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Effects of Shoot Decapitation on Cashew Seedlings (*Anacardium Occidentale*) in the Nursery

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ABSTRACT:

Injured cashew seedlings during nursery operations occasioned by accidental breakage, disease infection are usually considered unfit for transplanting but often discarded during plantation establishment. Hence, this study investigated the effects of point of decapitation of the shoot on the growth of cashew seedlings in the nursery at the Federal University of Agriculture, Abeokuta, Ogun state. Completely Randomized Design was used for the experiment. Treatments were cashew seedlings decapitated at 1 cm below the apical bud; above 4 leaf attachment, 5 cm above the cotyledon and seedlings not decapitated served in four replicates. At 4 Weeks After Sowing (WAS) treatments were applied on cashew seedlings arranged evenly at fifty seedlings per treatment per replicate, totaling 800 seedlings. Data collected were subjected to Analysis of Variance and significant means were compared using standard errors of means at 5% probability level. Results showed that decapitation at 5cm above cotyledon produced highest number of buds, decapitation at 4 leaf attachments produced significantly highest number of leaves, leaf area and dry matter of cashew seedlings were linearly related ($r^2 = 0.96$). the study concluded that cashew seedlings decapitated at 4 leaf attachment had superior dry matter which is recommended as good transplanting materials.

Keywords: Shoot decapitation

1.0 Introduction

Cashew is a crop of considerable economic importance to Nigeria and other tropical countries (Ezeagu, 2002). Cashew is recognized worldwide for its exclusive kernel taste and nutritive value. Cashew nuts contains 21% digestible proteins, 47% fats (cholesterol-free), 22% carbohydrates, minerals (calcium, phosphorus and iron), vitamins A, B and D, nicotinic acid and riboflavin plus Cashew Nut Shell Liquid (CNSL) for industrial uses (Yahaya, 1999). The most expensive part of cashew is "Cashew Nut Shell Liquid" and can be used as paint and also insecticide.

Apical dominance is the term used to describe the control of the shoot tip over axillary bud outgrowth (Cline, 1997). Breaking the apical dominance (decapitation), relieves the hitherto dormant axillary buds. Indeed, decapitation has been widely used to study axillary bud outgrowth. Apical dominance acts as a plant survival mechanism by providing a reservoir of meristems that can replace the damaged primary shoot. This mechanism works when the primary shoot is damaged or removed through disease, herbivore grazing, pruning or accidental breakage. Cashew seedling that suffers injury in the nursery in the form of accidental breakage of the growing point (apical meristem) are usually considered unfit for transplanting and as such discarded (CRIN, 1972; Adenikinju, 1996).

It has been documented that apical dominance is transduced through shoot – based auxins suppressing the synthesis of cytokinins in the shoot (kyozuka, 2007).Injured cashew seedlings during nursery operation occasioned by accidental breakage, disease infection or herbivore grazing are usually considered unfit for transplanting and hence often discarded during plantation establishment. This amounts to waste and loss of planting materials. Intentional or accidental breakage of the apical dominance (decapitation) at different height levels of the seedlings could influence the growth of shoot and root of cashew seedlings.

1.1 Objectives:

- To determine the effects of shoot decapitation on Number of buds
- To determine the effects of shoot decapitation on Number of Leaves,
- To determine the effects of shoot decapitation on Leaf Area
- To determine the effects of shoot decapitation on Stem girth

2.0 Materials and methods:

Cashew nuts of jumbo nut-size (12 – 15.9 g/nut) were sown in propagation bags (45×13 cm). The experiment was laid out in completely randomized design with four replications. At 4 Weeks After Sowing (WAS), when germination was completed, treatments were applied.

The treatments are;

1. No decapitation (Control)
2. Decapitation at 1 cm below the apical bud
3. Decapitation above point of four leaves attachment
4. Decapitation at 5cm above the cotyledon

Fifty (50) cashew seedlings were assigned per treatment per replicate, giving a total of 800 potted seedlings used for the study.

At 8WAS, two cashew seedlings were randomly sampled per treatment. The shoot was severed from the root at the shoot/root junction. The root was carefully immersed and rinsed in a water bath. These samples (seedlings) were taken at 14 days interval for 12 harvests for the determination of Total leaf area (cm^2) and dry matter yield (g/plant).

