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FLOWERING PHENOLOGY OF AFRICAN PEAR (*DACRYODES EDULIS (G. DON)HJ LAM*) UNDER NIGERIAN ECOLOGICAL CONDITIONS

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ABSTRACT

A-three-year trial of flowering phenological characteristics of 150 African pear tree were studied in South-South and South-East Nigeria to study the flowering phenology of African pear (Dacryodes edulis) under Nigerian Ecological conditions. Five States were selected, three locations in each State, ten mature African pear trees were selected and tagged for data collection. Also, meteorological data were collected for three years. The surveyed trees were monitored till flowering time. Data were collected on start of flower formation, peak of flowering, days to anthesis, average temperature and rainfall during the months of flowering. Data collected were analysed using analysis of variance and percentages were calculated where appropriate. Result obtained indicated that there were variations in the time of flowering. African pear had peak flowering in January in Imo, Rivers and Delta States for 2013-2015, while Abia and Enugu had their peak flowering for the same period in February and March, respectively. African pear flowered between the temperatures of 27.0^{0}C to 29.5^{0}C. Rainfall ranged from 0.00mm to 137.50mm. The flowering season was affected mainly by temperature. Time of inflorescence flower bud formation to anthesis lasted for 2-5 days, but majority took 3-4 days to reach anthesis. In the study, under Nigerian ecological condition, African pear flowered when the temperature was high and when humidity was low. The planting of African pear that flowers around January and February should be encouraged because they had the highest yield and potential to ripe during hunger period.

Key words: Phenological, African pear tree, Meteorological data, Flower formation and Anthesis

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INTRODUCTION

African pear (AP) refers to as Bush butter grows very well in these regions. It is an indigenous tropical fruit tree species (TFTS) used as food, medicine, livestock feed and for ornamental purposes. The fruits are available during the hunger period in these zones. It is a source of high quality nutritious non greasy natural vegetable oil (44-67 %) with possible numerous industrial uses (Waruhiu, Kegu, Atagana, Tchoundjeuz, & Leakey, 2004, Okorie, Ezeanyika & Marx,

2006). African pear is eaten with maize. Flowers are useful in apiculture (Ajibesin, 2011 & Okorie *et al.,* 2006). Due to poor funding of indigenous fruit trees crops research (Okorie, 2001), AP have not been researched much in the area of flowering phenology. Knowledge of AP flowering phenology is important for the development and improvement of the species. Phenology is an essential component in whole crop simulation models which can be applied in specific development processes to maximize yields. Citrus and mango growers have been able to improve production and yield by manipulating the phenology and physiology of these crops (Rohde, 2007, Kumar, Khurana, & Sharma, 2014). Phenology plays a key role in the survival of any plant. This is seen in the manifestation of the phyiological aspects of any plant, the timing of such events as flowering is very critical. Also the time progress and duration of flowering in plum cultivars were affected by phenology (Szabo & Nyeki, 1996). The timing of life history events may be largely influenced by evolutionary constraints with selection merely modifying a predetermined underlying pattern as with all other genetically controlled characteristics (Chapman, Wragham, Kennard, & Zanne, 1999). Furthermore, under subtropical conditions, mango (*Magnifera indica (L*) flowers in response to cool temperature (Nunez- Elisea & Davenport, 1995). In the work of Sukhvibal, Hetherington, Vithanage, Whiley & Smith, (2000), mangoes failed to flower at $20/15^0$C. Reports on the duration of cold temperature needed for floral initiation vary from 4days to 2weeks in the cultivar 'Haden' and up to 35days in 'Tommy Atkins' and 'Keitt' (Yeshitela, Robbertse, & Stassen, 2004). Such work is lacking in AP. The overall objective therefore was to study and evaluate the flowering phenology of African pear under Nigerian ecological condition.

MATERIALS AND METHODS

The survey on flowering phenology of AP was conducted from 2013-2015 in five States, three locations in each State of South-South and South-East Nigeria which lies between $4^0$30' and $5^0$30' N and Longitude 5^0 0' and 9^0 0' E, Altitude between 220m-400m above sea level (NIMET, 2014) located in the humid tropical rain forest zone of West Africa and are characterized by warm wet season (Mid-March to October) and a hot dry season (November to Mid- March). There is short duration drought of about 10 - 14 days in August. Much of the day time during the wet season, relative humidity is near saturation point with maximum and minimum temperatures of 30^0C and 21^0C (NIMET, 2014). The States were: Imo, Abia, Enugu, Rivers and Delta where

the species occurs. The communities covered in Imo State include: Logara, Imo State University Orchad in Uratta and Umuduru Egbeaguru. Abia State: Oboro, Isiala Ngwa and Alayi. Delta State: Ugbolu, Anwai and Ogwashiukwu. Rivers State: Etche, Elele and Obiebe. Enugu State: Nsukka, Oba Owerre Nzoba and Oboko Amachalla. In each location ten mature trees were selected and tagged. Individuals were assigned to observe the tagged trees and data for flowering phenology were collected. A microscope and camera were given to each individual in a particular location to capture this phenological data twice a day (morning and evening) by counting the number of days. A planned visit was made to each of the various locations during flowering to examine the Bud, identify the flower bud, and identify the mean time of flower formation which include start of flowering and peak of flowering, and days of inflorescence bud formation to anthesis in all the location. At flowering, Microscope were used to check the time of flowering and anthesis formation which were recorded as Number of Trees/month and Number of Trees/day, respectively. Data were collected based on time and number of days to flowering and anthesis. Data on rainfall and temperature were also collected. Collected data were subjected to analysis of variance (ANOVA) technique and means were separated using the Duncan's New Multiple Range Test (Gupta, 2011).

