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EFFECT OF SOIL MANAGEMENT PRACTICES ON EVAPORANSPIRATION OF SORGHUM PLOT

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ABSTRACT
The trial was conducted to quantify soil water loss under sorghum at Samaru (11^o 11'N, 7^o 36'E, 686m above mean sea level) on the Northern Guinea Savanna Ecological Zone of Nigeria during 2005/06 rainy seasons. The treatments, which consisted of two soil management practices, mulched soil and bared soil, were replicated four times in a randomized complete block design. Microlysimeters were installed at 8 weeks after sowing (WAS) for daily reading of potential evapotranspiration . Data were analyzed using the two way analysis of variance, and Pearson correlation analysis. Results from the two seasons indicated that there was a significant positive correlation between the yield, yield components and potential evapotranspiration under mulched soil. Under bare soil, water loss was not significantly correlated with the yield and yield components.

KEYWORDS: Sorghum, water loss, potential evapotranspiration and management practices.

INTRODUCTION

Sorghum originated in the northeast quadrant of Africa and spread from there throughout Africa and into India. In 1994, sorghum ranked fifth among the most important cereal crops of the world after wheat, rice, maize, and barley in both total area planted and production. Eighty percent of the area devoted to sorghum is located within Africa and Asia, with average yields of 810 and 1150 kilograms per hectare, respectively. It is a cereal crop that matures lately when compared to millet. It requires a warm temperature at night to germinate generally; less moisture is required than almost any other crop (Dennett *et.al*, 1981). It is often grown in areas with rainfall as low as 280mm per annum and needs less than 310mm of rainfall (Rosenberg, 1984, Dennett *et.al*, 1981). It does best in areas of low humidity. Excessive rains cause harm to it and the fruit needs to set in hot dry weather. It does better than any other cereal crop in poor conditions (Rosenberg, 1984, Dennett *et.al*, 1981). Grain sorghum plants are coarse annual grasses. Nearly all varieties grown in the United States are "dwarf" types, with stems under 5 feet in height and suitable for harvesting with combine harvesters. Many taller- stemmed varieties are grown in other countries.

Sorghum is of Gramineae family, closely related to maize and predominantly self-pollinating. It is grown on 44 million ha in 99 countries in Africa, Asia, Oceania, and the America. Major producers are the USA, India, Nigeria, China, Mexico, Sudan and Argentina .The crop occupies 25% or more of arable land in Mauritania, Gambia, Mali, Burkina Faso, Ghana, Niger, Somalia and Yemen, and >10% of this area in Nigeria, Chad, Sudan, Tanzania and Mozambique (Benami, *et al,* 1993).

Sorghum is a staple food crop of millions of poor in semi-arid tropics of Africa and Asia. It has gained increasing importance as a fodder (green/dry) and feed crop in the last decade. For direct human use (>55%), grain is mostly consumed in the form of flat breads and porridges (thick or thin); stover is an important source of dry season maintenance rations for livestock, especially in Asia; also an important feed grain (33%), especially in the America(Benami, *et. al*,. 1993).

Evapotranspiration is the total process of water transfer into the atmosphere from vegetated land surfaces (Michael *et. al*, 2005). It involves the conveyance of water vapor mass from the earth's surface and the reservoir within the soil into the atmosphere. Evapotranspiration is considered as an energy transfer process since the evaporation process which constitutes a crucial component of evapotranspiration involves the change of water from liquid to vapor requiring the heat of vaporization. It is equivalent to consumptive use which includes all the water consumed by plants plus the water evaporated from bare land and water surfaces in the area occupied by the crop. Incoming solar radiation under field conditions supplies the energy for the evapotranspiration (Doorenbo *et. al*, 1977). It can be determined by direct measurement or calculated from crop and climate data. Therefore, the objective of this study is to assess the water loss of sorghum under soil management practices.

MATERIALS AND METHODS

Direct measurement of potential evapotranspiration was made using microlysimeters during the wet season of 2005/2006 at the Institute for Agricultural Research's experimental farm at Samaru (11^o 11'N, 07^o 38'E, 686m above sea level), Zaria.

The experiment was replicated four times in a randomized complete block design. It was made up of two soil management practices namely: Mulched soil and bare soil. Seeds were sown on 30th June, 50cm apart, along the edges of 75cm spaced ridges. 2 plants per stand after thinning (53333) plants per hectare). The plot size was 27m^2. Spot application of fertilizers was carried out at the rate of 30kgN ha^{-1}, 30kgP^{2}O^{5}ha^{-1} and 30kgK^{2}Oha^{-1} using 20- 10 – 10 compound fertilizer (Urea). Nitrogen fertilizer was split applied at 3 and 5 weeks after sowing (WAS) followed by careful hand pulling of weeds, which were carried out, at 8WAS. The microlysimeters were installed at 8WAS for daily reading of potential evapotranspiration (water loss from sorghum).

Data collected were stand count at 50% emergence, potential evapotranspiration, yield component such as no. of plants per plot at harvest, heads per plot, plant height, no. of leaves at the main stem, seed weight, panicle weight, stover weight, and 100grain weight. Data were analyzed using the two way analysis of variance, and Pearson correlation analysis.

RESULTS AND DISCUSSION

There was a significant positive correlation between the following factors: no. of plants per plot and panicle weight (Table 1), no. of heads per plot and plant height, no. of heads of heads and panicle weight, plant height and no. of leaves on the main stem, no. of leaves on the main stem and panicle weight, seed weight and no. of plants per plot, seed weight and no. of leaves on the main stem, stover weight and no. of plants per plot.

