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Effect of Soil Solarisation on Weeds Management and Productivity of Okra (*Abelmoschus esculentus* L.) in Sudan Savanna, Maiduguri Borno State

Abubakar Hussaini[1]; Abdulhamid Muhammad Yusuf[2]; Mohammed Ibrahim Shuwa[3] and Kaka Aisha Sadiq[4]

[1]Teaching and Research Farm, University of Maiduguri, Borno State, Nigeria
[2]Department of Crop Science, Federal University of Agriculture, Zuru, Kebbi State
[3&4]Department of Agricultural Science and Technology, Ramat Polytechnic, Maiduguri, Nigeria
hussainiabubakar302@gmial.com; mohammedshuwa43@gmail.com; abdulhamidmuhammad50@gmail.com and kaka113mag@gmail.com

***Abstract**: Field trial was conducted to determine the Effect of Soil Solarisation on Weeds Management and Productivity of Okra (Abelmoschus esculentus L.) in Maiduguri at Ramat Polytechnic Teaching and Research Farm Maiduguri, during 2022 raining season. The experiment consists of five (5) treatments (T1 = weedy check, T2 = solarisation for 2 weeks, T3 = solarisation for 4 weeks, T4 = solarisation for 6 weeks and T5 = solarisation for 8 weeks), laid out in Randomize Complete Block Design (RCBD) and replicated three time. Parameters measured are: Plant height, Number of leaves, Leaf area/plant and 50 % Flowering; Data collected were subjected to analysis of variance. The result showed that solarisation at 8 weeks recorded the highest plant height, most number of leaves per plant, largest leave area per plant at all the sampling periods, and 50 % 0f the plants attainted flowering earliest as well as highest yield at harvest while the 50 % of plants attainted flowering late and shortest plants were recorded in weedy check, as well as fewest number of leaves per plant, smallest leave area and fewest yield at harvest. Recommendation based on the result, it is therefore recommended that, solarisation for 8 weeks should be used in Maiduguri as it controls weeds efficiently and it increases nutrient quality of the soil. The crop should be tested against other weed control methods for further weed control in the system.*

***Keywords**: Soil Solarisation, Weeds Management, Productivity, Okra.*

INTRODUCTION

*Abelmoschus esculentus (*L.*)* is an important vegetable crop belonging to the family *Malvaceae* and it is reported that okra originated in Ethiopia and is now widely spread all over tropical, subtropical and warm temperate regions of the world, including in West Africa, India, Brazil and the United States (Saifullah and Rabbani, 2009). The world production of common okra as a fresh vegetable is estimated at 1.7 million tons per year (Schippers, 2000). Okra is the most important vegetable crop in West Africa and a source of calorics (4550 kcal kg-1) for human consumption and it ranks first before other vegetable crops (Babatunde *et al.,* 2007). In Nigeria it ranks third in terms of consumption and production area following tomatoes and pepper (Ibeawuchi, 2007).

The composition of okra leaves per 100 g edible portion is: water 8 1 .50 g, energy 235.00 kJ (56.00kcal), protein 4.40 g, fat 0.60 g, carbohydrates 1 .30 g, fibre 2.10 g, Ca 532.00 mg, P 70.00 mg, Fe 0.70 mg, ascorbic acid 5.9.00 mg, β-carotene 5.00 μg, thiamin 0.25 mg, riboflavin 2.80 mg, niacin 0.20 mg (Varmudy, 2011). Carbohydrates are mainly present in the form of mucilage (Liu *et al*., 2005; Kumar *et al.,* 2009). The leaf buds and Flowers are also edible (Doijode, 2001). Its production is a source of income for rural smallholder fanners and retailers in urban centres.

