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SHORT COMMUNICATION

Growth and development of cacao (*Theobroma cacao* L.) seedlings in the nursery as influenced by pod maturity and retaining period after harvesting

Olaiya, A. O.

Plant Physiology and Crop Production Department, Federal University of Agriculture, Abeokuta, Nigeria.

Correspondence e-mail: olaiyaabideen@yahoo.com; +2347065946496

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ABSTRACT

A pot experiment was conducted to evaluate the effect of pod maturity stage and post harvest handling on germination and growth of cocoa seedlings at the Federal University of Agriculture, Abeokuta. The experiment was laid out in Completely Randomized Design with six treatments and three replicates each. The treatments were planting the cocoa seed on the day of pod harvest (HD), storing the cocoa pods for one week after harvesting before planting (1AH), storing the cocoa pods for two weeks after harvesting before planting (2AH), planting seeds extracted from physiological matured greenish yellowish pods at harvest (GY), fully riped yellowish pods (Y) and overripe deep red pods (DR) making six treatments and three replicates each. Data were collected on plant height (cm), stem girth (cm), number of leaves and leaf area (cm²) on weekly interval for 12 weeks. The data were subjected to analysis of variance and the means separated by Duncan's Multiple Range Test.

The result showed that at 12 weeks after planting (WAP) GY was significantly different from 1AH and 2AH but not significantly different from HD on the basis of plant height. DR was significantly different from others; it had 58.60cm² as leaf area at 19 WAP while others range between 32.00 and 51.94cm². Based on the number of leaves, the treatment (Y) Yellow is significantly different from others; it had 20.67 leaves at compared to 14.67 and 19.67 leaves for other treatments at 19 WAP. There was no significant difference obtained from the analysis of the stem girth of all the six treatments at 15 WAP. From all the growth parameters measured Y was ranked best followed by other treatments in this order, Y<GY<DR<HD<2AH<and 1AH respectively. Therefore, fully ripe pods are hereby recommended as planting material to be planted on harvest without storage.

Keywords: Cocoa, Growth, Development, Nursery, Pod

INTRODUCTION

Cocoa seedlings vigour are known to be influenced by various factors such as bean position (Ibikunle, 1967), varietal influence

(Adenikinju, 1971); bean maturity (Adenikinju, 1975a) and environmental factors (Atayese *et al.*, 2012). Cocoa seeds readily germinate when sown and do not

pass through a dormancy period. They lose viability within 5-7 days of extraction from the pod unless specially treated, and germinate within 7-10 days. As a general rule, cacao trees get their start in a nursery bed where seeds from high yielding trees are planted in fiber baskets or plastic bags. The seedlings grow so fast that in a few months and are ready for transplanting. The cacao tree bears fruit (or pods) all year round, harvesting is generally seasonal. The pods come in a variety of types since cacao trees cross-pollinate freely (Olaiya and Fagbayide, 2003).

It requires training and experience to know by appearance which fruit is ripe and ready to be cut. Ripe pods are found on trees at all times in the growing season in the tropics, with its evenly distributed rainfall. In Nigeria, there is a main harvest period lasting up to four months during dry seasons and a mid-crop harvest lasting only for two months during the wet seasons (Olaiya, 2006). Climatic factor is the main cause of wide variations in harvest times with frequent fluctuations from year to year even within the same location. Cocoa cultivation is going into extinction due to urbanization and competitiveness in Nigeria economy. The discovery of Oil since 1958 has generally affected agricultural sector with commodity crops being the worst hit (Opeke, 1989). In order for this trend to be reversed, there is the need for more detailed knowledge on how to raise planting materials among cocoa farmers to complement other government efforts to revamp cocoa industry, hence the justification of this work which is to increase efficiency in raising planting materials in cocoa nursery.

MATERIALS AND METHODS.

The experiment was laid out in a Completely Randomized Design (CRD) with six treatments and three replicates each

using F³ Amazon cultivar. The Treatments were: Physiologically Matured Greenish Yellowish pods (GY); Fully Matured Ripened Yellowish Pods (RY); Over-Ripened Deep-Red Pods (DR); Planting on harvested day (HD) - cocoa pods planted on the day of harvest; Planting a week after harvesting (1AH) - Cocoa Pods stored for one week after harvesting before planting; and Planting two weeks after harvesting (2AH) - Pods stored for two weeks after harvesting before planting. All pods were harvested from the same tree and the pods were stored in the open platform in the laboratory.

