EFFECTIVENESS TEST OF THE MULTIPLICATION TECHNIQUE OF PINEAPPLE DISCHARGES (ANANAS COMOSUS) ON THREE GROWING SUBSTRATES

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Abstract: The trial focused on the multiplication of pineapple suckers obtained from their cut stems and grown in trays under 3 treatments with 4 repetitions. The objective of the trial is to test the efficiency of the multiplication of pineapple shoots on the three culture substrates. The experimental device is completely randomized. The T1 treatment consists of cow dung, decomposed plant debris, landfill sand, coarse coconut fibers and those partially powdered. The T2 treatment consists of coarse coconut fibers and those partially powdered. The T3 treatment consists only of white sawdust. The results obtained showed that, 30 days before weaning, the high number of rejections (7.62±2.25) was obtained from the T1 treatment. The pineapple stems of treatments T2 and T3 gave respectively 5.56±2.06 and 6.69±3.38 rejections. At the 4th weaning, the rods of the T1 treatment gave more rejections (10.50 ± 1.29) than those of the T2 and T3 treatments which gave only 8.25 ± 0.96 and 9.50 ± 1 respectively 29 rejections. The suckers of the T1 treatment produced more leaves (22.75±0.96) on the 60th day after the 4th weaning than those of the T2 and T3 treatments which produced only 20.25±0.5 and 22± respectively. 0.82 sheets. They also weighed more (69.57±0.99g) than those of the T2 and T3 treatments which each gave 49.57±1.87g. Thus the approach of the T1 substrate improved the number of suckers, that of the leaves as well as the mass of the suckers.

Keywords: substrate, sawdust, efficacy, weaning, coconut fibers

1. INTRODUCTION

With the development of trade, the cultivation of pineapple *(Ananas comosus)* and its use have spread. Improving its performance remains a major challenge in view of the method of obtaining releases which is still traditional and which therefore proves to be long and tedious. It is therefore necessary to remedy this problem. It is with this in mind that the test was conducted on the use of different substrates made up of coarse coconut fibers, partially powdered coconut fibers, compost and sawdust in order to release their efficiency on the production of pineapple suckers. Cultivated for its fruit which is consumed fresh dried or in the form of juice from processing factories, pineapple is a herbaceous plant belonging to the Bromeliaceae family (Morton 1987, Ouagbéni, 2019). Since 1970 pineapple cultivation has increased dramatically (OCAB, 2001, Thiemele, 2015), which is of economic importance for tropical and subtropical countries whose pedoclimatic factors accommodate the requirements of the crop and thus contribute to the increase in yield. Togo a tropical country, therefore offers enormous agro-climatic potential for pineapple cultivation with satisfactory yields in recent years from the two major cultivated varieties: Brazza and Cayenne. The emergence of new variable preservation and processing techniques leads to enormous needs for pineapple fruits in processing plants. Unmet needs which are the direct cause of a huge need for planting material (pineapple shoots) (Ouagbéni, 2019). Pineapple is one of the most important intensively grown tropical fruit species (Mukendi, 2014). The word pineapple comes from the tupi guarni nana nana which means "perfume of perfumes" (Adabe, 2016) whose stem forms the axis of the plant. It is visible externally only when the leaves and roots are removed. The stem of the adult plant remains very short, measuring 20 to 25 cm in length, with a diameter of 2 to 3.5 cm at its base and 5.5 to 6.5 cm at the widest part just below below the terminal meristem. It has a large number of very short internodes. This stem is often called the stump (Duval, 1995). The leaves are emitted by the terminal meristem the adult plant has about 70 to 80 leaves. Depending on the cultivar, the edges of the leaf blade can be entirely spiny or smooth. (Lebeau, 2008). The fruit is the fleshy part of the plant it comes from the inflorescence and is carried by the peduncle which is an extension of the stem and which constitutes the heart of the fruit. Only one fruit is produced per plant (Ratinarivo, 2010). Temperature is the main factor that determines the range of pineapple and influences the branching of suckers during its propagation. Temperatures below 20°C or above 45°C are considered unfavorable to the development of pineapple and temperatures below 30°C or above 48°C are unfavorable to the proliferation of suckers in an experimental device but, the optimum temperature is 35 to 45°C (Diary, 2003). The pineapple is not very demanding in water, it needs about 2 to 4 mm of water per day which corresponds to precipitation of the order of 1200 to 1500 mm of water well distributed throughout the year. Excess water during multiplication in an experimental device causes the latter to rot (Diary, 2003). Light has a very marked effect on pineapple yield. It is possible by playing on the weight of the suckers and the planting dates to reduce the duration of the vegetative stage in order to spread out the harvest as well as possible and hope to produce just after the production of the season. (Maladar, 2007). This sector encounters shortages and difficulties of all kinds for its emergence. Surveys have shown in Togo that access to land and credit infrastructure and illiteracy are the real constraints to the development of this sector (Dogble, 2013). Indeed, to cultivate pineapples intensively producers are sometimes confronted with practical difficulties: gathering a sufficient number of shoots, transporting them to the production site ensuring that sanitary conditions are met (Bidima, 2005). The supply of pineapple suckers is not always easy for those who want to practice pineapple cultivation. When we manage to find some, they are often of approximate quality hence the need for the producer to produce and package it himself. The objective of the trial is to test the efficiency of the multiplication of pineapple suckers on three growing substrates. The results obtained showed that the approach of the T1 substrate consisting of cow dung, decomposed plant debris, landfill sand coarse coconut fibers and those partially powdered improved the number of rejects that of leaves as well as although the mass of releases.

