ACCESSING THE EFFECT OF MULCHING, ORGANIC AND INORGANIC FERTILIZERS ON THE RHIZOME YIELD OF GINGER (ZINGIBER OFFICINALE) IN ABUJA, NIGERIA.

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ABSTRACT

The paper investigated the effect of Mulching, Organic and Inorganic Fertilizers on the Rhizome yield of Ginger (Zingiber Officinale) in Abuja, Nigeria. Field trials were carried out in the 2019 cropping season at the University of Abuja Teaching and Research Farm, main campus Gwagwalada. The experiment contained 7 treatments laid out in a randomized complete block design (RCBD) and replicated three times. The results showed that the plots treated with mulching had the highest ginger plant height at 2WAP (23.30^{a}) and 3WAP (28.91^{a}) while control (19.67^{b}) had the lowest plant height. The plots treated with mulching had the highest number of ginger leaves at 2WAP (8.67^{a}) and 3WAP (11.33^{a}) and control (8.00^{bc}) had the lowest number of leaves at 3 WAP. Stem diameter was significantly higher in soils treated with mulching at 2 WAP (1.240^{a}) while the application of the different fertilizers did not have any significant effect on the stem diameter at 3 WAP. The plots treated with mulching and its combinations gave the highest number of tillers at 2 WAP while the control plots gave the least number of tillers at both 2 WAP (1.00^{b}) and 3 WAP (1.000^{c}). Rhizome fresh weight was highest in soils treated with NPK + mulching (23.69^{a}) and lowest (10.17^{d}) in the control plots while the Rhizome dry weight was highest in soils treated with NPK + mulching (16.58^{a}) and lowest (7.12^{d}) in the control plots. It is therefore concluded that mulching is imperative for the successful production of ginger in Abuja, Nigeria.

Keywords: Ginger, Inorganic fertilizer, Mulch, Organic fertilizer, Rhizome, yield.

INTRODUCTION

Ginger (Zingiber officinale) belongs to the family Zingiberaceae. It is an economically important plant largely cropped for a variety of uses, especially for its medicinal and flavoring potentials (Schwertner and Rio, 2007). Like any other plant, ginger requires the right kind of nutrient to sustain its growth and to also ensure maximum yield (Egbuchua and Enujeke, 2013).

Rayar (2000) reported that soils of the Savanna are characterized by high mineral but low organic matter content and become major constraints in attaining sustainable agriculture. Furthermore, because of their inherently poor fertility status and low productivity, the soils are more susceptible to erosion by wind and water. In general, the soils are deficient in N and P and have a low capacity to hold nutrients. These deficient nutrients can be added to the soil through the application of organic manure, inorganic fertilizers, and mulch. Fertilizers of both organic and inorganic sources either singly or in combination have contributed to improving the soil chemical properties and increasing crop production (Rayar, 2000; Azeez and Adetunji, 2005). Mulches have also helped to reduce competition from weeds, maintain soil temperature and reduce evaporation from the soil (Zhao et al., 2014). Jen-Hshuan (2006) identified that organic fertilizer supplies nutrients more balanced, which helps keep plants healthier while chemical fertilizers are quite high in nutrient contents, so only

relatively small amounts are required for crop growth (Agben and Hauser, 2004).

Statement of Problem

Most soils of the savanna zone of Northern Nigeria are weakly buffered and chemically fragile. These soils are inherently low in organic matter content and low activity clay and subsequently low in fertility status (Wapa et al., 2014). These deficient nutrients can be supplied to the soil through mulch, organic and inorganic fertilizer for sustainable plant growth and optimum yield. This study, therefore, aims to compare the independent and combined effects of mulching, farmyard manure, and inorganic fertilizer on the growth and yield of ginger in the study area.

Objective of the Study

The objective of the study is to access the effects of mulching, farmyard manure, and inorganic fertilizer on the growth and rhizome yield of ginger in Abuja, Nigeria.

Materials and methods

Study area Description

This field experiment was conducted at the University of Abuja Teaching and Research Farm, main campus, Gwagwalada. Gwagwalada is a large municipality and the headquarters of a large district in central Nigeria. It is located in Nigeria country in the Towns place category with GPS coordinates of 8° 57' 2.9988" N and 7° 4' 36.2532" E.

Gwagwalada, Nigeria is a part of the Federal Capital Territory and a large district with a total population of close to a quarter of a million. The town is quite large and advanced, with the number of residents close to 145,000 people. It is a small agricultural and manufacturing center in the area. (Where is Gwagwalada, Nigeria on Map Lat Long Coordinates, n.d.)

Land Preparation

The field experiment was conducted for one main cropping season of 2019 using rainfall. The field was cleared, ploughed, and harrowed to a fine tilth. The field was then marked out into plots of 2x2m (4m2) with an inter-row spacing of 1.0 m and intra-row spacing of 0.5 m. The total area used for this research was 17x8m (136m2).