RESULTS AND DISCUSSION

Rainfall and temperature of the survey site where the African pear trees were growing are presented in figure1-6. The result of the rainfall during the months of February and March were low in all the states ranging from 15mm to 152mm in 2013. There was a little change in 2014, Rainfall pattern ranged from 0.00mm to 190mm from the months of January to March. While in 2015, the rainfall pattern ranged from 0.00mm to 150mm. After March, there was a rise in rainfall from April till September or October in some States followed by a decline in rainfall by the month of November to December. Also, temperature of the surveyed sites were high from January to April ranging from 25^0C to 28^0C (Fig.4-6) and decreased from May to September, October to December witnessed an increase in temperature for the period of study (2013-2015). Result obtained from the flowering phenology of African pear from the five States, three locations in each State showed that African pear flowering started from December in some states while in others January, peak flowering was January in Imo State, Rivers State and Delta State while Abia State and Enugu were February and March respectively (Fig. 7-11). Mean days of

inflorescence flower bud formation to anthesis in all the States took 2-5 days but majority of the trees flower bud reach anthesis at three to four days (Fig. 12 - 16). These results indicated that African pear flowers when the rainfall is low and temperature is high in all the locations. Discernible character variation existed among the African pear trees in terms of time of flower formation, flower bud to anthesis under Nigerian ecological condition.

Field survey results indicated that high concentration of flowering were in the month of January in some States (Imo, Rivers, and Delta), February in Abia and March in Enugu. Therefore African pear flowering took place when the temperature was very high and rainfall very low (December to March). It prefers low humidity and high temperature for its flowering. African pear flowered between the temperatures of 27^0C to 29.5^0C. The rainfall for the flowering period ranged from 0.00mm to 137.50 mm (Figure 1-6) during the period of the study (2013 -2015). This showed that rainfall played minor role in the flowering of African pear. Peak flowering of African pear in five States were staggered during the dry season. This indicated that African pear responded to general environmental signals associated with dry season. Also date and period of flowering of some African pear were similar between locations with different temperature intensity and duration indicating that fixed temperature or humidity levels did not trigger flowering in African pear trees. Furthermore, the same African pear trees flowered at similar times in other states and locations supporting one of the predictions of phylogenetic hypothesis that historical constraints may affect phylogenetic patterns. (Wright, Muller-Landau, Calderón, & Hernandéz, 2005). More so, another relationship that disturbed flowering between African pear trees within and between different locations may be time of rainfall which resulted to harmattan suggesting that the first rain that ushered in the harmattan were a strong force that influenced the staggered flowering pattern within African pear trees. This force pressure may have caused divergence in flowering time between African pear trees within and between locations. Chapman *et al.,* 1999 indicated that flowering occur in response to the stimulus offered by increasing temperature in dry season (harmattan) after having been released from dormancy. Higher dry season temperatures accelerate biophysical processes advancing the timing of flowering. The effect of the warm harmattan dry season temperatures is suppressed until a quota of cold temperature is accumulated releasing the plant from rainy season dormancy (Numnez-Elisea & Davenport, 1995).

Result of the mean days of flowering to anthesis revealed 2 to 5 days. This may be as result of variations in time of flower formation or in temperature range. Mean days of flower formation to anthesis in all the locations varied. Peak anthesis was within three to four days in all locations for the period of three years. This may be as result of climatic factors mainly temperature prevailing at that point in time (Yeshitela *et al*., 2004). And also genetic variations between the trees. Majority of African pear anthesised within 3-4 days, few trees took 2 and 5 days. Those that anthesised very early may be those that ripe first while those that anthesised late may be among the seedless. Again, it was observed that all flowers in an inflorescence do not open at the same time but follow acropetal booming, all do not reach anthesis at the same time , some flowers bud fall off before anthesis as a result of pest and diseases attack or due to unfavourable climatic conditions.

CONCLUSION

Phenology is the study of developmental timing in relation to calendar. This study quantified and evaluated the time duration of flowering which included the start and peak of flowering and flower bud to anthesis. This include the start, duration and end. In African pear, flowering take place in due season. This means the events occur in its own calendar slot. Flowering of African pear in the five States of South-South and South-East of Nigeria and three locations in each State confirmed this. At Delta State, flowering started by December for the three years. Rivers State, flowering started by December in 2014 and January in 2013 and 2015. Flowering commenced by January for the three years at Imo, Abia and Enugu States. Peak flowering for the period of survey was January for Imo, Rivers, and Delta States and February and March for Abia and Enugu States.Time of African pear flowering started from December to March. The duration of flower to anthesis ranged between 2 to 5 days with peak at 3 to 4 days in all locations. Flowering season in AP were affected by temperature. African pear flowered at the temperature of 27^0C to 29.5^0C and rainfall of 0.00mm to 137.50mm. Therefore, African pear flowered when the temperature was high and at low humidity. The planting of African pear that flowers by December to February should be encouraged, because it has highest yield and potential to ripe during hunger period and should also be encouraged for apiculture.