Weeds are plants growing out of a place where they are not desired for a particular period of time. Weed problems have turned into a continuing struggle for farmers on account of the pressure to raise crops and maximize crop production to meet increasing demand of the fast growing human population. Weeds are the scarce and silent robbers of plant nutrients, soil moisture, solar energy and also occupy the space which would otherwise be available to the main crop; harbour insect-pests and disease-causing organisms; exert adverse allelopathic effects; reduce quality of farm produce and increase cost of production. Weeds, unlike other pests, are omnipresent and account for at least one-third of this loss. Losses due to weeds are higher than those from insects and diseases – insects 30%, weeds 45%, diseases 20%, other pests 5% (Rao, 2000). Therefore, efficient weed management approach is expected to contribute significantly in sustaining agriculture. There are several methods for controlling weeds such as cultural method, manual and mechanical method, chemical method, allelopathy and integrated approach. The most practised one is hand weeding but it is laborious, time consuming, costly and also is not feasible under all situations. Now-a-days, for effective and economic weed control, herbicides are gaining popularity among the farmers. Out of total pesticide use, 17% is herbicides. The compound growth rate of herbicide consumption has been 13.7% against – 3.88% of insecticides for the last one decade (Aulakh, 2005). But the continuous use of herbicides poses many problems such as, it causes health hazards, pollutes the environment, contaminates drinking water, contaminates the soil and terrestrial system, contaminates food and agricultural produces, contaminates aquatic and marine products, causes toxicity to the succeeding crop, develops resistance in weeds and causes shift in weed flora.

Therefore, interest in non-chemical approaches which aim to reduce pesticide usage is growing. So, there is a great necessity for the development of alternative non-hazardous means of weed management. In this light, harvesting of solar energy through soil solarisation for controlling weeds is a potential step to reduce the dependence on chemicals.

MATERIALS AND METHODS

Field experiment was conducted at department of Agricultural Technology School of Agriculture and Applied science Ramat Polytechnic Maiduguri Integrated Teaching and Research Farm during the 2022, raining season. The site is located at longitude (11.50^{0}N and latitude 10.935^{0}E). Maiduguri fall unrainydera semi-arid zone, characterized by violent wind, long dry season and short raining season. The mean annual rainfall in the area range from 300-500mm falling mainly between June - September with a peak in August. Temperature range from 35^{0}C in December/January to a maximum of 40^{0}C in April.

The materials that were used for this project include: okra, ranging pole, measuring tape, rake, digital scale, a weighing scale, transparent polyethylene, poultry manure, shovel and hoe. The treatment consists of five weed control method namely: T1 (weedy check), T2 (solarisation for 2 weeks), T3 (solarisation for 4 weeks), T4 (solarisation for 6 weeks) and T5 (solarisation for 8 weeks) were laid out in Randomized Complete Block Design (RCBD) replicate three times

The experimental site was cleared, tilted and prepared into beds, these was done manually using hoe. The field was laid according to the experimental design. Plots were measured 3m x 3m and the net plot is 2.8 x 2.8m^2, sowing was carried out at a spacing of 60cm x 60cm. Data were collected on plant height, number of leaves, leaf area per plant, days to 50% flowering, Yield weight per plot at harvest. The soil organic matter was determined before sowing and after sowing by measuring the weight (Fang C.M *et al.,* 2005). Data collected were subjected to analysis of variance technique (ANOVA) using statistic 8.0 and means were separated using least significant difference at 5% level of probability.

RESULTS

Table1: Physico-Chemical Characteristics of the Soil at the experimental site in 2022

Treatments	**Before Solarisation**	**After Solarisation**
pH in H_2O	6.89	6.90
EC (mmhos/cm^3)	0.27	0.25
Moisture content (g/g)	1.51	1.53
Water Holding Capacity (%)	51	54
Organic carbon (%)	0.60	0.58
Organic matter (%)	1.12	1.12
Total N (%)	0.30	0.38
Available potassium (me/100g)	0.763	0.812
Availabel calcium (me/100g)	0.640	0.590
Available Magnesium (me/100g)	0.301	0.400
Available phosphorus (me/100g)	0.70	0.89
Available Aluminium (me/100g)	0.10	0.14

Mechanical analysis (0-15 depth)

Clay (%)	5.56	6.90
Sand (%)	89.31	87.44
Silt (%)	10.02	9.02
Field Texture	Sandy Loam	Sandy Loam

Table 1 shows the details of the physico-chemical properties of the soil at the experimental site. The soil was coarsed, well drained sandy loam having low to moderate organic matter content.

