GROWTH REGULATORY HORMONES EFFECTS IN PINEAPPLE PRODUCTION FOR FOOD INCREASE THROUGH VOCATIONAL AGRIC EDUCATION AND TRAINING IN NIGERIAS TERTIARY INSTITUTIONS

UDENSI EDWIN .O
efednoz@gmail.com
Technology and Vocational Education Department
Enugu State University of Science and Technology Enugu.

Abstract
Instructional delivery in Nigerian tertiary institution calls for innovation in this digital era. Refocusing on proper implementation of the tenets of Technical Vocational Education and Training (TVET) demands that apprenticeship training, experimenting and trials would re-energize trainees in internalizing the parameters through which they would be replicated for repositioning vocational education as the main hub of entrepreneurship studies. Effect of growth regulatory hormones on pineapple production for effective refocusing of technical vocational education and training (TVET) instructional delivery in tertiary institutions in Nigeria is the focus of this paper. Specifically, the study described the effects of ethrel administration on flower induction in 6-12 months smooth cayenne propagules fruit yield. The trial was carried out in Agricultural Education demonstration farm of Enugu State University of Science and Technology. Experimental design was used for the study. One hundred and twenty propagules of smooth cayenne, from Cross River State Commercial pineapple farm project were used. It resulted that the mean period of months after administration of ethrel at 100ppm approximately for calcium carbibe (CaC_2) to attain the mean fruit weight at application of 1.5g gave the biggest and brightest fruits among the other treatments. In conclusion, the use of selected growth regulators in instructional delivery on pineapple production, can re-energize youths in embarking on commercial production of pineapple. Recommendations include that for effective refocusing of Technology and Vocational Education and Training (TVET) on Instructional delivery, practical knowledge of pineapple production should be demonstrated on the farm laboratory and that ethrel growth regulator should be applied at 120ppm for flower induction in smooth cayenne production.
Keywords: Instructional delivery, trial, ethrel, calcium carbide, Pineapple.

Introduction

Technical Vocational Education and Training (TVET) is generally concerned with teaching and learning of skills for boosting productivity. According to Ndomi (2017), farmer trainees are made more effective if exposed to operations making use of tools and equipment as in the farm occupation itself. The farmer training can be exposed to skills in pineapple production among others.

Pineapple, (*Ananas Comosus L.* Merr) is a perennial herbaceous plant of the botanical family *bromeliaceae* that reaches a height of 50cm (Pamplona-Roger, 2014). Pineapple is an ancient crop that was domesticated prehistorically and dispersed several years before Christopher Columbus voyage in the year 1493. Pineapple is categorized into six classess: *Ananas comosus Var. ananassoides* formerly *Ananas anassoides* and *Ananas nanus*; *Ananas comosus var bracteatus* formerly *Ananas bracteotus* and *fritzme Italian*; *Ananas comosus var comosus* (cultivated variety); *Ananas comosus var erectifolius; Ananas comosus var paraguazensis; Ananas macrodontes* (Coppen d' Eeckenbrugge and Leal, 2013).

Pineapple production benefits are many. The farmers enjoy the followings: provision of gainful employment, good source of income, improved standard of living, supply of raw materials to feed and food industry, supply of raw materials to agro-based firms such as the fruit juicing and canning firms, supplying the pineapple with needed materials and serving as sources of revenue to the government (Emedo, Maduka and Oranekwulu, 2015). Pineapple is locally grown for fresh, tasty, juicy flesh that provides vitamins and minerals together with fibre that aids digestion and metabolism. It is of value industrially and very effective in paper production, textile and confectioneries. Pineapple is made into concentrate and used in soft drink industries as flavours.