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APPENDICES

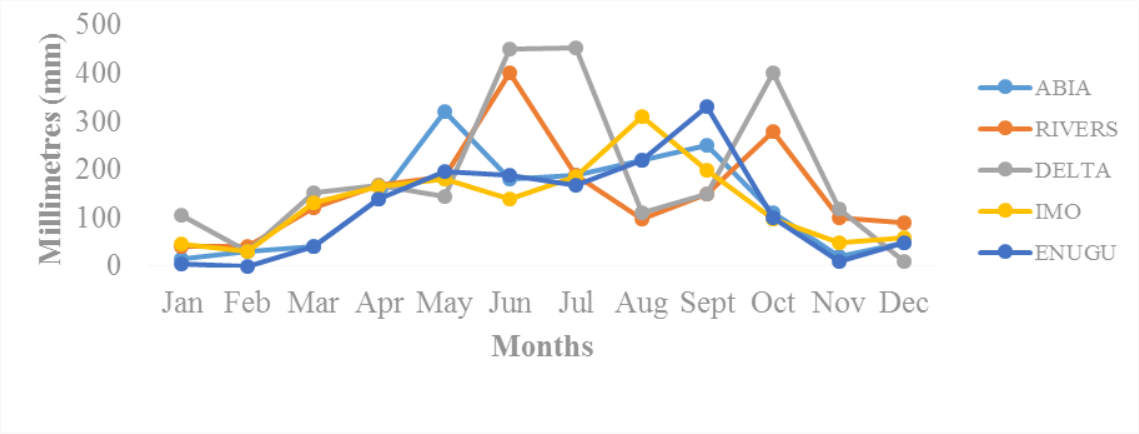

Figure 1: Mean monthly rainfall for the five study locations in 2013.

