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Response of Okra (*A moschus esculentus* (L) Moench) to some Mulch Materials.

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ABSTRACT

Two experiments commenced in the dry and wet seasons, growth of two commonly grown okra cultivars, not mulched and mulched separately with oil palm bunch refuse, grass and brown wood shavings were studied. The two okra cultivars were: Emerald (green, smooth pods) and Clemson Spineless (green, smooth, ribbed pods). In both experiments soil temperatures were similar in mulch and unmulched treatments in the wet season planting while the mulch treatment reduced soil temperature by about 2°C in the bunch refuse and up to 4.1°C in the wood shavings during the dry season planting. These reductions in soil temperature led to a greater enhancement of crop growth in the mulched treatment of dry season planting, and equally, significant differences for most growth parameters within these mulch treatments. Highest yield of 26.8 pods/plant was obtained from Emerald cultivars and was significantly (P = 0.05) higher than 22.4 pods/plant obtained from Clemson spineless with bunch refuse treatment. The importance of mulching was emphasized by higher soil moisture content which occurred in the mulched treatment during the dry season. In both experiments, bunch refuse was outstanding in enhancing crop growth. During the two seasons of study, mulching with wood shaving suppressed weed growth while grass and especially unmulched soil encouraged weed growth.

INTRODUCTION

Research has shown that mulching improves plants growth, through enhanced soil moisture conservation, reduced soil temperature, prevention of soil compaction, provision of nutrients and reduction of diseases (Gunn et al, 1961; Hartley 1971;Tunner and Gilbank, 1974).

Okra is among the most commonly grown vegetables throughout Nigeria because of its mucilaginous, drawing fruit much liked for soups. The crop grows well under most Nigerian climatic conditions. The crop can do well in the rainforest of Nigeria where the bimodal rainfall results in two distinct growing seasons (dry season – September to December and wet season – march to June).

Okra is grown on about 2 million hectares annually in Nigeria (FMAWRRD, 1989). Okra is the leading vegetable in the vegetable market of Nigeria with high nutritional value, Taylor, (1966). For greater yield, application of 60KgN/ha^{-1}, 20KgP/ha^{-1} 20KgK/ha^{-1} will be required Adelena, 1985, (NIHORT 1976 – 1986, and Ayodele, 1993. In some part of the world, young shoots and leaves are eaten or used as toddler for the feeding of livestock and the fibre in the stem is used in making fish lines, traps and hammocks (Irvine, 1969).

The objective of this paper is to study the growth and yield of okra plants planted on bare soil and under the modifying influence of three mulch materials in order to determine the suitability of the mulch materials. These mulch are chosen because they are readily available and one of low economic use.

MATERIALS AND METHODS

The experiment was conducted at the farm of the College of Education, Akamkpa which lies between 8°14' and 8°20'E longitude 5°14'N and 5°18'N latitude with a rainfall over 2,000mm in the rainforest vegetation, of the basement complex soil. The area was previously cropped with cassava followed by four years fallow in which *Centrosoma pubescence* and *Panicum maxima* (Guinea grass) were the dominant fallow species. The site was manually cleared, allowed to dry for some days, then gathered together and removed. The plot size was 5m x 5m. Plots were uniformly planted to okra at inter row spacing of 50cm and intra-row spacing of 30 cm without tillage. The experiment was a 2 x 4 factorial, laid out in randomized complete block design (RCB) with four replications. The cultivars were Emerald (green, smooth pods) and Clemson Spineless (green, smooth ribbed pods). Four seeds of each cultivars of okra were planted per hole and thinned down to 2 plants about two weeks after seed germination.

The treatments were mulch of oil palm bunch refuse, grass, brown wood shavings and unmulched soil. Mulch materials were applied shortly after seed planting at the rate of 5t / ha for each season of the experiment.

Soil temperatures were recorded at 8.00 a.m. and 4.30 p.m. daily at 5cm depth, Iremiren (1982) three months after sowing. The plants/plot were randomly sampled and tagged for the determination of growth parameters number of leaves, plant height, number of pods/plant and pod dry weight/plant fresh pod yield / plot and weeds from the plots were regularly removed and their fresh weight recorded. The monthly soil moisture content in the plots was determined gravimetrically from September – December 1993 and March – June, 1994.

