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Response of Two Pearl Millet Cultivars (*Pennisetum glaucum*) to Water Stress in the University Garden at Gadau, Bauchi State University

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Abstract:
The response of two pearl millet cultivars to water stress in the university garden at Gadau, Bauchi state university was investigated by the determination of number of leaves and height of shoot, biomass of roots and shoot. For the purpose of this study two pearl millet cultivars were selected (Gero and Maiwa). The plant seeds were collected from the local farmers in Gadau village of Bauchi state, Nigeria. Split plot experimental design was employed on the two treatments. The treatment that received water from the beginning of the experiment to the end served as the control, while the other treatment received water at an interval after 28 days for 14 days. Results recorded did not show major reduction in Gero and Maiwa biomass in the treatment that received water at interval. No significant difference ($p<0.05$) of root biomass, shoot biomass, height and number of leaves between the irrigated treatments and the water stressed.

1. Introduction

Pearl millet (*Pennisetum glaucoma* (L.) R. Br) is an important crop in the Savanna. African countries like Nigeria produce a lot annually, in fact Nigeria produced 7.06 metric tons in 2008/2009 cropping season (NBS, 2013). The global ranking of countries that produce millet rank Nigeria second after India, this makes it an important crop in the country. It is ranked third in Nigeria, among cereal crops bested by maize and sorghum respectively. As a staple food in the Sahel savanna and parts of African Sudan savanna, the agricultural sector gives the crop an important status due to its ability to adapt to stressful conditions, like severe drought, high temperature and poor soil (Rai and Kumar, 1994).

Improvement programs for pearl millets are designed in Nigeria, to produce high yield for human food and fodder, which will go a long way in aiding the growing population (Izge, 2006).

Gero and Maiwa are two popular pearl millet varieties in the northern part of Nigeria, and local farmers cultivate these local varieties yearly.

Water deficit is among the important abiotic factors limiting crop productivity in the savanna, and climate change can make drought stresses even more severe in some years to come. To maintain international availability of food for the rich and poor, there is the need to identify crops that can adapt to limitation of water to some certain level (Moussa & Abdel-Aziz, 2008). The leaf gas exchange of plants is reduced under water stress and it leads to reduction in biomass accumulation and yield. Pearl millet production face numerous problems and finding ways of improving its productivity is vital Kusaka *et al.,* (2005).

2. Materials and Methods

The study was conducted at Bauchi State University Main Campus, Botanical garden research plot (1).

Good quality plant seeds were collected from the local farmers in Gadau village. Field sand was collected from the Botanical Garden, Department of Biological sciences, Bauchi State University Gadau. The soil was mixed with organic manure and then filled into the plastic pots leaving a space of about 3cm from the top, tiny holes were made underneath the pot in order to remove excess water.

Tap water was applied to each plastic pot to moisten the soil, three-five (3-5) seeds were planted in each sand filled plastic pots, after germination only 1 or 2 viable seeds were left in the plastic pots to grow. The observation started exactly 3days after planting.

For the first 28 days the plants were watered continuously, after 28 days the method of alternate wetting and drying was implemented (Umar, 2006) in which the experimental plants were watered at 5days interval and the control plants were watered continuously. By the end of the 6^{th} week, the plants were gently uprooted from the base. The shoot and roots were carefully separated, the roots were gently washed to remove soil debris and then both root and shoot were dried and weight individually. The experiment was a split plot design with 3 replicates each.

The data was collected based on physical measurements of plant height and counting of number of leaves which was taken at week six (42days). Root and shoot biomass was measured after drying.
Minitab statistical package general linear model (version 16) was used to analyze the data collected.

3. Results and Discussion

The ability of crops to tolerate water deficit in drought prone areas is an important characteristic, thus the need picks out local millet varieties with such attributes (Mohammed *et al.,* 2014). Determining such characteristics requires a lot of dedication and commitment (Moumeni, *et al.*, 2011), and since environmental factors are now unpredictable, which usually leads to reduction in yield, plants with the ability to tolerate drought can be very significant(Lafitte, *et al.,* 2007). The capacity of plant to retain high root and shoot weight when subjected to water stress at an early stage, can improve their survival as well as yield (Reddy, *et al.*, 2002). These study was carried out to help local farmers in Gadau town and Bauchi State, Nigeria by identifying which millet variety, between Gero and Maiwa is resistant to reduction of water. Table 1, 2, 3, and 4 showed the effect of limiting water on Gero and Maiwa.

Cultivar/water	DF	Seq SS	Adj SS	MS	F	P
Cultivar	1	0.709	0.569	0.569	0.21	0.655
Water	1	0.695	0.695	0.695	0.26	0.622
Error	8	21.192	21.192	2.649		
Total	10	22.596				

Table 1: Effect of water deficit on root biomass to the millet cultivars

DF = degree of freedom, Seg SS =sequential sum of squares, Adj SS=adjusted sum of squares MS = means of squares,
F = F ratio, P = Probability level.