Table 2: Effect of soil solarisation on plant height cm of Okra

Treatments	**Plant height (cm)**		
	2 WAS	**4 WAS**	**6 WAS**
T_1	5.86^b	15.13^b	21.33^b
T_2	9.20^{ab}	19.00^b	29.86^a
T_3	10.66^a	19.53^b	30.90^a
T_4	10.56^a	19.80^b	29.90^a
T_5	11.76^a	22.43^a	31.80^a
LSD (0.05)	1.63	1.05	1.09
Level	*	*	*

T_1 = weedy check

T_2 = 2 weeks of solarisation

T_3 = 4 weeks of solarisation

T_4 = 6 weeks of solarisation

T5 = 8 weeks of solarisation

WAS = Week after Sowing

LSD = Least Significant Difference

Table 2 shows the effect of soil solarisation on the plant height of Okra at 2,4 and 6 WAS. This table shows that solarisation had a significant effect on the plant height of okra, where solarisation for 8 weeks recorded the highest plant height at 2,4 and 6 WAS which was statistically the same with T2, T3, T4 both at 2 and 6 WAS but statistically different with T1 at 2 and 6 WAS and all other treatments at 4 WAS.

Table 3: Effect of soil solarisation on Number of leaves of Okra

Treatments	Number of Leaves		
	2 WAS	4 WAS	6 WAS
T_1	3.70^{b}	5.10^{b}	8.90
T_2	5.56^{ab}	7.76^{a}	10.43
T_3	7.56^{a}	7.53^{a}	9.53
T_4	5.56^{ab}	6.56^{ab}	11.53
T_5	7.90^{a}	8.23^{a}	10.23
LSD (0.05)	1.55	0.87	1.07
Level	*	*	NS

T_1 = weedy check

T_2 = 2 weeks of solarisation

T_3 = 4 weeks of solarisation

T_4 = 6 weeks of solarisation

T5 = 8 weeks of solarisation

WAS = Week After Sowing

LSD = Least Significant Difference

NS = Not Significant

Table 3 shows the effect of soil solarisation on number of leaves per plant of Okra. Solarisation had significant effects on number leaves per plant of Okra at 2 and 4 WAS where treatment 5 recorded the highest number of leaves per plant at 2 and 4 WAS which was statistically the same with treatment 2, 3 and 4 both at 2 and 4 WAS While treatment 1 recorded the least number of leave per plant but there was no significant difference at 6 WAS.

Table 4: Effect of soil solarisation on leaf area per plant of Okra

Treatments	Leaf Area		
	2 WAS	4 WAS	6 WAS
T_1	18.133^{b}	61.43^{b}	374.77^{b}
T_2	29.233^{a}	105.37^{ab}	566.93^{a}
T_3	26.667^{ab}	124.43^{a}	507.73^{ab}

T_4	31.467[a]	111.60[a]	475.52[a]
T_5	31.667[a]	147.73[a]	594.27[a]
LSD (0.05)	4.66	17.11	73.87
Level	*	*	*

T_1 = weedy check
T_2 = 2 weeks of solarisation
T_3 = 4 weeks of solarisation
T_4 = 6 weeks of solarisation
T5 = 8 weeks of solarisation
WAS = Week after Sowing
LSD = Least Significant Difference

Table 4 shows the effects of soil solarisation on leaf area per plant of Okra. Solarisation had significant effects on leaf area per plant of okra at all the sampling period. All treatments receiving solarisation are statistically the same where solarisation for 8 weeks gave the largest leaf area per plant of okra at all the sampling period compare to weedy check which gave the smallest leave area per plant at all the sampling period.

Table 5: Effect of soil solarisation on days to 50% flowering and okra yield at

Harvest

Treatments	Days 50% flowering	Yield
T_1	51.00[a]	132.38[e]
T_2	44.00[b]	242.96[d]
T_3	42.00[c]	256.83[c]
T_4	41.33[d]	273.67[a]
T_5	40.33[a]	268.92[a]
LSD (0.05)	0.632	19.570
Level	*	*

T_1 = Weedy Check
T_2 = 2 weeks of solarisation
T_3 = 4 weeks of solarisation
T_4 = 6 weeks of solarisation
T5 = 8 weeks of solarisation
WAS = Week After Sowing
LSD = Least Significant Difference

Table 5 shows the effect of soil solarisation on days to 50% flowering and yield of Okra at harvest. Solarisation and poultry manure had significant effect on number of day to 50% flowering of okra where the control treatment significantly recorded the highest number days to 50% flowering which was statistically different with rest of the treatment and T_5 had the lowest number to 50%

flowering. Solarisation has significant effect on yield of okra, where treatment 4 had the highest yield per plot and treatment 1 had the least yield of okra at harvest.

4.2 Discussion

Growth and yield of Okra (*Abelmoschus esculentus*) as affected by solarisation.

