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Saw milling machines and the effects of saw–dust on germinability and vegetative growth of *Aframomum melegueta* (*Zingiberaceae*): A non–timber forest product

Abstract

Effects of saw–dust from 3 types of saw–milling machines on the vegetative growth of the alligator pepper, Aframomum melegueta were investigated for 12 weeks. For planting, the soil's bulk was varied using different saw–dusts types. The experiment was carried out with a completely random design with 4 treatments and 4 replicates. The treatments: To (control), T1 (saw–dust from plane machine), T2 (saw–dust from circular machine) and T3 (saw dust from band saw machine) were applied to the seeds of A. melegueta. The obtained results were subjected to analysis of variance (ANOVA) using least significant difference (LSD) to determine the difference between means. At 4, 6, 8, 10, and 12 WAP (weeks after planting), T2 had the highest value of leaf area while T1 had the lowest leaf area value. At 4, 6, 8, 10 and 12WAP, T2 had the highest value of plant height while T1 had the lowest plant height value. At 4, 6, 8, and 12 WAP T2 had the highest value of number of leaves while T1 had the least value of number of leaves. At 4, 6, 8, and 12 WAP T2 had the longest internodes, while T0 had the shortest internodes. Sawdust from the circular saw is recommended for improved germinability and growth of alligator pepper.

Keywords: saw–dust, saw–milling machine, leaf area, internodes

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Introduction

Aframomum melegueta (Zingiberaceae), popularly known as alligator pepper, is a species of ginger, native to West Africa, and an important cash crop in Southern Ethiopia. The leading producers of alligator pepper are Ghana, Ivory Coast, Nigeria, Senegal and Liberia.[1] It was used as a flavor in historical times and still used for the production of beer, wine and spirit and the flavoring of vinegar.[2] In Nigeria, the leading producer states include Ondo, Edo, Ogun, Anambra and Plateau states. These plants are herbaceous perennials and like the grains of paradise (species, family); they are natives of swampy habitats along the West African coast. Its trumpet–shaped, purple flowers develop into 5 to 7cm long pods containing numerous small, reddish–brown seeds, which are the sources of the flavoring (Figure 1 & 2).[3]

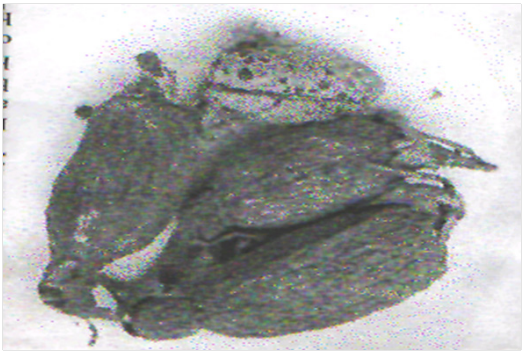

Figure 1 Pods of Aframomum melegueta (Alligator pepper).

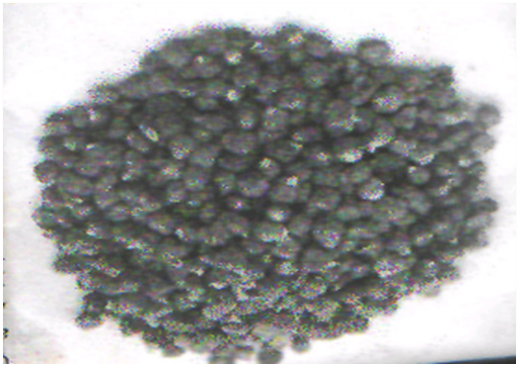

Figure 2 Seeds of Aframomum melegueta (Alligator pepper).

Sawmilling machines

Sawmilling machines are used for flattening, curved or irregular surfaces by mounting the work piece to a slotted table and feeding against a rotating cutter containing a multiple cutting edge. The band saw is a power tool which uses a blade consisting of a continuous band of metals with teeth along one edge to cut various work pieces. The band usually rides on two wheel rotating in the same plane, although some band saws may have three or four wheels. Band sawing produces uniform cutting action as a result of an evenly distributed tooth load. There are different types of band saws e.g. metal cutting, timber cutting, head saw, re–saw, double cut saws and automated saws.[4]

The Circular machine uses a toothed metal cutting disc or blade.