The samples (root, stem and leaves) were separately dried in an oven at 80°C until constant weights were obtained and the dry weights were recorded.

2.1 Data Analysis

The data were subjected to Analysis of Variance using GenStat 12 and means compared using standard error in bars at 5% propability level.

Simple linear regression was used to determine the extent to which there is a linear relationship between seedling weight and total leaf area.

3.0 Result and discussion

3.1.1 Number of buds/plant

The number of buds per plant was significantly influenced by shoot decapitation *($P \leq 0.05$)*. Cashew seedlings decapitated at 5cm above the cotyledons produced highest number of buds/plant when compared to the other treatments of decapitation. The un-decapitated cashew seedlings recorded least number of buds, 2.80 and 9.00 at 5 and 12 WAS respectively. The number of buds of 5.75, 5.50 and 6.40 were produced by the seedlings decapitated at the base of apical bud, base of point of 4-leaf attachment, and 5cm above the cotyledon respectively at 5 WAS. At 12 WAS, the bud production increased by 58.92%, 56.00% and 55.86% for seedlings decapitated at the base of apical bud, above the point of 4-leaf attachment and at 5cm above the cotyledon respectively. The differences were significant at $P \leq 0.05$ (Figure 1).

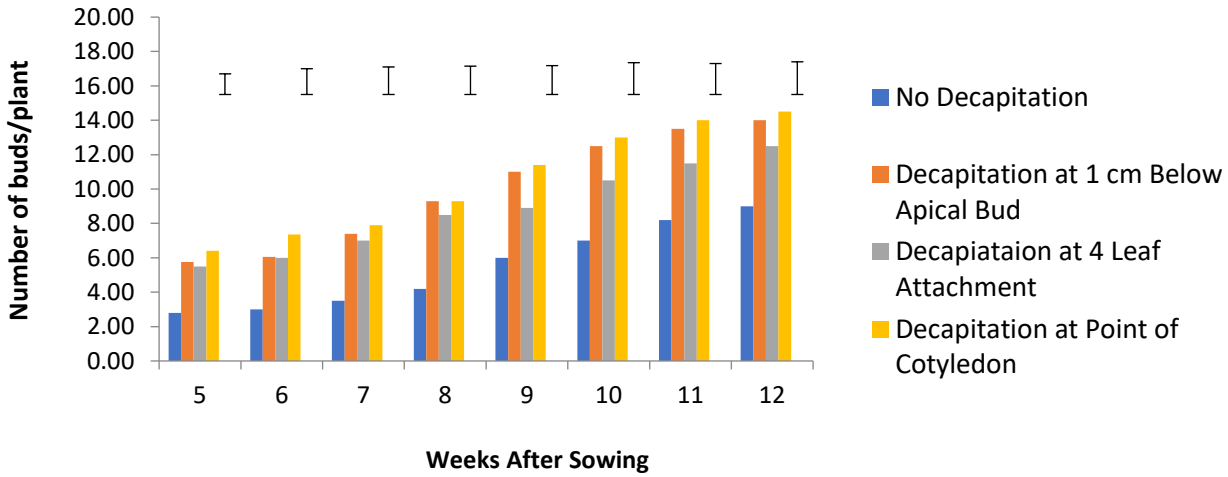


Figure 1: Number of buds per plant of cashew seedlings as affected by point of shoot decapitation 5 – 12 WAS…

3.1.2 Shoot production

At 5WAS, decapitated cashew seedlings above the point of 4-leaf attachment produced the highest number of shoots of 1.60 compared to the un-decapitated seedlings that had the least number of shoots of 1.00. At 12 WAS, cashew seedlings decapitated above the point of 4-leaf attachment produced higher mean number of shoots of 3.58. This was 58.10% higher than the number of shoots produced by the un-decapitated seedlings (Figure 2).

