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Effect of Planting Date on the Yield and Proximate Composition of Pumpkin (*Cucurbita pepo* Linn.) Fruit

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Authors' contributions

This work was carried out in collaboration between both authors. Author OCA designed and monitored the study. Author FMO carried out the study, managed the analyses of the study, managed the literature searches and wrote the first draft of the manuscript. Both authors read and approved the final manuscript.

Research Article

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ABSTRACT

This work was aimed at determining the effects of planting date on the yield and proximate composition of pumpkin fruits. The experiment was a randomized complete block design. In the study was used four planting dates (1- 1st of April; 2- 15th of April; 3- 1st of May; 4- 15th of May). The experiment was replicated thrice. Standard analytical methods were used to analyze the fruits for the proximate content. The data collected, were subjected to analysis of variance. Means, where significantly different, were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability. Studies were carried out in year 2007 and 2008 at the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Osun state, Nigeria, with 4 planting dates each. The yields of the crops planted on the 1st and 15th of April were not significantly different but significantly out-yielded (53.56 and 49.93 tons ha^{-1} respectively) every other crop planted subsequently. The 1st planting date produced significantly highest protein (17.98 g $100g^{-1}$), crude fibre (1.90 g $100g^{-1}$) and ash (3.9 g $100g^{-1}$), compared to other planting dates. Lesser rainfall, moderately higher temperature and higher sunshine hour were observed to be responsible for the results.
In conclusion, early planting (April) or planting at the onset of rainfall will bring about optimal yield and food value of pumpkin at the location where this experiment was

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conducted (rainforest tropical region).

Keywords: Planting date; proximate; pumpkin; yield.

1. INTRODUCTION

Cucurbita pepo Linn. belonging to the cucurbitaceae family is originated from North and Central Americas, where it has been reported to have variety of uses ranging from domestic to medicinal. Pumpkin has been an important food in Mexico for centuries. Fruits are processed and consumed in variety of ways. Commercially canned pumpkin pie mix may be made of *C. pepo*. Nearly nature fruits are stuffed with meat and other ingredients and then baked. The immature fruits are eaten. In the USA, the most familiar use of pumpkins is for Halloween - Jack -0' - lanterns. Every autumn, the orange, round or oval fruits are carved into grotesque faces and illuminated from within the candles. The fruits flesh of wild species generated a saponin-rich froth when rubbed, and has been employed to wash clothes. Native American dried strips of pumpkin flesh in the sun for preservation. Pumpkin is usually cooked today by boiling or drying. Pumpkin is a gentle and safe remedy for a number of complaints [1].

Planting date has been reported to influence the yield and chemical composition of crops [2,3,4]. Vitamin C content has been shown to be affected by seasonal factors such as sowing time and harvesting date [5,6,7]. Musnicki et al. [8] stated that some environmental and agronomic factors might significantly change crop yield. Chiu [9] also reported maximum amounts of total tannin content in Pauchung tea to be obtained during summer months due to strong sunshine and higher temperatures. Mudau et al. [10] reported tannin contents to be increased when bush tea samples were collected during autumn, which has the coolest temperatures. Green tea grown in an area with high temperature, long sun exposure time and high rainfall had higher levels of thiamine, but lower levels of isoleucine, leucine, valine, alanine and caffeine than green tea grown in areas with relatively low temperatures, short exposure time and low rainfall [11].

Information is scarce in the literature on the agronomic requirement and food value of pumpkin in the tropics, especially in Nigeria. A major step in the development of agronomic package for a new crop involves determination of appropriate planting dates or a range of dates during which optimum yield and optimum fruit quality can be guaranteed. This is a very important aspect of this research especially now when climate change is a major world problem. For a successful exploitation of this plant, information on planting date as well as the food value is crucial. This study therefore investigated the effect of planting dates on the yield and proximate composition of *C. pepo* fruit.

