FRUITING PATTERNS OF EXPLANTS FROM ACROPETAL LOCI OF PINEAPPLE GROWTH AXIS

EMMA-OKAFOR, L.C., OKOLI, N.A., ALAGBA, R.A., IBEAWUCHI, I.I., OBIEFUNA, J.C. and KEYAGHA E.R.
DEPARTMENT OF CROP SCIENCE AND TECHNOLOGY,
FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI
Corresponding author e-mail: lilianokafor35@yahoo.com

Abstract
Pineapple with low multiplication ratio (1:3) is vegetatively propagated using available sucker, crown and slips. Rapid multiplication techniques generated massive propagule production. Field report from commercial pineapple growers indicated significant (p=0.05) growth and yield variations among the explants developed on various loci along the pineapple stem. This experiment carried out in 2013 cropping season at Federal University of Technology, Owerri, studied the fruiting of explants (250± 5g) derived from the anterior, central, posterior loci and crown of mature pineapple stump. Same weight (250± 5g) sucker was the control. The treatments consisted of four loci explants manured with three poultry manure rates 5,10, 20 tha^{-1} respectively. Uniform explants (250± 5g) were established in 50.0 x 50.0cm double row system with 100.0cm inter double row alley. The 4x3 factorial experimentwas executed in a randomized complete block design of three replicates. The anterior and central loci explants matured uniformly early at 500-520DAP and produced heavy pineapple fruits 3.8kg/plant. Fruit yield of the control was highly variable, (1.8-2.5kg/plant) with significant (p=0.05)ratoon yield decline. The posterior loci and crown explants matured late in a staggered pattern over 550-700 DAP. Significant (P≤0.05) fruit yield decline of ratoon pineapple ranged between 45-60%. A research clue for uniform selection of suckers for uniform pineapple orchard fruiting pattern is in view.

Keywords: *Fruiting, explants, acropetal, pineapple yield.*

Introduction

Pineapple (Ananascomosus L.)Merr.)belongs to the family Bromeliaceae. It is known as the queen of fruits because of its excellent flavour and taste. According to Ubi et al. (2005), the pineapple plants are drought tolerant and well adapted to the tropical sandy soils with pH ranging from 4.5 to 6.5. The plants are propagated from suckers or from the crowns, which grow on top of the fruit. It is one of the most important commercial fruit crops in the world available throughout the year. Pineapple production in 2011 constituted more than 19 million MT (metric tons) (FAOSTAT 2009). Thailand is the largest producer of pineapple, accounting for 13% of global output, followed by Brazil and Costa Rica. Production of pineapple in Nigeria accounted 1.4 million MT in 2011 (about 7% of the world production), which placed it in the seventh position (FAOSTAT 2009). The fruits are used mainly for fresh consumption and fruit juice, while in some parts of the world the fermented juice is used to make vinegar and alcoholic spirit. Leaves can be used in three forms: fresh, dried and in silage (Geocoppens 2001). Centrifuge sludge left over from juice production may be used as pork feed (FAO 2004), while fruit core is used for preparing candy. The leaves yield a silky fibre, which is used for making a fine fabric popularly known as piña cloth in the Philippines and Taiwan. Pineapple fibres in some countries are exploited for paper production. Pineapple is also used as ornamentals symbolizing welcome, high living and opulence. Pineapple is a well-positioned fruit since its trade is oriented towards developed countries such as Japan, the USA and the European Community (Coveca 2002). The pineapple is the third most important tropical fruit crop after banana and citrus (Hassan et al. 2012), contributing to over 20% of the world production of tropical fruits (Coveca 2002). In countries producing the pineapple, nearly 70% is consumed as fresh fruit. In Nigeria, pineapple production is the main source of income for many farmers. Until recently, about 80% of the fruits came from small farms managed under mixed cropping systems (Kochhar 2006). Pineapple (*Ananascomosus)* grows extensively in the tropical rainforest agroecology of Nigeria under favourable environment. The pineapple is a significant foreign exchange earner and a popular desert, livestock feed and agro-industrial raw material. Pineapple has been a regular feature in most farmingsystems as a protected crop. Recently, economic awareness of pineapple and its role in national economy, constituted a veritable article of trade in rural and urban markets. Morphologically, pineapple sucker vary in size with age and location on the plant. In the field, these sucker variations manifest in irregular fruiting which makes harvesting uneconomical and time-consuming (Ucheagwu, 1980).

