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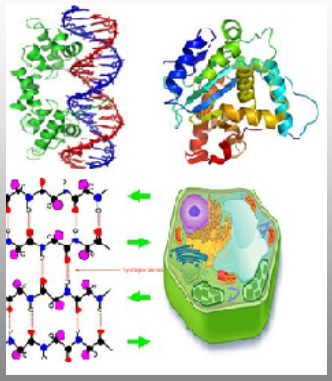

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Effects of Moisture Variation on Dry Season Production of Beans at Federal University of Agriculture, Abeokuta, Nigeria

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ABSTRACT

A field experiment was carried out at the farm of the Federal University of Agriculture, Abeokuta (FUNAAB) to study the effects of moisture stress levels on the production of bean. Randomized complete block (RBCD) was used during the field experimentation with 4 replicates which include grass and nylon mulching, and 3 treatments were considered, (control, no water and excess water respectively). The results showed that the water stress treatment significantly reduced the numbers of leaves per plant, leaf length, leaf width, plant height, and stem girth. Also, the grass and nylon mulched replicates were significantly increased, particularly at the excess water treatment. Significant difference was observed in the different characters studied in the various treatments. In this respect; excess watering treatment exhibited vigorous growth, greater number of leaves per plant, leaf length, leaf width, plant height and larger stem girth compared to the control treatment, while the no water treatment showed stunted growth due to low water potential of the un-mulched replicates.
Keywords: soil moisture, multiple comparism analysis, replicates, water treatments.

INTRODUCTION

Bean is one of the ancient human food resources and has probably been used as a crop since Neolithic times (Suleiman, 2000). Inadequate archaeological evidence has resulted in contradicting views supporting Africa, Asia, and South America as origin (Johansson, et al. 2002).

Bean is one of the ancient human food resources and has probably been used as a crop since Neolithic times (Suleiman, 2000). Inadequate archaeological evidence has resulted in contradicting views supporting Africa, Asia, and South America as origin (Johansson, et al. 2002). Presently, bean is grown throughout the tropic and subtropics areas around the whole world were rainfall resources are characteristically low (300-600 mm) and variable (Valenzuela and Smith, 2002).

Presently, bean is grown throughout the tropic and subtropics areas around the whole world were rainfall resources are characteristically low (300-600 mm) and variable (Valenzuela and Smith, 2002).

Generally, bean is better adapted to drought, high temperatures and other biotic stresses compare with other crops (Fall, et al. 2003). Many cultivators of beans are, however, damage by drought and high temperature, especially during reproductive development, resulting in few flowers being produced and substantially reduced beans productivity (Ahmed, 1992). The low productivity has been attributed to water deficit, the persistent of the traditional cropping systems, pests and diseases. Generally, under adequate soil moisture conditions, the beans flowers over a long period, produces more seeds, and yield loss is limited. On the contrary, under water deficit conditions, as is often the case in semi-arid zones, the flowering period is cut short and the seed matures earlier. Moreover, the formation of new floral nodes and flowers are delayed or aborted, thus leading to low productivity (Turk and Hall, 1980). In addition, been is also sensitive to drought at different stages of growth.

The objective of this study is to determine the growth response of beans plants to varying moisture situation. Moisture affects plant growth and the variation in crop yield has been related to variations in moisture content (Moormann and Kang, 1978). This study will give useful information on the proper balance of water when growing bean plant in dry season for optimum production. This is important as all parts of beans that are used for food are nutritious, providing protein, vitamins and minerals and this makes beans the most important source of cheap protein in Nigeria (Abebe, 2005).

A field experiment was conducted at the farm of Federal University of Agriculture Abeokuta, Nigeria to study the moisture variation on the production of beans. Federal University of Agriculture, Abeokuta is situated on a land area of about 97ha between longitude 3^0 24′ and 3^0 26′ and latitude 7^0 13′ 30″ and 7^0 14′ 30″. It is bounded in the South by Ogun, Osun River Basin Development Authority (OORBDA) headquarters and in the west, by Ogun River.

The University is located in Abeokuta the capital of Ogun State and the historic town is situated in South Western part of Nigeria which covers a geographical area of about 150 square kilometers. To the west of Ogun State, is the Republic of Benin, Lagos State lie on the South, Ondo State to the East and Oyo State on the North.