Source: NIMET

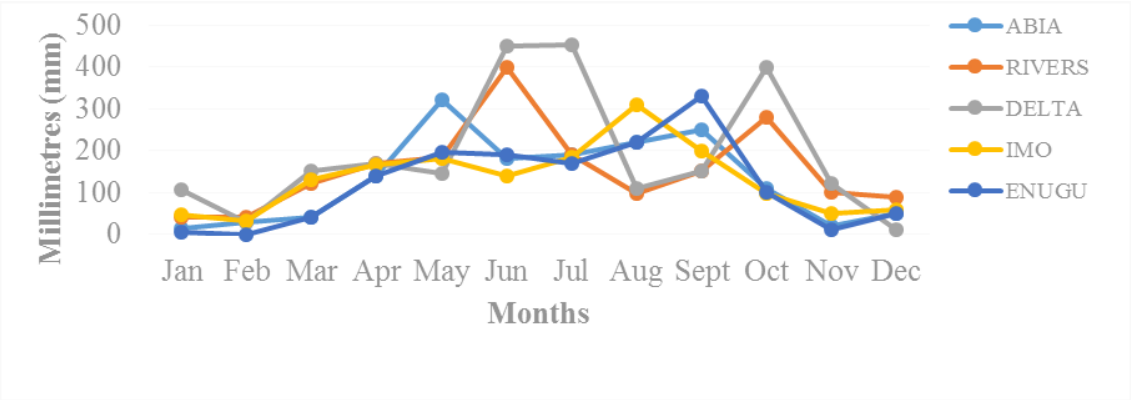

Figure 2: Mean monthly rainfall for the five study locations in 2014

Source: NIMET

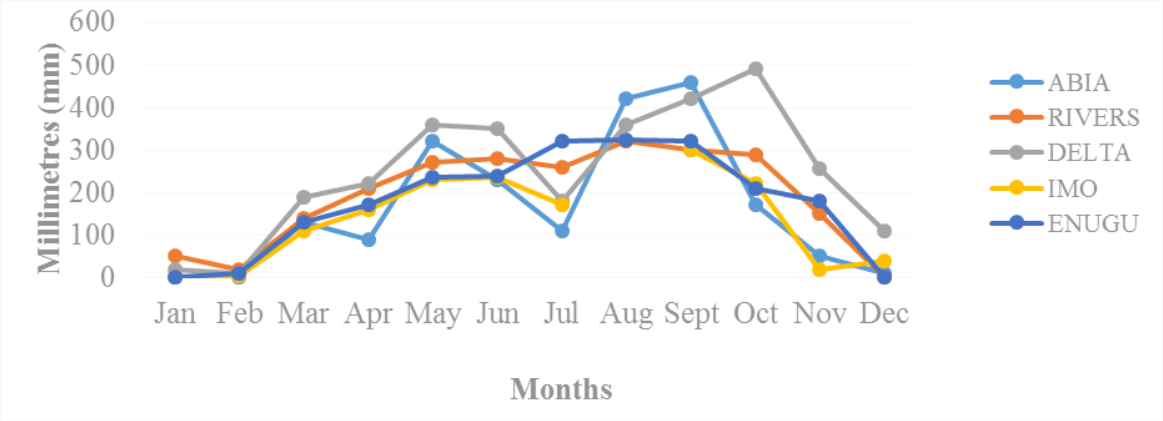

Figure 3: Mean monthly rainfall for the five study locations in 2015

Source: NIMET

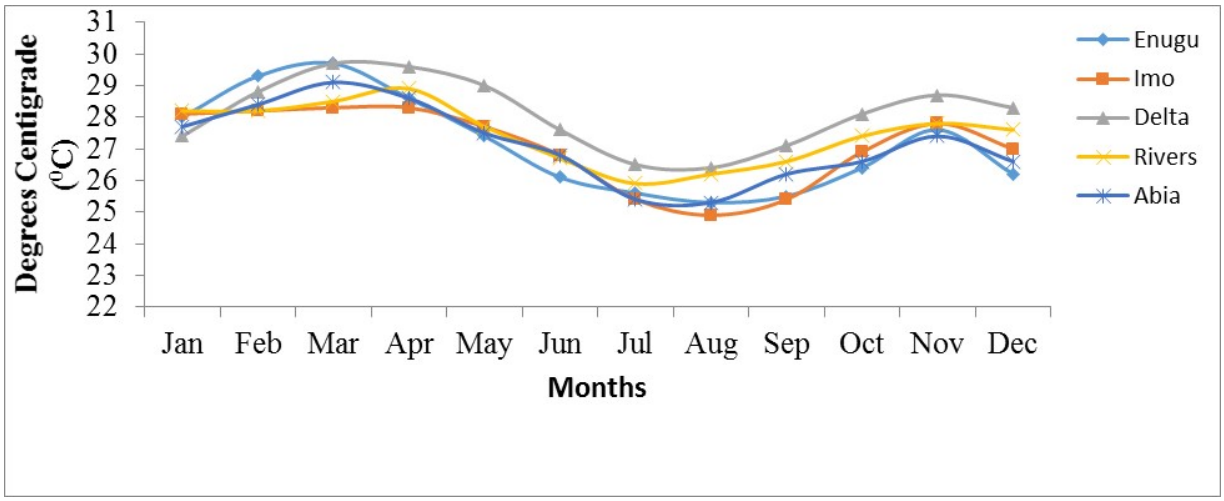

Figure 4: Mean monthly temperature for the five study locations in 2013

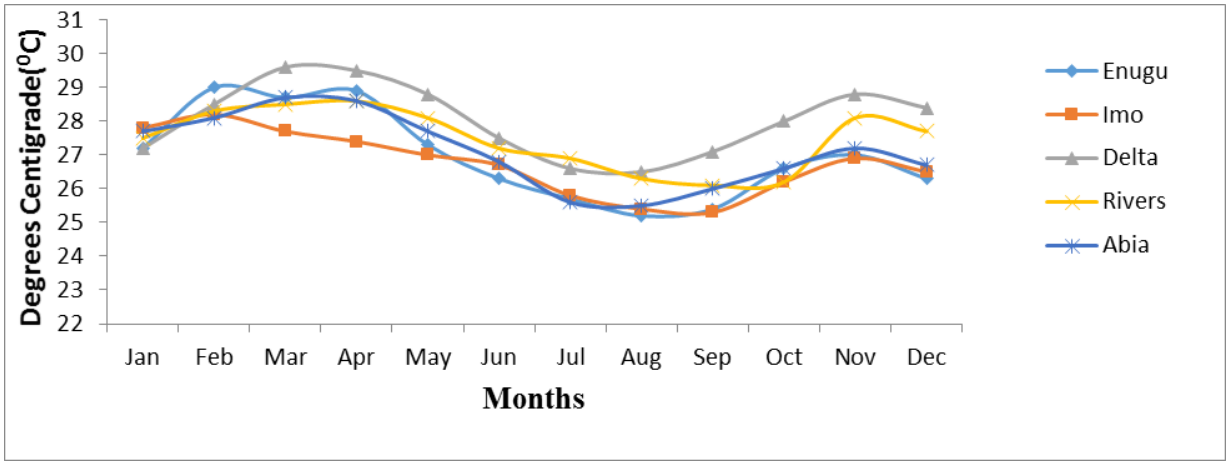