2. MATERIALS AND METHODS

2.1 Materials

2.1.1 Experimental site

The trial was carried out in Zinguera in the Gulf prefecture (Maritime region of Togo). The soil is of the ferralitic type, commonly called “terre de barre”. It is well drained and has a low rate of organic matter (< $10g.kg^{-1}$). Its potassium content is less than 2 $cmol.kg^{-1}$; it has a total phosphorus content ranging from 250 to 300 $mg.kg^{-1}$, a cation exchange capacity of 3 to 4 $meq.kg^{-1}$, a pH of 5.2 to 6.8 (Detchinli, 2015, Amouzouvi 2017). The climate is subequatorial with two dry seasons and two rainy seasons. The dry seasons go from mid-July to the end of August and from mid-November to mid-March while the rainy seasons occupy the period from mid-March to mid-July and that from September to mid-November with an annual precipitation included between 800 to 1100 mm of water. The average annual temperature is 27°C (Kadanga, 2017)

2.1.2 Plant material

The plant material is composed of leafless pineapple stems of the Smooth Cayenne variety. These stems come from the mother stock of pineapples from a plantation that has already been harvested. The choice was made for this variety because of its appreciation by consumers, its preference on the international market and especially for the rarity of its suckers.

2.1.3 Phytosanitary treatment equipment

Treatments were carried out with fungicides in order to prevent mold from the stems and substrates used during the experiment. The products such as BANKO PLUS and MANCOZEB were used respectively at the rate of 53.33ml for 10 liters of water.ha-1 and 50g for 15 liters of $water.ha^{-1}$. The other materials used are landfill sand, compost, white sawdust, coarse coconut fibers and those partially powdered for the manufacture of substrates, knives to clear the roots of pineapple stems, sachets nurseries to contain the seedlings after the weaning of the suckers, the scales and the tape for the weight gain and the size of the suckers, the plates and the seals for and the watering can.

2.2 METHODS

Experimental device and expression of treatments

The trial was conducted following a completely randomized design of 3 treatments with 4 repetitions in a tank 3.0m long by 1m wide. To avoid mixing of substrates in the tank, the repetition compartments are separated by boards measuring 0.03m thick and 0.33m wide. Each compartment has a side dimension of 0.5m, i.e. an area of 0.25m2, a depth of 0.5m and contained 6 pineapple stems cut longitudinally, i.e. a total of 72 cut stems for the entire test. The T1 treatment consists of 30.8 kg of soil, 1 kg of coarse coconut fibers and 4 kg of partially powdered coconut fibers. The T2 treatment consists of 2kg of coarse coconut fibers and 6kg of partially powdered coconut fibers and the T3 treatment consists only of 20kg white sawdust divided into 5kg in 4 compartments.