MATERIAL AND METHODS

Seventy two seeds of beans were grown in a randomized complete block design (RCBD)with four replicates, (two un-mulched and two mulched replicate) and three watering treatments was considered under irrigated condition and the planting technique used was sowing. The plot size was 5.3m by 7.5m consisting of six ridges of 1.8m in length in two rows. Each ridge, 20cm high was spaced at 25cm and crop was planted at a spacing of 25cm. Soil type was loamy soil and the sowing depth was about 2 to 3cm.

Planting was done on 7th March 2011, with one seed sown per hole. The seeds was planted 25cm apart in rows which consist of twelve ridges. Before planting, the experimental site was cleared using cutlass and small trees were cut off allow sunlight reach the bean plant and the soil was tilled (to turn the soil over) with hoe so as to give the plant the most ideal conditions for growth and development before the sowing of the seed was done. First weeding was done manually by hand picking about 2-3 weeks after planting and weeding was done 4-6 weeks after planting and subsequent weeding was done as necessary.

Plot size was 5.3cm by 7.5, inter row spacing was 25cm, Intra-row spacing was 1.1cm, between plant spacing as 25cm and number of standing as 72 beans plants.

Data on morphological traits were collected from each treatment in each ridge every week by using a meter rule and vernier caliper, also the soil temperature using soil thermometer and soil moisture content was determined using soil moisture tester meter.

The morphological traits are the followings: plant height (cm), stem girth (cm), leaf length (cm), leaf width (cm), number of leaves). Plant height was measure from the inflorescence top of the plant to the soil surface in centimeter (cm). Stem girth is the circumference of the stem above the soil was measured with vernier caliper in centimeter (cm). Leaf length was measured from the leaf apex to the bottom of the leaf (from top) in centimeter (cm). Leaf width was measured from across the widest part of the leaf (from top) in centimeter (cm). Number of leaves is the number of leaves of the leaves from each treatment counted and recorded.

The materials used for the soil moisture determination are soil moisture meter, pressurized meter, pressure gauge, ruler, nylon, stopwatch, weighting meter. Soil auger was used to collect soil samples at the location of planting from different depth in the soil, the depth were measures with the aid of a meter rule, the depth of which the soil sample were taken are (5cm, 10cm, 15cm, 200cm), the samples were placed in different nylons and weighted on a soil moisture meter one after the other and a certain mass (20g) was used placed in a pressurizes container and a quantity 3-5 spoons of calcium carbide was added, then the chamber was sealed and the two materials were brought into the content by shaking for one minute, after then the readings were recorded and the procedure were repeated for the remaining soil samples. The reaction of the calcium carbide on the water in the soil produces acetylene gas, the amount which depends on the quantity of water in the soil.

A pressure gauge calibrated for moisture content, fitted at the base of the cylinder is where the moisture content is read off as soon as the needle records a steady level. This was carried out at the laboratory and the procedure of subsequent determination of soil moisture content for the experiment was the same.

DATA ANALYSIS

Data was collected from the experiment unit every Friday for 8 weeks which was subjected to Analysis of Variance (ANOVA) and least difference (LSD) using Statistical package for social science (SPSS). The use of Anova is to test the formulated hypothesis, that there is no significant difference between the different water treatments.

H_o: There is no significant difference between the effects of different water treatment.

H_1: There is significant difference between the effects of different water treatment

Reject H_o if $P_{cal} > P_{tab}$ and accept H_1 if $P_{cal} < P_{tab.}$

P_{tab} = 0.05 (at 5% significance level). This implies that error is allowed to a level of 5% to give room for more precision.

N.B: P_{cal} =Calculated P- value and P_{tab} = Tabulated p-value.

RESULTS AND DISCUSSION

The result of the stem girth in each replicates is given below in Table 1.

Table 1. Results of Stem Girth.

STEM GIRTH	P_{tab}	P_{cal}
Replicate 1	0.05	0.402
Replicate 2	0.05	0.893
Grass Mulched Replicate	0.05	0.807
Nylon Mulched Replicate	0.05	0.769

The table 1 above shows that the P_{cal} for the stem girths (0.402, 0.893, 0.807, and 0.769) is greater than the P_{tab} (0.05) so we reject H_o and accept the H_1, then we conclude that there is significant difference between the effect of difference water treatment on the stem girths of the beans plant in each replicate at 8 weeks after planting.

The result of the plant height in each replicates is given below in Table 2.

Table 2. Results of plant Height.

