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Suckering and Survival Capacity of Pineapple (Annas comosus L. Merr) Propagules in Selected Potting Substrates

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Abstract
A potted experiment was conducted in the greenhouse unit of the Department of Crop Science, University of Calabar, Nigeria to determine the suckering capacity of different sizes of pineapple (*Ananas comosus* L. Merrill) crown suckers using different potting substrates. Three sizes of the crown suckers (Whole, ½, ¼ and 1/8) and three potting substrates (Sawdust, Topsoil and a 50:50 mixture of Sawdust and Topsoil) were laid out in a 3 X 4 factorial experiment laid out in a randomized complete block design with three replicates at five plants per replication. Growth parameters evaluated were survival percentage, number of plantlets per plant, number of leaves per plant, leaf area (cm^2), number of roots per plant and root length (cm). Result obtained indicated that whole and half suckers all survived in all the media while the mortality rates were 22.7 % for the 1/8 suckers in the sawdust substrate, whereas 11.1 and 44.5 % mortality rates were recorded for the quarter and 1/8 suckers respectively in the topsoil medium. All split crowns showed enhanced suckering capacity and produced significantly ($p = 0.05$) more suckers than the control. Whole crowns generated only one new sucker per crown but splitting the crown into two, four or eight portions generated 6, 12 and 17 new suckers per crown respectively. Significant propagule size X potting substrate interaction on root proliferation and elongation in the sawdust medium indicates favourable growth conditions provided by the potting substrate.
Keywords: Pineapple, potting substrate, propagule size, sucker survival, suckering capacity,

Introduction

Pineapple (*Ananas comosus* L. Merrill) is the third most consumed fresh fruit after banana and citrus worldwide because of its attractive flavour and refreshing sugar-acid balance (Usman *et al*, 2013). It is the most important member of the family *Bromiliaceae* and is rated as the most excellent fruit among the world's healthiest foods providing a rich source of the protein digesting enzyme bromolain. The pineapple is an excellent source of Vitamin C and Manganese and a very good source of Copper, Vitamin C, Vitamin B, B6, dietary fibre, folate and pantothemic acid (Geo and Leal, 2003). The fruit is mostly consumed fresh and serves as an ideal dessert and is often an important component of fruit salads to enhance their palatability.

Top largest producers of pineapple in order of importance are the Philippines, Brazil, Costa Rica, Thailand and China which together accounted for about 52 % of the annual global output of the crop in 2012 (FAOSTAT, 2012). Nationally, Nigeria is the sixth largest world producer of pineapple (FAO/World Bank,1999).

Pineapple has long been cultivated as an important cash crop under the peasant and smallholders systems principally in the southern parts of the country under rain-fed conditions. As a high value crop, and many state governments and farming NGOs/groups have embarked on its commercial cultivation as a poverty alleviation strategy in producing communities. But commercial scale cultivation of the crop requires large quantities of planting suckers which are always in short supply due their low natural regeneration capacity. One of the most serious production challenges frequently encountered by commercial farmers is therefore scarcity of high quality crown suckers which are the best planting materials. This has forced the farmers to utilize available inferior planting materials such as lateral suckers, slips and ratoons. These materials are highly variable in yield and quality and also require a long period of intensive care in the nursery which prolongs their productive cycle. Field establishment and survival of these materials is also low, making them unsuitable in commercial production which requires uniform maturity for easy harvesting and marketing or processing.

Different split crown techniques have been developed to mass produce uniform suckers for large scale farming (Abul-Soad *et al*, 2006; Agogbua and Osuji, 2011) but most of these techniques require high technical expertise and huge capital investment and are therefore uneconomical to the pro- poor farmers. Furthermore, the survivability of the split crowns is affected by their size and the quality of the potting substrate in which they are nursed prior to field planting. Rapid mass multiplication of pineapple in the nursery requires high quality potting substrate to enhance seedling growth.

Currently, most greenhouse floriculture depends on commercial growing media such as imported cocopeat, pro-mix peat moss and pertite which are expensive and scarce and their production poses grave environmental and ecological consequences (Ostos *et al*, 2008). Exploration and selection of the proper growing medium is therefore of critical importance for successful nursery plant.

The need to evaluate the suitability of different sizes of propagules and potting substrates for rapid on-farm mass production of high quality uniform pineapple suckers using affordable growth media resources was the objective of this trial.

MATERIALS AND METHODS

The trial was conducted at the green house unit of the Department of Crop Science, University of Calabar. The experimental area is located in the coastal high rain forest zone of Cross River estuary on Latitude 4^{O} 59’36’’ N and Longitude 8^{O} 19’05’’ E. The area receives mean annual rainfall of over 2500 mm bimodally distributed with peaks in July and September. The mean relative humidity ranges between 70 – 90 % and the mean monthly minimum and maximum temperatures are 23 ^{0}C and 30 ^{0}C respectively.