2.2.1 Conduct of the trial

The operation consisted of uprooting pineapple plants on which the fruits have already been harvested. The uprooted plants are stripped by hand of their leaves and their peduncles as well as the envelopes around the stems while avoiding injury to them. Using a knife, the terminal base of the stems and the roots are eliminated. The stems are cut longitudinally into two equal portions and then completely soaked for 30 seconds in a solution of BANKO PLUS at the rate of 53.33ml in 10 liters of water. The stems thus cut and treated are then placed on a clean jute bag in the shade for a good distribution of the product.

2.2.2 Binding of cut stems

Each sectioned part of the rods is slightly pushed 0.03m into the substrate, taking care to orient the cut side towards the substrate to facilitate effective contact between the rod and it. The arrangement of the cut stems in the tray is made in 3 lines on the substrate. The cut stems are placed in groups of 2 (figure 1) on each line thus forming parallels and climbed between them in order to allow future seedlings to develop well. A light watering is done after their introduction on the different substrates to allow them to adhere well. Beforehand, the different substrates contained in each compartment of the tank have been watered. A first pass with simple water and a second pass with the rest of the solution used to treat the stems. The placing of the cut stems in a container is completed with the hermetic closure of the container using a transparent polyethylene plastic film (figure 2). The tray can only be opened during watering.

Figure 1 Arrangement of the cut stems in the tray

Figure 2: Tray covered with polyethylene plastic ba

Figure 3: Appearance of buds on the cut stems two weeks after sowing

Figure 4: Seedlings at six weeks after transplanting

Figure 5: Seedling weaning

Figure 6: Transplanting weaned seedlings into nursery bags containing potting soil

2.2.3 Maintenance work

To allow the growth and development of the seedlings, the frequency of watering was 3 times a week. The quantity of water provided per frequency was 3 watering cans of 10 l or 30 l of water. Each compartment received 2.5 liters of water per spray. To combat fungi on seedlings, MANCOZEB was used at a dose of 50g per 15 l of water used at once for all treatments.

2.2.4 The growth of young plants and their weaning

Three days after placing the sectioned stems in a container, the axillary buds, the base of the seedlings to be produced, appear and are clearly visible after two weeks (figure 3). The seedlings are regularly weaned when they have at least 10 leaves and a minimum height of 10 cm and whether or not they bear roots. The weaning operation consisted of gently detaching the seedlings from the mother stems by hand (figure 5). The collection of seedlings continued over time until the reserves of the mother stem were exhausted. The counting of suckers began 30 days after the placing of the sectioned stems in a tank. Four (4) weanings were carried out: 52 days after placing the sectioned stems in a tank. 27 days after the first weaning, 23 days after the second and fourth weaning 55 days after the third weaning. The recount of the leaves is resumed 60 days after each weaning.

2.2.5 The bagging of young weaned suckers

The young plants thus weaned are transplanted into polyethylene nursery bags (figure 6) filled to 2/3 of the substrate consisting of cow dung, decomposed plant debris and landfill sand. The young plants are introduced into the bags taking care to keep them straight. Regular watering continued until their effective resumption.

2.2.6 Method of data collection and analysis

The parameters studied during the trial (number of shoots and leaves, the size of the shoots as well as their mass) were taken from 3 seedlings chosen at random. The data obtained were entered with the Excel 2016 software. The statistical analysis of these data following ANOVA at the 5% threshold with segregation of the means was carried out using the GenStat software according to the Duncan test.

3. RESULTS AND DISCUSSIONS

3.1 Results

Average number of seedlings in the tank under the different treatments

The number of seedlings in the tank under the different treatments is obtained by simple counting in each compartment and is recorded in Table 1.