All treatments were planted the same day with one seed per pot and each pot is the experimental unit. Four replicates were planted while three was used for the analysis. The shade was provided by big cashew trees in the school farm; polythene bags were black small size typically used for raising cocoa seedlings in Nigeria and the planting media was topsoil collected from fallow land adjacent to the planting site. There was no fertilizer application. Data were collected on germination and the following growth parameters: Days to emergence - recorded as number of days between planting and emergence; the percentage germination - this was done by counting the number of seedlings that germinated per treatment divided by the total no of seedlings planted for each treatment and then multiplied by 100 percent; Plant height - which was determined by measuring with a long metre rule from ground level to the apical region of the stem; the number of leaves per plant - counted and recorded; Stem girth, which was measured using a Vernier caliper; and leaf area - a leaf was tagged on each plant and the length and breadth of the leaf was recorded to get the Leaf Area by multiplying the Length x Breadth x leaf area factor (Adenikinju, 1975b).

All data collected were subjected to Analysis of Variance (ANOVA) and the treatment means separated using Duncan's Multiple Range Test (DMRT).

RESULTS

Germination

All the treatments germinated early within two weeks and attained 50 percent with no significant difference amongst the treatment means (Table 1). All the treatments had between 93 and 100 % germination percentage at 4 WAP with no significant difference amongst the treatments.

Table 1: Cocoa seed emergence as affected by pod characters at planting

TREATMENTS	DAYS TO 50% EMERGENCE	EMERGENCE % at 4WAP
HD	10 ^a	98 ^a
1AH	9 ^a	100 ^a
2AH	12 ^a	93 ^a
GY	14 ^a	95 ^a
Y	11 ^a	96 ^a
DR	10 ^a	94 ^a

Number of leaves

Table 2 showed the effect of cocoa pod stage at harvesting on number of leaves of cocoa seedlings. At 12 Weeks After Planting (WAP) GY was significantly different from the other treatments having 12.33 leaves, then followed by RY with 10.67 leaves while 1AH had lowest value of 7.00 leaves. At 19 WAP, RY was significantly different from others with 20.67 leaves, and then followed by HD with 19.67 leaves while 1AH had the least value of 14.67 leaves.

Plant height

The effects of cocoa pod stage at harvest and post harvest handling on plant height of cocoa seedlings at various weeks after planting was shown in Table 3. The treatment GY was significantly different from all other treatments at 13 WAP but not significantly different from HD. It had the height 27.43 cm while other treatments ranged between 27.37 cm and 17.63 cm. At 19 WAP, the result showed that GY was not significantly different from RY and DR but was significantly different from HD, 1AH and 2AH.

Table 2 : Number of leaves of cocoa seedlings as affected by pod characters at planting.

TRT	12WAP	13WAP	15WAP	16WAP	17WAP	18WAP	19WAP
HD	10.00 ^{ab}	11.33 ^b	15.33 ^a	16.00 ^{ab}	17.67 ^a	19.67 ^a	19.67 ^{ab}
1AH	7.00 ^c	9.00 ^c	11.33 ^c	13.00 ^c	13.00 ^d	14.33 ^c	15.33 ^c
2AH	9.00 ^b	10.67 ^b	12.67 ^b	12.67 ^c	12.67 ^d	14.00 ^c	14.67 ^d
GY	12.33 ^a	14.00 ^a	14.67 ^{ab}	15.00 ^b	15.67 ^b	17.67 ^{ab}	18.00 ^b
Y	10.67 ^{ab}	13.00 ^{ab}	15.67 ^a	17.67 ^a	17.67 ^a	19.33 ^a	20.67 ^a
DR	7.33 ^c	10.67 ^b	12.00 ^b	13.33 ^c	14.00 ^c	16.00 ^b	16.33 ^c

Means with the same letter in the same column are not significantly different at p=0.05

Leaf area

Table 4 showed the effect of cocoa pod stage at harvesting on leaf area of cocoa seedlings at various weeks after planting. DR was significantly different from all other treatments with the value of 55.74 cm² at 13 WAP followed by GY and RY which were not significantly different from each other. Treatment 1AH had the least value of 28.71 cm², which was significantly different from all other treatments. The same trend was recorded till 19 WAP.

Stem girth

The stem girth of cocoa seedlings is the least affected growth parameter by the treatments. There was no significant difference obtained from the analysis of the stem girth of all the six treatments at 15 WAP (Table 5). However, at 19 WAP DR and RY recorded the highest girth which were not significantly different from each other but significantly different from the rest treatments while GY and 2AH had the least values that were not significantly different from each other.

Table 3: Plant height (cm) of cocoa seedlings as affected by pod characters at planting.