The potting substrates used were topsoil (TS), fine sawdust (SD) and a mixture of topsoil and fine sawdust (TS + SD) in equal proportions (50:50). Black polythene bags used for planting of the suckers measured 30 cm x 50 cm and perforated at the bottom for free drainage and aeration. They were filled with the appropriate media to a depth of 5 cm to the brim for effective retention of irrigation water. The polythene bags were watered to field capacity a day prior to planting of the suckers to allow the media to absorb enough water and be ready for planting of the materials.

Crown suckers of the Smooth Cayenne pineapple variety which has large fruits with high sugar content and is very popular in Nigeria were used as planting materials. They were obtained from the commercial farms at Orimekpang, a traditional pineapple growing area in Boki Local Government Area of Cross River State. Crowns weighing 200g each were cut from freshly harvested fruits and split with a sharp budding knife into three different sizes viz: ½, ¼ and 1/8 with whole crowns (WC) used as the control. The crown leaf splits were planted in the polyethene bags with the cut surfaces upward to minimize humidity rot. No fungicides or insecticides were used as there was no incidence of fungal pathogens or insects. No fertilizer was applied as there were no signs of nutrient deficiency. The polyethene bags were well watered throughout the duration of the experiment which lasted for three months after which the suckers were mature enough for milking (Ucheagwu and Obiefuna, 1986) and the experiment was terminated.

The experimental design used was a 3 x 4 factorial combinations of the three growth media and the four split crown sizes, laid out in a randomized complete block design with three replications each made up of five plants.

Data collected from sample plants were survival percentage, number of plantlets per plant, number of leaves per plant, area of D- leaf, number of roots per plant and root length. The data obtained was analyzed using analysis of variance (ANOVA) technique and significant means were compared using the Fisher’s least significant difference (F-LSD) at p = 0.05 level of probability.

RESULT AND DISCUSSION

Sucker survival percentage, mean number of plantlets and leaves per plant were significantly (p = 0.05) influenced by potting substrate and sucker size. All propagules attained 100 % survival rate in the sawdust (SD) substrate except the 1/8 suckers, while in the topsoil (TS) substrate the same level of survival was obtained in the whole (control suckers) and ½ suckers, followed by ¼ suckers and least in the split into eight portions. However in the substrate mixed with sawdust and topsoil (SD + TS), all the materials survived irrespective of their size (Table 1). The trend of survival and establishment of the suckers in the different potting substrates may indicate that sucker size influenced its survival more than the type of the potting substrate in which they were nursed. The control and half split suckers all survived in all the potting substrates while the mortality rates of other suckers were 22.7 % for the 1/8 size suckers in SD, while 11.1 and 44.5 % mortality was recorded for the ¼ and 1/8 suckers respectively in TS. The high mortality rate ranging from 22.7 to 45.5 % in the 1/8 suckers might be attributed to the limited nutrient reserves in these materials, necessitating prolonged and careful handling in the nursery to ensure their survival.

The sucker generation potential of the suckers also varied significantly in different potting substrates. Suckers split into two and four portions produced the highest number of plantlets per plant, followed by the 1/8 suckers and lowest in the control or unsplit suckers in SD substrate, while half suckers raised on TS potting material more plantlets followed by ¼ suckers whereas whole suckers had lowest plantlets/plant. In the SD + TS composite substrate, complete suckers produced fewer plantlets than other suckers which had similar suckering capacity.

Split suckers particularly those split into two or four portions produced 50 % more plantlets than the intact ones. Enhanced suckering advantage of the split crowns may be ascribed to the breakdown of apical dominance in such suckers. Agogbua and Osuji (2011) similarly reported higher suckering capacity of all split crowns compared to the control. The lowest plantlets produced by the whole suckers used as control was therefore obviously due to the strong apical influence which inhibited the development of axillary or lateral buds. This is an indication that sucker multiplication techniques which involve the destruction of the terminal bud could be a strategic on-farm solution to scarcity of high quality pineapple propagules.

Leaf production also varied significantly with propagule size and type of potting mixture used with the highest number of leaves in whole or check materials while split crowns did not differ in this parameter in the SD medium. A similar trend in leaf production was recorded in the TS and SD + TS media in which plants that developed from intact crowns maintained higher leaf productivity than all other propagules in other media (Table 1).

The influence of treatment on leaf area, rooting capacity and the development of the plantlets presented in Table 2 showed that plantlets developed from check crowns had largest leaf area in all media followed by the half and one quarter split crowns in the TS and TS + SD media respectively, and least in all other propagules irrespective of the potting substrate used. Whole crowns produced the highest number of roots followed by the crowns split into half, one quarter and least in those split into eight portions and planted in the SD medium. Unsplit materials also had more roots in the TS medium followed by the one quarter splits while half crowns and those divided into eight splits produced similar roots number.

Root length similarly varied among the propagules in different potting substrates with longest roots in whole and half crowns, followed by quarter suckers and shortest in crowns split into eight portions (Table 2).