Soil solarisation had significant effect on plant height at 2, 4 and 6 WAS. This agrees with the work of (Lombardo *et al.,* 2012 and Scopa *et al.,* 2008) which states solarisation with plastic material had significant effect on soil PH, EC, nutrient availabilities and soil micro flora their by improving crop growth in may important crop plants like tomato and melon.

Significant effect was observed on number of leaves per plant and leaf area per plant due to soil solarisation, as well as largest leaf area per plant throughout the sampling period. These further confirm the finding of Sofi *et al.,* (2014) who reported that solarisation with plants material was significant on crop vigour.

Significant effect was observed on yield and yield parameters as affected by soil solarisation at different solarisation period. The 8-week solarisation period had the least number of days to 50% flowering which indicates no delayance in flowering. This is tallied with findings of Ranson and Vision which state that solarisation alone helps in raising the temperature of the soil, thereby inducing early flowering in crop plants. 6 weeks of solarisation had the highest pro yield of okra at harvest throughout the harvesting period. This agreed with the findings of Iombardo *et al.,* 2012.

Effect of solarisation on weed control

The result exhibited that solarisation had a positive effect on weed control in crop fields, this was further confirmed. The research findings of Patricio *et al.,* 2006; Culmon *et al.,* 2006; Bonanomi *et al.,* 2008 and Ozores-Hampton *et al.,* 2012 stated that a significant reduction of weed cover was observed with soil solarisation with transparent plastic sheets coupled with slight canola straw. This reduction might be due to the rise in the temperature of the soil more especially the top most surface of the soil directly under the polyethylene sheet cover than in the non solarisation soil which improved heat conductivity of the soil.

5.2 Conclusion

In conclusion, this study showed that 8 weeks of solarisation is most effective as it controls weed and promotes the growth and yield of okra, in Maiduguri Sudan Savanna of Borno state Nigeria.

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REFERENCES

Aulakh, K. S. 2005. In: *Inaugural address, Souvenir, National Biennial Conference, Indian Society of Weed Science*, held at Ludhiana, Punjab, April 6-9.

Babatunde, R.O., Omotesho, O.A, Sholoton O.S., (2007) Socio Economic Characteristics and Food Security Status of Farming House held in Kwara State, North Central Nigeria. *Pakistan Journal of National* (1)*,* 10.

Bonanomi, G., M. Chiurazzi, S. Caporaso and G. Del Sorbo, G. Moschetti and S. Felice. (2008). Soil solarisation with biodegradable materials and its impact on soil microbial communities. Soil Biology & Biochemistry. 40: 1989-1998.

Doijode S.D., (2001). Seed Storage of Horticultural Crop. Food Production Press, New York USA.

Fang C.M., Smith P., Monorieff J.B. (2005). Similar response of cable and resistant soil organic matter pools to changes in temperature. Nature. 436:881 – 883.

Ibeawochi, I.K. (2007). Intercreping a Food Production Strategy for Resources Poor Farmers, Notore and Science Vol. 5, No pp. 46 – 49.

Lombardo, S., Longo, A.M.G., Lo Monaco, A., & Mauromicale, G. (2012). The effect of soil solarisation and fumigation on pests and yields in greenhouse Tomatoes. Crop Protection, 37, 59-64

Ozores-Hampton, M.P., Obreza, T.A., & Stoffella, P.J. (2004). Mulching with composted municipal solid waste for biological control of weeds in vegetable crops. Compost Sci. Utilization, 9, 352-361.

Rao, V. S. 2000. Principles of weed science. Second edition, published by Mohan Primlani for Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, pp. 1.

Saifullah M., Rabbani M.G., (2009). Evaluation and Characterization of Okra (*Abelmoschus esculentus L. moeneh*) Genotypes. *Sorrel J. Agric.* 7:92 – 99.

Schippers, R.R., (2000). African Indegenous Vegetable: An Overview of the Cultivated Species. Chathan, UK: Natural Resource Institute/Acpeu Technical Center for Agricultural and Rural Cooperation, 103 – 113 pp.

Sofi, T.A., Tewari, A.K., Razdan, V.K., & Koul, V.K. (2014). Long term effect of soil solarisation on soil properties and cauliflower vigor. Phytoparasitica, 42, 1–11. DOI 10.1007/s12600-013-0331-z

Varmudy, D.R. (2011). Soil solarisation: pathogen and disease control and increases in crop yield and quality: short- and long-term effects and integrated control, in Soil solarisation (J. Katan and J.E. DeVay, Eds.). CRC Press, Boca Raton, Florida. 39-50.