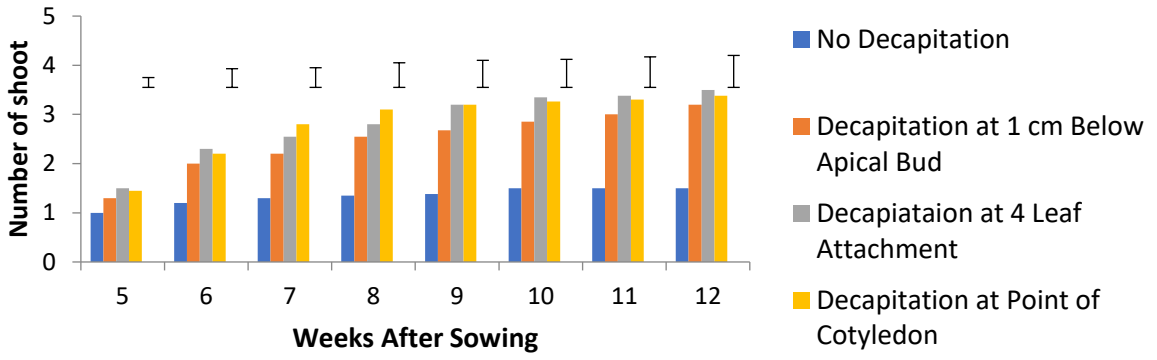


Figure 2: Number of shoot per plant of cashew seedlings as affected by point of shoot decapitation 5 – 12 WAS

4.1.3 Number of leaves

Number of leaves of cashew seedlings in the nursery was significantly *($P \leq 0.05$)* affected by decapitation. The seedlings decapitated at 1 cm below apical bud had the highest of 11.00 leaves at 9WAS followed by un-decapitated seedlings (10.00), seedlings decapitated above the 4-leaf attachment had 6.00 leaves and 5cm above the cotyledon with 5.00 leaves. At 19, 21 and 23WAS seedlings decapitated at the point of 4 leaf attachment and 1 cm below apical bud produced significantly higher number of leaves compared to the un-decapitated cashew seedlings. However, at 31WAS, cashew seedlings decapitated at point of 4-leaf attachment and those decapitated at 1 cm below apical bud produced higher number of leaves of 35.00 and 33.00 respectively while the un-decapitated seedlings produced 30.00 leaves. The differences were not significant *($P \leq 0.05$)*. Cashew seedlings decapitated at the point of cotyledon had the least number of leaves of 23.00 at 31WAS (Figure 3).

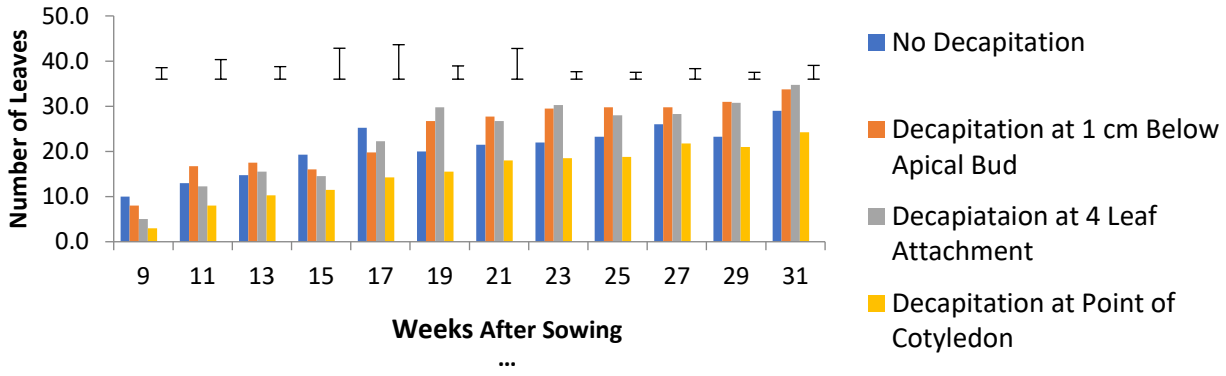


Figure 3: Number of Leaves per plant of cashew seedlings as affected by point of shoot decapitation 5 – 12 WAS

3.1.4 Stem girth (mm)

At 9WAS, mean stem girth of seedling decapitated above the 4-leaf attachment had the highest value of 5.70 mm followed by cashew seedlings decapitated at 1 cm below apical bud and un-decapitated cashew seedlings with 5.60 mm stem girth. Seedlings decapitated at 5cm above the cotyledon had the least stem girth of 3.70 mm. At 11WAS – 23WAS cashew seedlings decapitated above the 4-leaf attachment was significantly higher than un-decapitated seedlings, 1 cm at below apical bud and 5 cm above the cotyledon. At 31WAS, seedlings subjected to decapitation at 1 cm below apical bud and decapitation above the 4-leaf attachment had stem girth of 11.40 mm and 10.60 mm respectively while un-decapitated seedlings, had stem girth of 10.20 mm (Figure 4).