Rapid propagule multiplication techniques for explants production addressed the propagule demand for orchard development (Ucheagwu and Obiefuna, 1982). However, significant fruiting variations existed among the explants although regenerative vigor of axillary bud was the basic consideration. Need therefore arises to ascertain the physiological basis of irregular fruiting patterns of explants as aspects of locations of these explants on themother stems (Norman, 1978). Work on 'sugar-loaf' pineapple reported that pineapples established from crowns and slips developed superior vegetative growth than those from suckers. However, pineapples established from suckers matured early and produced large fruits than those from slips and crowns. Physiologically, suckers, slips and crowns appear in an ascending acropetal loci of the leaf axils on pineapple growth axis.

The situation suggests the dormancy of most axillary buds during pineapple growth phase and attributable to apical dominance (Leopold, 1964). This paper investigated the fruiting patterns of explants from the acropetal loci of pineapple growth axis in southeastern Nigeria.)

Materials and methods

Location

The field experiment was conducted between 2013 – 2015 cropping season at the Teaching and Research Farm, of Federal University of Technology, Owerri, located at longitude $7^0$7' E, latitude 5^0 27' N and altitude 55.7m above sea level. The climate of the area is characterized by two distinctive rainy (March-Oct) and dry (Nov. –March) seasons which are influenced by the effect of the humid maritime air mass. The mean annual rainfall is about 2500mm and is bimodal with peaks in July and September. It has a temperature range of 20^0C and 32^0C. The soil is ultisol, acidic and low in mineral nutrients (Onweremadu*et al.* 2007). The five year fallow experimental site was cleared manually.

Experiment

The experiment was a 4x3 factorial in a randomized complete block design of three replicates. The treatments consist of four explants each from anterior, central, posterior and crown loci growth axis and three poultry manure rates (0, 5, 10 tha^{-1}) respectively.

Stems of three year old pineapple stands (*Ananascomosus cv* 'Smooth cayenne') from university pineapple orchard, were harvested and defoliated. The defoliated pineapple stumps were sawn into the anterior, central(middle), posterior and crown regions according to the physiological maturity along pineapple standgrowth axis.Each physiological mature length(20-59g) had at least 30-40 viable axillary buds. These portions of physiologically matured pineapple lengths were immersed in Benlate solution for 2 minutes(for control of stem rot) and nurtured in a pre-nursery rooting medium of 1:1 river sand and saw dust for eight weeks(Ucheagwu and Obiefuna, 1982). Thereafter the plantlets were milked from pre nursery and further nursed in the standard nursery media of 2:1:1 (top soil, poultry manure; river sand) for another six months before transplantingas an explants to the plowed and harrowed field. These explants (250$\pm$5g) and the same weight (250$\pm$5g) sucker (control) were spaced 50.0x50.0cm in a double row system with 100.0cm alleys in a 4.0x4.0m experimental plots. Poultry manure was broadcast in 2 split doses at 3 monthly intervals beginning from 2 months after field transplanting.Routine cultural practices were applied as necessary.

Data collection/Analyses

Growth and yield data of plant and ratoon pineapples were collected and statistically analyzed usingGenstat 2012. Treatments means were tested for significant difference using Fishers LSD (Obi 2002) at 5% level of probability.

Results and discussion

The results showed that most axillary buds in pineapple growth axis are viable propagule buds for rapid propagule multiplication in pineapple (Table 1). However, the field performance of these explants derived from various loci manifested vegetative and yield variations. Although explants derived from anterior, central, posterior, crown splits and the control sucker developed similar pineapple leaf whorl arrangement which resulted in similar D-leaf length at 50% flowering. Field establishment was best with anterior and central explants and least with crown splits.