Experimental Design and Treatments

This experiment was laid out as a randomized complete block design (RCBD) with three replications and 7 treatments for the test crop. Three treatments were farmyard manure, NPK, and mulching only and the rest were a combination of any two.

Application of Fertilizer and Organic Manure

Nitrogen fertilizer NPK 15:15:15 in the recommended rate (400kg/ha) was used for the study. The NPK fertilizer was applied at specific rates to the concerned plots at the time of planting. The remaining N was provided by urea (30% N) at the recommended rate of 65.2kg/ha. Urea was applied to the concerned plots two weeks after the emergence of ginger. Farmyard manure was used at the rate of 25 t ha-1 and organic mulch (Urtica dioica) which is also known as common nettle or nettle leaf was applied at the rate of 30 t ha-1to the concerned plots at the time of planting.

Planting and Harvesting

A high-yielding variety of ginger called **Tafin Giwa** (which is also known as elephant foot)

obtained from Kaduna State University was used and ginger was sown in May. Paraquat was used to control pre-emergence weeds while weeds were managed by hand weeding after weed emergence. Late-emerging weeds were removed by hoeing to avoid interference with the ginger plants.

Data Collection

- **Plant Height (cm):** was recorded by measuring the height from the soil surface to the tip of five randomly taken ginger plants and the average was used.
- **Number of Leaves:** This was measured by counting the number of leaves of five randomly taken ginger plants and the average value was used.
- **Days to Emergence:** recording the number of days from the date of sowing to the date when 50% of the plants in a plot emerge above the ground.
- **Tillering:** was recorded by counting the number of tillers per plant of five randomly taken ginger plants and the average value was used.
- **Stem diameter (cm):** was recorded by measuring the width of the stem using a meter rule.
- **Rhizome Yield (t/ha):** was measured using electronic balance and then converted to hectare basis.

Statistical Analysis

All data collected were subjected to Analysis of Variance (ANOVA) using GEN STAT (12.00 version) software. The differences between means were tested with Duncan's Multiple Range Test (DMRT) (Duncan, 1955) at a 5% level of probability.

Results and Discussion

The results of the effects of mulch, organic and inorganic fertilizers on plant height are presented in Table 1. It shows that the plots treated with mulching had the highest plant height at 2WAP (23.30a) and 3WAP (28.91a) while the control had the lowest plant height at 3 WAP (19.67b). This is because mulches create a favorable environment for the growth of ginger when compared to the control plots. According to (N.R.C.R.I Bulletin, 2004), mulches reduce the direct evaporation of water from the soil surface and thereby conserving soil moisture. They also help to control weeds, modify soil temperature and control erosion, add plant nutrients to the soil through the decomposition of plant residue used for mulching, promote soil aeration, increase organic matter and soil biotic population. Ahaiwe et al., (2016) reported that all mulched plots (irrespective of the mulch type) had higher leaf length than the control plot. Probably, the mineralization of mulches increased the nutrient pool available for the ginger plants to absorb and produce more leaves than in the control plot. Islam et al., (2015) also reported that mulch had a significant influence on plant height. The tallest plant (74.29 cm) was found in treatment M 2 (rice straw mulch) while the lowest (57.30 cm) in M0 (control) treatment at 125 DAP.

The results of the effect of organic and inorganic fertilizers on the number of leaves are presented in Table 4. It shows that the plots treated with mulching had the highest number of leaves at 2 (8.67a) and 3 WAP (11.33a) while the control had the lowest number of leaves at 3 WAP (8.00bc). This result is in agreement with Islam et al., (2015) who reported that in the case of mulch, the

maximum number of leaves (129.28) was recorded from M2(rice straw) while the minimum (70.55) was recorded from M0 (control) treatments at 125 DAP.

Table 1: Effect of Mulching, Organic and Inorganic fertilizers on the Plant Height and Number of Leaves of Ginger

Treatment	Plant Height 2 WAP (cm)	Plant Height 3 WAP (cm)	Number of Leaves 2 WAP	Number of Leaves 3 WAP
NPK	12.98^{c}	22.15^{ab}	6.00^{b}	8.33^{bc}
FY M	16.72^{abc}	25.04^{ab}	7.00^{ab}	9.33^{abc}
Mulching	23.30^{a}	28.91^{a}	8.67^{a}	11.33^{a}
NPK + FYM	16.45^{abc}	22.85^{ab}	5.67^{b}	9.33^{abc}
NPK + Mulching	20.86^{ab}	28.41^{ab}	8.67^{a}	10.67^{ab}
FYM + Mulching	20.54^{abc}	27.84^{ab}	7.67^{ab}	10.00^{abc}
Control	14.05^{bc}	19.67^{b}	5.67^{b}	8.00^{bc}
LSD	**6.99**	**8.22**	**1.93**	**2.31**