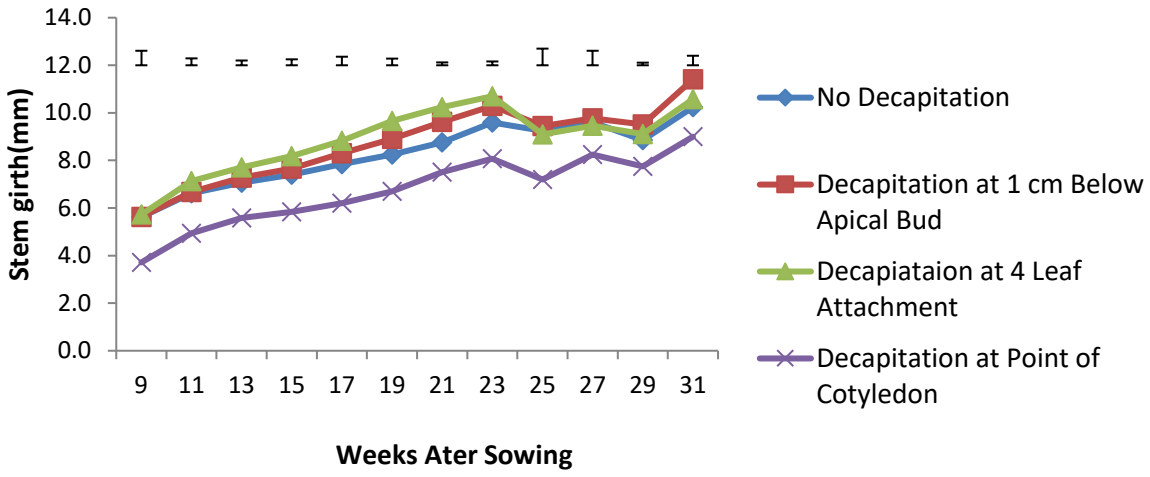


Figure 4: Number of stem girth per plant of cashew seedlings as affected by point of shoot decapitation

9 – 31 WAS

3.1.5 Leaf area (cm^2)

The leaf area at 9WAS, un-decapitated cashew seedlings recorded 61.30 cm^2 leaf area as against 49.20 cm^2 and 29.80 cm^2 leaf area observed in seedlings decapitated at 1 cm below apical bud and above the point of 4-leaf attachment respectively, while seedlings decapitated at 5cm above the cotyledons had least leaf area of 14.40 cm^2. At 29WAS cashew seedlings decapitated 1 cm below apical bud was significantly higher *($P \leq 0.05$)* from that of un-decapitated, 4 leaf attachment and decapitation at 5cm above cotyledon. At 31WAS, the leaf area of the decapitated seedlings was not different *($P \leq 0.05$)* from that of un-decapitated seedlings. Seedlings subjected to decapitation at 1 cm below apical bud and above the 4-leaf attachment had 197.20 cm^2 and 108.60 cm^2 leaf areas respectively while un-decapitated seedlings had 164.80 cm^2 and seedlings decapitated at 5cm above cotyledons that had 81.20 cm^2 (Figure 5).

