment consists of three main plots comprising three local millet cultivars; Dembi (V1), Bauoda(V2) and Hariri(V3), while the sub-plots consist of four sowing dates. The treatments were arranged in split plot design with four replicates to make a total of 48 plots (3 x 4 x 4). The plot area was 4 x 4 m and the space between rows was 75 cm. Sowing was applied throughout four sowing intervals namely: S1 = first sowing date in July $19^{th}$ in season one and July $5^{th}$ in season two, S2 = second sowing date in July $25^{th}$ in season one and July $10^{th}$ in season two, S3 = third sowing date in July $31^{th}$ in season one and July $16^{th}$ in season two, S4 = fourth sowing date in August 6 in season one and July $22^{th}$ in season two.

## 2.3 The Climate of Study Area

The beginning of the rainy season is typical of the semi-arid savannah which is marked by great irregularity. The average temperature does not vary significantly between months especially during the rainy seasons, where the relative humidity is high. The potential evapotranspiration is about 180 cm/annum, with maximum of 20.1 cm in May and minimum of 4.2 in September. The annual mean temperature range from 25C to 27C. The hottest month in the year is May while the coldest month is January (metrological station reports -ELGeneina). The rainy season is usually begins in the late June and extends to September, with occasional limited showers in April, May and October. The annum rainfall during the last 10 years varied from 280mm to 726.7 mm. The total rain fall in 2011 was 358.8 mm and in 2012 was 726.7mm.

## 2.4 Land Preparation and Data Collection

Land preparation, for the two seasons, started in late May by cleaning the land from the big shrubs then ploughing using disc followed by leveling to assist in easy and proper preparation of the plots. To determine the average plant height; LAI, stem diameter, plant density, ten plants were randomly marked in each treatment during seedling, flowering and maturity stages in the two seasons. After maturity also panicle height, panicle diameter and yield in kg/ha were taken.

## 2.5 Statistical Analysis

The data collected in the two seasons were analyzed using statistical analyses for split design according to [9]. The mean were compared according to LSD.

## 3. RESULTS AND DISCUSSION

The effect of sowing dates on plant height of three millet cultivars during three growing stages were presented in Tables 1a and 1b. The results showed significant difference for most parameters through three stages for two seasons except for seedling stage of first season. The three cultivars had no clear variation in plant height, sometime $V_2$ was the tallest in plant height. The first sowing date $S_1$ produced the tallest plant height during three stages for two seasons. The interaction of cultivars with sowing dates produced the tallest plants, almost $S_1V_2$ in maturity stage of first season and three stages of second season. During first July ($S_1$) plants showed vigorous growth and this could be due to fact that at this time the rain was continues and well distributed to enable good germination of seeds and well established of plants. [10] obtained the same results under similar area and condition in Sudan.

The data of LAI showed in Tables 2a and 2b for two seasons. Among cultivars $V_3$ showed the lowest LAI in all readings with significant difference except in seeding stage of first season, in which $V_1$ gave the lowest values. Sowing date $S_1$ revealed the widest LAI compared with other sowing date with significant difference. The interaction between cultivars and sowing dates showed highly significant difference at p=.01 and $V_1S_1$ had the highest values for the two seasons. This was in line with [11], but in contrast to [10] who found insignificant difference between sowing dates and varieties and attributed that may be due to the dry spills during the seasons.

