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# Effect of Sowing Date and Variety on Growth and Yield of Pearl Millet (Pennisetum Glaucum l.) Grown on Two Soil Types Under Rain - Fed Condition at Zalingei Area in Sudan

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## ABSTRACT

Two field experiments were conducted at the University of Zalingei demonstration farm, Zalingei, Sudan, during 2005 rainy season, to investigate the effect of sowing date and variety on growth and yield of pearl millet under rain fed condition and to assessment crop pests and diseases Two locations of different soil types ( sandy loam and clay loam ) were chosen for the study ,two sowing dates (15th of July as early sowing date and 1st of August as late sowing date ) and four millet varieties ( Dembi from North Darfur, Improved Dembi,Bauoda and Drmsa ( local names )were used Treatments were arranged in split plot design replicated four times with sowing dates in the main plots and varieties in the subplots. For the pests and diseases assessment the growing season was divided into three periods (first, middle and end of the season). Results showed that the early sowing date resulted in significant ($P \leq 0.05$) number of leaves / plant (25.6) compared with late sowing date (22.2), whereas sowing date had no significant effect on other growth attributes but the early sowing date produced tall plants at the two sites (132.1, 117.9 cm) successfully. The results also indicated that the variety had a significant effect ($P \leq 0.05$) on plant height. The results showed significant difference ($P \leq 0.05$) between the two sowing dates in number of days to maturity, whereas the plants grown earlier were reached maturity stage earlier than late plants at the two sites, on the other hand results indicated that the variety had significant effect ($P \leq 0.05$) on most crop yield component whereas, results showed insignificant interaction between sowing dates and varieties. Results showed that pearl millet was infected by many pests and few diseases and the spread of pests and diseases was affected by the growth stage, also the results showed that varieties were different in disease resistance Drmsa recorded the highest level of foliage disease incidence at early sowing date (41%) whereas, North Darfur Dembi recorded 30.9% but at late sowing date North Darfur Dembi recorded the higher infestation percentage 36.1% and Bauoda recorded the lowest infestation percentage (16.8%).With regard to soil type, results showed that disease incidence on pearl millet were found to be high in case of location 2 than in location 1. Beside the above mentioned pests and diseases, results also showed that there was high infestation of Buda ( Striga hermontheca ) among the pearl millet crop.

**Keywords:** *Sowing date. Variety .rain fed. Pearl millet*

## 1. INTRODUCTION

Universally, cereals are important food crops, among which millet is the sixth most important cereal in the world. Among the millet, pearl millet, is very important and is grown as stable cereal on an estimated area of 25-36.9 million hectares [12; 8].In Sudan pearl millet is an important cereal crop, next to sorghum. It contributes the stable food of the majority of inhabitants of Western part of Sudan (Darfur and Kordofan) where it occupies an area of 1.2- 2.938 million hectares [2; 8; 11; 13; 14]. Most of the millet area in the Sudan (95%) is cultivated and harvested under traditional rain fed agriculture. Some farmers in the mechanized clay plain of central Sudan started to grow pearl millet instead of sorghum [6].there are many pearl millet cultivars in Sudan according to time of maturity , plant height and grain color like Kano, mayoa, Abusof, Dembi, Drmsa, Bauoda, Sharoba and wild cultivar (wey-wey) . In Darfur Dembi is relatively a dwarf short day to maturity, red seeded variety .A taller longer season white seeded type has different names in different places [17].Generally, pearl millet did not receive the appropriate attention. Therefore, the present study was conducted to investigate the effect of sowing date and variety on growth and yield of pearl millet under rain fed condition and to assessment crop pests and diseases.