Table 1: Growth and yield of explants from four acropetal loci of pineapple axis

Treatments				**Days to 50% harvest**	
Loci explants	**Poultry manure (tha^{-1})**	**D-Leaf length cm**	**Field establishment (%)**	**Plant crop**	**Ratoon crop**
Anterior	5.0	78.62	86.54	510.56	1038.46
	10.0	80.84	92.62	507.82	1084.06
	20.0	86.54	94.48	501.48	1068.84
Central	5.0	70.52	86.12	520.44	1248.56
	10.0	76.18	88.64	520.65	1144.20
	20.0	87.06	92.56	520.18	1154.62
Posterior	5.0	71.02	75.68	545.62	1290.54
	10.0	76.72	86.48	537.34	1254.40
	20.0	80.58	88.62	536.72	1256.50
Crown split	5.0	54.84	72.60	569.84	1294.62
	10.0	66.36	78.56	555.76	1234.08
	20.0	72.46	78.66	544.56	1188.86
Control	5.0	70.62	88.46	566.58	1132.52
	10.0	78.79	92.52	542.58	1198.78
	20.0	81.84	96.08	544.80	1196.82
$LSD_{0.05}$ loci		**80.60**	**10.56**	**15.22**	**22.66**
$LSD_{0.05}$ manure		**6.08**	**6.52**	**8.40**	**9.06**
$LSD_{0.05}$ loci x manure		**2.46**	**4.08**	**8.06**	**8.44**

Furthermore, the explants from the anterior and central pineapple loci were significantly ($p \geq 0.05$) superior to plants derived from the crown splits in orchard establishment which was least influenced by the poultry manure rates. The crown splits established poorly in the field. Flowering among the explants showed significant variations. Thus, the anterior and central explants matured significantly ($p \geq 0.05$) early and uniformly (500-520) DAP while maturity in posterior crown explants and control spanned over 536- 570 DAP. Fruit maturity in the ratoon pineapple followed similar pattern. The explants differed significantly (p=0.05) in sucker production.

Most explants anterior and central produced heavy pineapple fruits which increased with increasing poultry manure rates. These were significantly superior ($p \geq 0.05$) those of the crown splits, posterior and control explants (Table 2).

The ratoon pineapple showed significant yield variations influenced by the explants, loci and poultry manure rates. However, ratoon pineapple fruit yield was inferior to those of plant crops explants irrespective of explants loci. The explants developed from the anterior, central and posterior produced more suckers than crown explants plots. Increasing poultry manure accelerated sucker production in ratoon pineapple. The variations in cumulative stands productivity of explants indicated acute pineapple yield decline per hectare over time.

Table 2: Growth and yield of explants from four acropetal loci of pineapple axis

Treatments			**Fruit weight (kg/plant)**		
Loci explants	**Poultry manure (tha^{-1})**	**Sucker per plant**	**Plant crop**	**Ratoon crop**	**Stand productivity (kg)**
Anterior	5.0	2.06	2.64	2.24	4.88
	10.0	3.06	3.08	2.57	5.65
	20.0	3.12	3.82	3.25	7.07
Central	5.0	2.12	2.48	1.99	4.47
	10.0	3.88	3.80	2.47	6.27
	20.0	3.56	3.65	3.22	6.87
Posterior	5.0	2.64	1.86	0.85	2.72
	10.0	3.26	2.46	1.38	3.84
	20.0	3.06	2.44	1.42	3.86
Crown split	5.0	1.05	1.06	0.58	1.64
	10.0	2.05	1.86	1.08	2.94
	20.0	2.18	1.88	1.05	2.93
Control	5.0	2.50	1.42	1.44	2.86
	10.0	3.05	2.22	1.60	3.82
	20.0	3.16	2.30	1.38	3.68
$LSD_{0.05}$ loci		**1.04**	**0.58**	**0.72**	**1.05**
$LSD_{0.05}$ manure		**0.62**	**0.24**	**0.40**	**0.52**
$LSD_{0.05}$ loci x manure		**0.46**	**0.46**	**0.08**	**0.18**

Discussion

Anterior, central, posterior, crown split explants and traditional stone weight sucker (control) manifested similar growth but poor establishment characteristics though variable yield component attributes. These explants are shoots (suckers) since each emanated from the buds located in the leaf axils of mature pineapple stems (Leopard, 1964; Clark and Heath, 1959). The anterior explants emanated from most physiologically mature pineapple stem while the posterior and the crown explants are least mature (Leopard, 1964, Ucheagwu and Obiefuna, 1982) and therefore highly juvenile and naturally highly vegetative. The growth hormone gradient and carbonhydrate concentration skewed towards the anterior which is the preferential propagule choice as in yam (Nwoke and Okonkwo, 1978).