There were no significant differences on stem diameter of three millet cultivars as affected by sowing dates for two seasons except on the cultivars of flowering stage of season two Tables 3a and 3b. Effect of sowing dates on three cultivars of pearl millet on plant density was presented in Tables 4a and 4b for two seasons. The cultivars had no significant variation, except in maturity stage at second season and $V_1$ had height plant density. Sowing date showed significant difference and $S_1$ had the highest plant density for all stages for two seasons, except in first season in seedling stage in which $S_2$ higher plant density. On the other hand, the interaction had significant difference and the following values had the biggest values respectively for two seasons for the three stages, $V_2S_2$, $V_3S_2$, $V_3S_1$, $V_2S_1$, $V_3S_2$ and $V_1S_1$. Effect of sowing dates on panicle diameter and panicle high was presented in Table 5 for two seasons. The result showed significant difference for both readings. $V_1$ and $V_2$ had the thickest panicle diameter for season one and two respectively. Among the sowing date $S_1$ produced plants with the biggest panicles for two seasons, interaction between $V_1S_1$ and $V_2S_2$ had the highest values for the two seasons. For panicle height cultivars $V_2$, and sowing dates $S_3$ were the best values for two seasons. $V_2S_2$ and $V_1S_3$ were the best values of interaction for two seasons respectively.

**Table 1a. Effect of sowing dates on three cultivars of millet on plant height during season 2011/12**

| Treatments | Seedling stage | | | | Flowering stage | | | | Maturity stage | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean |
| $S_1$ | 124.2 | 110.1 | 121.8 | 118.7 | 220.7 | 217.2 | 183.4 | 207.1 | 234.1 | 235.8 | 207.6 | 225.8 |
| $S_2$ | 121.2 | 103.1 | 114.9 | 113.1 | 220.5 | 232.2 | 180.6 | 211.1 | 219.3 | 212.2 | 199.9 | 210.5 |
| $S_3$ | 96.3 | 80.2 | 95.8 | 90.8 | 210.2 | 220.0 | 172.8 | 201.0 | 22.6 | 227.5 | 218.2 | 156.1 |
| $S_4$ | 85.2 | 98.1 | 94.4 | 92.6 | 188.3 | 214.1 | 167.1 | 189.8 | 231.9 | 231.9 | 189.7 | 217.8 |
| Mean | 106.7 | 97.9 | 106.7 | | 209.9 | 220.9 | 176.0 | | 177.0 | 226.9 | 203.9 | |
| Cv% | | | | 6.7 | | | | 1.3 | | | | 6.4 |
| LSD(v) | | | | $21.12^{ns}$ | | | | 15.67** | | | | 46.8* |
| LSD(s) | | | | $16.11^{ns}$ | | | | 15.39** | | | | 44.9** |
| LSD($_V X_S$) | | | | $29.92^{ns}$ | | | | 26.37* | | | | 79.5** |

*$S_1$ = first sowing date in July 19$^{th}$, $S_2$ = second sowing date in July 25$^{th}$, $S_3$ = third sowing date in July 31$^{st}$, $S_4$ = fourth sowing date in August 6$^{th}$. $V_1$ =Dembi, $V_2$= Bauoda, $V_3$= Hariri. *, ** Significance at P< 0.05 and P< 0.01, respectively, ns not significant*

**Table 1b. Effect of sowing dates on three cultivars of millet on plant height during season 2012/13**

| Treatments | Seedling stage | | | | Flowering stage | | | | Maturity stage | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean |
| $S_1$ | 126.6 | 135.3 | 130.0 | 130.6 | 237.1 | 244.0 | 218.8 | 233.3 | 250.5 | 247.6 | 224.2 | 240.8 |
| $S_2$ | 123.1 | 126.3 | 119.2 | 122.9 | 203.7 | 230.6 | 210.3 | 214.9 | 215.2 | 240.5 | 215.3 | 223.7 |
| $S_3$ | 105.5 | 100 | 100.5 | 102.0 | 220 | 230.3 | 219.5 | 223.3 | 234.3 | 233.7 | 221.0 | 229.7 |
| $S_4$ | 94.9 | 99.3 | 100.6 | 98.3 | 220 | 222.1 | 196.7 | 212.9 | 233.2 | 327.4 | 200.1 | 253.6 |
| Mean | 112.5 | 115.2 | 112.6 | | 220.2 | 231.8 | 211.3 | | 233.3 | 262.3 | 215.2 | |
| Cv% | | | | 5.5 | | | | 4.8 | | | | 7.8 |
| LSD(v) | | | | $20.06^{ns}$ | | | | 13.06* | | | | $51.31^{ns}$ |
| LSD(s) | | | | 13.89* | | | | 10.30* | | | | $47.87^{ns}$ |
| LSD(VXS) | | | | 26.86* | | | | 18.89* | | | | $83.14^{ns}$ |