Despite the superior growth exhibited by whole crowns which could be attributed to their size advantage and hardiness, this advantage did not translate to higher sucker yield which was the main focus of the research. The sucker yield trend of the different propagules indicates that the crown splitting technique of suckering multiplication is effective strategy of mass producing uniform suckers for commercial pineapple production. The number of suckers generated increased as the crown was split into more portions. Whole crowns developed only one or two suckers but dividing them into two increased the number of suckers to six which almost doubled (11.6) by splitting into four portions and further increased to 15.7 when the crowns were split into eight portions. A similar sucker yield trend was obtained by Agogbua and Osuji (2011) who also reported higher sucker productivity in all split crowns compared to the whole crowns used as control and attributed the phenomenon to a breakdown of apical influence in split crowns.

However, splitting the crowns into four or more portions produced suckers that were fragile and exhibited poor vegetative growth. Such weak suckers usually required longer period of intensive care to harden them enough to survive in the field after transplanting. Such suckers also usually have high field mortality as exhibited in this study. The long period of nursery care required by these suckers obviously prolongs the naturally long production cycle of the crop thereby tying down the farmers' capital.

Significant propagule size X growth substrate interactions were observed on root proliferation and elongation (Table 3). Observation of the rooting capacity of the different propagules across the potting substrates show that sawdust produced the highest mean root number in all propagules , followed by topsoil and lowest in mixed substrate. Longest roots were also found in the sawdust medium indicating that the medium provided more favourable growth conditions which better promoted sucker growth than other media. According to Walliser and Oster (2013), a good potting substrate should be well-drained with sufficient water holding capacity and should provide physic-chemical support to the seedlings. Mulugeta (2014) also emphasized that a high quality potting substrate should satisfy the needs for good seedling growth within a limited space of a polythene bag or containers. Sawdust possesses these qualities which promoted a healthy root system and subsequently a better quality suckers with high field survivability and high sucker productivity.

CONCLUSION

The quality of a potting substrate and manipulation of apical dominance are critical in sucker multiplication in pineapple. Among the potting substrates evaluated, sawdust best promoted the survival and growth of the suckers in the nursery while split crowns had higher sucker generation capacity which increased as the number of ssplits were increased. Sawdust is abundant, readily available and cost-free and could be an effective alternative to the costly industrial potting mixtures.

Table 1.Effect of growth media and crown size on the percentage survival, plantlets plant $^{-1}$, and leaf proliferation in pineapple.

Treatment	Survival (%)	plantlets plant^{-1}	Leaves plant^{-1}
Sawdust			
Control (WC)	100.0	1.0	8.7
½	100.0	3.0	5.0
¼	100.0	3.0	5.3
1/8	77.3	2.0	5.3
Mean	**94.3**	**2.3**	**6.1**
Topsoil			
Control (WC)	100.0	1.0	9.0
½	100.0	3.0	6.0
¼	88.9	2.7	5.0
1/8	55.5	1.7	3.0
Mean	**86.1**	**2.1**	**5.8**
Topsoil + sawdust			
Control (WC)	100.0	1.0	9.0
½	100.0	3.0	6.0
¼	100.0	3.0	5.0
1/8	100.0	3.0	5.0
Mean	**100.0**	**2.5**	**6.3**
LSD$_{(0.05)}$	**8.45**	**0.24**	**1.02**

Table2. Influence of growth medium and crown leaf size on growth of plantlets

Treatment	Leaf area (cm^2)	Roots plant^{-1}	Root length (cm)
Sawdust			
WC (control)	21.7	24.7	18.8
½	4.0	10.7	18.0
¼	5.7	8.0	9.5
1/8	4.7	3.8	8.7
Mean	**9.0**	**11.8**	**13.8**
Topsoil			
WC (control)	20.0	18.3	14.2
½	10.3	3.3	8.9
¼	5.2	8.3	5.0
1/8	2.7	4.0	2.8
Mean	**9.6**	**8.5**	**7.7**
Topsoil + Sawdust			
WC (control)	20.0	12.0	8.6
½	6.3	3.7	4.5
¼	9.0	3.0	8.5
1/8	3.0	4.0	7.0
Mean	**9.6**	**5.7**	**7.2**
LSD$_{(0.05)}$	3.12	1.26	2.02
Interaction			
CS X PSNS	*	*	

CS: Crown Size
PS: Potting Substrate
NS : Not significant at 5 % level of significance
*Significant interaction effect at 5 % level of significance

Table3. Interaction between Crown size X Potting substrate for roots plant^{-1} and root length of plantlets.

	Potting substrate					
	Root length (cm)			Roots plant^{-1}		
Treatment	SD	TS	SD + TS	SD	TS	SD + TS
WC (control	24.7	18.0	12.0	18.0	14.2	8.6
½	10.7	3.3	3.7	18.0	8.9	4.7
¼	8.0	8.3	3.0	9.5	5.0	8.5
1/8	2.7	4.0	4.0	8.7	2.8	7.0
Mean	**11.5**	**6.0**	**4.1**	**13.8**	**7.7**	**7.2**
$LSD_{(0.05)}$	1.26					

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