## 2. MATERIALS AND METHODS

Two field experiments were conducted at the University of Zalingei demonstration farm, Zalingei, Sudan ,during 2005 rainy season, to investigate the effect of sowing date and variety on growth and yield of pearl millet grown on two soil types under rain fed condition and to assessment crop pests and diseases two locations of different soil types location1of sandy loam soil and location 2 of clay loam soil [16] were chosen for the study, at distance of 1 km from each other which were designated as L1 and L2 respectively. Treatments consisted of two sowing dates (15th of July as early sowing date and 1st of August as late sowing date) which were designated as $t_1$ and $t_2$ respectively. Four millet varieties (Dembi from North Darfur local farmers, Improved Dembi from ministry of agriculture West Darfur state, Bauoda and Drmsa(local names)from local farmers of Zalingei area were grown. They were designated as ND, ID, B and DR respectively. Treatments were arranged in split plot design replicated four times with sowing dates in the main plots and varieties in the subplots. The size of the main plots and subplots were 16×4 and 4×4 m respectively. Measurements of vegetative growth attributes were carried on plant samples from the three central rows of each plot. Three plants were selected randomly from each plot and tagged for

plant height, number of leaves/ plant, leaf area and stem diameter. Plant height was measured at maturity this was done from the soil surface to the bottom of the head. The number of leaves/ plant and leaf area measured after 60 days from sowing when plants showed good vegetative growth. Leaf area was obtained on basis of Marshal Formula [15]. The stem diameter was measured by using Vernia Clipper. Number of days to 50% flowering, number of days to milky stage and number of days to maturity were determined from sowing until 50% of the plants flowered, the grain showed milky signs and majority of the grains on the heads matured (maturity was indicated by the formation of black layer at the base of the grain. Plants were left in the field for 25-30 days after maturity; this was meant to allow for complete maturity and minimum grain moisture content to prevent rotting later on. The crop was manually harvested by using traditional implement and stored in paper bags at room temperature for a month to complete drying. Thereafter, head length and yield were recorded. Heads harvested from each plot were threshed and the weight of grain was determined, this was used in calculation of grain yield per hectare. A random sample of 1000- grains was taken from each plot and then weighed to obtain 1000-grain weight. All collected data for the two locations were statistically analyzed. Analysis of variance and test of significance were done according to standard procedure of split plot design [9]. Means were differentiated according to Duncan's Multiple Range Test (DMRT). for the Pests and diseases inventory the growing season was divided into three periods (early season, middle of the season and late season) according to pests and diseases incidence .Readings were taken periodically every seven days walking in W shape method was used during the inventory .Data were recorded due to disease symptoms for diseases and infection symptoms or pest appearance for pests.