There was also a significant correlation between potential evapotranspiration in the months of August and September and the no. of leaves as well as no. of heads per plot, no. of plants per plot, Stover weight and panicle weight under mulch soil. There was a significant correlation between the month of October and no. of plants per plot and plant height under mulched soil.

Table 1: Correlation coefficients of the relationship between potential evapotranspiration under mulched soil and yield components.

Variable	Correlation Coefficients									
	V_1	V_2	V_3	V_4	V_5	V_6	V_7	ACTAug	ACTSept	ACTOct
V_1				0.56	0.56	0.91	0.99		0.89	0.82
V_2	0.71		0.61	0.63	0.68	0.87				
V_3	0.56	0.72		0.73					0.79	0.81
V_4	0.56		0.73		0.81		0.75	0.91	0.84	0.61
V_5	0.89	0.62		0.81					0.84	0.56
V_6	0.91	0.62		0.75					0.73	0.56
V_7	0.99	0.68							0.98	
EVAPOAug		0.87		0.91					0.77	0.9
EVAPOSept	0.89		0.79	0.84	0.84		0.98	0.77		
EVAPOOct	0.82		0.81	0.6	0.56	0.56		0.87		

V_1 = no. of plants/plot, V_2 = no. of heads/plot, V_3 = plant height, V_4= no. Leaves, V_5= panicle wt, V_6= seed wt, V_7= Stover wt, EVAPOAug = Potential evapotranspiration for month of August, EVAPOSept = Potential evapotranspiration for month of September, EVAPOOct = Potential evapotranspiration for month of October

Under bare soil due to excess water loss, there was no significant correlation between the potential evapotranspiration and the yield components in all the three months (Table 2.0).

Table 2.0: Correlation of potential l evapotranspiration with the yield components under bare soil.

	V_1	V_2	V_3	V_4	V_5	V_6	V_7
EVAPOAug	0.21	0.044	0.35	0.032	0.21	0.33	-0.081
EVAPOSept	-0.036	0.22	-0.071	0.053	-0.055	-0.094	0.006
EVAPOOct	-0.063	0.48	-0.066	0.14	0.16	0.16	0.31

It was observed that yield components (Table 3.0) does better under bare soil than mulched soil.

Table 3.0: Statistical parameters of the yield components under mulched soil and bare soil.

Level of treatment	No of	Plants per plot	No of	Heads per plot	Plant	Height	No. of leaves on the main stem		Panicle weight
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean
Bare	11.21	2.35	15.07	3.60	155.43	18.53	13	1.66	0.88
Mulch	10.07	1.93	14.64	3.95	151.93	12.85	13.35	1.78	0.79

From the analysis of variance only the month of October potential evapotranspiration is significant with the yield components. This is because in the month of October, sorghum plant has matured and ready for harvesting , it does not need much water to grow so the water loss through potential evapotranspiration is low even though potential evapotranspiration is highest in this month when compared with the months of August and September (Table 4)

Table 4.0: Analysis of Variance between monthly potential evapotranspiration and the yield components.

Monthly pot. evaporanspiration	Mean	F Value	Standard error	CV
EVAPOAug	3.27	1.17	0.64	20.89
EVAPOSept	2.23	0.18	0.27	24.08
EVAPOOct	3.61	4.90	0.50	18.76

$P > 10\%$

Monthly potential evapotranspiration and yield components were compared using t test. It was observed that it was only in October that potential evapotranspiration was significant with yield components (Table 5.0).

Table 5.0: T test between monthly potential evapotranspiration and yield components.

Monthly actual evapotranspiration	T values
EVAPOAug	1.08
EVAPOSept	0.43
EVAPOOct	2.21

When water loss from sorghum for the three months were compared under mulch soil and bare soil, it was observed that water loss was high under bare soil than under mulched soil. This is because mulching helps to reduce water loss from the soil. (Table 6)

Table 6.0: Statistical parameters for potential evapotraspiration from August to October.

Variable	Treatment	Standard deviation	Standard error	Minimum	Maximum
EVAPOAug	Mulch	2.17	0.37	1.48	6.75
	Bare	2.24	0.38	1.99	7.43
EVAPOSept	Mulch	1.50	0.28	1.32	3.54
	Bare	1.60	0.26	1.45	3.54
EVAPOOct	Mulch	2.45	0.45	0.68	8.06
	Bare	2.87	0.54	2.29	8.75

CONCLUSION

It can be concluded that sorghum does better under mulch soil than bare soil. The water use of sorghum is highest in the month of October during the grain filling stage. Interaction between the potential evapotranspiration and yield components is more evidence in the month of October when the water loss is highest due to the termination of rain. From the experimental results, it is observed that the water loss is highest under bare soil.

REFERENCES

Benami, A and Ofen, A. 1993. Principles, Design and Agricultral practices. Published by Agricultral project, Kfer Galim,30865, Jerusalem, Isreal. Pp 1 – 144

Dennett, M.D. Eiston J and Speed C.B. 1981. Climate and cropping systems in West Africa Geoforum, Vol. 12 (2) 193 – 202.

Doorenbo, J. and Pruitt 1977. Guideline for predicting crop water requirements, irrigation and drainage. Paper 24, FAO, United Nations, 144pp.

Micheal, A,M. and Ojha, T.P (2005). Principles of Agricultural Engineering. Volume II, Jain Brothers. New Delhi

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