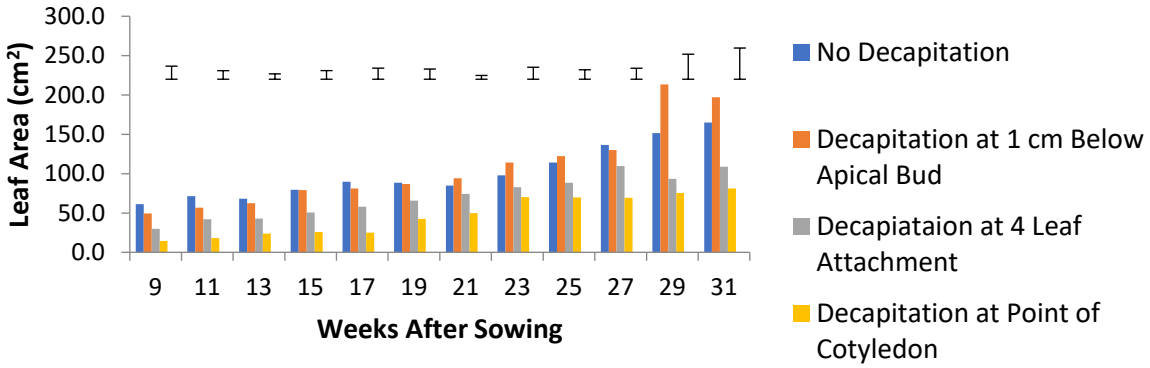


Figure 5: Leaf Area per plant of cashew seedlings as affected by point of shoot decapitation 9 – 31 weeks After Sowing

3.1.6 Total leaf area (cm^2)

Cashew seedlings decapitated 1 cm below apical bud had highest average total leaf area which was significantly higher than un-decapitated seedlings; seedlings decapitated at 4 leaf attachment while the seedlings decapitated at 5 cm above cotyledon had lowest total leaf area (Figure 6c) at 31 WAS. The differences were significant at $P \leq 0.05$. At 9WAS un-decapitated seedlings, was 15.35%, 69.25% and 89.68% higher in average total leaf area than seedlings decapitated at 1 cm below apical bud; seedlings decapitated at 4 leaf attachment and 5 cm above cotyledon, respectively. At 31WAS, seedlings decapitated at 1 cm below apical bud was 23.56%, 40.95% and 70.32% higher in average total leaf area than un-decapitated seedlings; seedlings decapitated at 4 leaf attachment and 5 cm above cotyledon, respectively (Figure 6).

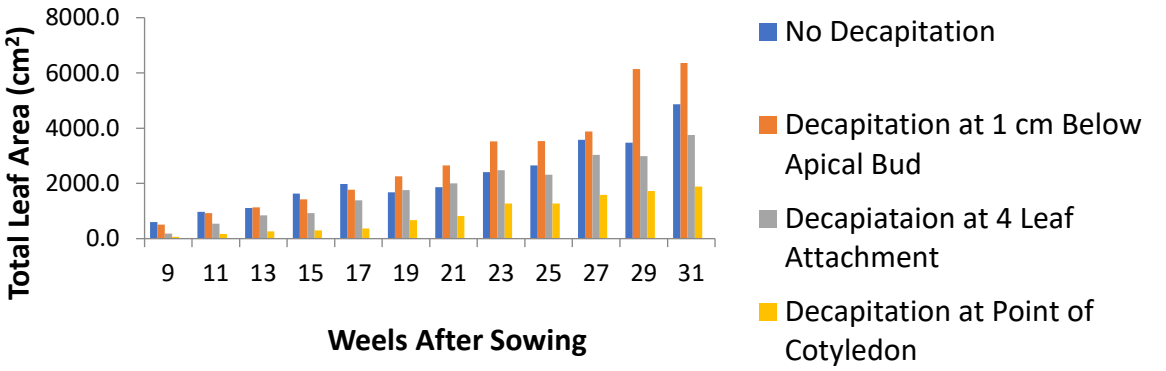


Figure 6: Total Leaf Area per plant of cashew seedlings as affected by point of shoot decapitation 9 – 31 weeks After Sowing

3.1.7 Total Dry weight production

The un-decapitated cashew seedlings had highest average dry weight, which was, mostly, significantly higher *(P≤ 0.05)* from the values of dry weight of decapitated seedlings between 9WAS and 15WAS. At 9 WAS, the average dry weights of un-decapitated cashew seedlings were 22.80%, 57.77% and 66.32% higher than dry weights of cashew seedlings decapitated at 1 cm below apical bud, point of 4 leaf attachment and 5 cm above cotyledon respectively. At 17WAS – 31WAS, seedlings decapitated at 1 cm below apical bud has significantly higher dry weight than un-decapitated cashew seedlings, decapitation at 4 leaf attachment and seedlings decapitated at 5cm above cotyledon point. At 31 WAS, dry weight in cashew seedlings decapitated at 1 cm below apical bud was 12.04%, 25.10% and 48.67% higher than un-decapitated cashew seedlings, decapitation at 4 leaf attachment and 5cm above cotyledon point, respectively (Figure 7).