TRT	12WAP	13WAP	15WAP	16WAP	17WAP	18WAP	19WAP
HD	26.77 ^a	27.37 ^a	30.30 ^a	31.03 ^a	31.77 ^{ab}	32.23 ^{ab}	33.03 ^{ab}
1AH	16.40 ^c	17.63 ^d	19.73 ^d	20.37 ^d	20.93 ^d	22.47 ^d	24.77 ^c
2AH	18.50 ^{bc}	19.83 ^c	22.93 ^c	24.07 ^c	24.80 ^c	25.53 ^c	26.73 ^c
GY	26.60 ^a	27.43 ^a	31.17 ^a	32.87 ^a	33.30 ^a	34.07 ^a	34.87 ^a
Y	22.73 ^b	25.03 ^{ab}	26.77 ^c	30.07 ^{ab}	31.23 ^{ab}	32.50 ^{ab}	34.20 ^a
DR	19.87 ^{bc}	22.00 ^b	28.80 ^{ab}	29.97 ^b	30.77 ^{ab}	32.23 ^{ab}	34.00 ^a

Means with the same letter in the same column are not significantly different at p=0.05

Table 4 : Leaf area (cm²) of cocoa seedlings as affected by pod character at planting.

TRT	12WAP	13WAP	15WAP	16WAP	17WAP	18WAP	19WAP
HD	34.37 ^c	36.41 ^c	37.51 ^c	37.65 ^c	38.21 ^c	38.87 ^c	39.50 ^c
1AH	28.29 ^d	28.71 ^d	29.75 ^d	30.15 ^d	30.73 ^d	31.29 ^d	32.00 ^d
2AH	30.08 ^d	31.39 ^{cd}	32.70 ^d	33.58 ^d	33.99 ^d	34.32 ^d	34.76 ^d
GY	46.94 ^{bc}	47.20 ^b	48.64 ^{bc}	48.90 ^{bc}	49.44 ^b	49.86 ^b	50.03 ^b
Y	48.14 ^b	48.19 ^b	50.10 ^b	50.28 ^b	50.63 ^b	51.32 ^b	51.94 ^b
DR	54.90 ^a	55.74 ^a	57.53 ^a	57.78 ^a	58.05 ^a	58.33 ^a	58.60 ^a

Means with the same letter in the same column are not significantly different at p=0.05.

Table 5: Stem girth (cm) of cocoa seedlings as affected by pod characters at planting.

TRT	12WAP	13WAP	15WAP	16WAP	17WAP	18WAP	19WAP
HD	0.15 ^b	0.17 ^b	0.21 ^a	0.23 ^{ab}	0.24 ^a	0.27 ^{ab}	0.27 ^{ab}
1AH	0.17 ^{ab}	0.20 ^a	0.22 ^a	0.23 ^{ab}	0.23 ^{ab}	0.27 ^{ab}	0.27 ^{ab}
2AH	0.17 ^{ab}	0.18 ^{ab}	0.21 ^a	0.21 ^c	0.21 ^b	0.25 ^b	0.25 ^b
GY	0.17 ^{ab}	0.19 ^{ab}	0.22 ^a	0.22 ^b	0.22 ^{ab}	0.25 ^b	0.25 ^b
Y	0.18 ^{ab}	0.19 ^{ab}	0.22 ^a	0.24 ^a	0.24 ^a	0.28 ^a	0.29 ^a
DR	0.20 ^a	0.21 ^a	0.22 ^a	0.25 ^a	0.25 ^a	0.29 ^a	0.29 ^a

Means with the same letter in the same column are not significantly different at p=0.05.

DISCUSSION

The earliness to 50% germination recorded was in agreement with Adenikinju (1975a) who reported between 34 and 60 percent germinations within 14 days after planting. This was as a result of pre-sowing treatment of removal of mucilage with sawdust and washing before planting

In this experiment, the result of the analysis indicated that at 12 WAP, HD and GY had the highest plant height of 26.77 cm and 26.60 cm respectively; whereas at 19 WAP, there was no difference between GY, RY and DR, Based on the leaf area, treatment DR had the highest throughout the duration. Though GY had a good start with mean number of leaves of 12.33 at 12 WAP, it was displaced by RY from 15 WAP till the end of the experiment. The lower values obtained for all the growth parameters may be due to environmental factor especially high temperature which lead to high transpiration rate (Atayese *et al.*, 2012).

CONCLUSION

It is apparent from this study that the treatment RY is the best for good seedling production because it had the highest number of leaves which is the most important growth parameter of cocoa seedling. It was followed by HD, GY, DR, 1AH and 2AH respectively.

In conclusion, combining all the growth parameters evaluated in this study, performance of the treatments can be ranked in this order; RY>GY>DR>HD>2AH>1AH respectively. Though, there was no significant difference between the values obtained for 2AH and 1AH, those of 2AH was higher than 1AH and this could be further evaluated in another experiment. On the basis of findings in this research farmers can be advised to harvest yellow matured ripened pods and sow the seeds immediately for good seedling production. Delaying

planting after pod harvest may not advisable.

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