The term is also loosely used for the blade itself. The blade is a tool for cutting wood or other materials and may be hand–held or table mounted. It can also be used to make narrow slots. Saws are mostly designed with a blade designed to cut masonry, plastics or metals.[5] Plane machine are machines used for shaping wood. They are used to flatten, reduce the thickness of and impart a smooth surface to a rough piece of timber. Plane machines are used to produce horizontal, vertical, or inclined flat surfaces on work pieces usually too large for shaping. Special types of planes are designed to cut joints or decorative moldings. Plane machine consists of three elements; a cutter head, a set of in–feed and an–out feed rollers which draws the board through the machine and a table which is adjustable relative to the cutter which controls the resultant thickness of the board.[6]

Methodology

The experiment was carried out in Ogbomoso, Nigeria. Ogbomosho is situated within the coordinates Lat 8^0 IO'N of the equator and longitude 4^0E of the GMT. The climatic condition of Ogbomoso is mostly influenced by Northeast and Southeast trade winds. The rain extends from March till Nov. while the second season is warm and starts from late Nov.to early Mar. The temperature ranges from 28°C to 33°C and humidity is high at 74% all year round except in Jan. when dry winds blow from the North. The soil is moderately well drained, with a sandy loam texture. The top soil is loamy and was collected from under a *Gmelina arborea* Roxb (Verbenaceae); vegetation. The sawdust used in the experiment was collected from a saw–mill within the Ogbomoso metropolis and derived from 3 different sawmilling machines, namely band saw, plane machine and circular machine. Sawdust from band saws and circular saws has particles as sawdust while circular saws have shavings as their sawdust. The sawdust so collected was from the same tree species.

Nursery Operation

The alligator pepper plants were planted into pots, which were perforated to prevent water logging of the soil. The topsoil was collected and mixed with sawdust in the ratio of 1:3, and used to fill the pots which were then watered before the seeds were sown. After planting, the seeds were covered with topsoil. Watering was done twice daily, early in the morning and late in the evening for 4 weeks before transplanting to the experimental site. A watering can was used in order to prevent water logging of the seeds. The site was cleared manually and beds were made 2×2m with a 1m gap in between them. The plants were planted 2 per hole and consequently 12 plants per bed. Weeding was done manually to prevent competition with the young alligator pepper seedlings and also to reduce insect attack.

Data collection

To facilitate easy collection of data the following morphological parameters were taken:

a) **Plant height:** This is the total height of plant measured from the soil level to the tip of the terminal leaf.

b) **Inter–node:** The node is the point where shoots appear. The distance between one node and the other is called the inter–node.

c) **Leaf area:** This was the leaf area index (LAI) measurement for the sampled plants. This is the total area of leaf tissue per unit ground surface area, considering one side only.

Results

The application of saw–dust of *Gmelinaaborea* from three different saw–milling machines (Circular, Band saw and Plane machines) as bulk density enhancer have effects on the germinability and growth parameters of *Aframomum melegueta* (alligator pepper).

Effects of saw–dust of Gmelina arborea on leaf area of alligator pepper

The leaf area was physically influenced by the application of saw–dust; with an optimum value obtained at T_0 and T_2 while T_1 had the lowest value of 0.53 at 4WAP (Table 1). At 6 WAP, the highest value was obtained at T_2 while T_1 had the lowest value. At 8WAP, the optimum value was also obtained at T_2, while the lowest value was obtained at T_1 (Table 1). At 10 WAP, T_2 had the highest value while T_1 had the lowest value. At 12WAP, T_2 had the highest value, while T_1 had the lowest value of 4.60 (Table 1). There was no significant difference between any of the treatments (Table 2).

Effects of sawdust on the height of alligator pepper plants

The plant height was physically influenced by the application of saw–dust with the optimum values obtained at T_2 (1.43cm) while T_3 (0.53cm) had the lowest value at 4WAP. At 6WAP, T_2 (4.10cm) had the optimum value while T_1 (1.30cm) had the lowest value. At 8WAP, T_2 (6.68cm) had the highest value while T_1 had the optimum value (2.85cm) which is the lowest value. At 10 WAP, T_2 (7.58cm) had the highest value while T_1 (3.38cm) had the lowest value of leaf area. At 12WAP, T_2 had 10.73cm had the optimum value while, T_1 only had 4.35cm had the lowest value (Table 3).

Effects of saw–dust of Gmelina arborea on the number of leaves of alligator pepper

Numerically, the application of saw–dust affected the number of leaves produced by the plant. At 4WAP, T_2 produced the highest number of leaves, followed by T_1 while, T_0 and T_3 had the lowest number of leaves produced at 0.10 and 0.10, respectively although the differences were not significant. At 6WAP, T_2 led with the highest number of leaves followed by T_0 and T_3 while, T_1 had the lowest value of 1.50, however, the differences were not significantly different. At 8WAP, T_2 led with the highest number of leaves followed by T_3, while T_0 and T_1 had the least values. At 10WAP, T_2 leads again followed by T_3 with a value of 4.50 while T_0 and T_1 had 3.75. The results were not significantly different statistically. At 12WAP, T_2 (9.25) had the highest number of leaves followed by T_3 with a value of 5.50 while T_0 and T_1 had 5.25 (Table 4).