Figure 5: Mean monthly temperature for the five study locations in 2014

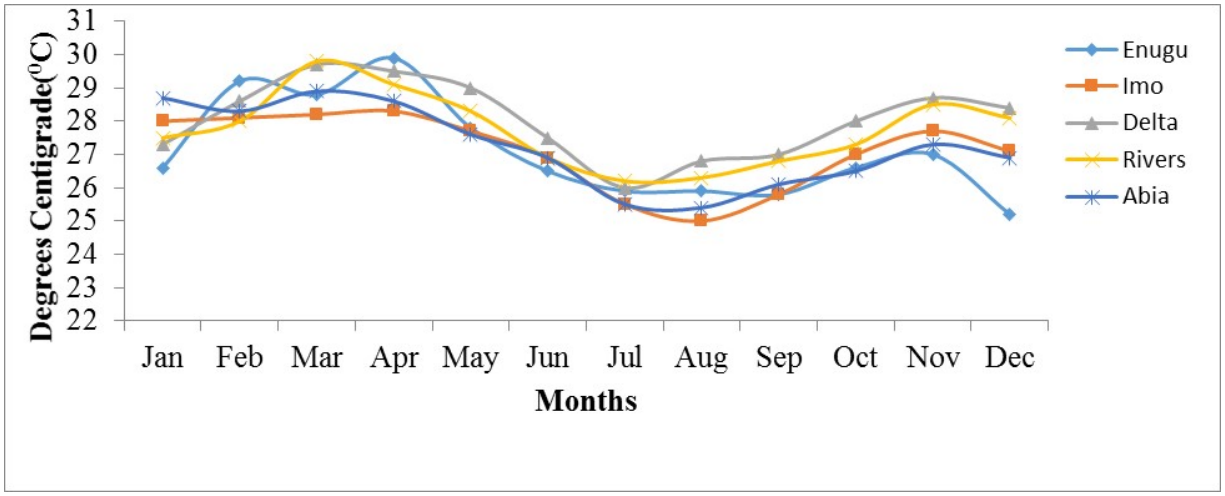

Figure 6: Mean monthly temperature for the five study locations in 2015

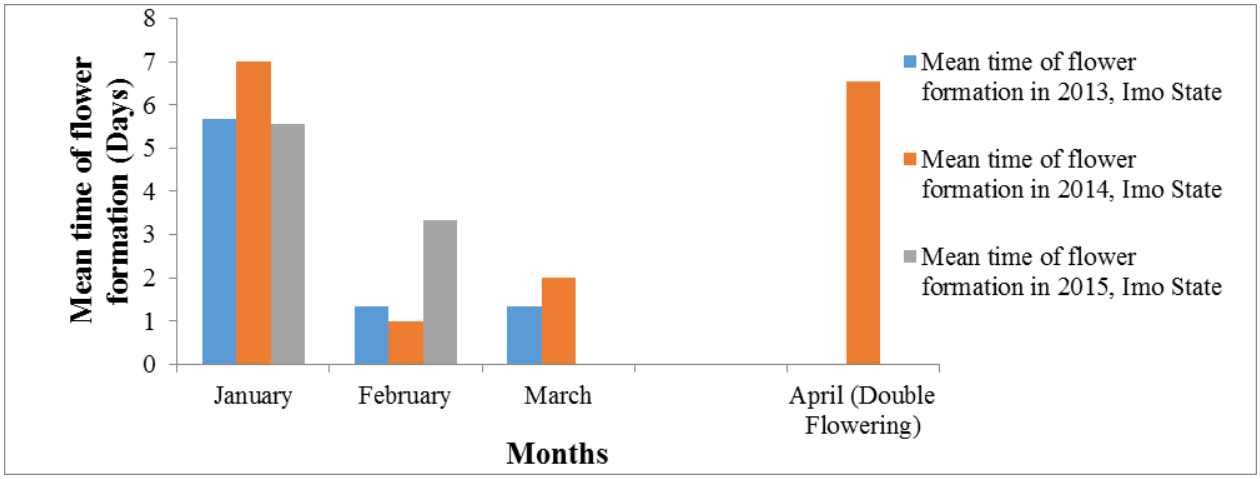

Figure 7: Mean time of flower formation in Imo State from 2013-2015.

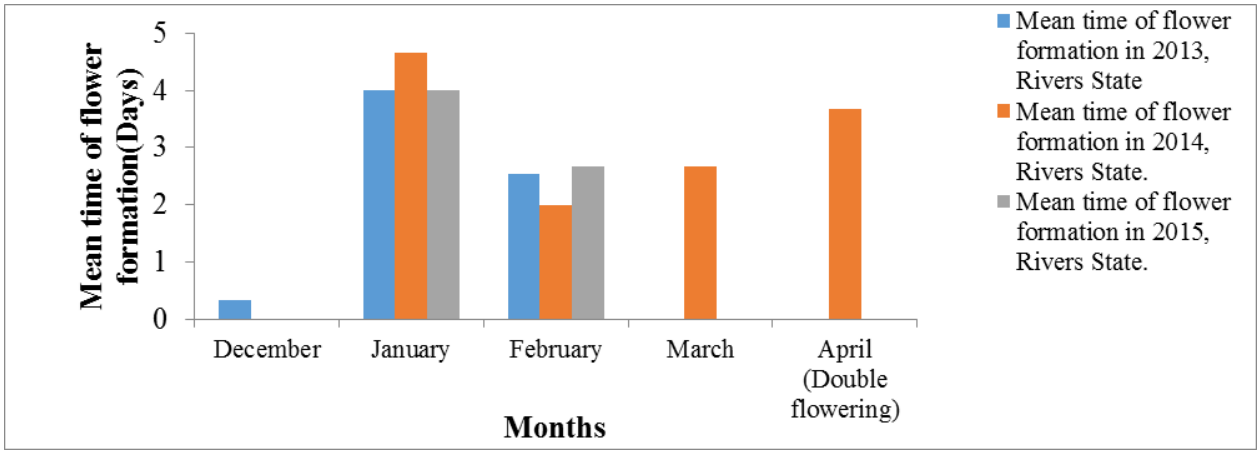

Figure 8: Mean time of flower formation in Rivers State from 2013-2015.

