GROWTH AND FRUIT YIELDS OF THICKHEAD (*Crassocephalum crepidioides* (Benth.) S. Moore) AS INFLUENCED BY PROPAGULE HEIGHT AND CUTTING SURFACE PREPARATION IN OYO, NIGERIA

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Abstract
It has been observed in the recent time that thickhead could not be usually cultivated but only available in the wild for man use consequent upon dearth fruits and seeds. In view of this, the experiment was conducted to determine growth and fruit yields of thickhead, as influenced by propagule height and preparation at Teaching and Research Farm, Emmanuel Alayande College of Education, Oyo, Oyo State, Nigeria. A pot experiment was carried out in the screen house arranged in Completely Randomized Design (CRD) and replicated three times. The treatments imposed were three levels of propagule height and three levels of cutting surface preparation resulting in a nine treatment combinations. In the course of the experiment, observations were made and data were collected at 10 and 17 weeks after planting. The means were separated using Duncan Multiple Range Test (DMRT) at 5% probability level. The result obtained from the finding showed that $T_5(H_1S_1)$ performed best whereas $T_9(H_2S_2)$ performed below expectation in term of growth parameters and fruit yields. Therefore, the recommended cutting height for thickhead, Crassocephalum crepidioides is 15 cm above the ground and round cutting surface should be stick-to to enhance high regeneration and fruit yields in the study area.

Keywords: Propagule, thickhead, Crassocephalum crepidioides, regeneration, cutting height, round and bevel surface

Introduction

Thickhead 'Ebolo' *Crassocephalum crepidioides* is one of the underutilized indigenous vegetables in Nigeria among other like Fluted pumpkin "Apiroko" *Telfairia occidentalis*, Glossy nightshade "Odu" *Solanum nigrum,* Snake tomato "Tomatielejo" *Trichosanthes cucumerina,* Bitter leaf "Ewuro" *Vernonia amygdalina,* Field pumpkin *"* Elegede" *Curcubita pepo,* Amaranth *"*Tete" *Amaranthus virides*, Bologi "Woorowo" *Senecio biafrae* and Egg plant "Igbagba"*Solanum macrocarpon* (Rosulu, 2012).

Thickhead is an erect, slightly succulent, annual herb up to 100-180 cm tall, stem rather stout, soft and ribbed pubescent. Leaves are arranged spirally, simple lobed or pinnatifid, stipules absent, lower leaves with short petiole, upper ones sessile, blade elliptical to obvate–elliptical in outline, usually lobed, irregularly serrated. Inflorescence is cylindrical head 13-16 mm × 5-6 mm arranged in a terminal corymb, many flowered, outer involucral bracts unequal, 1-4 long. Flower is bisexual, equal corolla tubular, 9-11 mm long, yellow or orange with anthers united into tube, purple and inferior ovary. Fruits are ribbed achene 2 cm long, hairy, dark purplish crowned by white caduceus hairs, 9-12 mm long seed with epigeal germination (Kostermans *et al.*, 1996).

The seedling of thickhead appears 8 to 10 days after sowing. Growth of seedlings is fast within 40-45 days after sowing, the plants are reap for the first harvest by uprooting, and harvesting for seed can start on 15 to17 weeks after sowing (Okigbo, 1999). Tannin found in the roots

of the plant is used to treat swollen lips and according to Dairo and Adanlawo (2007), it is a good source of protein in human and animal nutrition. It also possesses antioxidant and cyto-protective properties (Wijaya *et al*, 2011).

Thickhead germinates at temperature between 10°C and 40°C, the power limit of germinated temperature explains the incidence at high altitudes. Nakamura and Hossain (2009) reported a germination range of 10-30°C with an optimum of 15-20°C. Seeds germinate over a wide pH range (2 to 12) with highest germination rate between pH 4 and 10. Germination rate may be drastically reduced after one year and emergence is high on the soil surface while no seedling emerged from a depth of above 1cm and seeds have no apparent dormancy and retain high viability after room temperature for 10 months (Nakamura and Hossain, 2009). Thickhead produce seeds with silky pappus hairs (plumed seeds) that can be easily dispersed by wind and or water, (Denton, 2004).