Effects of saw–dust of Gmelina arborea on internodes distance of alligator pepper

The application of saw–dust affected the inter–node length of the plant considering physical measurement. At 4WAP, T_2 (0.15cm) produced the highest internode length followed closely by T_0, T_1 and T_3 with values of 0.10, 0.10 and 0.10, respectively, although there was no significant difference among treatments. At 6WAP, T_2 (0.45cm) had the highest value followed by T_0 (0.28cm) and T_1 (0.28cm) while T_3 (0.20cm) had the lowest value, with no significant difference. At 8WAP, T_2 (0.73 cm) had the highest value followed

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by T_3 (0.58 cm), while T_0 (0.43cm) and T_1 (0.43cm) had the least value, respectively, with no significant difference among treatments. At 10WAP, T_2 (7.58cm) had the highest value, followed by T_3 (4.80) while T_0 (0.60cm) had the least value. At 12WAP, T_2 (9.33cm) had the highest value, distantly followed by T_3 (6.53 cm) while T_0 (0.68 cm) had the least value.

Table 1 Leaf area as affected by the application of different types of Saw-Dust of *Gmelina arborea*

Treatment	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP
T_0	1.78	2.56	3.75	4.50	5.20
T_1	0.53	1.33	2.48	3.38	4.60
T_2	1.78	3.58	5.28	7.58	9.33
T_3	1.25	2.50	3.58	4.80	6.33

Keys:
T0–Control
T1–Saw-dust from plane machine
T2–Saw-dust from circular machine
T3–Saw-dust from CD6 machine
WAP–Weeks after planting

Table 2 Plant height as affected by the application of different types of Sawdust of *Gmelina arborea*

Treatment	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP
T_0	0.90	2.15	3.53	4.73	5.90
T_1	0.88	1.30	1.93	2.85	4.35
T_2	1.43	4.10	6.68	8.65	10.73
T_3	0.53	1.80	3.20	4.88	6.28

Table 3 Number of leaves as affected by the application of different types of Sawdust of *Gmelina arborea*

Treatment	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP
T_0	1.00	1.75	2.75	3.75	5.25
T_1	1.25	1.50	2.75	3.75	5.25
T_2	1.50	2.75	4.50	6.75	9.25
T_3	1.00	1.75	3.50	4.50	5.50

Table 4 Internodes distance as affected by the application of different Sawdust of *Gmelina Arborea*

Treatment	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP
T_0	0.10	0.28	0.43	0.60	0.68
T_1	0.10	0.28	0.43	3.38	4.60
T_2	0.15	0.45	0.73	7.58	9.33
T_3	0.10	0.20	0.58	4.80	6.53

Discussion

Plant Growth promoters are substances that improve the overall health and development of plants. These substances may be either synthetically produced or obtained from derivatives.[7] Apart from growth enhancers that operate within the framework of seed anatomy, the growth environment of trees' seeds can affect early germination of seeds and effective growth of its seedlings. The used type of soil for planting may have a great effect on how the density will affect aeration. Bulk density is an indicator of soil compaction. It reflects the soils ability to function for structural support, water and solute movement as well as soil aeration. Sandy and sandy loamy soils have greater percentage of high bulk density.[8] A quantitative assessment of soil compaction is always required to enhance soil management for crop production and environmental sustainability.[9] The saw–dust of *Gmelina arborea* can perform favorably and can compete with inorganic fertilizers in enhancing or promoting soil nutrient status and increasing the germ inability and vegetative growth of *Afromomum melegueta.* Saw–dust is a by–product of saw–milling in Nigeria and it is not converted to any other used product; it is just burnt off. The use of saw dust for growth enhancement in the form of soil bulk density refiner will help in environmental cleansing through the reduction of the saw–dust volume at the incinerator.[10,11]

Conclusion

In this research work, 3 different types of saw–dust of *Gmelina arborea* obtained from 3 different saw–milling machines (band, plane and circular machines) were investigated. There were increase in germ inability and vegetative growth of *Aframomum melegueta* with the application of various types of saw–dust when compared with that of the control treatment. The highest values of leaf area, plant height, number of leaf and internode were successfully recorded at T_2. The size of the particles of each type of saw dust affects the aeration of the soil used for the seedlings of *Aframomum melegueta.* For breeding purposes, the application of T_2 (Saw–dust from circular machine) is therefore highly recommended for best performance in terms of leaf area, plant height, number of leaves and inter–node length. Similarly, T_3 (Saw–dust from band machine) can be used in place of T_2 in the absence or unavailability of T_2 since T_3 also gave a good performance in terms of number of leaves, leaf area, internode length and plant

height. As a way of encouraging farmers to go into Organic agriculture, T_2 should be used in the place of inorganic fertilizer to promote the germ inability and vegetative growth of *Aframomum melegueta*.

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None.

Conflict of inertest

Authors declare there is no conflict of interest.

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