Planting of pineapples serve in checking erosion in tropical rainforest areas having high rainfall. Some use it as boundary plants, others use it for aesthetics. Pineapple has been shown to prevent stomach cancer by inhibiting the formation of nitrosoamines, cancer causing agents (Pamplona-Roger, 2016). Pineapple extract is used for production of wine, ice cream, vinegar, yogurt, alcoholic beverages and flavourings. The tender shoots and terminal buds are used for salad and desserts. This tropical fruit is one of the richest foods in manganese, a trace element, actively involved in formation of reproductive cells in both male and female. Fresh pineapple juice

consumed before meals reduces appetite and constitutes a good complement to weight-loss diets. It is also, slightly diuretic (facilitates urine production) and is a good source of folates (Pamplona-Roger, 2014).

Pineapple (*Ananas comosus*) has attained the annual world production of 14 million tonnes and 70% is consumed as fresh fruit (Anon, 2012). It is no doubt growing in popularity and producing countries as Nigeria is commercially producing the crop, so she is rated 6th out of 79 countries producing this important fruit. The mean production was achieved by Nigeria back in 2003 (FAO, 2014).

Pineapple was produced in Nigeria in compounds as inter crops with other food crops as cocoyam, newly established tree crops like citrus, oil palm, cocoa, kola nuts, but recently, attention has been drawn to its importance and as such new technologies are applied to sustain its production. Pineapple production requires various conventional instructional approaches based on basic principles of participation, communication, teaching and training techniques. The demonstration farms established by students in their penultimate years do not have the pineapples planted, yielding fruits before they graduate. The pineapples mature naturally in 18-24 months range depending on variety and propagules used, that is, the sucker, crown, ratoon, hapas or slip, but Ubi and Ubi (2017) postulated that fruits of pineapple mature five to six months after floral induction or twelve to eighteen months after planting, depending on the size, age and type of planting materials as well as good farm management adopted and environmental conditions.

Therefore shortening the period of maturity becomes pertinent of growth regulatory hormones on pineapple production for effective refocusing TVET instructional delivery in tertiary institutions

in Nigeria. Teaching agricultural techniques is not restricted to the classroom as such the use of growth regulators in pineapple production requires demonstration during instructional delivery.

The emphasis placed on functional agricultural practices as a TVET programme demands that graduates in related courses participate in practicals. The TVET is evolved to refocus attention to teaching and learning appropriate skills that would enhance production in a chosen field of endeavour like agriculture. There is need to match the production rate with consumption.

The high demand for pineapple requires that gaps created when it is seasonally produced be closed as a means refocusing TVET on instructional delivery in tertiary institutions for more productivities.

Instructional delivery on pineapples in Nigeria institutions is an important choice because it is in synergy with technological principles that enhance selective use of growth hormones and substances for crop growth. Instructional delivery based on TVET carries students along in land management, crop separation, clearing and processing (Opeke, 2010). Growth regulators in pineapple production can be refocused as instructional delivery materials for guide production, fastening of growth of pineapple plants and thereby creating opportunities for employment of youths in farming, teaching and demonstrations.

There are various growth hormones and substances for enhancement of fruiting and ripening of pineapples. They include: Ethephon, ethrel (2-Chloro etilfosfonic acid), b-napthalene acetic acid (BNA), naphthalene acetic acid (NAA), indolbutiric acid (IBA), calcium carbide (CaC_2) b- hydroxyethyl hydrazine (BOH), hydroxy-ethyl hydrazine (HOH), ethylene (C_2C_4) succiric acid and acetylene (C_2C_2) (Cooke and Randall in Ubi & Osodeke (2016). Other growth regulatory hormones are Alpha Naphthyl Acetic Acid (ANAA). Beta Naphthyl Acetic Acid