At germination, plants were sprayed weekly for 4 weeks with cymbush (cypermethrine) E. C. insecticide at the rate of 5m/10 litres of water for the control of flea beetles and other leaf – eating insects. Two weeks after planting, N.P.K. fertilizer (20:10:10) was applied at the rate of 200Kg/ha using band placement method (HIHORT, 1986). At about 50% flowering, a second

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TABLE 1: METEOROLOGICAL CONDITIONS AT COLLEGE OF EDUCATION, AKAMKPA, CROSS RIVER STATE, NIGERIA SEPTEMBER, 1993 – JUNE, 1994

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mch.	April	May	June
Total rainfall (mm)	492.6	241.3	102.2	35.0	8.1	27.8	65.2	232.6	241.0	250.1
Maximum temperature (0c)	35.4	26.5	32.7	31.0	34.8	35.2	34.7	32.9	31.3	30.2
Minimum Temperature (0C)	32.6	24.3	19.7	21.7	22.6	22.5	23.8	23.4	22.6	21.7
Mean Radiation (J/Cm2/day)	1533.4	1561.2	1578.4	2519.7	1574.7	1578.2	17184	1776.6	1671.1	1571.0

TABLE 2

Soil temperature (°C)

Experiment 1 (dry season) 1993 Month	Bunch refuse	Grass	Wood shavings	Unmulched soil	LSD (P=0,05)
September	32.6	30.9	36.0	38.6	1.2
October	33.8	33.6	32.4	36.7	1.6
November	28.5	32.4	30.6	36.5	1.4
December	28.2	30.6	28.5	35.6	1.3
Experiment 2 (wet season) 1994					
March	31.5	30.4	30.6	30.6	NS
April	31.2	31.5	31.2	31.1	NS
May	32.6	32.6	33.5	33.7	NS
June	34.8	33.9	34.9	34.6	NS

Soil moisture content (%)

Experiment 1 (dry season) 1993 Month	Bunch refuse	Grass	Wood shavings	Unmulched soil	LSD (P=0,05)
September	5.2	4.3	4.7	3.4	0.7
October	4.7	4.4	5.1	3.4	0.7
November	4.1	4.0	4.3	2.3	NS
December	3.2	3.1	3.4	2.6	NS
Experiment 2 (wet season) 1994					
March	4.3	4.6	4.9	3.4	0.3
April	5.3	4.7	4.8	3.7	0.8
May	6.7	5.7	6.8	3.5	0.6
June	6.8	6.4	6.9	3.6	NS

dose was applied by top dressing with urea (46:0:0) at the rate of 50kg/ha.

Analysis of variance for RCB design was used to compare the treatment and their means were compared with Fisher's Least Significant Difference (LSD) at 5% level.

RESULTS

Soil temperature and soil moisture content

Compared with the unmulched soil, bunch refuse reduced the mean monthly soil temperature by about 2°C and up to 4.1°C in the wood shavings during study period (Table 2). The temperatures were not significantly (P = 0.05) different between the mulch and unmulch treatments in the wet season planting and range from 30.1 – 30.4°C in the morning and 31.1 – 34.5°C in the evening. The % moisture content in experiment 1 declined sharply in all treatments from September to December (Table 2).

The lowest soil moisture content occurred generally in the unmulched soil in all the months and was significantly lower than that of the mulch treatment by up to 1.3%. The mulch materials were observed to conserve soil moisture to a similar extent. In experiment 2, the % soil moisture continued increasing sharply in all treatments from March to June. The treatments used in this study have provided ideal growth conditions through enhanced soil moisture conservation, reduced soil temperature, improved soil texture and aggregation, reduced weeds and diseases and promotes biodegradation and soil nutrient status. Although some mulch materials are bound to create a negative effect of

immobilization, in which nitrate nitrogen is used up by microflora, but in this study, a very positive effect was observed due to the application of the recommended fertilizer rates to the mulch treatments, bringing about mineralization. The availability of N within the mulch treatments therefore became a function of its concentration.

Okra Growth and yield

Mulching exerted significant (P = 0.05) influence on all okra growth parameters measured in the two cultivars during the study period (Table 3 and 4). Wood shavings performed poorly within the mulch treatments and their values for these parameters were significantly low, but higher than the unmulched plots. In experiment 1, leaf production, plant height, number of fresh pods per plant and pod dry weight/plot were significantly (P = 0.05) higher in Emerald cultivar than in Clemson spineless and this was obtained in the bunch refuse treatment. Very low dry weight of 35.6kg and low number of leaves per plant of 5.0 occurred in the unmulched and wood shaving treatment for Clemson spineless cultivar respectively. The interaction of cultivars x mulch treatment in terms of fresh pod yield (Kg/ha) is presented in table 5. Highest fresh pods yield of 73.8 (Kg/ha) was obtained from Emerald during the dry season planting and was significantly (P = 0.05) higher than 70.6Kg/ha obtained from Clemson spineless. During the wet season planting, highest fresh pod yield of 80.1 Kg/ha was obtained from Clemson spineless and was significantly higher than 77.9 Kg/ha obtained from Emerald cultivar. The fresh pod yield did not differ significantly (P = 0.05) among the mulch treatments, but seasonal variations were observed among the cultivars. The cultivars produced their highest yields at different treatments and at different seasons (Table 5).

