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Influence of Different Tillage Methods and Organic Manure on the Performance of African Spinach (*Amaranthus cruentus* L.)

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ABSTRACT

Tillage practices is crucial in enhancing soil conditions for crop production, influencing many soil factors. A field study was carried out in 2023 to investigate the impact of different tillage methods (Ridge, Heap, Seedbed and no tillage as control with addition of organic manure on the growth and yield of African spinach. The study encompasses various parameters, including plant height, leaf area, stem girth, and ultimately, yield parameters (Biomass fresh weight). The results of the study showed that Ridge as a tillage method with addition of organic manure gave optimum yield among the treatments. Africa spinach in this treatment had the highest plant height, leaf area, stem girth and biomass fresh weight values of 27.75, 19.55, 4.33 and12.5 respectively except in number of leave which had 12.5for seed-bed. Ridge tillage and organic manure had significant effects on growth and yield of Africa spinach ($p \leq 0.05$). Its therefore suggested for increase Africa spinach production in Nigeria.

***Keywords**: Africa spinach, Tillage methods, Growth parameter, Yield parameter, Manure, Ridge, Heap.*

INTRODUCTION

Tillage involves the mechanical manipulation of soil to create an optimal environment for seed germination and plant growth. The specific tillage method used depends on the factors such as crop species, weather conditions, location and the timing of the tillage process. Zhang *et al*. (2012) reported that tillage helps in reshaping the physical, chemical and biological properties of the soil.

Soil organic matter refers to animal and plant residues in various stages of decomposition. The final form of decomposed organic matter is a brown to black, gelatinous substance called humus. Humus provides plants with the necessary nutrient elements for plant growth. The humus makes the soil to increase its permeability and its retention capacity for water and nutrients. One of the way to increase the nutrient status of the soil is utilization of organic materials such as poultry waste, compost and animal manure. (Mpanga *et al*., 2021). Mpanga *et al*. (2021) reported that organic manures provide a source of all necessary macro- and micro-nutrients in utilizable forms which improve the physical and biological properties of the soil.

African spinach originated from South American and is among the world's oldest cultivated vegetable crop (FAO, 2024). It is grown in tropical, subtropical and temperate regions for its nutrient-rich leaves and seeds, which are high in vitamin A, Calcium, protein and minerals (Iyaka,

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2013), and its edible parts of leaf, stem and roots of plant.

Given the relative low level of African spinach yield during production in Nigeria compared to other continents, there is a need to identify the most effective land tillage methods in addition to nutrient level augmentation. Therefore, its role in cropping system need to be understood more. The objective of the study was to evaluate the influence of different tillage practices and organic manure on the growth and yield of African spinach.

MATERIALS AND METHODS

The study was carried out during the September-November, 2023 in the Teaching and Research farm of the Department of Agricultural Technology, The Federal Polytechnic, Ado Ekiti. The land preparation was done manually. A 10m x 6m plot was marked out and divided into two sets (addition of manure and without manure) 1m x1m plot with 0.5alley was made in each set and experimental design was Randomized Complete Block Design (RCBD) with 8 treatments and 4 replicates.

The African spinach (*Amaranthus cruentus*) seeds was obtained from International Institution of Tropical Agriculture, (IITA) Ibadan Oyo State Nigeria. The seeds were planted using drilling method at a spacing of 30 cm x 30 cm and data was taken from five randomly selected stands on each plot.

All data collected from growth and yield parameters (plant height, stem girth, leaf area, number of leaves, number of root and after harvest were analyzed using GenStat 4.0 and means was subjected to separation using DMRT at 5% probability level.

RESULTS

Table 1: Effect of Different Tillage Methods and Organic Manure on Plant height of African spinach

Treatments	Plant height (cm) WAS 2	WAS 4	WAS 6
CM	6.33[a]	15.54[a]	21.55[a]
HM	6.37[a]	15.76[a]	26.58[a]
RM	4.63[a]	15.08[a]	27.75[a]
SM	6.18[a]	16.80[a]	25.66[a]
CN	5.58[a]	11.86[a]	20.22[a]
HN	5.44[a]	14.66[a]	23.74[a]
RN	5.72[a]	14.43[a]	21.81[a]
SN	5.72[a]	14.43[a]	26.63[a]
SE±	±0.83	±2.11	±2.26