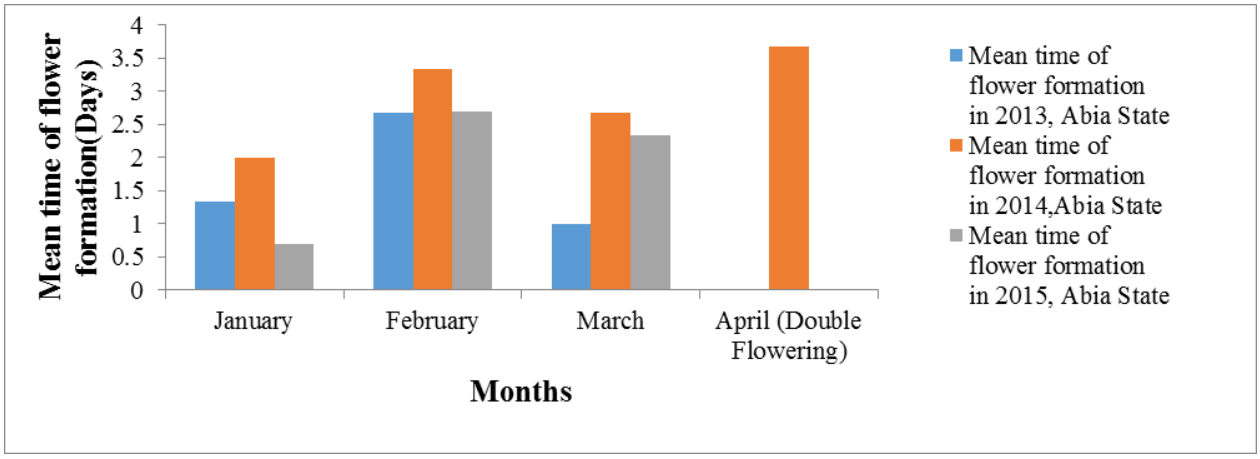

Figure 9: Mean time of flower formation in Abia State from 2013-2015.

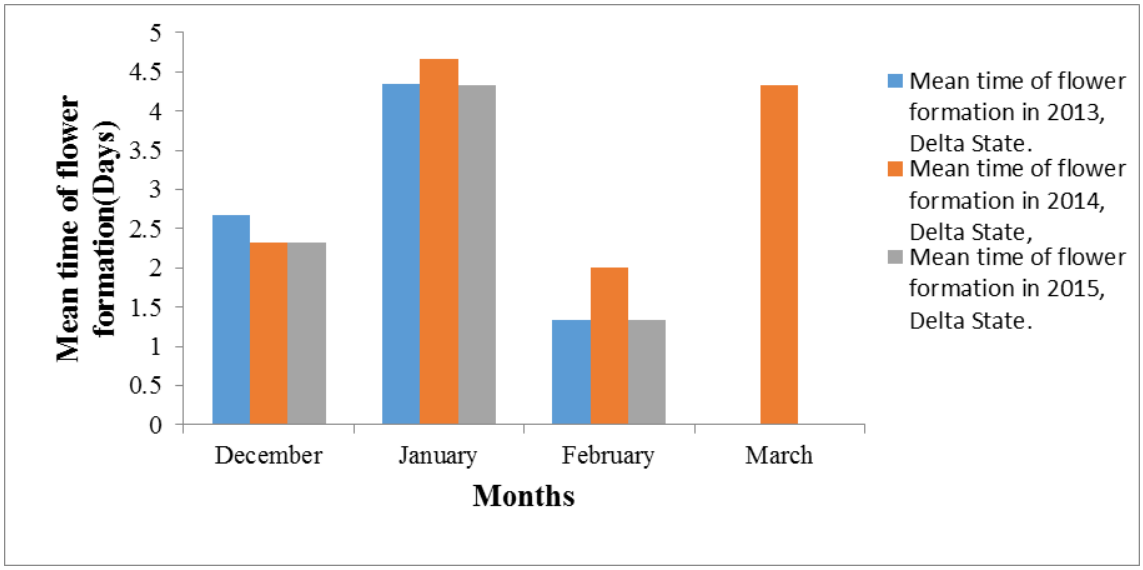

Figure 10: Mean time of flower formation in Delta State from 2013-2015.