Table 1: Effect of treatments on the average number of seedlings, 30 days after transplanting

Traitements	Nombre moyens de plantules par traitement	Signification
T_1	6.31±3.66a	
T_2	5.5±3.43a	NS
T_3	6.12±3.11a	
CV (%)	26.3a	
PPDS	1.131	

CV=Coefficient of Variation, LDP: Least Significant Difference, NS: Not Significant, S: Significant

According to the data in Table 1 and 30 days after transplanting, the greatest average number of seedlings is obtained under the T1 treatment (6.31±3.66a), followed closely by the T3 treatment (6.12±3.11a) , then by T2 (5.5±3.43a). Statistical analyzes showed that there is no significant difference between the average numbers of seedlings per compartment obtained on the stems subjected to the three different treatments. The use of two types of coconut fibers combined with potting soil; of the two types of coconut fiber only and sawdust therefore did not have a positive impact on the average number of seedlings per compartment.

3.2 Average number of seedlings in the tank under the different treatments according to weaning

Data on the number of seedlings in the tank under the effect of the different treatments were obtained by counting and by treatment, and recorded in Table 2.

Table 2: Evolution of the average number of seedlings per weaning under each treatment

Weanings	Weaning ages	**T_1**	**T_2**	**T_3**
Weaning **1**	52 days	8.00±0.82b	6.00±0.82b	7.00±1.15b
Weaning **2**	23 days	5.00±0.82c	3.25±0.96c	1.50±0.58c
Weaning **3**	27 days	7.00±1.15b	4.75±0.96bc	8.75±1.26ab
Weaning **4**	55 days	10.50±1.29a	8.25±0.96a	9.50±1.29a
Significance		S	S	S
CV%		9.50	17.00	18.70

PPDS	1.162	1.514	1.999

CV: Coefficient of Variation LDP: Least Significant Difference NS: Not Significant S: Significant

The average number of seedlings per treatment varied at different weanings. The highest numbers of seedlings were recorded at the fourth weaning with respectively 10.5±1.29 9.50±1.29 and 8.25±0.96 seedlings for treatments T1 T3 and T2. On the other hand, at the second weaning, a fall in the number of seedlings was observed under these treatments. The analysis of variance revealed a significant difference between the mean numbers of seedlings during each weaning. This statistically demonstrates that the frequency of weaning has a major influence on the regrowth of seedlings.

3.3 Average number of leaves per seedling

The average number of leaves per seedling was obtained by counting at different weaning periods. The results obtained are recorded in Table 3.

Table 3: Effect of treatments on the average number of leaves per seedling according to age

Treatments	Average number of leaves at 1st weaning	Average number of leaves 60 days after weaning
T_1	20.5±1.29a	22.75±0.96a
T_2	19±00a	20.25±0.5b
T_3	20±0.82a	22±0.82a
CV (%)	5.3	4.4
PPDS	1.824	1.657
Significance	NS	S

CV: Coefficient of Variation, LSD: Smallest Significant Difference, NS: Not Significant, S: Significant

At the first weaning, 52nd day after transplanting, the seedlings of the T1 treatment had the greatest number of leaves (20.5 ± 1.29) followed by that of the T3 treatment (20 ± 0.82 leaves) then those of the T2 processing (19±00 sheets). The analysis of variance revealed a non-significant effect of the treatments on the average number of leaves per seedling. Statistically, the use of these three different treatments did not give a remarkable variation in the number of leaves between the seedlings on the 52nd day after transplanting. On the other hand, these treatments had a significant effect on the average number of leaves per seedling on the 60th day after weaning and formed 2 statistically distinct classes and b. The weaned suckers are then transplanted into nursery bags to allow the seedlings a good and rapid recovery (Figure 6). According to the results in Table 3 the highest number of leaves (22.75±0.96) was obtained from seedlings of treatment T1 and the lowest number of leaves (20.25±0.5) from seedlings, under T2 treatment. Indeed, the average of the leaves of the seedlings remains high under the T1 and T3 treatments compared to the T2. These results show that the use, on the one hand, of the two types of coconut fiber combined with soil and, on the other hand, white sawdust makes it possible to have more leaves than using only the two types of coconut fiber.