PLANT HEIGHT	P_{tab}	P_{cal}
Replicate 1	0.05	0.980
Replicate 2	0.05	0.912
Grass Mulched Replicate	0.05	0.955
Nylon Mulched Replicate	0.05	0.973

The table 2 above shows that the P_{cal} for the stem girths (0.980, 0.912 0.955, and 0.973) is greater than the P_{tab} (0.05) so we reject H_o and accept the H_1, then we conclude that there is significant difference between the effect of difference water treatment on the stem girths of the beans plant in each replicate at 8 weeks after planting.
The result of the leave length in each replicates is given below in Table 3.

Table 3. Results of leave length.

LEAVE LENGTH	P_{tab}	P_{cal}
Replicate 1	0.05	0.983
Replicate 2	0.05	0.783
Grass Mulched Replicate	0.05	0.912
Nylon Mulched Replicate	0.05	0.958

The table 3 above shows that the P_{cal} for the leave length (0.983, 0.783 0.912, and 0.958) is greater than the P_{tab} (0.05) so we reject $H_{o\ and}$ accept the H_1, then we conclude that there is significant difference between the effect of difference water treatment on the leave length of the beans plant in each replicate at 8 weeks after planting.

The result of the number of leaves in each replicates is given below in Table 4.

Table 4. Results of Number of Leaves.

LEAVE LENGTH	P_{tab}	P_{cal}
Replicate 1	0.05	0.993
Replicate 2	0.05	0.941
Grass Mulched Replicate	0.05	0.783
Nylon Mulched Replicate	0.05	0.858

The table 4 above shows that the P_{cal} for the leave length (0.993, 0.941 0.783, and 0.858) is greater than the P_{tab} (0.05) so we reject H_o and accept the H_1, then we conclude that there is significant difference between the effect of difference water treatment on the number leaves of the beans plant in each replicate at 8 weeks after planting.
The result of the leaf width in each replicates is given below in Table 5.

Table 5. Results of Leaf width.

LEAF WIDTH	P_{tab}	P_{cal}
Replicate 1	0.05	0.986
Replicate 2	0.05	0.739
Grass Mulched Replicate	0.05	0.993
Nylon Mulched Replicate	0.05	0.991

The table 5 above shows that the P_{cal} for the leaf width (0.986, 0.739, 0.993, and 0.991) is greater than the P_{tab} (0.05) so we reject H_o and accept the H_1, then we conclude that there is significant difference between the effect of difference water treatment on the leaf width of the beans plant in each replicate at 8 weeks after planting.

The result of the multiple mean comparison (LSD) carried out in the treatment is given below in Table 6.

Table 6. Results of mean comparison Multiple comparisons (LSD).

(i) Water	(j)Water	Mean difference (I-j)
Excess Water	Control	0.77250
	No Water	0.70000
Control	Excess Water	-0.77250
	No Water	-0.07250
No Water	Excess Water	-0.70000
	Control	0.07250

N.B: I = Treatment held constant

J = Treatment varied

The table 6 above shows that excess watering treatment had the highest mean difference when varied with other treatments, hence we conclude that it has the highest significant effects on the growth parameters and is best suitable for growing beans at dry season.

DISCUSSION

Results of this study revealed that the excess watering treatment had the highest significant effects on the stem girths, plant heights, leave length, number of leaves and leaf widths of the beans plants which implies that the beans plants that received excess water showed vigorous growth statistically compared to other treatment considered. Also, the excess watering treatment had the highest significant effects on the growth parameters compared to the control treatment and this is attributed to the fact that adequate soil moisture has effect on vegetative development. This observation is in agreement with the evidences reported by Bates and Hall, 1992 who showed that under field conditions beans exhibits rapid growth and extreme drought avoidance at the vegetative stage to the extent that water conservation by the remaining tissue ensures plant survival.

The beans plants that received no water treatment in the un-mulched replicate was significantly decreased in the growth parameters studied as a result of water stress; in this regard it showed stunted growth due to low water potential level, and this did not occur in the nylon and grass mulched replicates. This is in conformity with the observation of Anyian and Herzog, 2004 who reported that under water deficit conditions, leaf area was sharply reduced as a result of leaf growth reduction and abscission. The reduction in leaf area reduces crop growth and thus biomass production.

It was also reported by Gomesda et al. 2001, that water stress has a significant effect on the growth and biological nitrogen fixation of bean crop.

The multiple comparison analysis (LSD) showed that excess watering treatment had the highest significant effect on mean number of leaves, leaf width, stem girth and plant height per plant particularly in the grass and nylon mulching replicate. On the other hand, the growth parameters in the no water treatment were significantly decreased as a result of water stress in this regard; number of leaves, leaf width, leaf length, stems girth and plant height per plant was significantly reduced, resulting in stunted growth of the beans plant. Also, the excess watering treatment showed vigorous growth in the mention attributes compared to the control treatment.