## 3. RESULTS AND DISCUSSION

Results in (Table1) showed that sowing date had no significant effect on growth attributes at both locations except number of leaves/ plant after 60 days after sowing at location 1 and leaf area at location 2 in which early sowing ($t_1$) indicated significant leaf area this may be due to the high fertility in location 2 compared with location 1 that reflected on good vegetative growth. There was significant difference ($P \leq 0.05$) between sowing dates in number of leaves/ plant at location1where early sowing indicated significantly higher number of leaves (25.6) compared with later sowing date (22.2) [7] reported that the sowing dates and species have significant differences in mean of leaf area index (LAI). First sowing date has the most LAI at three species. Results in (Table1) showed that variety had significant effect ($P \leq 0.05$) on plant height at the two locations, leaf area and stem diameter and location 1 and 2 respectively. DR gave taller plants (154cm) at location 1 .Whereas, B gave taller plants at location 2(134.8cm) but the difference between the tow varieties was not significant at the two locations; this may be attributed to the variety genotype and their adaptability to the environmental conditions in the area. For the leaf area ND resulted in higher leaf area (205.2 $cm^2$) compared with other varieties this may be due to variety adaptability to low soil fertility and low rain fall which are compatible to the environmental factors at 2005 season of low rain fall (395mm) and soil of location1.Whereas results indicated no significant difference between varieties for number of leaves/ plant at the two locations the variety had significant effect ($P \leq 0.05$) on stem diameter at the two locations (Table 2). Results in (Table 3) showed no significant differences between the two sowing dates for number of days to 50% flowering and head length at two locations, but to the number of days to milky stage results indicated significant difference ($P \leq 0.05$) between the two sowing dates at the two locations, the number of days to milky stage for early and late sowing dates were 62.2,68.8 and 69.7,76.4 at the two locations respectively , which was reflected on number of days to maturity that results showed significant difference ($P \leq 0.05$) between the tow sowing dates for plants to reach maturity stage[4] reported that days to heading decreased with late sowing date but growing degree days remained relatively constant .Results in (Table 3) indicated that sowing date had significant effect ($P \leq 0.05$) on 1000 - grain weight at location 1only.Whereas, yield was significantly influenced≤(P 0.05) by sowing date, early planting resulted in best yield ( 316.9 and 355.6 kg/ fed) compared with late planting (244.8 and 289.4 kg/fed) at the two locations respectively [18] observed that sowing date did not have significant influence on plant height ,panicle weight, number of panicles per plot ,panicle length, panicle diameter, and weight of 1000 grains but Stover yield and grain yield per hectare were both significantly influenced by sowing date .similar results were reported by [5] that the different dates of sowing significantly influenced the grain yield of pearl millet during all the years of experimentation and on pooled basis. In study of late planting date influences the yield and distribution of pearl millet forage[ 10 ] reported that total dry matter yields were the highest in the late April planting and decreased linearly for each day plantings were delayed past late April in 2008 and 2009 and quadratically during the extreme drought conditions of 2007. Results in (Table 4) appeared that variety exerted significant ($P \leq 0.05$) effect on most of the yield attributes except 1000-grain weight at location 1 and number of days to 50% flowering and head length at location 2. It was found that ND matured earlier (73.6, 79.0days) flowed by ID (81.3, 74.2 days) then DR and B at the two locations respectively. On the other hand results indicated that DN produced heavy 1000- grain weight (8.6 gm), whereas B produced the lighter 1000- grain weight and the difference between the two verities was significant ($P \leq 0.05$). This may be attributed to the low rain fall and sowing date effects. Results in (Table 4) indicated that variety significantly ($P \leq 0.05$) affected grain yield. It was found that DN produced higher yield at location 1(330.3 kg/fed) and ID produced higher yield at location 2 (305.2 kg/fed) flowed by DR. Whereas, B produced lower grain yield (176.3 and 286.6 kg/fed) at the two locations respectively .Similar results were obtained by [5] that grain yield of pearl millet genotype differ significantly during all the seasons except during 2004.The interaction

of sowing date × variety showed non significant effect on reproductive phase parameters, this may be due to the dry spills during the season. In contrast results obtained by [5] indicated that the interaction effect due to sowing dates and genotypes on grain yield was significant.

**Table 1:** effect of sowing date on growth parameters at the two locations

| Location of Experiment | Sowing date | Plant height at maturity (cm) | No. of leaves/plant at 60 days after sowing | Leaf area($cm^2$) | Stem diameter at maturity (cm) |
|---|---|---|---|---|---|
| Location 1 | Early sowing date ($t_1$) | 140.7 | 25.6 | 185.4 | 1.09 |
| | Late sowing date ($t_2$) | 132.1 | 22.2 | 178.0 | 1.02 |
| | C.V (%) | 15.5 | 7.2 | 5.6 | 12.6 |
| | L.S.D | 24.3 | 1.9* | 11.6 | 0.20 |
| Location 2 | Early sowing date ($t_1$) | 132.3 | 23.1 | 150.6 | 0.90 |
| | Late sowing date ($t_2$) | 117.9 | 18.2 | 142.5 | 0.89 |
| | C.V (%) | 10.8 | 64.4 | 5.3 | 6.9 |
| | L.S.D | 15.3 | 15.01 | 9.1* | 0.10 |

* Significant at 5% level
Location 1 of sandy loam soil
Location 2 of clay loam soil
Early sowing date 15th of July ($t_1$)
Late sowing date1st of August ($t_2$)