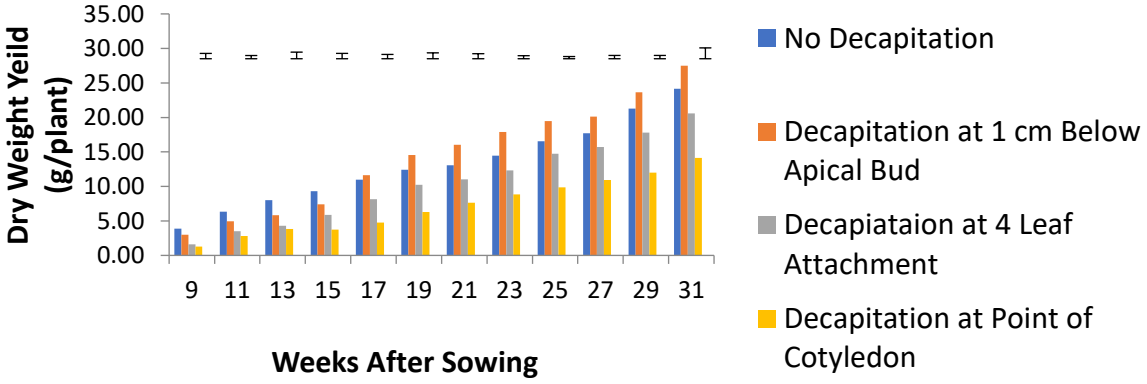


Figure 7: Dry weight yield per plant of cashew seedlings as affected by point of shoot decapitation 9 – 31 weeks After Sowing

3.1.8 Dry matter partitioning.

Dry matter partitioning is the end result of the flow of assimilates from source organs via a transport path to the sink organs. At inception of sampling un-decapitated cashew seedling has the highest assimilate import in leaves with 43.4%, while cashew decapitated at 1 cm below apical bud, 4 leaf attachment and 5 cm above the cotyledon has 39.5%, 31.5 and 11.5 respectively. Cashew decapitated at point of 4 leaf attachment has highest assimilate import in stem with 31.5% while cashew decapitated 5 cm above cotyledon has highest assimilate import in root of 63.5%. At 29 WAS, un-decapitated cashew seedling has the highest assimilate import in leaves with 42.8%, while cashew decapitated at 1 cm below apical bud, 4 leaf attachment and 5 cm above the cotyledon has 36.6%, 41.3 and 42.0 respectively. Cashew decapitated at 1 cm below apical bud has highest assimilate import in stem and root with 33.1% and 30.3% respectively (Figure 8).

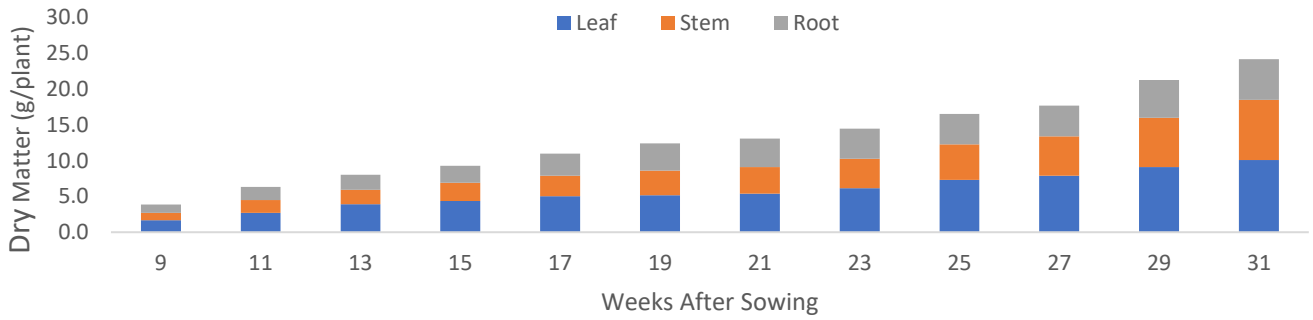


Figure 8a: Dry matter partitioning among the 3 plant organs of no-decapitation cashew seedlings