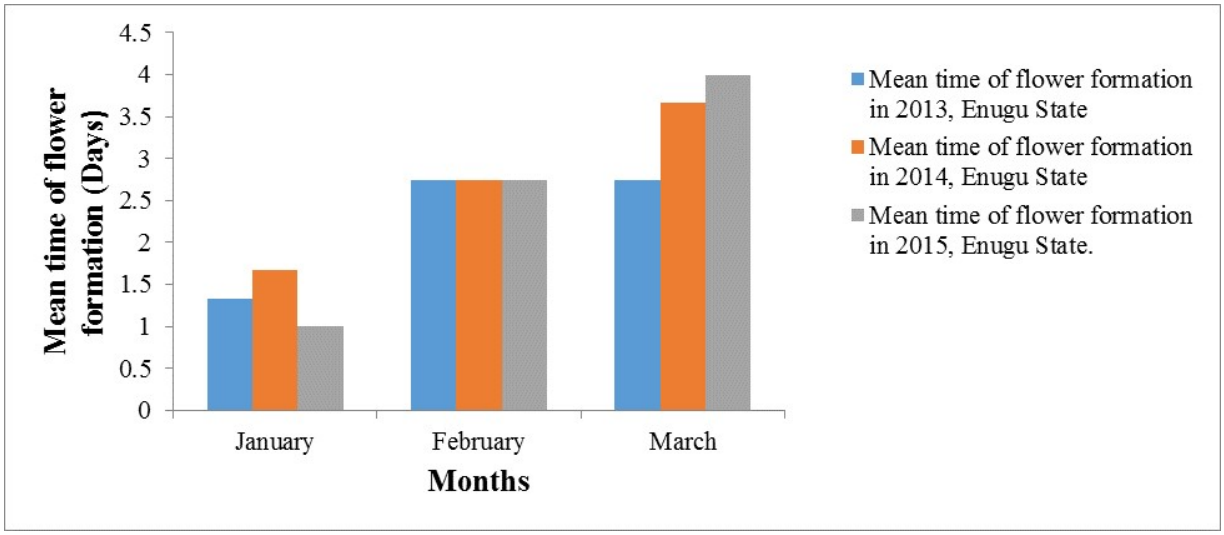

Figure 11: Mean time of flower formation in Enugu State from 2013-2015.

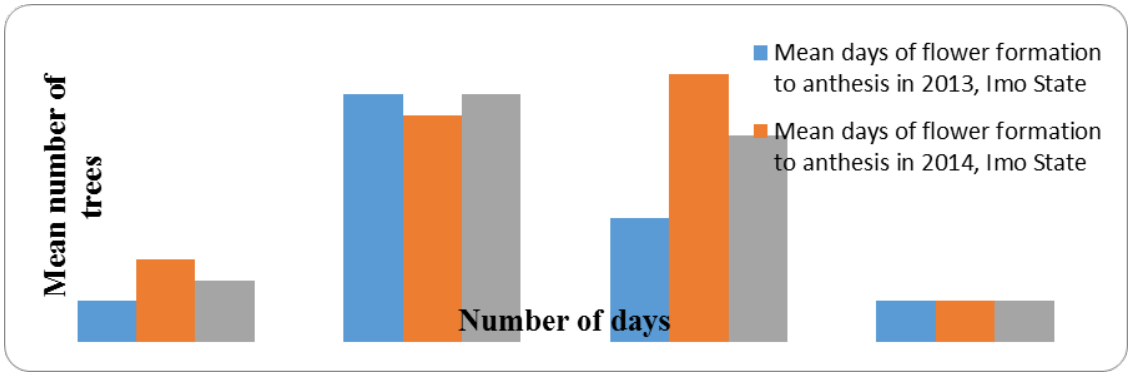

Figure12: Mean days of flower bud formation to anthesis Imo State from 2013 – 2015

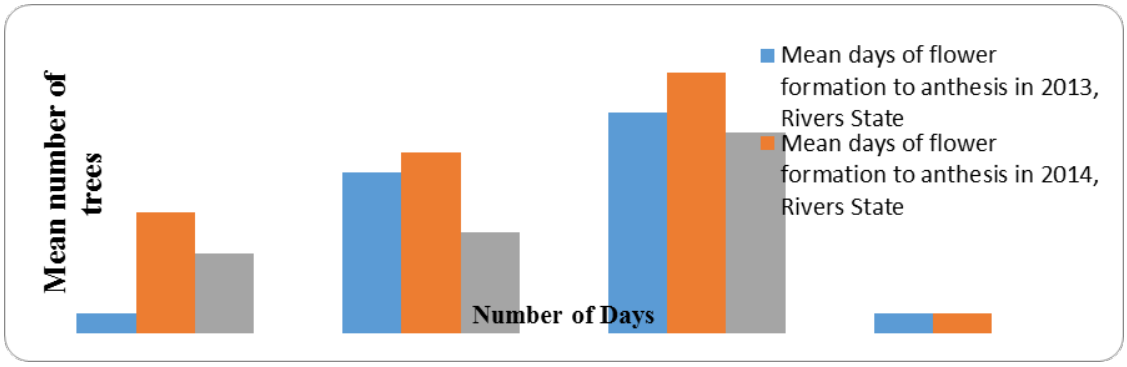

Figure 13: Mean days of flower bud formation to anthesis in in Rivers State from 2013 – 2015