3.4 Average size of a seedling

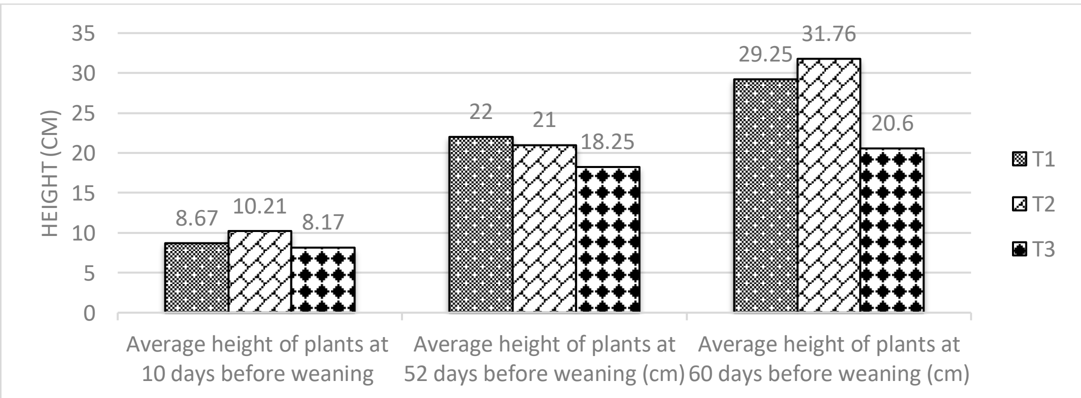

Figure 7: Effect of treatments on the average size of seedlings (cm) according to their age

The data in Figure 7 show that at 30 days after transplanting, the largest mean seedling size was recorded under the T2 treatment (10.21cm±0.73). The analysis of variance revealed a significant difference between treatments T1 and T2, T2 and T3, except between treatments T1 (8.67cm±0.49) and T3 (8.17cm±0.59). At 52 days at first weaning, the mean size of seedlings varied only slightly between treatments T1 (22cm±0.91) and T2 (21cm±1.08). Considering the general averages it is at the level of the seedlings of the T1 treatment that the largest average size was recorded (22cm±0.91), followed by the T2 treatment (21cm±1.08) then that of the T3 (18.25cm±1.73). The analysis of variance revealed a significant effect of the treatments on the average size of a seedling. Duncan's test at the 5% threshold at 60 days after weaning revealed that the seedlings of the T2 treatment provided the greatest average height with 31.76cm±1.44. The smallest average size was obtained from seedlings of T3 (20.6cm±0.56). The T1 treatment made it possible to obtain seedlings whose average size reached 29.25cm±1.53. Statistical analyzes showed that there is a significant difference between the average sizes of the seedlings on the three treatments. The average size of seedlings of treatments T1 (29.25cm±1.53) and T2 (31.76cm±1.44a) remained large compared to that of seedlings of treatment T3 (20.6cm±0.56).

These results demonstrate that the two types of coconut fiber used in the T1 and T2 treatments contributed effectively to the increase in the size of the seedlings compared to the effect of sawdust on the size of those grown under the T3 treatment.

3.5 Average mass of a seedling

The mass of the seedlings is obtained by weighing on an electronic scale, the results of which are recorded in the following table 4.

Table 4: Effect of treatments on mean mass of seedlings, (g)

Treatments	Average mass of seedlings at 60 days after weaning	Average mass of seedlings at 60 days after weaning
T_1	38±1.06a	69.57±0.99a
T_2	29.92±0.93c	49.57±1.87c
T_3	33.53±1.09b	49.57±1.87c
CV (%)	3,5	3.1
PPDS	2.044	3.175
Significance	S	S

CV=Coefficient of Variation, LDP: Least Significant Difference, NS: Not Significant, S: Significant

The greatest mean mass of seedlings (38g±1.06) obtained at first weaning is recorded under treatment T1 followed by T3 (33.53g±1.09) and T2 (29.92g±0.93). The analysis of variance revealed a significant effect of the treatments on the average mass of a seedling. Similarly, at 60 days after weaning, the greatest average mass of seedlings (69.57g ± 0.99) is obtained from treatment T1, followed by seedlings from treatment T3 (49.57g ± 1.87) then those from treatment T2 (49.57g±1.87). The average mass of the T1 treatment seedlings remains large compared to that of the T2 and T3 treatment seedlings. But that of the T3 treatment seedlings remained large compared to that of the T2 treatment seedlings. These results demonstrate that the two types of coconut fiber combined with potting soil increase the mass of the seedlings compared to the two types of coconut fiber alone or to white sawdust.