*$S_1$ = first sowing date in July 5$^{th}$, $S_2$ = second sowing date in July 10$^{th}$, $S_3$ = third sowing date in July 16$^{th}$, $S_4$ = fourth sowing date in July 22$^{th}$ $V_1$ =Dembi, $V_2$= Bauoda, $V_3$= Hariri *, ** Significance at P< 0.05 and P< 0.01, respectively, ns not significant*

**Table 2a. Effect of sowing dates on three cultivars of millet on LAI during season 2011/12**

| Treatments | Seedling stage | | | | Flowering stage | | | | Maturity stage | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean |
| **$S_1$** | 234.1 | 235.8 | 207.6 | 225.8 | 329.2 | 366.2 | 310.8 | 335.4 | 154.8 | 163.9 | 116.3 | 145.0 |
| **$S_2$** | 219.3 | 212.2 | 199.9 | 210.5 | 327.6 | 353.3 | 273.1 | 318.0 | 124.3 | 137.8 | 095.7 | 119.3 |
| **$S_3$** | 022.6 | 227.5 | 218.2 | 156.1 | 275.1 | 249.8 | 221.3 | 248.7 | 093.8 | 081.6 | 081.7 | 085.7 |
| **$S_4$** | 231.9 | 231.9 | 189.7 | 217.8 | 213 | 268.4 | 217.5 | 233.0 | 067.5 | 083.0 | 063.3 | 071.3 |
| **Mean** | 177.0 | 226.9 | 203.9 | | 286.2 | 309.4 | 255.7 | | 110.1 | 116.6 | 089.3 | |
| **Cv%** | | | | 6.4 | | | | 2.9 | | | | 3.4 |
| **LSD(v)** | | | | 46.8$^{*}$ | | | | 47.29$^{**}$ | | | | 22.15* |
| **LSD(s)** | | | | 44.9$^{**}$ | | | | 29.68$^{**}$ | | | | 19.9** |
| **LSD(VXS)** | | | | 79.5$^{**}$ | | | | 60.16$^{**}$ | | | | 34.94** |

*$S_1$ = first sowing date in July 19$^{th}$, $S_2$ = second sowing date in July 25$^{th}$, $S_3$ = third sowing date in July 31$^{st}$ , $S_4$ = fourth sowing date in August 6$^{th}$. $V_1$ =Dembi, $V_2$= Bauoda, $V_3$= Hariri. *, ** Significance at P< 0.05 and P< 0.01, respectively, ns not significant*

**Table 2b. Effect of sowing dates on three cultivars of millet on LAI during season 2012/13**

| Treatments | Seedling stage | | | | Flowering stage | | | | Maturity stage | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean |
| $S_1$ | 275 | 296.8 | 216.4 | 262.7 | 348.6 | 367.1 | 290.2 | 335.3 | 221.2 | 227.8 | 125.5 | 191.5 |
| $S_2$ | 252.4 | 248.2 | 231.1 | 243.9 | 271.9 | 297.3 | 270.7 | 280.0 | 156.7 | 179 | 113.7 | 149.8 |
| $S_3$ | 233.4 | 254.2 | 226.7 | 238.1 | 276.9 | 303.1 | 276.9 | 285.6 | 155.4 | 181.3 | 104.3 | 147.0 |
| $S_4$ | 188.2 | 243.1 | 213 | 214.8 | 284.5 | 309.5 | 257.5 | 283.8 | 158.1 | 172.6 | 101.3 | 144.0 |
| Mean | 237.3 | 260.6 | 221.8 | | 295.5 | 319.3 | 273.8 | | 172.9 | 190.2 | 111.2 | |
| Cv% | | | | 4.7 | | | | 5.5 | | | | 4.5 |
| LSD(v) | | | | 19.14** | | | | 31.07** | | | | 26.87** |
| LSD(s) | | | | 15.67** | | | | 22.42** | | | | 14.11** |
| LSD(VXS) | | | | 28.35** | | | | 42.58** | | | | 31.64** |

