African Orphan Crops and Climate Change: Effects of sowing date and cultivar on the agronomic performance of pumpkin (*Cucurbita pepo* L.) fruit.

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Abstract

Climate change is a major challenge to the world today especially the African continent with significant threat to food security, human health and economic stability. In sub-Saharan Africa, where rainfed agriculture is still the primary source of food and income, two-thirds of the working population still make their living from agriculture. Promoting agro-biodiversity is particularly important for local adaptation and resilience. Around the world, about 7,000 plant species are harvested from the wild for food. These species of plant are known to better withstand adverse weather conditions compared to the cultivated crops. There are more than enough underutilised crops in Nigeria such as pumpkin (*Cucurbita pepo* Linn.) that can be a good crop to meet up with the challenge of climate change. The fruit of *C. pepo* has a shelf life of 3-6 months depending on the cultivar and the crop has been found to be drought resistant and high in nutrients and antioxidants. There are a number of agronomic practices that can be adjusted or manipulated in the quest for finding remedy to adverse effects of climate change in the continent. Hence, in 2007 and 2008, the effects of planting date and cultivar on the agronomic performance of pumpkin fruit were evaluated at the Teaching and Research Farm, Obafemi Awolowo University, Osun-State, Nigeria. In the study were four planting dates (1st of April; 15th of April; 1st of May; 15th of May) and three cultivars (cvs. Green, White and Orange). As the planting dates were delayed, pumpkin fruit yield and nutrient contents diminished significantly (P=0.05). The cultivars were discovered to have similar ability to withstand drought. Across the planting dates, cv. Green was found to have capacity to better withstand excessive rainfall compared to the remaining cultivars. Adaptation to climate change involves deliberate adjustments in cropping systems. Locally-existing solutions such as crop

cultivars, time of sowing which could be adjusted and the cultivation of African orphan crops could be explored so that food insecurity mediated by climate change could be mitigated.

Introduction

According to FAO, 2013, Africa has been estimated to be the region with the highest prevalence of undernourishment, with more than one in five people estimated to be undernourished. 1.2 billion people can not meet their daily food requirement globally and about 2 billion people are malnurished. Africa takes the lion share of these estimates. Around the world, about 7,000 plant species are harvested from the wild for food. These species of plant are known to better withstand adverse weather conditions compared to the cultivated crops and are richer in nutrient and bioactive compounds (Oloyede and Adebooye, 2013). According to CTI, 2014, orphan crops also reffered to as neglected and underutilised plant species are vital food crops for subsistence farmers in many African as well as Asian and South American countries. They often have a strong cultural importance, and are more nutritious and drought resistant than many of the large commodity crops. These crops are often called orphan or neglected because despite their potential to nourish the developing world, they have historically been overlooked and under-funded by development agencies and researchers. There Meanwhile there are more than enough underutilised crops in Africa such as Nigerian pumpkin that if well popularised can bring about food and nutrition securities. The fruit has a shelf life of 3-6 months, hence it is a source of rich food during the dry season. Pumpkin has high food value, high antioxidant activities and bioactive compounds (Oloyede et al., 2012; Oloyede and Adebooye, 2013). Pumpkin is drought resistant. It’s young leaves, young and mature fruits, and seed are edible and are utilized at different developmental stages as vegetables in Nigeria (Oloyede and Adebooye, 2013). Season, cultivar and the time of sowing are some of the agronomic factors that affect growth, yield and nutritional composition of vegetables. Effects of sowing date and cultivars on the yield and yield components of pumpkin were hence evaluated.

Material and Methods

The study was conducted during 2007-2008 at the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Nigeria. The soil of the site was classified as sandy loam. Land was ploughed twice and harrowed once before sowing. Two seeds per hole were sown and the seedlings were thinned to one plant per stand at 2 weeks after planting (WAP). The experiment was a randomized complete block design. It consisted 4 sowing dates (1 and 15 April and 1 and 15 May) and 3 cultivars (1=green, 2=white, 3=orange). Pumpkin seeds were sown at a spacing of 2×2 m in both years. Plot size was 8×4 m. The experiment was replicated three times. 180 kg/ha of NPK 15:15:15 fertilizer was applied at 2 weeks after plant emergence. The insecticide (lambda-cyhalothrin) was applied biweekly from 6 to 10 weeks after planting. In addition to manual weed control, the post-emergence herbicide, glyphosate was applied at the rate of 200 mL/15 L at 4 and 7 weeks after planting. At 15 weeks after planting fruits were harvested from 4 rows in the plot. Data were taken on yield and yield components of pumpkin fruits across the cultivars. Data were subjected to analysis of variance SAS (ver. 9.1, SAS, Inc., Cary, NC). Means were separated using Duncan Multiple Range Test.

Results

Rainfall and hours of sunshine were different and temperatures similar for the cropping years (Table 1). The crops grown during the first and second planting durations (April to July) had less total rainfall, higher average temperature, and higher total sunshine for both 2007 and 2008. Crops grown during the third and fourth planting durations (May to August) had higher total rainfall, lower average temperature and lower total sunshine hour for 2007 and 2008.