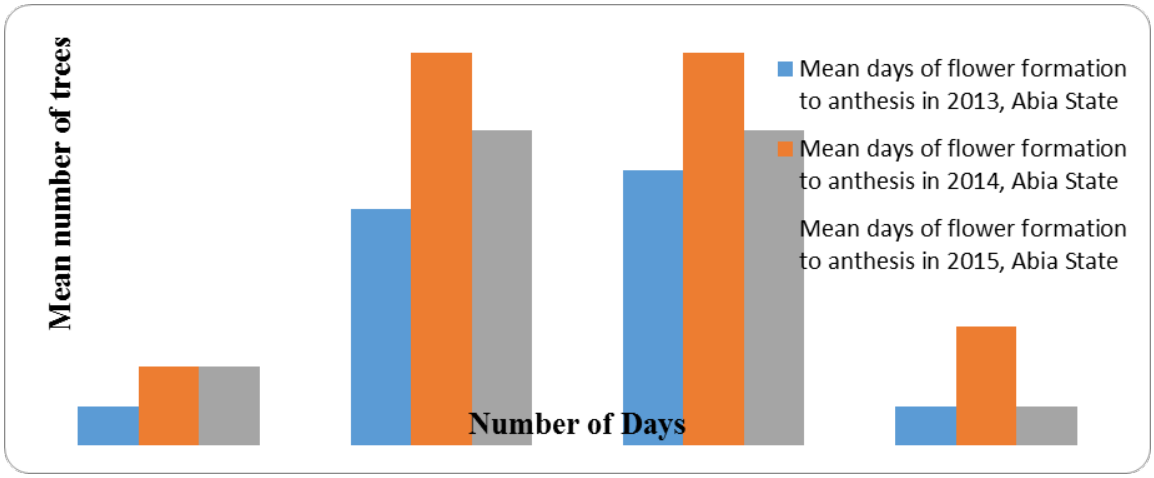

Figure 14: Mean days of flower bud formation to anthesis Abia State from 2013 – 2015

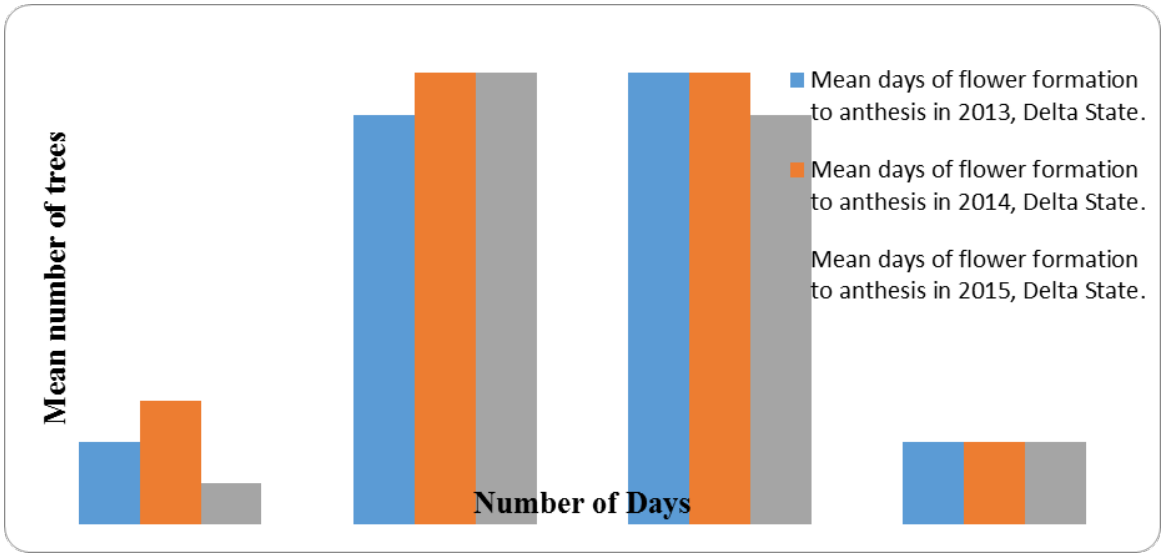

Figure 15: Mean days of flower bud formation to anthesis Delta State from 2013 – 2015

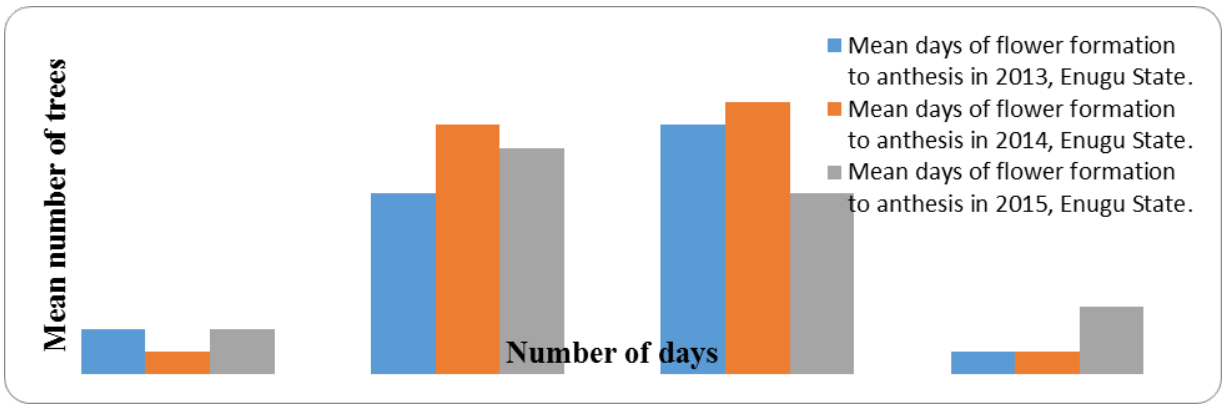

Figure 16: Mean days of flower bud formation to anthesis Enugu State from 2013 – 2015