*$S_1$ = first sowing date in July 5$^{th}$, $S_2$ = second sowing date in July 10$^{th}$, $S_3$ = third sowing date in July 16$^{th}$, $S_4$ = fourth sowing date in July 22$^{th}$ $V_1$ =Dembi, $V_2$= Bauoda, $V_3$= Hariri *, ** Significance at P< 0.05 and P< 0.01, respectively, ns not significant*

**Table 3a. Effect of sowing dates on three cultivars of millet on Stem diameter during season 2011/12**

| Treatments | Seedling stage | | | | Flowering stage | | | | Maturity stage | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean |
| $S_1$ | 1.1 | 1.2 | 1.0 | 1.2 | 1.9 | 1.8 | 1.7 | 1.8 | 1.0 | 1.2 | 0.9 | 1.0 |
| $S_2$ | 0.9 | 1.0 | 0.9 | 0.9 | 2.1 | 1.8 | 1.5 | 1.8 | 1.0 | 0.9 | 0.8 | 0.9 |
| $S_3$ | 0.9 | 0.8 | 0.8 | 0.8 | 1.8 | 1.6 | 1.4 | 1.6 | 1.0 | 1.0 | 0.7 | 0.9 |
| $S_4$ | 0.9 | 0.8 | 0.8 | 0.8 | 1.8 | 1.7 | 1.5 | 1.6 | 0.8 | 7.1 | 0.8 | 2.9 |
| Mean | 0.9 | 0.9 | 0.9 | | 1.9 | 1.7 | 1.5 | | 0.9 | 2.6 | 0.8 | |
| Cv% | | | | 5.7 | | | | 4.1 | | | | 71.3 |
| LSD(v) | | | | $0.18^{ns}$ | | | | 0.26* | | | | $3.03^{ns}$ |
| LSD(s) | | | | $0.13^{ns}$ | | | | $0.28^{ns}$ | | | | $2.96^{ns}$ |
| LSD(VXS) | | | | $0.25^{ns}$ | | | | $0.47^{ns}$ | | | | $5.08^{ns}$ |

*$S_1$ = first sowing date in July 19$^{th}$, $S_2$ = second sowing date in July 25$^{th}$, $S_3$ = third sowing date in July 31$^{st}$ , $S_4$ = fourth sowing date in August 6$^{th}$. $V_1$ =Dembi, $V_2$= Bauoda, $V_3$= Hariri. *, ** Significance at P< 0.05 and P< 0.01, respectively, ns not significant*

**Table 3b. Effect of sowing dates on three cultivars of millet on Stem diameter during season 2012/13**

| Treatments | Seedling stage | | | | Flowering stage | | | | Maturity stage | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean |
| **$S_1$** | 1.0 | 0.9 | 0.9 | 0.9 | 1.3 | 1.4 | 1.3 | 1.3 | 0.8 | 0.9 | 0.7 | 0.8 |
| **$S_2$** | 0.9 | 2.9 | 0.8 | 1.6 | 1.2 | 1.3 | 1.1 | 1.2 | 0.6 | 0.6 | 0.7 | 0.6 |
| **$S_3$** | 0.9 | 0.9 | 0.8 | 0.9 | 1.2 | 1.1 | 1.1 | 1.1 | 0.7 | 0.7 | 0.7 | 0.7 |
| **$S_4$** | 0.8 | 0.8 | 0.7 | 0.8 | 1.2 | 1.2 | 1.1 | 1.2 | 0.7 | 0.7 | 0.7 | 0.7 |
| **Mean** | 0.9 | 1.4 | 0.8 | | 1.2 | 1.3 | 1.1 | | 0.7 | 0.7 | 0.7 | |
| **Cv%** | | | | 30.3 | | | | 30.0 | | | | 2.0 |
| **LSD(v)** | | | | $1.01^{ns}$ | | | | $0.15^{ns}$ | | | | $0.13^{ns}$ |
| **LSD(s)** | | | | $0.96^{ns}$ | | | | $0.26^{ns}$ | | | | $0.10^{ns}$ |
| **LSD(VXS)** | | | | $1.66^{ns}$ | | | | $0.14^{ns}$ | | | | $0.19^{ns}$ |