2. MATERIALS AND METHODS

Studies were carried out in 2007 and 2008 at the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Nigeria. The plants were raised directly from seeds. Two seeds were planted per hole. A week after emergence, seedlings were thinned to one per hole on the basis of visual observation of vigour. The experiment was a randomized complete block design. In the study was used four planting dates (1- 1st of April; 2- 15th of April; 3- 1st of May; 4-15th of May). The plot size was 8 m x 4 m and the plants were spaced 2m x 2m. The experiment was replicated thrice. Weed control was effected manually using hoe and cutlass

and using herbicide (Glyphosate). Insecticide (lambda-cyhalothrin) was applied weekly immediately the plants started flowering.

2.1 Data Collection

Data were collected from the middle row while the first and third rows served as guard rows. Data were collected on the following traits:

Number of fruits per plant: The number of marketable fruits were taken and recorded.
Fruit diameter: This was measured using graduated ruler.
Fruit length: This was also measured using graduated ruler.
Average fruit weight: This was taken per plot after harvest.
Weight of seeds/fruit: Four fruits were selected per plot and the average found.
Number of seeds/fruit: Four fruits were selected per plot and the average found.
Fruit yield: Fruits harvested from the middle row per plot were weighed and converted to yield per hectare using:

$$\text{yield (tons/ha)} = \frac{\text{weight/plot (kg) x } 10{,}000\ \text{m}^2}{\text{Area of plot (m}^2\text{) x } 1{,}000\ \text{kg}}$$

1,000 kg = 1 ton and 10,000m^2 = 1ha

2.2 Laboratory Analyses

After harvest, fruit samples were analyzed for protein, fibre, moisture, carbohydrate, ash and fat contents following the routine chemical analytical methods [12].

2.3 Statistical Analysis

The data collected, were subjected to analysis of variance [13]. Means, where significantly different, were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability.

3. RESULTS

3.1 Effect of Planting Date on Fruit Yield and Yield Parameters of Pumpkin

The summary of the weather data at the location of the experiment for two cropping years was presented in Table 1. The data showed that the crops grown during the first and second planting durations (April to July) had lesser total rainfall, 688.3mm and 795.4mm, higher average temperature, 106.4 and 104.8 and higher total sunshine hour, 24.2 and 22.36 hr, for 2007 and 2008 respectively. On the other hand, crops grown during the third and fourth planting durations (May to August) had higher total rainfall, 754.9mm and 812.9mm, lower average temperature, 102.5 and 101.7 and lower total sunshine hour, 19.95 and 19.97 hr, for 2007 and 2008 respectively.

Table 2 showed that the number of marketable fruits and fruit yield reduced significantly as planting dates were delayed. The number of marketable fruits (14/plot) was highest in the first planting date, it reduced by 7% at the 2nd planting date while at the 3rd and 4th planting dates the reduction was by 57% and 93% respectively. Consequently, the fruit yield was also highest in the first planting date followed subsequently by other planting dates. There was no

significant difference in the fruit yield of the first and second planting dates. Mean fruit yield of planting dates 1 and 2 was (52 tons/ha). This reduced by 60% at the 3rd planting date and 92% at the 4th planting date. The yield was lowest in the fourth planting date (4 tons/ha). There was no significant difference in the fruit diameter, fruit length and number of seed per fruit among the planting dates. The weight of seed per fruit was highest in the first and second planting dates, though the weight did not differ significantly between the dates. Seed weights per fruit were lowest in the 3rd and 4th planting dates and were also similar at the same dates.

3.2 Effect of Planting Dates on the Proximate Composition of Pumpkin Fruits

The effect of planting date on the proximate composition of pumpkin is presented in Table 3. The results showed that planting dates have significant effect on the protein, ether extract (fat), crude fibre and carbohydrate contents of pumpkin fruits, but did not influence moisture and ash contents significantly. The protein and crude fibre contents decreased significantly as planting date was delayed. While, the Carbohydrate contents increased significantly as planting date was delayed. The highest crude fibre content was found in the 1st planting date (18%), this reduced by 22% at planting dates 3 and 4 and by 5% at planting date 2. Fat content was similar between planting dates 1 and 2 and between planting dates 3 and 4 but lowest in 1 and 2. Crude fibre was similar in planting dates 1 to 3 while it was lowest in the last planting date.