(BNAA), Sodium salt of Alpha Naphtyl Acetic Acid among others (Ubi & Osodeke, 2016). Application of growth regulators according to Cooke and Randall in Ubi and Osodeke (2016) promotes the translocation of endogenous auxin, indo-acetic acid (IAA) from the activity sites to the apical meristern of the plant. The use of selective growth regulators obtain uniform flowering and fruiting in pineapple production is extensively practiced in developed countries and for commercial pineapple production in Hawaii and Latin America, diverse groups of chemicals can force flowering (Batholomew, Paull and Rohrbach 2013). Susceptibility of pineapples to flower inducement is influenced by factors, such as plant size, vigour and variety (Coppen's Eeckenbrugge & Leal, 2011). Batholololomew (2015) reported that ethephen and ethrel induced flowering within 35-47 days of application. Choice of smooth cayenne species of the pineapple was made because the sugar content is high and has low acid. The ripening of smooth cayerne starts from the bottom progressing to the top. The flesh is seedless, pale yellow, soft, juicy, flavourful and low in ascorbic acid content.

Statement of the Problem

The extended maturity period of unimproved pineapple species of 2-3 years kept farmers off production of pineapple and caused short supply to the populace and consumers. The huge capital investment in procuring pineapple propagules for commercial production scared the farmers, coupled with the lack of awareness on production techniques, hence loss of interest in pineapple. People abhorred the taste of local pineapple which is very sour, and causes burning sensation in the range. What are the means of rekindling interest in pineapple production and to solve the problem of extended maturity period, improved fruit size, yield and weight by flower inducement using selected regulatory hormones? Effective refocusing of production of pineapple as (TVET), is the experimental study as embarked upon to create experiential knowledge and

practice of pineapple farming. What are the means of shortening the period of maturity of pineapple to increase its regular supply in the market to make food sufficient for the populace. This constitutes the problem of the study.

Purpose of the Study

The general purpose of this study was to selectively use some growth regulators in pineapple productions for effective refocusing of TVET instructional delivery in tertiary institutions in Nigeria. Specifically, the study sought to determine:

1. the effect of ethrel administration on flower induction in 6-12 months smooth cayenne pineapple propagules;
2. effects of calcium carbide administration on 6-12 months smooth cayenne propagules to find mean fruit weights;
3. effects of ethrel administration on 6-12 months smooth cayenne progagules.

Materials and Methods

The design was experimental and the trials were carried out at Enugu State University of Science and Technology, Agricultural Technology Education demonstration farm. The progagules for the study was 120 smooth cayenne pineapple variety obtained from Cross River State Commercial Pineapple production project and they served the population for the study. The Pineapple propagules were 40 of 6,9 and 12 months of age each. Pineapple propagules of both crowns and suckers from previous year were planted in double row at 0.5m x 0.5m on beds with one meter space each. There were 15 stands of 2 plants each making it 30 on each treatment of 4 replications. The cultural practices applied were weeding by hoeing and hand picking, mulching

and construction of bunds to prevent soil erosion and retention of water at off seasons. Irrigation was practiced in dry period.

Fertilizers were applied at the rate of 500kg N, 300kgP and 500kg/k per ha. The fertilizers were applied in four split doses on pineapples of the ages range 6, 9, 12 months from time of planting. Five rates of ground calcium carbide applied per pineapple in two plants per stand were randomized for the sub plots or treatments. The ground calcium carbide were in measures of 0.5g, 1.0g, 1.5g, 2.0g and 2.5g for fruit weight of smooth cayenne while 20, 40, 60, 80, 100, 120 and 140 ppm ethrel were also randomized into plots at 9 months of the trial, for flower inducement on variety of the smooth cayenne.

The different rates of ground calcium carbide were applied once, while the parts per million rates of ethrel were applied in 50 mls dispensable cans of water per plant. Calculations were made and digitally recorded for:

- The number of days of flowering from the date inductants were applied.
- The gestation period from the date of induction to the date of harvesting.
- Weights of fruits at harvest and yields in kilogrammes from appearances of inflorescence to maturities of fruits and ripenings.

Results

The inductants applied enhanced flowering significantly as shown in the tables below:

Table 1: Effects of ethrel administration on flower inducement of smooth cayenne variety of pineapples at the ages of 6, 9, and 12 months.