The nutritional composition of "Ebolo" leaves per 100 g portion is water (79.9%), energy (268 kj), protein (3.2 g), fat (0.7 g) and Phosphorus (52 mg). Thickhead is eaten by human in many countries in Africa. Succulent leaves and stems are used as a vegetable in soups and stews, especially in West and Central Africa. In Sierra Leone they are popular and are made into a sauce with groundnut paste. In Australia, this species is eaten as a salad green, either cooked or raw. It is also used in traditional African medicine to treat indigestion, stomach ache, epilepsy, sleeping sickness and swollen lips. Tomimori *et al*., (2012) reported antitumor activity associated with nitric oxide production. It is also used as green fodder for poultry and livestock (Denton, 2004).

The annual production of thickhead may reach 25-27 t/ha of leaves and shoots from repeated harvesting. Thickhead is an annual weed that flowers all year round with a high seed production capacity, it is able to produce 29 flowers with approximately 4379 seeds per plant, reaching a plant density of 70.5 individuals per square meter in tea plantations (Kadereit, 2009). The wide genetic variation is yet to be exploited and there are no records of germplasm collections in Africa. Breeding of improved cultivars is needed, as well as research to solve the problem of seed availability that has hitherto limited cultivation (Denton, 2004). Information about its germination and seed production is scanty in literature.

According to Sakpere *et al*., (2013) *Crassocephalum crepidioides* produced up to 768-1152 seeds per plant indicating that the seed production potential of the plant is very high. Germination percentage was not consistent with age and may be influenced by seed maturity, *Crassocephalum crepidioides* produced an average of 96 seeds per inflorescence and there were 8 to 12 inflorescences per plant. The average weight of 1000 seeds was 0.176 g.

Annually considerable amounts of "ebolo" are harvested from the wild. In planted fields harvesting is by uprooting or repeated cuttings. The first harvest by uprooting can be expected 5-6 weeks after transplanting, and the first cutting is carried out when the plants are 20-25 cm tall. This shoots are cut at 8-10 cm above ground to allow profuse production of new shoots. Repeated cutting is carried out at intervals of 7-14 days depending on plant growth and vigour. The can be done for 40-50 days. Harvesting is often done in the evening or early morning to keep the leaves fresh for the market (Zollo *et al*., 2000).

Thickhead produce seeds (Achenes) profusely. The weight of 1000 seeds is 0.2g the seeds are difficult to process and preserve due to the fine pappus hairy covering the achenes, they are easily dispersed by wind. Removing the pappus is possible when the fruits are fully ripe, but before they spread naturally. Seedlings are normally raised in nursery in specially prepared cool spots. Direct sowing is less common, the seeds are drilled on the seedbed and watered

twice daily. The seedlings are transplanted with a ball of earth attached and are planted on raised beds when they are 8-10 cm tall at a spacing of 20 cm x 20 cm. Transplanted crops produce vigorous plants with large leaves, (Lemmens, 2003).

Despite all the accrued benefits of thickhead, it is a known taboo that it can only be available and marketed during the arrival of the new yam in rainy season and always in short supply. There is dearth information on its growth and seed production. In view of this, there is the need to break the taboo and make it available all the year around using appropriate production technique and determining appropriate cutting height that enhances seeds/fruits production.

Materials and Methods

Location of the Experiment

The experiment was conducted at the Teaching and Research Farm, Emmanuel Alayande College of Education, Oyo, Oyo State, Nigeria. Oyo lies on the longitude 3° 75′ East of the Greenwich meridian and latitude 7° 51′ North of the equator. It is about 55 kilometre north east wards from Ibadan the capital of Oyo State. The altitude is between 300 and 600 metres above sea level. The mean annual temperature is about 27°C while that of rainfall is 1165 mm. The vegetation of the area is Guinea Savanna zone (Iwena, 2012).

Soil preparation and poultry droppings

Soil was collected under the big and well-formed tree canopies at depth 0-15 cm and air dried for 4 days and sieved through a 2 mm sieve. For seedbed preparation, 37.5 kg of top soil was mixed with 9.35 kg of poultry manure (that is ratio 4:1). The poultry droppings used for the experiment was cured for three months under shade to ensure full decomposition. For soil physical and chemical properties, composite soil samples were collected from the bulk. For potting, soil mass of 6 kg was used to fill each pot. The dimension of pot used was 26.5 cm × 30 cm height and width respectively.

Sources of Propagule

The thickhead seeds used for the experiment was obtained from the wild at Afijio Local Government, Jobele, Oyo State, Nigeria.