The statistical analysis of the relationship between soil depth versus soil temperature and soil depth versus soil moisture, showed that decreased soil temperature and increased soil moisture and significantly effects on mean number of leaves, leaf width, leaf length, stem girth and plant height per plant particularly on week 6 of the growing period, resulting to vigorous growth in the mention attributes compared to the other weeks.

Since all calculated valves are greater than tabulated values ($P_{cal} > P_{tab}$), we therefore eject the H_o and accept the H_1 and concluded that there exist significant difference between the effects of different watering treatment on the beans plant during the growing period.

CONCLUSION

From the result of the analysis obtained, it can be concluded that the excess watering treatment in the grass and nylon mulched replicates showed the best growth of the beans plant under adequate soil moisture conditions while the no water treatment in the un-mulched replicate was significantly decreased as a result of water stress, the beans plant showed stunted growth due to low water potential level, and this did not occur in grass and nylon mulching replicates. Therefore, in other to achieve a better yield of beans crop, excess watering treatment as well as mulching either grass or nylon is necessary or advisable in order to increase soil moisture storage in the soil needed for rapid growth of the beans plant. This is evident from the result obtained in agronomical parameters analyzed and mean comparison. Generally, mulching are good for crop production in dry or wet season because they protect the soil against raindrops impact, decreases inflow velocity by imparting roughness and improved infiltration capacity. It also suppresses of weed, enhance burrowing activities of some species of earthworms which improves transmission of water through the soil profile and reduces surface crusting and run-off and improve soil moisture storage in the root zone. Based on the analysis carried out, it is therefore recommended that the use of excess watering treatment and mulching is necessary in beans production in dry season which can be grass, metamorphic rocks, saw dusts, plastics, nylons etc. for rapid growth and optimum beans yield.

REFERENCES

Suleiman, A. H., 2000. Effect of water stress at different stages of growth on the performance of cowpea (Vigna unguiculata [L] Walp) cultivars. M.sc. (Thesis), University of Khartoum, Sudan.

Johansson R.C., Tsur, Y., Roe, T.L., Doukkali, R., Dinar, A. 2002. "Pricing irrigation water: A Review of theory and practice." *Water Pol*. 4(2): 173-199.

Valenzuela, H. and Smith, J., 2002. Green manure crops: Cowpea. Cooperative Extension Service. College of Tropical Agriculture and Human Resources University of Hawai at Manoa ASPGM-6.

Fall, L.D., Fall-Ndiaye, M.A., Badiane F. A. and Crueye, M., 2003. Genetic diversity in cowpea (Vigna unguicilata L. Walp) varieties determined by ARA & RAPD techniques. *African Journal of Biotechnology* 2(2):48-50.

Ahmed, F.E., Hall, A.E. and De, Mason, D.A., 1992. Heat injury during floral bud development in cowpea (Vigna unguicilata L. Walp) *Am. J. Bot*, 79: 784-791.

Turk, K.J. and A.E. Hall, 1980. Drought adaptation of cowpea III. Influence of drought on plant growth and relation with seed yield. *Agronomy Journal*, 72: 428-433.

Moormann, L. J. and Kang, E. I., 1978. Seed yield water use and water use efficiency of cowpea in response to drought stress at different developmental stages. PhD Thesis, Cornell University.

Abebe, G., Hattar, B. & AL-Tawaha, A.R.M., 2005. Nutrient availability as affected by manure application to cowpea (Vigna unguicilata L. Walp) on calacarious soils. *Journal of Agriculture and Social Sciences* 1 (1): 1- 6.

Bates, L. H., Hall A.E. and Hoover, R.M. 1982. Seed yields and water use of cowpeas (Vigna unguicilata L. Walp) subjected to planned-water deficit, Irrigation Science, 3:237-245. 410. “Cowpeas” 1909. KSU Experiment Station. Bulletin No. 160.

Anyian, A.O. and Herzog, H., 2004. Water-use efficiency, leaf area and leaf gas exchange of cowpea under mid-season drought. *Euro. J. Agron*, 20: 327-339.

Gomesda, S. J. A., Costa R. C. and Oliveira, J.T.A., 2001. Drought – induce effects and recovery of nitrate assimilation and nodule activity in cowpea plants inoculated withbradyrhizobium spp, under moderate nitrate level, Brazilian Journal of microbiology 32 (3)

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