Cultivar/water	DF	Seq SS	Adj SS	MS	F	P
Cultivar	1	0.222	0.277	0.277	0.14	0.716
Water	1	0.331	0.331	0.331	0.17	0.691
Error	8	15.591	15.591	1.949		
Total	10	16.144				

Table 2. Effect of water deficit on shoot biomass to the millet cultivars

DF = degree of freedom, Seg SS =sequential sum of squares, Adj SS=adjusted sum of squares MS = means of squares,
F = F ratio, P = Probability level.

Cultivar/water	DF	Seq SS	Adj SS	MS	F	P
Cultivar	1	3.71	5.35	5.35	0.06	0.812
Water	1	15.65	15.65	15.65	0.18	0.685
Error	8	707.19	707.19	88.40		
Total	10	726.55				

Table 3. Effect of water deficit on height to the millet cultivars

DF = degree of freedom, Seg SS =sequential sum of squares, Adj SS=adjustedl sum of squares MS = means of squares,
F = F ratio, P = Probability level.

Cultivar/water	DF	Seq SS	Adj SS	MS	F	P
Cultivar	1	0.30	0.24	0.24	0.02	0.895
Water	1	0.37	0.37	0.37	0.03	0.870
Error	8	102.96	102.96	12.87		
Total	10	103.64				

Table 4. Effect of water deficit on number of leaves to the millet cultivars

DF = degree of freedom, Seg SS =sequential sum of squares, Adj SS=adjusted sum of squares MS = means of squares,
F = F ratio, P = Probability level.

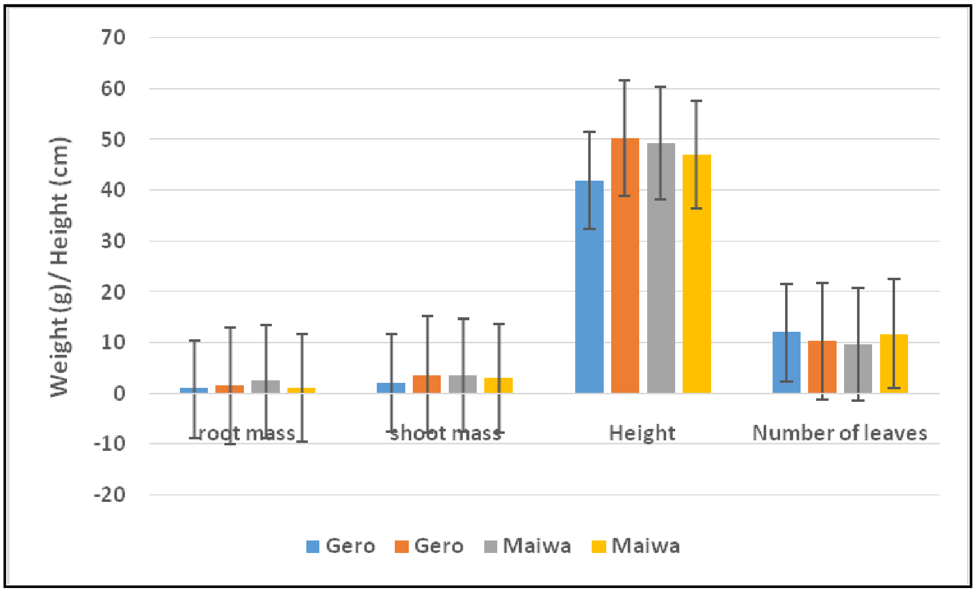

Figure 1: Number of leaves, height and biomass of Millet varieties

4. Water Deficits

There was no general reduction in plant biomass with increase in water deficit in the two cultivars. No significant difference ($p<0.05$) of root biomass, shoot biomass, height and number of leaves between the irrigated treatments and the drought (Figure 1). Thus Gero and Maiwa possess resilient characters to drought. Identifying varieties with such traits is very important, because water deficit plays a role in limiting productivity (Mohammed, *et* al; Price, *et al.,* 1999 and 2002; Gorantla *et al.,* 2007).

Physiological and biochemical changes at cellular, which are usually associated with water stress are protein to lipid interactions, protein to protein interaction, changes in concentration of solute, turgor loss and changes in membrane composition and fluidity (Mohammed *et al.,* 2014, Seghatoleslami *et al.,* 2008). Avoiding dehydration and tolerating dehydration are ways plants maintain turgidity during water deficit, which are controlled by traits like root biomass, root depth, capacity to grow through compacted layers of soil, and thicknessof the roots (Degenkolbe, 2009).The ability of Gero and Maiwa to produce osmorotectants which is an adaptive trait to water deficit could be a reason for tolerance of water deficit. Jeong *et al.*, 2010 obtained a different result.

5. Conclusion

This study concludes that both pearl millet cultivars 'Gero' and 'Maiwa' are tolerant of water stress.

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