Effect of seed size on germination and early growth of maize (Zea mays).

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Abstract- The effect of seed size on germination and early growth of maize plant, was examined within three weeks to determine the best seed size require for planting. The larger size seed produced significant growth compared to medium size and small size. The seedling height, seedling width, and seedling biomass increased in larger size seed. The significant growth observed in larger size seed showed that larger size seed are good seed size for maize planting.

Index Terms- maize seedlings height, maize seedlings germination, maize.

I. INTRODUCTION

Maize is believed to have originated from Mexico and it is a widely cultivated crop in Central and South America. Maize was introduced into Africa in the 1500s and has since become one of Africa's dominant and staple food crops. Like in many other regions, it is consumed as a vegetable eventhough it is a grain crop. Africa produces 6.5% of the world's grain production, and the largest African producer being Nigeria with nearly 8 million tons produced annually, out of a worldwide production 785 million tons. Maize was introduced by the Portuguese to the West African coast during the early sixteenth century [1]. In Nigeria, maize is one of the agricultural commodities which serve as a raw material and food crop for human consumption. Maize grows across a range of agro-ecological zones in Nigeria but a lot of its production is from the northern part of the country that includes states like Adamawa, Bauchi, Yobe, Sokoto, Kebbi, Katsina, Nasarawa and Niger. The two types of maize grown are the yellow and white varieties.

Maize is a staple food crop for human and animal consumption, it is also important in breweries, paper and fabric manufacturing, adhesive and pharmaceutical industries and other useful products that generate a large source of income [2]. It is also an excellent source of carbohydrate and has complete nutrients than any other cereal. The protein content of maize is higher than that of polished rice and its fat content is higher than that obtained from wheat, sorghum and rice.It is also a good source of minerals. There are many end products from maize such as popcorn, snacks, biscuits and cereals. Traditionally, the dry stem of maize is used for fencing small farm land or gardens or the same can be thrashed and used as fodder for farm animals.

Seed germination is an essential process in any plant development in order to obtain an optimal number of seedlings that results in higher seed yield. In a likewise manner, it is important to know the effect of seed size on germination and seedling performance of maize plant for production of maize on a large scale. It was however important to identify the best seed sizes that had fast germination rate and high percentage germination that could be recommended for farmers to use for the production of maize on a large scale for commercial purposes.

II. MATERIALS AND METHODS

The research work was carried out in the Biological Sciences research garden of Adamawa State University in Mubi, which is located in the North-Eastern part of Adamawa state of Nigeria, between the latitude 9'0 30 and 11'0 N of the equator and longitude of 13'0 and 13'0 45E of the Greenwich meridian. It shares borders with Borno State in the north, Hong and Song in the west, and theRepublic of Cameroon in the South East [3].

The type of vegetation found falls within the Sudan Savannah belt of Nigeria vegetation zone and this vegetation type is often called Combretaceae woodland savannah [4]; and it is made up of grasses, and dry land weed inter-spaced by shrubs and woody plants; which collectively make up about 70% of the vegetation.

The soil colour ranges from yellow through red to brown and is generally stony and shallow with almost undefined profile. The soil contains oxides of iron and aluminum [3]; and these are responsible for the varied coloration. The three main soil types from the study area include lithosols, luvisols and gleyiccombisols.

The climate in Mubi is of a tropical wet and dry type [4] with temperatures ranging from warm to hot throughout the year and an average rainfall between the ranges of 900mm to 1050mm annually.

Seed Viability Test

The seeds were obtained from Mubi main market. These were placed in a bucket of water for a viability test.The seeds that sunk down were classified as viable seeds, while those that floated were classified as non-viable. The viable seeds were then collected and sun dried.The seeds were further soaked in 70% ethanol for 5 mins to sterilize the seed surface, washed in distilled water and further sundried [6].

Soil Sterilization

The soil that was used was sterilized by autoclaving at 100°C for 15mins using steam.The soil sample to be used as

rooting medium was in the ratio 1:2:1 (sand: loam: manure) and these were all mixed together.

Seed planting

Perforated planting pots were filled with ¾ of the soil mixture, soaked with water and left for 2 days. Three seeds were planted in each pot to a depth of 1.5cm and left to germinate. The planting pots consisted of six replicates and the seedlings were separated into three different sizes for the two varieties as; sy, my and ly for yellow maize, and sw, mw and lw for white maize.A total of 108 seeds were planted for both varieties and these were watered twice a week and kept in the greenhouse under stable conditions.