The number of pods per plant in the two cultivars were lowest in the wood shavings and similar to the unmulched soil in Experiment 1 (Table 3). At 3 months, the highest mean pod dry matter (80.2g) occurred in Emerald cultivar with bunch refuse treatment and this was significantly (P = 0.05) higher than the respective values of other mulch treatment and those of Clemson spineless cultivars.

In experiment 2 (Table 4) the pod dry weight was similar for mulch treatment in the two cultivars but significantly higher than unmulched soil. The highest value (79.9g) occurred in Emerald cultivar with bunch refuse treatment. Very low number of leaves of 5.3 was

TABLE 3: Growth and yield parameters of okra and weed fresh weight at 3 months (Experiment 1 September – December dry season 1993)

Cultivars	Bunch Refuse	Grass	Wood Shavings	Unmulched Soil	Lsd (P=0.05)
Emerald					
Plant height (cm)	62.8	54.0	48.2	37.6	8.9
No. of leaves/ Plant	9.6	7.4	6.6	5.5	1.6
No of pods/ Plant	26.8	23.2	19.5	18.1	3.8
Dry weeds yield /plot (Kg/ha)	45.3	50.4	41.3	61.8	6.2
Pods Dry Weight (g/plant)	80.2	76.6	64.4	45.5	12.6
Fresh pod yield (Kg/ha)	87.4	84.5	71.6	51.7	10.2
Clemson Spineless					
Plant height (cm)	58.7	48.2	45.3	36.8	7.5
No. of leaves/ Plant	7.2	6.1	5.0	5.4	1.4
No of pods/ Plant	22.4	20.3	18.5	17.2	3.1
Dry weeds yield /plot (Kg/ha)	44.0	49.7	41.3	62.5	6.1
Pods Dry Weight (g/plant)	76.6	73.7	63.5	35.6	10.8
Fresh pod yield (Kg/ha)	85.5	82.6	70.7	42.8	9.6

TABLE 4: Growth and yield parameters of okra at three months Experiment 2 March – June 1994 (Wet season)

Cultivars	Bunch Refuse	Grass	Wood Shavings	Unmulched Soil	Lsd (P=0.05)
Emerald					
Plant height (cm)	61.7	50.5	46.6	38.0	7.8
No. of leaves/ Plant	9.5	7.6	5.6	5.4	1.5
No of pods/ Plant	27.2	23.1	19.5	18.1	3.8
Dry weeds yield /plot (Kg/ha)	46.2	51.3	42.1	63.8	6.4
Pods Dry Weight (g/plant)	79.9	79.5	79.9	37.9	NS
Fresh pod yield (Kg/ha)	87.8	87.6	87.5	48.7	NS
Clemson Spineless					
Plant height (cm)	57.6	49.1	43.5	37.2	7.0
No. of leaves/ Plant	7.3	6.2	5.3	5.2	1.4
No of pods/ Plant	23.7	22.4	20.6	19.4	3.2
Dry weeds yield /plot (Kg/ha)	45.1	51.0	42.1	63.2	6.3
Pods Dry Weight (g/plant)	79.7	79.9	79.8	46.1	NS
Fresh pod yield (Kg/ha)	88.3	87.8	87.9	56.2	NS

obtained from Clemson Spineless in plots treated with wood shavings and this value was similar to the 5.2 reported in the unmulched soil for the two cultivars. The average response of Emerald cultivars to mulch treatment in terms of growth parameters, was significantly (P = 0.05) higher than Clemson spineless throughout the experimental period.

Weed Growth

In both experiments and in the two cultivars, mulching with wood shavings suppressed weed growth than either bunch refuse or grass mulch, while unmulched soil encouraged weeds growth throughout the experimental period.

DISCUSSION

A similar soil temperature in the mulched and unmulched treatments in experiment 2 (wet season planting) suggests that the prevalent high rainfall (Table 2) suppressed the impact of the incident solar radiation on soil temperature. On the contrary, low rainfall in the early months of the dry season planting favoured reflection of solar radiation by the mulched materials and an attended reduction in soil temperature by different degrees. This condition led to the greater enhancement of plants growth parameters in the mulch treatment of the dry season planting. Again, the differences between the mulched treatments were more apparent in the dry season planting as significantly low leaf production, plant height, and number of pods occurred for wood shaving treatment, while significantly, higher plant dry weight occurred for bunch refuse treatment.