Effect of cultivars on pumpkin yield and components were presented on Table 2.

The result showed that cultivar “orange” had higher fruit yield compared to the other 2 cultivars. However the number of seeds per fruit was not affected by cultivar. It is noteworthy that the 3 cultivars that were evaluated were discovered to have similar ability to withstand drought. However, across the planting dates, cultivar “green” was found to have capacity to better withstand excessive rainfall compared to the remaining cultivars. For instance, at the fourth sowing date (May 15), the fruits of both cultivars “white” and “orange” were totally aborted due to excessive rainfall, while cultivar “green” still had some fruits, though with about 70% reduction in yield.

Table 3 showed that the number of marketable fruits and fruit yield reduced significantly as sowing dates were delayed. Consequently, the fruit yield was also highest in the first sowing date followed subsequently by other sowing dates. There was no significant difference in the fruit yield of the first and second sowing dates. Mean fruit yield of sowing dates 1 and 2 was (52 tons/ha). This reduced by 60% at the 3rd sowing date and 92% at the 4th sowing date. The yield was lowest in the fourth sowing date (4 tons/ha). The weight of seed per fruit was highest in the first and second sowing dates and lowest in the 3rd and 4th sowing dates.

Discussion

Proper selection of cultivars, sowing date, plant density, fertilizer level and other agronomic practices can improve the yield and directly influence the yield components of crops (Oloyede and Adebooye, 2013). The study of Mehdi et al. (2010) on effect of cultivars and plant density on the of faba bean corroborates the findings in this study. Lu et al. (2003) found that high input management practices in watermelon produced greater marketable yield, higher number of marketable fruit/plant, and higher fruit weight than did low input management practices. The crops planted in May in this study received more rainfall compared to those that were sown earlier. Low rainfall favoured pumpkin fruit yield and was highly depressed by much rainfall. Climatic factors vary with growing site, during the season and from year to year. Temperature, both in terms of total or average temperature and the extremes during the growth period, may influence crops and their quality (Lefsrud *et al.*, 2005).

Conclusion

Adaptation to climate change involves deliberate adjustments in cropping systems. Locally-existing solutions such as, selection of suitable crop cultivars, application of required fertilizer, time of sowing which could be adjusted and advancement of African indigenous and orphan crops could be explored so that food insecurity mediated by climate change could be mitigated in Africa.

Table 3: Effect of planting date on fruit yield and yield components

Planting date	Number of marketable fruits	Fruit yield (tons ha^{-1})	Fruit diameter (cm)	Fruit length (cm)	Number of seed fruit^{-1}	Weight of seed fruit^{-1}
1	14.11a	53.56a	12.78a	16.78a	336.35a	70.25a
2	12.53b	49.93a	12.28a	16.75a	334.29a	71.99a
3	5.65c	21.27b	12.24a	16.35a	332.38a	64.74b
4	1.38d	4.17c	12.12a	16.15a	331.71a	61.82b

Values are means of data obtained in 2007 and 2008. Means with the same letter in each column are not significantly different at 5% level of Probability using Duncan's Multiple range test.

Source: Oloyede and Adebooye (2013)

Table 1: Monthly meteorological data recorded during 2007 and 2008; Nigerian meteorological agency.

Month	2007 total rainfall (mm)	2008 total rainfall (mm)	2007 Average temperature/day (°C)	2008 Average temperature/day (°C)	2007 sunshine (hr)	2008 sunshine (hr)
Jan.	NR[a]	0.0	26.1	25.0	7.21	8.23
Feb.	NR	0.0	29.2	27.8	7.37	6.11
March	NR	41.7	29.8	28.1	6.74	7.42
April	116	238	28.4	27.7	7.53	5.89
May	165.3	51.3	27.2	26.6	5.72	6.41
June	218.8	193	25.9	25.7	6.93	5.67
July	182.6	313.1	24.9	24.8	4.02	4.39
Aug.	188.2	255.5	24.5	24.6	3.28	3.50
Sept.	207.7	273.8	24.9	25.4	0.64	3.56
Oct.	218.9	160	25.7	26.2	6.37	7.12
Nov.	36.3	0.0	26.9	27.6	7.42	7.92
Dec.	24.7	31.1	26.0	27.1	6.29	7.11

[a] NR = Not recorded.

Table 2: Effect of Cultivars on yield and components of pumpkin fruits sown in April 2007 and 2008 at 180 kg/ha of NPK 15:15:15 fertilizer

Cultivar	Number of marketable fruits/plot	Fruit yield (tons ha^{-1})	Fruit diameter (cm)	Fruit length (cm)	Number of seed/fruit
1	26a	75.5b	17.2b	18.5b	369a
2	25a	74.4b	15.3c	20.2a	367a

3	21b	85.0a	22.3a	16.3c	370a

Values are means of data obtained in 2007 and 2008. Means with the same letter are not significantly different at 5% level of probability

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