5. DISCUSSION

5.1 Effect of both types of coconut fibers combined with potting soil, of the two types of coconut fibers only and of sawdust on the average number of seedlings per treatment 30 days after transplanting

The seedlings of the T1 treatment which benefited from the nutrients of the two types of coconut fibers combined with the soil were identified by their production in a higher number of suckers (6.31 ± 3.66 suckers) and could be explained by the presence of compost formed from landfill sand enriched with decomposed plant debris which stimulated rapid regrowth of pineapple stem buds compared to the two types of coconut fiber alone or white sawdust. In addition it is recognized that the use of compost produced by organic waste increases the fertility of the growing medium (Weber 2007, Kitabala 2016) by improving their structure their water retention capacity and by stimulating microbial activity increases yields (Kowaljow, 2007).

5.2 Evolution of the average number of rejections per treatment

The mean number of rejections recorded during each weaning was specific to the frequency of weanings. Indeed, at the second weaning a drop in the number of seedlings was observed under all treatments due to the very short time interval between the first weaning and the second. Furthermore the highest production of seedlings is observed at the fourth weaning certainly due to a long interval of weaning time observed between the third weaning and the fourth and to a progressive expression of the use by the plants, of the nutrient elements of the culture rooting medium. For a mass production of suckers, it would therefore be advisable to give enough time to the substrate and the stems to express themselves better in order to provide better results. However the frequency of intervention to wean rejections should be low.

5.3 Effect of both types of coconut fiber combined with potting soil, of the two types of coconut fiber only and of sawdust on the average number of leaves per seedling.

During and after weaning, suckers from the mixture of the two types of coconut fibers only under treatment T2 produced fewer leaves than those from treatments T1 and T3. This would be due to the fact that coconut fibers are inert (Bongoua-Devisme, 2018) and therefore do not contain enough nutrients without being added to them. According to the reference (Ouagbéni, 2019) the use of coconut fibers alone as a growing medium does not promote better vegetative propagation especially the leaves of pineapple plants. On the other hand rejections of the T1 treatment took over in number of leaves which shows not only that the compost contained in the potting soil was an important source of nutrients but also that the coconut fibers contained in this treatment have an excellent nutrient retention capacity (Kpera, 2017). The shoots obtained under the T1 treatment assimilated the nutrients provided by the compost which were restored to them by the coconut fibers which allowed them to produce more leaves. Indeed, the richness of cow dung contained in the soil rich in organic matter, organic carbon and phosphorus undeniably contributes to improving the growth of plants (Foid, 2001). In their work on the potential of Moringa Oleifera for agricultural and industrial uses (Wightman, 1999) the authors found that cow dung improved plant growth sufficiently. These authors explained this result by the ability of cow dung to enrich the growing medium with nitrogen in a natural way. In addition, after weaning the shoots were transplanted into polyethylene bags containing pre-prepared compost which would have favorably induced the production of leaves.

5.4 Effect of the two types of coconut fiber combined with compost, of the two types of coconut fiber only and of white sawdust on the average mass of a shoot according to the periods

The different treatments had a significant effect on the average weight of suckers both at weaning and after weaning. The discharges from treatment T1 were identified by their greater mass than that of the discharges from the other treatments. Indeed, the rejections of the T1 treatment compared to the others produced more leaves which allowed them to capture sunlight to properly trigger photosynthetic processes to synthesize organic matter and increase their mass

5.5 Effect of the two types of coconut fiber combined with soil, of the two types of coconut fiber only and of white sawdust on the average mass of a shoot according to the periods

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6. CONCLUSION

Pineapple is a plant whose cultivation requires an improvement in techniques for obtaining its offshoots, which have remained rudimentary for a long time. The use of a potting mix consisting of cow dung decomposed plant debris and landfill sand as well as coarse coir fibers and partially powdered coir fibers helped to improve the number of rejects that leaves as well as the mass thereof. This growing medium would be best suited for mass production of vigorous suckers.

Disclosure of conflict of interest

Authors have declared that no competing interests exist

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