Means with the same letter within a column are not significantly different at 5% level of significance using Duncan Multiple Range Test (DMRT). CM-Control with Manure, HM-Heap with Manure, RM-Ridge with Manure, SM-Seedbed with Manure, CN-Control without Manure, HN-Heap without Manure, RN-Ridge without Manure, SN-Seedbed without Manure. WAS-Weeks after sowing

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Table 2: Effect of Different Tillage Methods and Organic Manure on Stem Girth of African Spinach

Treatment	Stem girth (mm) WAS 2	4	6
CM	1.20[a]	3.08[a]	4.13[a]
HM	1.11[ab]	2.93[a]	4.23[a]
RM	0.65[b]	2.90[a]	4.33[a]
SM	1.24[a]	3.15[a]	4.09[a]
CN	0.83[ab]	2.81[a]	3.93[a]
HN	1.01[ab]	2.88[a]	4.01[a]
RN	0.93[ab]	3.35[a]	4.23[a]
SN	0.95[ab]	2.90[a]	4.32[a]
SE±	±0.16	±0.19	±0.19

Mean with the same letter within a column are not significantly different at 5% level of significance using Duncan Multiple Range Test (DMRT).
CM-Control with Manure (no tillage), HM-Heap with Manure, RM-Ridge with Manure, SM-Seedbed with Manure, CN-Control without Manure (no tillage), HN-Heap without Manure, RN-Ridge without Manure, SN-Seedbed without Manure. WAS-Weeks after sowing.

Table 3: Effect of Different Tillage Methods and organic Manure on leaf area of African spinach

Treatment	Leaf area (c m^2) WAS 2	4	6
CM	5.67[a]	11.59[a]	15.37[bc]
HM	5.19[a]	11.50[a]	15.39[bc]
RM	4.69[a]	11.50[a]	19.55[a]
SM	5.98[a]	11.99[a]	15.44[bc]
CN	5.05[a]	10.95[a]	14.05[c]
HN	5.19[a]	13.40[a]	17.11[ab]
RN	5.01[a]	13.73[a]	15.43[bc]
SN	5.30[a]	12.95[a]	18.33[ab]
SE±	±0.70	±1.14	±1.25

Means with the same letter within a column are not significantly different at 5% level of significance using Duncan Multiple Range Test (DMRT).
CM-Control with Manure (no tillage), HM-Heap with Manure, RM-Ridge with Manure, SM-Seedbed with Manure, CN-Control without Manure (no tillage), HN-Heap without Manure, RN-Ridge without

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Manure, SN-Seedbed without Manure.
WAS-Weeks after sowing.

Table 4: Effect of Different Tillage Methods and organic manure on Stem Girth of African Spinach

Treatment	Number of leaves		
	WAS		
	2	4	6
CM	4.05^{ab}	7.60^{a}	10.45^{b}
HM	3.95^{ab}	7.30^{a}	11.45^{ab}
RM	3.90^{ab}	7.20^{a}	10.05^{b}
SM	4.45^{a}	7.90^{a}	12.50^{a}
CN	3.70^{b}	10.90^{a}	9.80^{b}
HN	4.10^{ab}	7.90^{a}	11.45^{ab}
RN	4.30^{ab}	8.55^{a}	12.25^{a}
SN	4.20^{ab}	7.45^{a}	11.25^{ab}
SE±	±0.23	±1.54	±0.59

Means with the same letter within a column are not significantly different at 5% level of Significance using Duncan Multiple Range Test (DMRT).
CM-Control with Manure (no tillage), HM-Heap with Manure, RM-Ridge with Manure, SM-Seedbed with Manure, CN-Control without Manure (no tillage), HN-Heap without Manure, RN-Ridge without Manure, SN-Seedbed without Manure. WAS-Weeks after sowing.

Table 5: Effect of different tillage practices and organic fertilizer on root number and biomass fresh weight of African spinach

Treatment	Number of Root
	WAS
	8
CM	16.00^{b}
HM	18.75^{b}
RM	19.9^{ab}
SM	27.95^{a}
CN	19.05^{ab}
HN	17.70^{b}
RN	16.00^{b}
SN	24.00^{ab}
SE±	±3.03

Means with the same letter within a column are not significantly different at 5% level of significance using Duncan Multiple Range Test (DMRT).