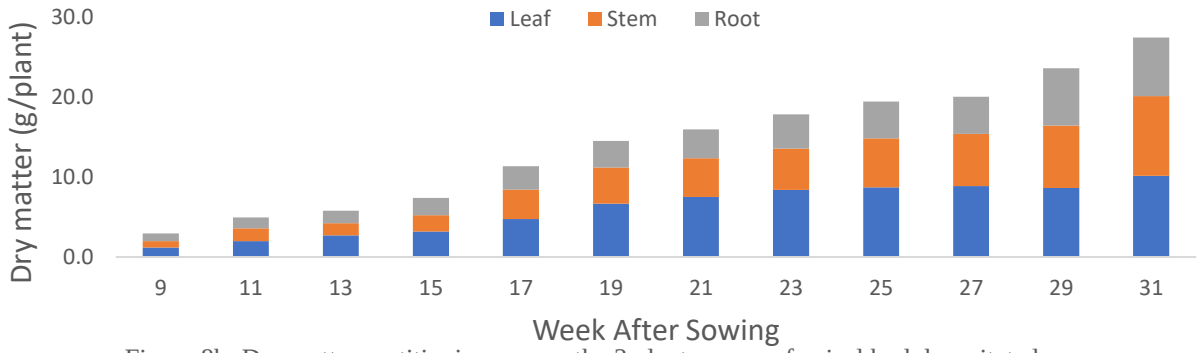


Figure 8b: Dry matter partitioning among the 3 plant organs of apical bud decapitated cashew seedlings

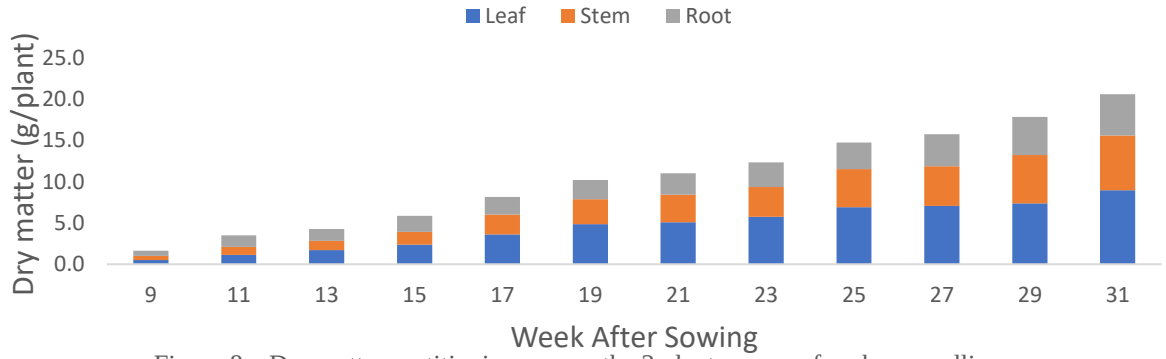


Figure 8c: Dry matter partitioning among the 3 plant organs of cashew seedlings decapitated at point of 4 - leaf attachment

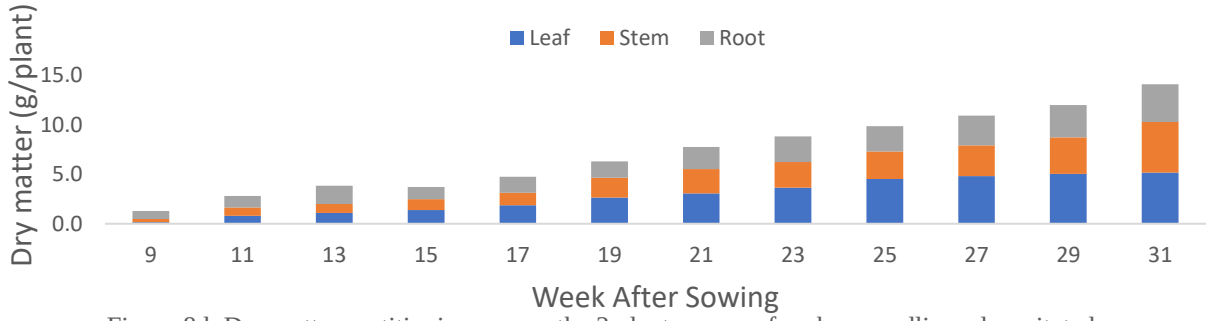


Figure 8d: Dry matter partitioning among the 3 plant organs of cashew seedlings decapitated at 5 cm above cotyledon