The growth differences between mulched and unmulched plants and within mulched plants may be partly due to soil temperature effects as treatment with lower soil temperature generally performed better. Lal (1975) reported high soil temperature as one of the factors which retarded crop growth in tropical soils and reducing this by mulching was beneficial to the crop.

Inspite of the fact that mulching did not lower the soil temperature in the wet season in the second experiment, it however improved the soil moisture regime during the dry season, probably by directly decreasing the losses caused by evaporation and, indirectly by lower evaporation through suppressed growth of weeds. The results implied that relatively high evaporation losses might have accompanied the higher soil temperature of the unmulched soil in the first planting season leading to water stress and the eventual poor plant growth. In both experiments, however, the pattern of partition of assimilates between the roots and the shoots of mulched and unmulched plants was

similar. Hence, the overall stress suffered by the plants of the unmulched soil was not detrimental enough to favour either the root or shoot at the expense of the other in the partition of the dry weight.

The application of wood shavings as mulch materials gave rise to immobilization process in the soil in which microbial organisms used up nitrate nitrogen in the soil during breaking down processes, thereby creating deficiency of nitrogen earlier in the season, (dry season) but competed favourably with other treatments later in the season (wet season).

CONCLUSION

This investigation has shown that okra growth and yield followed closely the treatment applied. The study has also shown that okra can be cultivated in both dry and wet seasons in Akamkpa, Cross River State, Nigeria using bunch refuse which is readily available in this area, to enhance soil moisture conservation, reduce soil temperature, improve soil fertility and fresh pod yield. The application of bunch refuse treatment for commercial production of okra would be beneficial in supplementing okra at the shortage of other vegetables in Nigerian markets at dry season for good economic returns.

Okra remains a warm season vegetable, the fresh pods of which are used boiled, in soups or fried. Okra seeds are roasted and ground as a coffee substitute or used in cooking. The taller heights obtained from okra will provide sufficient leaves and "stem" for fibre and other uses (Irvine, 1969). Martin and Ruberte, (1979), have reviewed such uses and have added still another, the preparation of vegetable curd from the seeds. For economic reason, cultivars that are high yielding should be extensively used, as may be evidenced from the plant height, number of leaves, and yield of fresh pods produced. This will lead to greater economic returns to the farmer.

REFERENCES

Adelena, B. O., 1985. Effects of N. P. K. fertilizer on the yield of Okra in South Western Nigeria. Samaru Journal Agric Resources, 3 (2): 67 – 72.

Ayodele, O. J., 1993. Yield responses of okra *Abelmoschus esculentus* (L) Moench) to N. P. and K fertilizers NIHORT Research Bulletin No. 13.

FMAWRRD, (Federal Ministry of Agriculture, Water Resources and Rural Development) (1989). Fertilizer use and Management Practices in Nigeria Series No. 2. W. O. Enwezor, (eds) Fertilizer Procurement and Distribution Division, Lagos.

Gunn, J. S., Sly, J. M. A. and Chapars, L. C., 1961. The Development of Improved Nursery practices for Oil Palm, W. Africa Inst. Of Oil Palm Res. 3: 198 – 232.

Hartley, G. W. S., 1977. The Oil Palm (*Eleasis guineanensis Jacob)* Longman, London

Iremiren, G. O., 1982. Study of the suitability of various materials as mulch of polybag oil palm seedlings: Journal of Nigerian Institute for Oil Palm Research, Vi. (22): 191 –193.

James, A. T., 1988. Post Harvest Biodeterrioration of Okra *Abelmoschus esculentus* (L) Moench. PhD thesis Univ. of Ibadan, Nigeria

Lal, R., 1975. Role of mulching techniques in tropical soils and water management. IITA Techincal Bulletin No. 1

Martin, F. W. and Ruberte, R., 1979. Milling and use of okra seed meal at the household levels. Journal of Agriculture. University of Puerto Rico. 63: 252 – 259.

NIHORT (National Institute for Horticultural Research 1976 – 1986). Advances in fruit and vegetable research at NIHORT. A commemorative publication to mark the 10th anniversary of the National Horticultural Research Institute (NHORT) Ibadan.

Taylor, D. A., 1996. Preservation, storage processing and marketing of horticultural produce in Nigeria. Proc. 14th HORTSON Conf. Ago Iwoye. 1 – 4 April, 1996; 9 – 13.

Turner, R. D. and Gilbank, R. A., 1974. Oil palm cultivation and management Incorporated society of Planters, Kuala, Lumpur.