4. DISCUSSION

Precipitation is the source for all soil moisture in rain fed cropping systems. Generally, as plants extract water from the soil, any change in the quantity of precipitation will affect the supply of soil moisture, thereby impacting final crop yield. If soil moisture is insufficient to meet the evaporative demand imposed by the atmosphere, the leaves of the plant lose turgor and the stomata close. As a result, the entry of CO_2 into the stomata is inhibited and photosynthesis is reduced, impacting biomass production, crop growth, partitioning to vegetative and reproductive structures and final yield. In this study, the result of the effect of planting dates on fruit yield and nutrient profile of pumpkin fruits was consistent with earlier findings on similar crops [4]. The level of management practices has been shown to affect crop quality. Lu et al. [14] 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. Leskovar et al. [15] reported that yield was affected by deficit irrigation in watermelon while lycopene was higher during deficit irrigation. The crops planted in May in this study received more rainfall, lower average temperature and lower sunshine hour compared to those that were sown earlier. Lesser rainfall, higher average temperature and higher sunshine hour favoured pumpkin fruit yield and was highly depressed by much rainfall, lower average temperature and lower sunshine hour. In the same way, crops that received lesser rainfall, higher average temperature and higher sunshine hour also had higher protein content. This might be as a result of pumpkin's ability to resist drought. Konova and Rainova [3] reported that soybean that received less water had higher crude protein and lower pH. They also stated that when moisture is high, the cell plasma is dilute; protein forming enzymes are retarded thus reducing protein synthesis.

Table 1. Summary of rainfall, average temperature and sunshine hour data at Ile-Ife, Osun-State during the cropping years (2007 and 2008)

Months	2007 Total rainfall/ month(mm)	2008 Total rainfall/month (mm)	2007 Average temperature/ day(ºC)	2008 Average temperature/ day(ºC)	2007 sunshine hr (hr)	2008 sunshine hr (hr)
January	NR	0.0	26.1	25.0	7.21	8.23
February	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
August	188.2	255.5	24.5	24.6	3.28	3.50
September	207.7	273.8	24.9	25.4	0.64	3.56
October	218.9	160	25.7	26.2	6.37	7.12
November	36.3	0.0	26.9	27.6	7.42	7.92
December	24.7	31.1	26.0	27.1	6.29	7.11

NR = Not recorded.
Source: Nigerian meteorological agency.

Table 2. 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 tests.

Table 3. Effect of planting date on proximate composition of pumpkin fruit (Dry weight basis)

Planting date	Crude protein g/100g	Moisture	Ether extract	Ash	Crude fibre	Carbohydrate
1	17.74a	1.87a	2.89b	3.78a	1.95a	71.77d
2	16.50b	1.89a	2.70b	3.68a	1.85a	73.38c
3	14.22c	1.84a	3.28a	3.19a	1.83a	75.65b
4	13.59d	1.85a	3.55a	3.36a	1.39b	77.65a

Values represent means of duplicate of 3 composite samples for each treatment.
Means with the same letter in each column are not significantly different at 5% level of Probability using Duncan's multiple range tests.

Also, Matsuzoe et al. [16] demonstrated that deficit irrigation in tomatoes increased lycopene and total carotenoid content. The positive effects of higher average temperature and higher sunshine hour on the yield and chemical composition of pumpkin fruits corroborates maximum amounts of total tannin content in Pauchung tea obtained during summer months due to strong sunshine and higher temperatures as reported by Chiu [8]. Climatic factors vary with growing site, during the season and from year to year. However, temperature, both in terms of total or average temperature and the extremes during the growth period, may influence the chemical composition negatively [17,18].

5. CONCLUSION

Based on the investigations from this study:

1. As the planting date was delayed, total fruit yield of pumpkin fruits decreased.
2. As the planting date was delayed also, the food value of *C*. *pepo* fruits reduced with the exception of carbohydrate.
3. Less rainfall, moderately high temperature and sunshine hour favoured the yield and chemical composition of pumpkin fruits.
4. Early planting is therefore suggested for the cultivation of *C*. *pepo.* as a strategy to avert the influence of climate change on the production of pumpkin and related crops.

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COMPETING INTEREST

Authors have declared no competing interests exist.

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