*$S_1$ = first sowing date in July 5$^{th}$, $S_2$ = second sowing date in July 10$^{th}$, $S_3$ = third sowing date in July 16$^{th}$, $S_4$ = fourth sowing date in July 22$^{th}$ $V_1$ =Dembi, $V_2$= Bauoda, $V_3$= Hariri *, ** Significance at P< 0.05 and P< 0.01, respectively, ns not significant*

**Table 4a. Effect of sowing dates on three cultivars of millet on plant density during season 2011/12**

| Treatments | Seedling stage | | | | Flowering stage | | | | Maturity stage | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean |
| **$S_1$** | 41.8 | 49.0 | 58.8 | 49.8 | 39.8 | 43.0 | 46.8 | 43.2 | 37.0 | 40.8 | 44.2 | 40.7 |
| **$S_2$** | 57.2 | 72.0 | 69.2 | 66.1 | 39.5 | 35.5 | 50.5 | 41.8 | 37.0 | 30.5 | 45.2 | 37.6 |
| **$S_3$** | 65.8 | 41.2 | 39.2 | 48.7 | 40.2 | 27.5 | 34.0 | 33.9 | 37.0 | 24.2 | 32.0 | 31.1 |
| **$S_4$** | 54.8 | 62.8 | 52.5 | 56.7 | 39.0 | 40.2 | 42.5 | 40.6 | 31.7 | 37.8 | 37.2 | 35.6 |
| **Mean** | 54.9 | 56.2 | 54.9 | | 39.6 | 36.6 | 43.5 | | 35.7 | 33.3 | 39.7 | |
| **Cv%** | | | | 7.0 | | | | 7.5 | | | | 8.6 |
| **LSD(v)** | | | | $14.2^{ns}$ | | | | $9.6^{ns}$ | | | | $10.1^{ns}$ |
| **LSD(s)** | | | | $15.2^{ns}$ | | | | $7.7^{ns}$ | | | | $7.81^{ns}$ |
| **LSD(VXS)** | | | | $25.5^{ns}$ | | | | $14.1^{ns}$ | | | | $14.4^{ns}$ |

*$S_1$ = first sowing date in July 19$^{th}$, $S_2$ = second sowing date in July 25$^{th}$, $S_3$ = third sowing date in July 31$^{st}$, $S_4$ = fourth sowing date in August 6$^{th}$. $V_1$ =Dembi, $V_2$= Bauoda, $V_3$= Hariri. *, ** Significance at P< 0.05 and P< 0.01, respectively, ns not significant*

**Table 4b. Effect of sowing dates on three cultivars of millet on plant density during season 2012/13**

| Treatments | Seedling stage | | | | Flowering stage | | | | Maturity stage | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean |
| $S_1$ | 52.5 | 53.2 | 51.5 | 52.4 | 37.0 | 34.5 | 36.2 | 35.9 | 28.2 | 25.0 | 25.5 | 26.3 |
| $S_2$ | 44.5 | 42.7 | 50.5 | 45.9 | 33.8 | 27.0 | 40.2 | 33.7 | 24.7 | 17.7 | 20.2 | 20.9 |
| $S_3$ | 40.3 | 38.2 | 42.7 | 41.3 | 32.2 | 28.5 | 24.8 | 28.5 | 26.5 | 19.5 | 12.5 | 19.5 |
| $S_4$ | 44.5 | 38.7 | 46.0 | 43.1 | 33.8 | 26.8 | 32.5 | 31.0 | 24.2 | 18.0 | 17.5 | 19.9 |
| Mean | 46.1 | 43.2 | 47.6 | | 34.2 | 29.2 | 33.4 | | 25.9 | 20.1 | 18.9 | |
| Cv% | | | | 2.3 | | | | 8.1 | | | | 6.9 |
| LSD(v) | | | | $5.79^{ns}$ | | | | $7.44^{ns}$ | | | | $6.83^{*}$ |
| LSD(s) | | | | 5.44 * | | | | $6.18^{**}$ | | | | $4.74^{*}$ |
| LSD(VXS) | | | | 9.44 | | | | $0.26^{**}$ | | | | $0.19^{**}$ |