**Table 2:** effect of variety on growth parameters at the two locations

| Location of Experiment | variety | Plant height at maturity (cm) | No. of leaves/plant at 60 days after sowing | Leaf area($cm^2$) | Stem diameter at maturity (cm) |
|---|---|---|---|---|---|
| Location 1 | Improved Dembi (ID) | 128.1 | 25.3 | 149.5 | 0.96 |
| | North Darfur Dembi (ND) | 125.0 | 22.4 | 205.2 | 1.10 |
| | Drmsa (DR) | 154.0 | 24.7 | 172.8 | 1.15 |
| | Bauoda (B) | 140.5 | 24.9 | 183.2 | 1.15 |
| | C.V (%) | 16.0 | 18.5 | 2.2 | 25.3 |
| | L.S.D | 13.4* | 3.3 | 29.0* | 0.2 |
| Location 2 | Improved Dembi (ID) | 115.5 | 19.9 | 157.3 | 0.83 |
| | North Darfur Dembi (ND) | 117.9 | 20.8 | 155.2 | 0.85 |
| | Drmsa (DR) | 132.3 | 21.1 | 153.4 | 0.06 |
| | Bauoda (B) | 134.8 | 20.9 | 163.3 | 0.95 |
| | C.V (%) | 14.5 | 25.6 | 20.6 | 24.8 |
| | L.S.D | 13.5 | 3.9* | 23.3 | 0.17* |

* Significant at 5% level

**Table 3:** effect of sowing date on yield parameters at the two locations

| Location of experiment | Sowing date | No. of days to 50% flowering | No. of days to milky stage | No. of days to maturity | Head length (cm) | 1000-grain weight | Yield (kg/ fed) |
|---|---|---|---|---|---|---|---|
| Location 1 | Early sowing date ($t_1$) | 54.5 | 62.2 | 75.2 | 22.8 | 10.0 | 316.9 |
| | Late sowing date ($t_2$) | 55.7 | 69.7 | 77.7 | 22.5 | 8.2 | 244.8 |
| | C.V (%) | 4.7 | 5.8 | 1.9 | 2.2 | 6.1 | 12.5 |
| | L.S.D | 2.9 | 4.3* | 1.2* | 1.1 | 0.6* | 17.6* |
| Location 2 | Early sowing date ($t_1$) | 61.4 | 68.8 | 81.8 | 20.4 | 7.9 | 305.6 |
| | Late sowing date ($t_2$) | 69.4 | 76.4 | 82.0 | 19.9 | 7.0 | 249.4 |
| | C.V (%) | 19.1 | 5.7 | 2.8 | 18.3 | 14.2 | 21.9 |
| | L.S.D | 14.1 | 4.5* | 2.3 | 4.2 | 1.2 | 7.9* |

* Significant at 5% level

Table 4: effect of variety on yield parameters at the two locations

| Location of experiment | variety | No. of days to 50% flowering | No. of days to milky stage | No. of days to maturity | Head length (cm) | 1000-grain weight | Yield ( kg/fed) |
|---|---|---|---|---|---|---|---|
| Location 1 | Improved Dembi (ID) | 53.8 | 62.5 | 47.2 | 18.7 | 9.4 | 235.7 |
| | North Darfur Dembi (ND) | 46.0 | 60.8 | 73.6 | 27.7 | 9.4 | 330.3 |
| | Drmsa (DR) | 61.9 | 71.0 | 73.4 | 22.3 | 9.8 | 281.6 |
| | Bauoda (B) | 59.2 | 69.3 | 79.5 | 22.1 | 9.2 | 276.3 |
| | C.V (%) | 8.5 | 5.4 | 5.9 | 6.4 | 7.1 | 19.1 |
| | L.S.D | 3.5* | 2.6* | 3.3* | 2.04* | 0.5 | 10.5* |
| Location 2 | Improved Dembi (ID) | 65.8 | 73.4 | 81.3 | 19.2 | 8.3 | 305.3 |
| | North Darfur Dembi (ND) | 64.9 | 71.8 | 89.0 | 20.5 | 8.6 | 291.9 |
| | Drmsa (DR) | 64.9 | 73.4 | 81.9 | 20.1 | 6.9 | 298.3 |
| | Bauoda (B) | 66.3 | 75.9 | 84.0 | 20.8 | 6.2 | 286.6 |
| | C.V (%) | 6.7 | 5.1 | 1.9 | 11.8 | 19.6 | 20.6 |
| | L.S.D | 3.3 | 2.7* | 1.3* | 1.8 | 1.1* | 14.9* |