Treatments (Parts per million PPM) of ethrel.	Mean period in months of flowering after administration of ethrel.	Mean period in months of gestation from date of ethrel administration.
0 (control)	5.5	10.3
20	5.3	10.2
40	5.1	8.8
60	4.4	9.2
80	3.0	7.5
100	2.5	6.9
120	1.9	6.5
140	1.8	6.5

Table 1 indicates that control had the highest flowering period of 5.5 months for smooth cayenne variety of the pineapple. It was 10.3 months on the whole from the time the treated crops produced inflorescence to maturity. Administration of ethrel reduced the mean period of flowering and gestation period as indicated in **Table 1**.

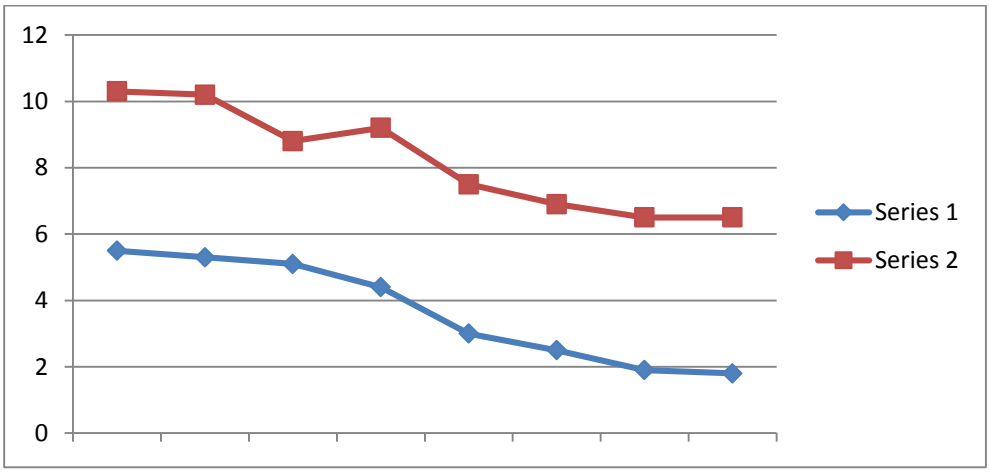

Fig 1: ethrel administration on flower inducement

Table 2: Effects of calcium carbide administration on mean fruit weight of smooth cayenne in kilogramme per plant.

wt CaC_2(g)	**0.0**	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**Mean**
Age (months)							
6	1.70	2.50	2.90	3.20	2.90	2.25	2.58
9	1.65	2.10	2.80	4.10	2.93	2.27	2.81
12	1.75	2.40	2.95	3.15	2.88	2.27	2.57
Mean	1.70	2.33	2.88	3.48	2.90	2.26	

Table 2 indicated that the weights of the fruits at 6, 9, and 12 months aged pineapples were relatively not different from the mean fruit weights. The calcium carbide (CaC_2) of weight 1.5g has weights of fruits 3.20kg, 4.10kg and 3.15kg and mean of 3.48kg. The mean weight is higher than other mean weights for CaC_2 weight of 0.5, 1.0, 2.0 and 2.5.