The crown splits and the traditional crowns which are formed by the posterior meristem of pineapple stem mature late in the orchard. Ratoon crop yields were inferior to those of the plant crop because the ratoon plants which developed from axillary buds along the stem axis depend entirely on the root systems of parent pineapple for soil nutrients and water. The pineapple age has its adverse implications on ratoon crop yield especially the deteriorating parent pineapple vigour and health for which root not nematode *Meloidogne incognita,* is implicated (Babatola, 1985).

Conclusion

The location of any planting material (sucker, slips crown)on pineapple stem influences the performance in the orchard. Furthermore the loci of sucker on the pineapples result on yield variations in the field even when same weight suckers are planted. The growth and yield of pineapple propagules are genetically determined but environmentally and nutritionally enhanced. Further, work on sucker location, size and weight may standardize criteria for uniform suckers selection in orchard development.

Acknowledgements

The authors are grateful to the Vice-Chancellor Federal University of Technology, Owerri Prof. F.C. Eze, Dean, School of Agriculture and Agricultural Technology, Prof. B.O. Esonu, Ag. Head, Department of Crop Science and technology for the research facilities used and the farm staff for technical assistance rendered.

References

Babatola, J.O. (1985). *Diseases and pests of fruits and their control in Nigeria.*Proc. National fruit production workshop, 120-132.

Clark, J.E and Heath, C.V.S. (1959).*Auxin and bulbing in onions.*Nature 184: 345-347.

Coveca C.A. 2002. Comisionveracruzana de comercializacionagropecuaria.Gobiernode l Estado de Veracruz, México [in Spanish]. Fakayode S.B., Rahji M.A.Y., Adeniyi S.T. 2012. Economic analysis of risks in fruit and vegetable farming in Osun state, Nigeria.Bangladesh J. Agril. Res. 37(3): 473-491. DOI: 10.3329/bjar.v37i3.12125.

FAO 2004.www.fao.org/livestock/agap/frg/afris/espanol.

FAOSTAT 2009. Top 5 facts sources: Food and Agriculture Organization of the United Nations. www.top5ofanything.com/index.

Geocoppens 2001.www.ciat.cgiar.org/ipgri/fruits_from_americas/d'Eeckenbrugge [in French].

Heath, C.V.S. and Holdsworth, M. (1948).*Morphogenic factors exemplified by onion plant.* Symptom Soc. Exp. Biol. 2: 326-350.

Kochhar S.L. 2006. Economic botany in the tropics.Macmillan India.203 pp.

Leopold, A.C. (1964). *Plant growth and development.* McGraw-Hill Book Company, New York: 298-303.

Norman, J.C. (1978). *Influence of planting materials on growth, flowering and fruiting of 'Sugar loaf' pineapples Ananascomosus.* (L. Meer) ActaHortic 84:191-197.

Nwoke, F.I.O and Okonkwo, S.N.C (1978).The effect of periodic removal of mother tubers on yield of *Discorearotundata.*Expl. Agric. 14, 145-150.

Ubi W., Iqwe H., Ekpe S., Ibor O. 2005. Preliminary trial of fertilizer types on pineapple (Ananascomosus) grown on coastal and sands of Cross River State, Nigeria. Global J. Pure and applied sci. 11(4):457-460. DOI: 10.4314/gjpas.v11i4.16534.

Ucheagwu, A.C. (1980). *Vegetative propagation Ananas Comosus L. Meer).* Ways of multiplying planting materials. Agronomy and soils department, University Hawaii, Honolulu.

Ucheagwu, A.C. and Obiefuna, J.C. (1982).*A rapid multiplication techniques in pineapples.* Paper presented at the 5th Annual Conference of Horticultural Society of Nigeria (HORTSON) held at ABU Zaria, 21st -25th, November, 1982.