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Full Length Research Article

EFFECT OF CULTIVARS ON THE GROWTH AND YIELD OF GINGER IN KAFANCHAN, KADUNA STATE, NIGERIA

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ABSTRACT
Experiments were conducted in the wet seasons of 2018 and 2019 to study the effect of cultivar on the growth and yield of ginger (*Zingiber officinale* Roscoe) in Kafanchan in Jema'a Local Government Area of Kaduna State, Nigeria. The treatments consisted of three cultivars of ginger (China, UG_1 and UG_2) arranged in a randomized complete block design (RCBD) and replicated three times. The parameters measured included number of shoots per plant, number of leaves per shoot, plant height, ginger fresh weight and ginger dry weight. Cultivar significantly affected the ginger fresh and dry weights, moisture content and plant height but did not have significant effects on the number of shoots per plant and number of leaves per shoot. The mean fresh and dry weights were 54.3 and 14.1 t/ha, 40.2 and 12.8 t/ha, and 27.0 and 8.4 t/ha for the China, UG_1 and UG_2 cultivars respectively. The China cultivar produced heavier fresh rhizomes than the UG_1 and UG_2 in both years of the study and the mean but this weight advantage did not reflect in the dry weight of the ginger especially when compared with UG_1. A further study is recommended to determine the pungency, aroma and oleoresin contents as well as market acceptability of the three ginger cultivars to enable a good recommendation to ginger farmers in the study area.

Keywords: Growth, Yield, Ginger, Cultivar, Effect.

INTRODUCTION

Ginger (*Zingiber officinale* Roscoe), which belongs to the order *Scitamineae* and the family Zingiberaceae, originated from Southeast Asia (Shuhaimi *et al*., 2012) and has been cultivated for thousands of years for use as a spice and for herbal medicinal purposes (Akram *et al*., 2011). Nigeria is among the major producers and exporters of ginger in the world. `Although it is grown in six states of Nigeria namely Kaduna, Nasarawa, Benue, Niger, Bauchi and Gombe, southern Kaduna area of Kaduna state is the main producing zone with over 95% of the country's total production (Okafor, 2002). Nigeria is the third largest exporter of ginger in the world after China and India (Eze and Agbo, 2011). Ginger production figures in 2013 put Nigeria as the fifth largest producer of ginger in the world (FAO, 2015). 90% of ginger produced in Nigeria is dried primarily for export while 10% is locally consumed (Guchemann, 2010). Nigeria's ginger is highly valued for its aroma, pungency, high oil and oleroresin content (Njoku *et al*., 1995).

Nigeria is the largest producer and exporter of ginger in Africa (FAO, 2008). However, the level of production is generally low compared to other export crops produced in the country. The yield is low but of high quality that has high demand in the world market. According to FAO (2011) ginger yield in Nigeria was about 3-4t/ha in 2009. Yet under improved cultivation conditions, yields could be as high as 21.7 t/ha (Sodangi, 2020) or more.

The quality of fresh ginger produced in Nigeria is the best in the world. However it has been observed that the quality of its dried ginger has been declining, due to low level of mechanization of ginger production and processing (Onu and Okafor, 2003), with attendant mould growth and loss of some important ginger qualities, as a result of which Nigerian ginger attracts the cheapest price in the world market (Ekundayo *et al*., 1988). This tendency has attracted the attention of many players in the International market, with remarks that the quality of Nigerian ginger should be improved (Okafor and Okafor, 2007).

The crop is widely grown by many farming communities in Kafanchan. Kafanchan is the Headquarter of Jema'a LGA of Kaduna State. Two commercial species are commonly cultivated in Kafanchan. The yellow ginger cultivar (UG_1) locally called "Tafin Giwa" with a bold yellow rhizome flesh is stout with short internodes. The black ginger cultivar (UG_2) locally called "Yatsun Biri" has a dull-grey colour rhizome. Kure (2007) reported that the yellow variety is more popular than the black variety, probably due to the high yielding capacity and pungency of the former. The "China" ginger, which has a very subtle flavor and fairly large rhizomes, is usually imported from areas such as China and India. One major shortcoming of ginger production in Nigeria is the very narrow gene pool on which the industry is based,

Ginger has an immense potential to boost economic development and reduce poverty through creation and expansion of employment opportunities and distribution of income and foreign exchange earnings. Despite all the potentials and opportunities the crop remains unexploited. This is attributed to several factors, including poor soil fertility, shortage of improved cultivars, poor agronomic practices and effects of pests and diseases (Hailemichael and Tesfaye, 2008; MOARD, 2007; Amadi *et al*., 2010)

This work was done to study the effect of cultivars on the growth and yield of ginger in Kafanchan, Kaduna State.

MATERIALS AND METHODS

The field was tilled and pulverized to produce a fine tilt. Ginger rhizomes, each having at least one active bud, were used as planting material. Each of the rhizomes was cut into smaller pieces of about 40g in weight. The treatments were arranged in a randomized complete block design (RCBD) and replicated three times. The treatments consisted of three cultivars of ginger (UG1, UG2 and "China") planted in Kafanchan in 2018 and 2020. Kafanchan (9°34'N, 8°18'E) is in Jema'a LGA of Kaduna State, Nigeria. Rhizomes were planted at a seed rate of 1500 kg/ha mother rhizomes. N, P and K were applied at the rate of 150, 50 and 50 kg/ha, respectively.