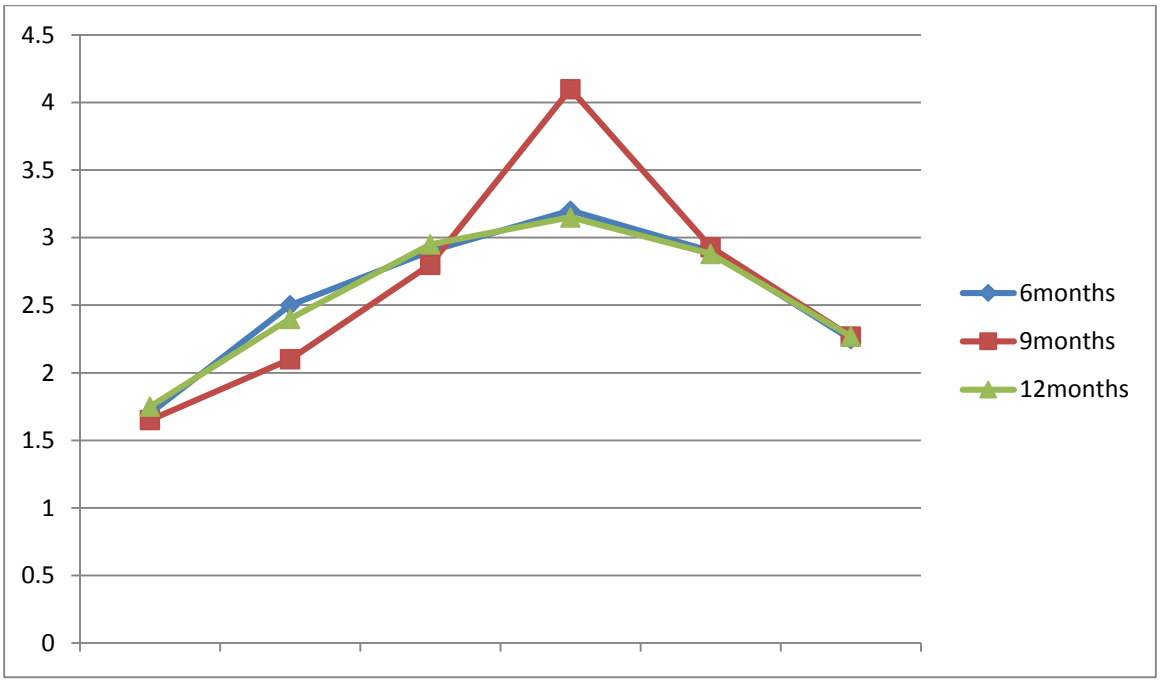

Fig 2: calcium carbide administration on mean fruit weight of smooth cayenne in kilogramme per plant.

Table 3: Effects of ethrel administration on period of smooth cayenne development and fruit yield.

Treatments of ethrel in ppm.	Mean period in months of fruit development.	Mean fruit yields in kg from appearance of flowering to harvesting.
0	5.0	1.5
20	4.7	2.0
40	4.9	1.4
60	4.7	1.4
80	4.6	1.8
100	4.7	1.8
120	4.6	1.6
140	4.7	1.5

Table 3 indicated that ethrel administration effects on period of the pineapple development were slightly different from that of the control, by between 0.1 and 0.4 for mean months of fruit development. The yields in kilogramme varied at ethrel application of 20ppm by 0.5kg while the difference in mean fruit yield for ethrel administration of 40, 60ppm, 80, 100ppm then 120ppm respectively were 0.1kg, 0.1kg, 0.3kg, 0.3kg and 0.1kg respectively.