Data Collection

Recording of data was carried out immediately after the first week of germination for three weeks and this was mainly by looking at the morphological parameters that included;seedlings height, seedlings width, seedlings leaf count, seedlings biomass and seed germination percentage. The data was analyzed using the analysis of variance (ANOVA).

III. RESULTS

Germination percentage

Table 1: Germination percentage for the yellow and white maize varieties

Treatment	Total no. of seeds planted	Total no. of germinated seedlings	Percentage of germinated seeds
Large size seeds	18	18	100
Medium size seeds	18	18	100
Small size seeds	18	18	90

Percentage germination of the seeds for both varieties indicated that seed size did not have any effect on the percentage of seeds that germinated.(F=1.000 at 5% probability level).

- *Seedlings height*

Table 2a: Seedlings height in Yellow maize

Treatment	1st week	2nd week	3rd week
Large size seeds	23.7	28.0	35.0
Medium size seeds	18.8	25.6	32.9
Small size seeds	17.9	22.0	29.1

There was a significant difference between the heights of the treatments during the 3 weeks of growth.
(f=12.159, at 1% probability level).

Table 2b: Seedlings height in White maize

Treatment	1st week	2nd week	3rd week
Large size seeds	25.0	30.0	36.0
Medium size seeds	19.5	26.2	32.9
Small size seeds	17.8	24.9	29.7

There was a significant difference that occurred between the treatments during the three weeks of growth.
(f=10.593, at 5% probability level).

- *Seedling width*

Table 3: Seedling width (cm) of Yellow maize for three weeks

Treatment	1st week	2nd week	3rd week
Large size seeds	0.55	0.95	1.10
Medium size seeds	0.50	0.70	0.85
Small size seeds	0.40	0.55	0.70

The result obtained indicated that a significant difference occurred between the treatments.
(f=6.165, at 5% probability level).

Table 4: Seedling width (cm) of White Maize for three weeks

Treatment	1st week	2nd week	3rd week
Large size seeds	0.55	1.00	1.20
Medium size seeds	0.50	0.80	0.90
Small size seeds	0.45	0.70	0.75

The results show that larger seed sizes have the best seedling width. (f=6.266, at 5% probability level).

- *Root weight*

Table 5: Root Biomass (g) of Yellow and White maize

Treatment	Yellow weight	White weight
Large size seeds	3.165g	3.160g
Medium size seeds	2.239g	2.125g
Small size seeds	1.650g	1.750g

The results show that there was a corresponding increase observed in the biomass of large size seeds in both the yellow and the white maize; which indicated that seed size has an effect on root biomass.

Table 6: Shoot Biomass (g) of Yellow and White Maize

Treatment	Yellow	White
Large size seeds	4.171g	4.130g
Medium size seeds	3.388g	3.480g
Small size seeds	2.920g	2.386g

The results show that there was an increase in the large size seeds in both the yellow and the white seeds.

This indicated that seed size has an effect on the shoot biomass.

IV. DISCUSSION

The results obtained from this study shows that large and medium size seeds had a higher germination percentage even though it was not any different from the small size seeds (Table 1); as the larger size seeds and medium size seeds germinated faster within three to four days than the smaller size seeds. The high germination rate and faster growth of the seedling may be attributed to greater food reserves available to the growing seedling. These findings are in agreement with the findings reported that seedlings of larger size seeds constantly maintain size advantage over small size seedlings[7]. This constant advantage of seedlings from larger size seeds was due to the large food material available to the growing seedlings.Seed size showed not to have any effect on the number of leaves as all the treatments developed equal number of leavesas growth progressed(Table2). However it was pointed out that the number of leaves may not be a good index for measuring potential productivity of the plant [8].The results also show that larger size seeds tend to have an increase in seedling height, width, and rapid biomass accumulation;more than the medium and small size seeds (Table 3&4). The corresponding increase in the parameters stated due to the larger size seeds, may be as a result of a large embryo and high food reserves for the supply of energy. These findings are supported by the fact that larger size seeds in turn produced larger embryos and have a high respiration rate that results in greater field emergence than the small size seeds. They seedlings height, width and biomass of large size seeds (Table 5 & 6) over the small size seeds indicated that larger size seeds can be the best recommendation in maize plant growth, as it was also reported that plants with larger biomass will consequently produce large grain [9].

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