Nursery Establishment

The seeds used were soaked for three days prior to sowing on the 14th April, 2017 using drilling method on prepared bed at a spacing of 10 cm by 10 cm apart on 1.4 m by 1.4 m bed and water slightly after sowing to avoid splashing. At the nursery stage, watering was done twice (early in the morning and late in the evening), weeding, diseases and pests control were also carried out while the seedlings were adequately shaded.

Prickling was done on 20th May, 2017 from nursery bed to small sachets polyethylene bag after the plant reached about 8 cm height with 4-5 leaves. Afterward transplanted to polyethylene bags after 2 weeks when the plant reach 20 cm height to impose treatment combinations and planted one stand per pot and treatment were applied on 3rd June, 2017.

Treatment Combinations

Seedling height

(H_o) Propagule height = 20 cm (control)
(H_1) Propagule height = 15 cm
(H_2) Propagule height = 10 cm

Surface Preparation
(S_0) No preparation
(S_1) Round
(S_2) Bevel

Experimental Layout
The experiment was a 3 by 3 factorial laid out in a Completely Randomized Design (CRD) replicated three times and arranged on welded irons.

Data Collection and Analysis
Data were collected on both growth and reproductive parameters thus:
Growth Parameters: Plant height (cm), number of branches/plant, number of leaves/plant, stem girth(cm), and leaf area (cm^2) while reproductive parameters included number of flowers/plant, number of fruits/plant, weight of fruits/plant and days to fruit maturity.

Plant height and leaf area were measured using a measuring tape, the plant height was taken from 5 cm above soil level to the apical meristem of the plant. The leaf length and breadth were measured to obtain the leaf area. The leaf area was estimated as its area multiplied by 0.62 (thickhead conversion factor), stem girth was measure using Vernier Calipers. The number of leaves and branches per plant were also obtained by counting. Data collected were subjected to analysis of variance (ANOVA). The means were separated using Duncan's Multiple Range Test (DMRT) at 5% probability level using SAS (2013).

Results and Discussion

Discussion
Table 1 shows the results of influence of propagule height and cutting surface preparation on growth parameters of thickhead. From the results obtained, T_5 (H_1S_1) produced significantly highest values with respect to plant height, stem girth, number of branches and leaf area with (184.7 cm), (2.8 cm), (21.3 cm) and (5693 cm^2) respectively while T_9 (H_2S_2) produced the least. With respect to number of leaves produced, T_3 (H_0S_2) produced the highest value without corresponding value in leaf area but T_5 (105) which produced 43% less number of leaves compared with T_3 (136) had significantly highest value of leaf area. This may be resulted from compensating effect on reduced number of leaves; the more the leaves the less the leaf area. The result obtained in connection with the cutting height negated the findings of Zollo *et al*., (2000) that cutting should be carried out at 8-10 cm above the ground level.

Without prejudice to any of the treatment combination, T_5 (H_1S_1) performed excellently across the reproductive parameters examined. Comparing days to fruit collection, it was found that there were no statistically significant differences among the treatments imposed but T_5 (H_1S_1) resulted in the least days (100) to fruit. Considering the number of flowers per plant, (T_5) also had the highest value (186) compared with other treatments and at the same time the highest value of cumulative weight of fruits. This result was not in line with Kadereit (2009) who reported 29 flowers per plant and 4379 seeds per plant. This variance might be due to varied ecological zones of the experiments. In addition, the finding in the current study is not in consonance with the observations by Sakpere *et al* (2013) that there were 8 to 12 inflorescences per plant. The current studies by implication observed 16 inflorescences per plant which is far above the former studies which might be consequence upon varietal differences and ecological variations. T_8 (H_2S_1) had the highest value for days to fruit collection produced the least number of flowers. This means that stress in flower production had deleterious effects on earliness in fruit.