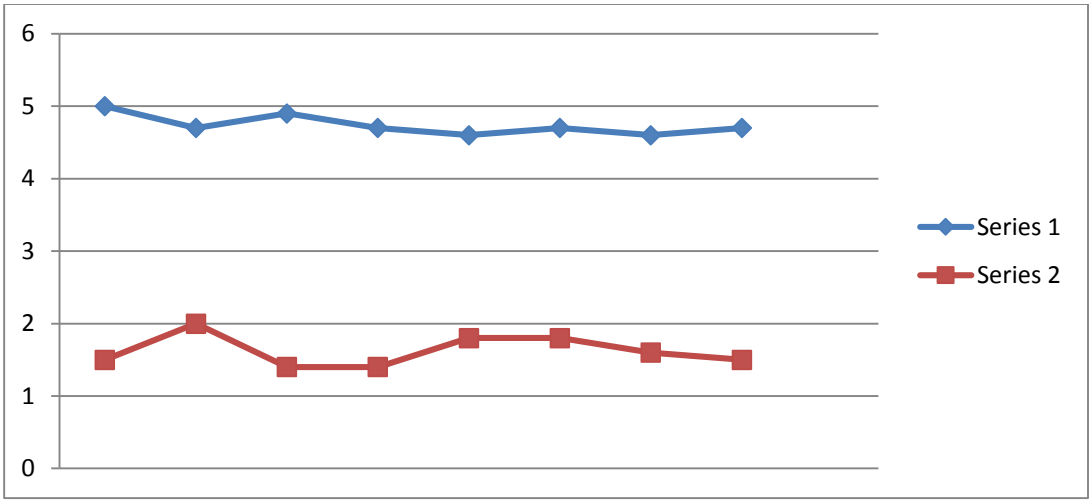

Fig 3: Effects of ethrel administration on period of smooth cayenne development and fruit yield.

Discussion of Results

Table 1 exhibited the result of the administration of various ppm ethrel. The hormone significantly hastened floral induction. Although, Bartholomew (2015) reported that ethephen and ethrel would induce flowering within 35-47days. The researcher observed that the experiment in Enugu State University of Science and Technology was with ethrel, it took 57 to 58 days to produce 50% flowering on the plot. The dosage of the ethrel was increased to 140 parts per million. The control took 5 ½ months while at 100ppm it took 2 ½ months. It would seem that application of the ethrel quantity below 60ppm had little or no effects on the crops, because both the crops with 20ppm and 40ppm treatments had a mean period of more than 5 months of flowering after the ethrel hormone administration. It was also found that the time range between date of administration of ethrel hormone and appearance of the inflorence was from one to three months at the rate of 80ppm upwards while doses of less than 80ppm had the appearance of inflorence at time range of 4 to above 5 months.

Smooth cayenne of the age 6 and 9 months reacted favourably at the administration of 1.5g of CaC_2 by the percentage of 50 and above producing flowers. It proved that 1.5g of CaC_2 was the optimum rate, because beyond that quantity flowering was delayed. Other reactions of the crops with heavier doses include severe leaf scorching, charring of leaves with rapidity and drooping of fruits before term or maturation which collaborated with Ubi and Ubi (2017) submission that higher concentration of growth regulators result in physiological alterations in the plants or may lead to fruit damage.

Table 2 shows that the pineapple variety produced significantly heavier fruits at 1.5g CaC_2 application than any other dose. The fruits also produced at this optimal dose were biggest and

brightest, all the same, the fruits produced by the application of either 1.0g or 2.0g of CaC_2 produced heavy fruits of equal sizes, and weights.

Table 3 shows the effects of ethrel administration on period of smooth cayenne fruit development and yield. The time range between the emergence of fruits and their maturities was five months approximately. Both the control and crops with various treatments exhibited this trait, proving that the maturity period of fruits from inflorescence to ripening is barely five months, this was supported by Ubi and Ubi (2017) who reported that fruits matures after five to six months of floral inductions. The fruits quality from the induced pineapples compared favourably with the fruits produced in the control in many respects; contrary to opinions that fruits produced from forced flowering are not natural as such cannot compare favourably with conventionally produced pineapple fruits.

Figs 1-3 are the graphical representations of the experiments. Fig 1 represents parts per million treatments with ethrel administration on pineapple for flower inducement and the gestation period after the appearance of pineapple. Fig 2 represents the effects of calcium carbide administration on fruit weights produced by smooth cayenne pineapple variety for 6,9 and 12 months; and fig 3 represents the effects of ethrel administration on period of fruit development and fruit yields in months.

The experiment revealed that there could be uniformity in fruiting and harvesting, hence application of growth regulators in sequence on pineapple products ensures steady supplies of fruits, which increases farmers incomes. The new knowledge include that lower concentrations of growth regulators result in development of small fruits sizes while higher concentrations of growth regulators result in wastes and may lead to fruits damages. Growth regulators give optimum yield

with ideal quantity applied. It is also noticed that untimely applications of the hormones result in small fruit head production or lower weights returns, while timely applications of the hormones enhance heavy fruit heads production in pineapples.