The ginger samples were sliced and sun-dried on black polythene sheets. The sliced ginger rhizomes were spread uniformly to

enhance drying, and weight reduction taken as moisture loss was monitored regularly using Mettler PE Top Loading Digital Balance. Data was collected on number of shoots per plant, number of leaves per shoot, plant height, ginger fresh weight and ginger dry weight. All data collected was subjected to analysis of variance (ANOVA) using Statistix version 10.0 (Statistix, 1985). Differences between treatment means were compared using Duncan multiple range test (DMRT) (Duncan, 1955).

RESULTS

The effect of cultivars on the fresh weight of ginger is presented in Table 1. Cultivars had a significant effect on the fresh weight of ginger in both years of the study. The China cultivar produced a mean fresh weight of 54.3 t/ha, which was significantly higher than UG_1 (40.2 t/ha) and UG_2 (27.0 t/ha). The mean fresh weight of UG_1 was significantly higher than that of UG_2.

Table 1: Effect of cultivars on the fresh weight of ginger in Kafanchan

Cultivar	Ginger fresh weight (t/ha)		
	2018	2019	Mean
"China"	55.8	52.8	54.3
UG_1 ("Tafin Giwa")	33.1	47.2	40.2
UG_2 ("Yatsun biri")	19.6	34.4	27.0
$LSD_{0.05}$	13.14	17.47	12.45

In 2018 the China cultivar had the highest dry weight (16.8 t/ha), which was statistically similar to the dry weight of UG_1 (13.3 t/ha) but significantly higher than UG_2 (7.8 t/ha). In 2019 UG_1 had the highest dry weight (12.2 t/ha), which was statistically similar to the dry weight of China cultivar (11.5 t/ha) but significantly higher than UG_2 (9.1 t/ha).The mean dry weight of the China cultivar (14.1 t/ha) was statistically similar to the mean dry weight of the UG_1 cultivar (12.8 t/ha) (Table 2). However, the mean dry weight of the UG_2 cultivar (8.4 t/ha) was significantly lower than the China and UG_1 cultivars (Table 2).

Table 2: Effect of cultivars on the dry weight of ginger in Kafanchan

Cultivar	Ginger dry weight (t/ha)		
	2018	2019	Mean
"China"	16.8	11.5	14.1
UG_1 ("Tafin Giwa")	13.3	12.2	12.8
UG_2 ("Yatsun biri")	7.8	9.1	8.4
$LSD_{0.05}$	4.86	6.01	3.72

In both years of the study and the mean, UG_1 and UG_2 had comparable water contents which were significantly lower than the water content of the China cultivar (Table 3). Cultivar did not have significant effects on the number of shoots per stand and number of leaves per shoot in any of the years of the study. However, the plant height was significantly affected by cultivar (Table 4). UG_1 and UG_2 had significantly shorter plants compared to the China cultivar.

Table 3: Effect of cultivars on the moisture content of mature ginger in Kafanchan

Cultivar	Moisture content (%)		
	2018	2019	Mean
"China"	69.8	82.2	76.0
UG_1 ("Tafin Giwa")	60.0	74.1	67.1
UG_2 ("Yatsun biri")	60.2	72.9	66.6
$LSD_{0.05}$	0.52	6.04	2.05

Table 4: Effect of cultivars on the number of shoots, number of leaves and shoot height of ginger in Kafanchan

Cultivar	No. of shoots/stand			No. of leaves/shoot			Plant height (cm)		
	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
"China"	4.6	4.3	4.4	14.8	11.3	13.1	37.1	67.7	52.4
UG_1 ("Tafin Giwa")	4.7	5.0	4.8	14.1	11.7	12.9	23.0	16.3	19.7
UG_2 ("Yatsun biri")	4.5	4.3	4.4	13.7	12.7	13.2	24.1	18.3	21.2
$LSD_{0.05}$	2.45	3.89	1.88	5.48	6.05	2.86	10.58	18.53	10.10

Discussion

The dry yield ranged between 7.8 t/ha (for UG_2) and 16.8 t/ha (for the China cultivar) in 2018, and between 9.1 t/ha (for UG_2) and 12.2 t/ha (for UG_1) in 2019. The mean yields of 12.8 and 14.1 t/ha for UG_1 and China, respectively, agree with a recent report by Thrive Agric (2020) that the average yields of ginger is between 13 and 27 t/ha. Also, yields of 9 – 11t/ha and 12 – 15 t/ha for UG_1 and UG_2, respectively have been reported by the National Root Crops Research Institute, Umudike (nrcri.gov.ng). The findings from this study also agree with Kure (2007) who reported that UG_1 yields more than UG_2.

Jayashreel *et al.* (2014) reported a moisture content of 81.3% in fresh ginger. They reported that ginger cultivars that yield very large rhizomes are often marketed as fresh ginger but are unsuitable for converting to the dried spice due to their high moisture content, as the high moisture content causes difficulties in drying and frequently a heavy wrinkled product is obtained and the volatile oil content is often low and below standard requirements. The finding in this research agrees with the assertion of Jayashreel *et al*. (2014) in that the moisture content of the China cultivar (the cultivar with the biggest rhizomes) was higher than the moisture contents of the other cultivars in both years of the study. This probably explains why the china cultivar is not popular in Nigeria.

The significant differences that were recorded in the fresh weights of the three cultivars in both years of the study did not reflect in the

dry weights, especially for the China and UG_1 cultivars. This was largely attributed to the high moisture content of the China cultivar. High moisture content in ginger has a number of disadvantages, including difficulties in drying, wrinkled dry ginger and low volatile oil content that falls below standard requirements.

Recommendation

A further study is recommended to determine the pungency, aroma and oleoresin contents as well as market acceptability of the three ginger cultivars to enable a good recommendation to ginger farmers in the study area.

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