*$S_1$ = first sowing date in July 5$^{th}$, $S_2$ = second sowing date in July 10$^{th}$, $S_3$ = third sowing date in July 16$^{th}$, $S_4$ = fourth sowing date in July 22$^{th}$ $V_1$ =Dembi, $V_2$= Bauoda, $V_3$= Hariri *, ** Significance at P< 0.05 and P< 0.01, respectively, ns not significant*

**Table 5. Effect of sowing dates on three cultivars of millet on panicle diameter during season 2011/12-2012/13**

| Treatments | Panicle diameter 2011 | | | | Panicle diameter 2012 | | | | Panicle height 2011 | | | | Panicle height 2012 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean |
| $S_1$ | 2.42 | 2.25 | 2.05 | 2.24 | 2.55 | 2.80 | 2.55 | 2.63 | 22.19 | 23.95 | 19.77 | 21.97 | 26.05 | 25.82 | 22.62 | 24.83 |
| $S_2$ | 2.05 | 2.00 | 1.95 | 2.00 | 2.47 | 2.60 | 2.32 | 2.47 | 22.12 | 26.75 | 20.47 | 23.11 | 25.85 | 27.82 | 23.77 | 25.81 |
| $S_3$ | 2.07 | 1.95 | 1.90 | 1.98 | 2.40 | 2.50 | 2.25 | 2.38 | 23.97 | 25.95 | 19.45 | 23.12 | 28.75 | 27.45 | 24.40 | 26.87 |
| $S_4$ | 1.95 | 2.02 | 1.85 | 1.94 | 2.12 | 2.67 | 2.12 | 2.31 | 23.00 | 25.1 | 19.85 | 22.65 | 26.27 | 27.60 | 21.35 | 25.07 |
| Mean | 2.13 | 2.06 | 1.94 | | 2.39 | 2.64 | 2.31 | | 22.82 | 25.44 | 19.89 | | 26.73 | 27.17 | 23.04 | |
| Cv% | | | | 2.1 | | | | 3.9 | | | | 2.8 | | | | 3.1 |
| LSD(v) | | | | 0.30 * | | | | 0.22 * | | | | 2.52* | | | | 2.41* |
| LSD(s) | | | | 0.23* | | | | 0.12 * | | | | 1.92* | | | | 2.03ns |
| LSD(VXS) | | | | 0.42* | | | | 0.27 * | | | | 3.57* | | | | 3.64* |

*$S_1$ = first sowing date in July 19th in season one and July 5th in season two, $S_2$ = second sowing date in July 25th in season one and July 10th in season two, $S_3$ = third sowing date in July 31st in season one and July 16th in season two, $S_4$ = fourth sowing date in August 6th in season one and July 22th in season two. $V_1$ =Dembi, $V_2$= Bauoda, $V_3$= Hariri. *, ** Significance at P< 0.05 and P< 0.01, respectively, ns not significant*