CM-Control with Manure (no tillage), HM-Heap with Manure, RM-Ridge with Manure, SM-Seedbed with Manure, CN-Control without Manure (no tillage), HN-

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Heap without Manure, RN-Ridge without Manure, SN-Seedbed without Manure. WAS-Weeks after sowing

Table 6: Effect of Different Tillage Methods and Organic Manure on Biomass Fresh Weight of African Spinach

	Biomass fresh weight (g)
Treatment	WAS 8
CM	0.11^{c}
HM	0.13^{b}
RM	0.18^{a}
SM	0.15^{ab}
CN	0.10^{d}
HN	0.11^{c}
RN	0.12^{b}
SN	0.13^{b}
SE±	±0.03

Means with the same letter within a column are not significantly different at 5% level of significance using Duncan Multiple Range Test (DMRT).
CM-Control with Manure, HM-Heap with Manure, RM-Ridge with Manure, SM-Seedbed with Manure, CN-Control without Manure, HN-Heap without Manure, RN-Ridge without Manure, SN-Seedbed without Manure. WAS-Weeks after sowing

RESULTS AND DISCUSSION

Plant height (cm)

The study showed that the plant height of all treatments were not significantly different. The height increased as the period progresses. Ridges with manure (RM) had the highest value (27.75) and Control without manure (CN) had the least (20.22) at 6 WAS.

Stem girth

Stem girth results showed that Ridges with manure (RM) was highest in all weeks. All the treatments were not significantly different except at 2 WAS where RM had least value (0.65) and CM had (1.20) Table 2.

Leaf area

Leaf area which is one of the growth parameter that determine yield of crop showed that all the treatments from 2 WAS to 4 WAS were not significantly different but at 6 WAS, Ridges with manure (RM) was significantly difference from other treatments with highest value (19.55) while control Without manure (CN) had the least value (14. 05) Table 3.

Number of leaves

The number of leaves in 2 WAS and 6 WAS were significantly different, Seedbed with manure (SM) had the highest value (12.50) and CN (9.80b) had the least value. The values increase as period increases (Table 4)

Number of root and Biomass Fresh weight

SM had the highest value (27.95) number of root and CN had least at 8 WAS. The trend for biomass fresh weight was contrary

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to number of root where RM had highest value (0.18) and CN had the least value (0.10) (Table 5 and 6).

DISCUSSION

Results from the study showed that addition of Ridge with organic manure attributed to the highest value of plant height which agreed with Ainika (2013) and Barau *et al*. (2018) which reported that application of poultry manure had great effects on growth parameters of amaranth. Also, the result aligned with Awe and Abegunrin (2009) which suggested that organic manure in addition with appropriate tillage have significant effect on amaranth. The highest value of stem girth agreed with Diamini *et al.* (2020) which reported that African spinach that are fertilized with organic manure had effect on Stem girth. Akinbile (2010) also reported similar results in NERICA rice under similar condition that the growth parameters including stem girth, leaf area, number of leave increased with the application of organic manure.

Also, this study have shown that type of tillage and addition of organic manure as a source of nutrients has direct effects on plant height, leaf area, number of leave and other agronomic parameters which corroborates the work of Christopher *et al*.(2011) which reported ridge tillage in addition to manure produced better than other tillage methods such as heap, seed bed and zero tillage in response to agronomic parameters. Ridge tillage showed clearly was the best which might be alluded to the fact that it increases soil macro porosity which reduce conduction of soil during the day. *Amaranthus cruentus* which varied significantly in the late stages of growth were aligned with Muhammed *et al.* (2010) which reported that effect of cow manure application rate increases the number of fruit and biomass weight of melon in the late stages of growth. Furthermore, addition of organic manure had significant impacts on the growth parameters including number of leaves which corroborate Afolayan *et al*. (2004) which suggested that the capacity of manure to improve soil organic matter, the plants grow in tilled portion performed better than untilled with respect to leaf area, root density and biomass fresh weight. The soil and organisms' activities help to release the chemical nutrient needed by the crops in relation to growth parameters. Moreover, Bawa (2010) reported high number of leaves, plant height and yield in amaranth production with addition of poultry manure.

CONCLUSION

The results of this study showed that application of manure on ridge tillage method had significant effects on African spinach growth and yield. Therefore, it is recommended in the African spinach production for a better performance.

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