Means with the same letter in a column for each factor are not significantly different ($P \leq 0.05$), LSD = Least Significant Difference, WAP = weeks after planting

Table 2 shows the effect of organic and inorganic fertilizers on stem diameter. Stem diameter was significantly highest in soils treated with mulching (1.240^{a}) at 2 WAP. The result also shows that the application of the different nutrient sources did not have any significant effect on the stem diameter at 3 WAP. Table 2 also shows the effect of organic and inorganic fertilizers on the number of tillers of ginger. It shows that the plots treated with mulching (2.33^{a}) and its combinations; NPK+ mulching (2.00^{a}), FYM+ mulching (2.00^{a}) gave the highest number of tillers at 2 WAP while the control plots gave the least number of tillers at both 2 WAP (1.00^{b}) and 3 WAP (1.000^{c}). Ghosh et al., (2007) reported that the application of straw mulch produced the maximum number of tillers per plant. Islam et al., (2015) also reported that the maximum number of tillers per plant (13.91) was found in M_2 (rice straw mulch) and the lowest (9.23) from M_0 (control) treatment at 125 DAP. Possibly mulch conserved the soil moisture in the soil to some extent which helped to produce a greater number of tillers per plant.

Table 2 Effect of Organic and Inorganic Fertilizers on Stem Diameter and Number of Tillers of Ginger

Treatment	Stem Diameter 2 WAP (cm)	Stem Diameter 3 WAP (cm)	Number of Tillers 2 WAP	Number of Tillers 3 WAP
NPK	0.733[c]	1.257	1.00[b]	2.333[b]
Farmyard Manure	0.983[abc]	1.333	1.33[b]	2.667[ab]
Mulching	1.240[a]	1.560	2.33[a]	3.000[ab]
NPK + Farmyard Manure	0.973[abc]	1.283	1.00[b]	2.333[b]
NPK + Mulching	1.067[ab]	1.437	2.00[a]	3.667[a]
Farmyard Manure + Mulching	1.123[ab]	1.350	2.00[a]	2.667[ab]
Control	0.900[bc]	1.133	1.00[b]	1.000[c]
LSD	**0.29**	**0.45**	**0.57**	**1.18**

Means with the same letter in a column for each factor are not significantly different ($P \leq 0.05$), LSD = Least Significant Difference, WAP = weeks after planting

Table 3 shows the effect of organic and inorganic fertilizers on rhizome fresh and dry weight of ginger. Rhizome fresh weight was highest in soils treated with NPK + mulching (23.69a) and lowest in the control plots (10.17d). A similar pattern was obtained for the rhizome dry weight of ginger as it was highest in soils treated with NPK + mulching (16.58a) and lowest in the control plots (7.12d). The combination of NPK and mulching resulted in higher uptake of NPK which in turn contributed to the increase in yield. This is in agreement with Mathew and Sreekala (2019) who reported that the interaction effects were significant throughout the periods of observation and among interaction, a combination of mulches and double the recommended dose of fertilizer obtained the highest dry yield on all periods of observation. Liasu and Achakzai (2007) had reported that the combination of mulch and inorganic fertilizer improved the growth and yield attributes of tomatoes. Islam et al., (2015) also reported that the maximum weight of primary and secondary rhizome per plant in M_2 (rice straw mulch) might be due to more soil moisture conserved by this treatment.

Table 3 Effect of Organic and Inorganic Fertilizers on Rhizome Fresh and Dry Weight of Ginger

Treatment	Rhizome Fresh Weight (t/ha)	Rhizome Dry Weight (t/ha)
NPK	21.18^{abc}	14.82^{abc}
FY M	18.26^{c}	12.78^{c}
Mulching	20.43^{bc}	14.30^{bc}
NPK + FYM	21.98^{ab}	15.39^{ab}
NPK + Mulching	23.69^{a}	16.58^{a}
FYM + Mulching	20.73^{abc}	14.51^{abc}
Control	10.17^{d}	7.12^{d}
LSD	**2.75**	**1.93**

Means with the same letter in a column for each factor are not significantly different ($P \leq 0.05$), LSD = Least Significant Difference

Conclusion and Recommendations

Conclusion

Rhizome yield and yield parameters of ginger were significantly increased with the application of mulching singly and in its combinations. NPK + mulching gave the highest rhizome yield, mulching gave the highest plant height, number of leaves, and stem diameter. Mulching, NPK+ mulching, FYM+ mulching also gave the highest number of tillers. It can be concluded that mulching is necessary to grow ginger successfully in Abuja, Nigeria.

Recommendation

From the findings of this study, the following recommendations were proposed:

1. Nitrogen fertilizer in combination with mulching will give an optimum yield of ginger on the savanna soils.
2. Room for further research on how the combination of the three treatments will affect the rhizome yield of ginger.

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