**Table 6. Effect of sowing dates on three cultivars of millet on Yield (Kg/fed) during season 2011/12-2012/13**

| Treatments | Straw yield 2011 | | | | Straw yield 2012 | | | | Grain Yield 2011 | | | | Grain Yield 2012 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean | $V_1$ | $V_2$ | $V_3$ | Mean |
| $S_1$ | 1.55 | 1.22 | 1.00 | 1.26 | 1.72 | 2.32 | 1.37 | 1.81 | 190.5 | 191.0 | 186.8 | 189.4 | 209.3 | 222.8 | 196.8 | 209.6 |
| $S_2$ | 1.47 | 1.27 | 0.97 | 1.24 | 1.47 | 1.97 | 0.90 | 1.45 | 169.0 | 170.0 | 164.8 | 167.9 | 176.0 | 186.8 | 164.8 | 175.9 |
| $S_3$ | 1.45 | 0.70 | 0.67 | 0.94 | 1.57 | 1.22 | 0.92 | 1.24 | 077.8 | 091.2 | 085.0 | 084.7 | 090.8 | 105.5 | 085.0 | 093.8 |
| $S_4$ | 1.10 | 1.07 | 1.12 | 1.10 | 1.10 | 1.27 | 1.25 | 1.21 | 037.8 | 052.5 | 034.2 | 041.5 | 054.2 | 65.00 | 034.2 | 051.1 |
| Mean | 1.39 | 1.07 | 0.94 | | 1.47 | 1.70 | 1.11 | | 118.8 | 126.2 | 117.7 | | 132.6 | 145.0 | 120.2 | |
| Cv% | | | | 19.7 | | | | 9.5 | | | | 9.2 | | | | 8.5 |
| LSD(v) | | | | 0.56* | | | | 0.43* | | | | 28.47* | | | | 28.36** |
| LSD(s) | | | | 0.29* | | | | 0.24* | | | | 26.67** | | | | 25.16** |
| LSD(VXS) | | | | 0.66* | | | | 0.52* | | | | 46.28** | | | | 44.35** |

*$S_1$ = first sowing date in July 19th in season one and July 5th in season two, $S_2$ = second sowing date in July 25th in season one and July 10th in season two, $S_3$ = third sowing date in July 31st in season one and July 16th in season two, $S_4$ = fourth sowing date in August 6th in season one and July 22th in season two. $V_1$ =Dembi, $V_2$= Bauoda, $V_3$= Hariri. *, ** Significance at P< 0.05 and P< 0.01, respectively, ns not significa*

Yield of straw and grain yield in kg/ha of three millet cultivars for two seasons were presented in (above) Table 6 the results obtained significant difference for all the readings. Pearl millet productivity was low as it ranged from 222 kg/ha to 34 kg/ha during two seasons respectively. This results was in line with, [12] who reported that pearl millet productivity was usually low and variable, because of natural causes, including a short rainy season that is spatially and temporally variable and poor soil quality. For straw yield cultivars $V_1$ and $V_2$ was the highest value for season one and two, and $S_1$ was the best sowing date for two seasons. In interaction results the best values were obtained in $V_1S_1$ and $V_2S_1$. Grain yield data $V_2$ and $S_1$ and their interaction ($V_2S_1$) were reviled the highest values. In general $S_1$ is the most ideal date for yield improvement. [13] respond that to periods of reduced photoperiod, striga infection, temperature and adequate rainfall. Also [14] reported that early sowing gave lower disease incidence and higher grain yield than late sowing. [10] found that on most crop yield component whereas, results showed insignificant interaction between sowing dates and varieties.

## 4. SUMMARY AND CONCLUSION

Pearl millet in this part of Sudan plays important roles for food security of people, but it faced great challenges represented in climate change and civil wars which leads to low production. To solve real problems and increase food security and productivity in this area. Studied sowing dates of three pearl millet cultivars under Darfor area conditions will give great contribution to this important area. Based on current data and plant growth habits planting date of early July had resulted in significantly higher yields of grain and stover. Dembi and Bauoda cultivars of millet were also of great productivity in two seasons, in spite of flocculation of rain fall. Research on sowing dates must lie heavily on the length of the growing period and the time of first rainfall put in consideration that the length of the growing period is mainly a function of the date of the first rains.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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