* Significant at 5% level

Results of pests and diseases inventory showed that pear millet was infected by many pests, such as the larvae of butter fly ( Spodoptera sp. ) , stem borer ( Chilo partellus ) , aphids ( Schisaphis graminum ) , white ants ( Microtermes theracalis ) , pearl millet head worm ( Heliocalis albipunctella ) , desert locust (Schistocerca gregaria ) and birds ( Quelea quelea athiopica ) . Beside the above mentioned pests , pearl millet was also found to be infected by some diseases such as , the damping-off of young seedlings which is caused by the fungus ( Pythium sp. & Rhizoctonia sp. ) , Downey mildew which is caused by (Sclerospora graminicola ) and the smut diseases which is caused by (Sphacelotheca sp. ), these diseases were reported in pearl millet worldwide [ 3 ] . The results also revealed that the spread of pests and diseases in pearl millet was affected by growth stage of the crop, results in Table (5) showed that the butter fly larvae and the damping- off diseases were appeared early in the season, however pearl millet head worm and smut diseases were appeared in middle and late season, these results were similar to those reported by [1].On the other hand results also showed that disease incidence was greatly affected by the crop sowing date , as Table (6) shows it was clear that disease incidence of foliage diseases among the different varieties of pearl millet under test was generally high in case of early sowing . Different varieties of pearl millet reflect different levels of resistance , it was found that while Drmsa showed the highest level of foliage disease incidence (41%) , North Darfur Dembi showed only (30.9%) under the same conditions (Table, 6) . But, in case of late sowing, results revealed that the lowest infestation by foliage pests was recorded in case of Bauoda variety (16.8%), while the highest infestation rate was recorded in case of North Darfur Dembi (36.1%) under the same conditions. With regard to soil type, results showed that disease incidence on pearl millet were found to be high in case of location 2 than in location 1 (Table, 6). Beside the above mentioned pests and diseases, results also showed that there was high infestation of Buda ( Striga hermontheca ) among the pearl millet crop under test and this might be due to the law soil fertility .

**Table 5:** pests and diseases that affecting pearl millet.

| Period of sampling | Pests | Diseases |
|---|---|---|
| Early season | Larvae of butter fly, the aphids, pearl millet stem borer, white ants and grass hoppers. | Damping-ff of young seedlings, seed and root rot. |
| Middle of the season | Pearl millet head worm. | Downey mildew and smut diseases. |
| Late season | Pearl millet head worm, desert locust and birds. | Downey mildew and smut diseases. |

**Table 6:** Infection of different pearl millet varieties by diseases under the Influence of sowing date and soil type

| Variety | Location 2(clay loam soil) | | | | Location 1(sandy loam soil) | | | |
|---|---|---|---|---|---|---|---|---|
| | Foliage diseases | | Downey mildew | | Foliage diseases | | Downey mildew | |
| | % of disease incidence in early sowing. | % of disease incidence in late sowing. | % of disease incidence in early sowing. | % of disease incidence in late sowing. | % of disease incidence in early sowing. | % of disease incidence in late sowing. | % of disease incidence in early sowing. | % of disease incidence in late sowing. |
| **ID** | 40.9 | 28.9 | 8.9 | 7.6 | 23.9 | 18.8 | 4.4 | 7.2 |
| **ND** | 30.9 | 28.5 | 10.0 | 9.0 | 37.6 | 36.1 | 9.5 | 4.2 |
| **DR** | 41.1 | 20.8 | 8.7 | 8.0 | 30.4 | 20.7 | 8.2 | 3.5 |
| **B** | 34.0 | 16.8 | 7.8 | 8.8 | 22.4 | 11.7 | 4.0 | 5.0 |

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