Conclusion

Use of flower inductants instructional delivery on pineapple productions can revolutionize the youths to embark on commercial pineapple productions in the Nation. Trainers need regular updates to train growers. Growers can use the identified growth regulators to induce fruits production all the year round in combination with the appropriate agronomic practices required of pineapple production.

The untreated smooth cayenne with agricultural cultural practices, took 20 months in the experiment and trial to develop flower, fruit, mature and ripen, but with inductants and appropriate practices, the period was reduced by four months using ethrel administration of between 100ppm and 120ppnm. The shortened period of gestation conversely reduces the productions costs and increase profit for the commercial farmers.

Recommendations

1. For effective contribution to food increase, refocusing of Technical and Vocational Education and Training (TVET) on instructional delivery, practical knowledge of pineapples productions should be demonstrated.
2. Ethrel growth regulators should be applied at 120ppm for flower induction.
3. CaC_2 should be administered at the optimum weight of 1.5g when plants are in age of 9 months for maximum weight output.

4. Ethrel growth regulators should best be applied at 80ppm for shortest mean period of development and for heaviest fruits yields after appearances of flowering to harvesting.

References

Anon (2012). *FAOSTAT Database*. Food and Agriculture Organization of United Nation.

Barathi, N. (2012) Plant T.C Listserv. www.agro.agri.umn.edu/plant-tc-listserv/

Bartholomew, D.P. (2015). Ecophysiology of Pineapple. *International Society for Horticultural Sci*. 1 (1) 4.

Bartholomew, D.P. Paull, R.E. & Rohrbach, K.G (2013). *The Pineapple: Botany, production and Uses.* Walling Ford, UK. CABI Publishing.

Coppens, d' Eeckenbrugge G & Leal, F (2013). *Pineapple*. Oxon Uk CABI Publishing.

Emedo, ABC, Maduka, B.C & Oranekwulu, S.C. (2015). *Comprehensive Agricultural Science for West African Senior Sec. Schools Onitsha*. De Diamond (JMB) Pub.

Food & Agric Organization (2014). Food and Agricultural Organization Year Book. www.fao.org.

Leifert, C. (2016). Quality Assurance Systems for plant cell Tissue Culture: The problem of Latent Persistence of Bacterial pathogens and *Agrobacterium* Transformed vector systems. In Proc Intl. Symp. Methods and markers for Quality Assurance in Micropropagation A.C. Cassells *et al* (Eds.) Acta. Hort. P530.

Merriam-Webster (2010) *Collegiate Dictionary* (12th ed). USA Merriam Webster incorporated.

Ndomi, B.M. (2017) Refocusing the Perspectives of Nigerians on Agricultural Production for Diversification of the National Economic Base. *Journal of Agric Educ. Teachers Assoc. of Nigeria* 1(1) 10-17.

Opeke, L.K (2010). *Commodity Tree Crops.* Ibadan: Spectrum Books Ltd.

Pamplona-Roger, G.D. (2014). *New Lifestyle Healthy foods*. 3rd print of 1st Edition in English Land. Spain: Educational & Health Library.

Pampona-Roger, G.D. (2016). *Encyclopedia of foods and their Healing power*. Spain: Educational and Health Library editorial (SAFELIZ).

Ubi, M.W & Ubi, W. (2017). *Pineapple Farming.* Calabar. Afrigrace Publications

Ubi, W & Osodeke V.E (2016). Toxicity of Aluminium to Pineapple (*Anannas cosmosus*) grown in acid sands of Cross River State. *Nigeria Global Journal of Environmental Sciences* 6(1) 16-19.

Uzoagulu, A.E (2011). *Practical Guide to Writing Research Projects reports in Tertiary Institution* (new Ed) Enugu: Cheston Ltd.