Table 1: Influence of Propagule height and cutting surface preparation on growth parameters of thickhead at 10 weeks after planting

Treatment	Growth Parameters				
	Plant Height (cm)	*No. of Leaves*	*Stem Girth (cm)*	*No. of Branches*	*Leaf Area (cm^2)*
T_1 (H_0S_0)	165.3^{a}	100^{ab}	2.3^{ab}	7^{c}	4925^{ab}
T_2 (H_0S_1)	130.3^{ab}	122^{a}	2.1^{ab}	19^{ab}	3323^{abc}
T_3 (H_0S_2)	140.0^{ab}	136^{a}	2.4^{ab}	17^{abc}	3517^{abc}
T_4 (H_1S_0)	28.3^{abc}	129^{a}	2.4^{ab}	18^{ab}	4210^{abc}
T_5 (H_1S_1)	184.7^{a}	105^{ab}	2.8^{a}	21^{a}	5693^{a}
T_6 (H_1S_2)	30.3^{abc}	132^{a}	2.4^{ab}	17^{ab}	3553^{abc}
T_7 (H_2S_0)	149.7^{a}	72^{bc}	2.3^{ab}	11^{abc}	3894^{abc}
T_8 (H_2S_1)	88.7^{bc}	69^{bc}	1.2^{c}	6^{c}	2072^{bc}
T_9 (H_2S_2)	81.0^{c}	60^{c}	1.3^{c}	9^{c}	1488^{c}

Note:- *H_0S_0 = 20 cm propagule height, no surface preparation; H_0S_1 = 20 cm propagule height, round surface; H_0S_2=20cm propagule height, beveled surface; H_1S_0=15 cm propagule height, no surface preparation; H_1S_1=15 cm propagule height, round surface; H_1S_2=15 cm propagule height, beveled surface; H_2S_0=10 cm propagule height, no surface preparation; H_2S_1=10 cm propagule height, round surface; H_2S_2=10 cm propagule height, beveled surface.*

Means with different letters of alphabets are significantly ($p \leq 0.05$) different along the column according to Duncan's Multiple Range Test.

Table 2: Influence of Propagule height and cutting surface preparation on reproductive parameters of thickhead at 17 weeks after planting

Treatment	Reproductive Parameters			
	No. of flowers	*Days to fruit collection*	*Cumulative No. of Fruits*	*Cumulativ weight of fruits (g)*
T_1 (H_0S_0)	110^{ab}	115^{a}	120^{ab}	15.66^{a}
T_2 (H_0S_1)	104^{ab}	126^{a}	76^{abc}	11.00^{ab}
T_3 (H_0S_2)	112^{ab}	136^{a}	78^{abc}	11^{ab}
T_4 (H_1S_0)	109^{ab}	133^{a}	71^{abc}	13.00^{ab}
T_5 (H_1S_1)	186^{a}	100^{a}	142^{a}	16^{a}
T_6 (H_1S_2)	95^{ab}	134^{a}	89^{ab}	11.33^{ab}
T_7 (H_2S_0)	128^{a}	115^{a}	116^{ab}	15.66^{a}
T_8 (H_2S_1)	73^{b}	146^{a}	58^{bc}	8.00^{b}
T_9 (H_2S_2)	97^{ab}	104^{a}	39^{c}	6.00^{b}

Note:- H_0S_0=20 cm propagule height, no surface preparation; H_0S_1=20 cm propagule height, round surface; H_0S_2=20 cm propagule height, beveled surface; H_1S_0=15 cm propagule height, no surface preparation; H_1S_1=15 cm propagule height, round surface; H_1S_2=15 cm propagule height, beveled surface; H_2S_0=10 cm propagule height, no surface preparation; H_2S_1=10 cm propagule height, round surface; H_2S_2=10 cm propagule height, beveled surface.

Means with different letters of alphabets are significantly ($p \leq 0.05$) different along the column according to Duncan's Multiple Range Test.

Conclusion

Based on the experiment conducted, it could be summarily concluded that thickhead, *Crassocephalum crepidioides* "Ebolo" has high regeneration potential at 15 cm cutting height but could not tolerate or withstand extremely low cutting height for instance 10 cm above the ground level. Also, number of leaves is not related directly proportional to leaf area production. It was established that thickhead could be cultivated even before the arrival of yam. That is to say it could be planted and harvested anytime of the year provided water is adequately available for the plant use.

Recommendations

Based on the results obtained from this experiment, it is recommended that:

i. The recommended cutting height for the thickhead, *Crassocephalum crepidioides* is 15 cm above the ground level to enhance high regeneration;
ii. In addition to the above, round cutting surface should be stick to;
iii. Upon the observation in the course of the experiment, it is recommended that opened and matured fruits are collected between 12.00 p.m. and 1.00 p.m. to avoid shattering if delayed.

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