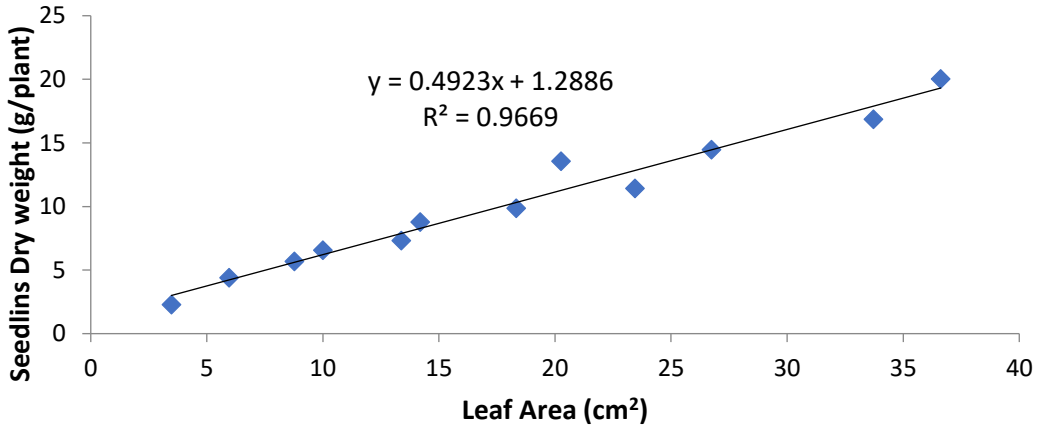
3.1.9 Relationship between Dry weight and Total leaf area in Nursery

The plotting of the leaf area against dry weight of decapitated cashew seedlings (trial 1) is linear with regression equation (Figure 9a):

$$Y = 0.4923x - 1.2886 \qquad R^2 = 0.9669$$

Y = total leaf area X = plant dry weight

In cashew seedlings, the linear relationship observed in changes between leaf area and dry matter with R^2 (coefficient of determination) of 0.9 is an indication that the dry matter production of the seedlings could be explained on the basis of leaf area.



4.0 Conclusion and recommendation

4.1 Conclusion

Decapitation of cashew seedlings, positively influence the dry matter yield and total leaf area of the seedlings of cashew in the nursery. Decapitation of the cashew seedlings resulted in the development of the axillary buds into shoots and increased in the number of leaves per cashew plant. This accounted for the high leaves per plant recorded by the decapitated cashew seedlings at 4 leaf attachment. If the shoot apex is subsequently decapitated, apical dominance is suppressed and one or more of these lower axillary buds begins to grow out. Within a few hours after apex removal, measurable increases in the length of the emerging lateral bud can be observed in some species. In other species the lag period may be longer depending upon the degree of inhibition and the stage of the cell cycle at the time of inhibition (Tamas, 1987). In the days and weeks following decapitation, subsequent elongation and development of the lateral bud into a branch shoot occur.

Due to the removal of the terminal bud via decapitation, the growth pattern of the seedlings became altered from the vertical (orthotropic) growth that was observed in the un-decapitated seedlings to lateral (plagiotropic) growth shown in the cashew seedlings decapitated at point of 4 leaf attachment and at 5 cm above cotyledon. This observation is in line with report from Streck (2005) that apical dominance is the central factor that determines the branching pattern in plants.

The stem girth of the decapitated cashew seedlings was also significantly wider than that of the un-decapitated cashew seedlings. Cashew seedlings decapitated at point of 4 leaf attachment had wider stem girth, because IAA content in the lower zone of the stem is low. After decapitation sugar, accumulates in the axillary bud which affects the increase in stem girth. Cashew seedlings decapitated 1 cm below apical bud recorded higher amounts of dry matter and total leaf area probably because of the increase in bud, branch and shoot formation after decapitation compared to seedlings decapitated at point of 4 leaf attachment, 5cm above cotyledon and un-decapitated seedlings. This indicates the significance of considering the point of decapitation while raising cashew seedlings.

4.2 Recommendation

- Cashew seedlings decapitated below apical bud and base of 4 leaf attachments are good planting materials for plantation establishment.
- Transplanting of decapitated cashew seedlings for field establishment should be at 17 - 19 Weeks After Sowing.
- The vigorous root and shoot growth of decapitated cashew seedlings could be exploited in field establishment studies.

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