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Inducing Tuber Formation in *Dioscorea bulbifera* L. Accessions through the Use of Minisetts

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Abstract **Original Research Article**

Dioscorea bulbifera a species of yam in the family Dioscoreaceae produces aerial bulbils in addition to underground tuber. The process of partitioning in this plant is poorly coordinated, as a result tuber formation do not occur in most cases. Therefore, minisetting was used as a signal induction mechanism to enable meristematic cells proliferate into tuber formation. Result revealed 25% of plants grown by whole bulbils produced tubers, while 80% of plants grown by minisetts produced tubers. Accession TDb3086 grown with whole bulbil had the highest average bulbil weight (218.71g), while its minisett had an average bulbil weight of 53.24g. Accession TDb3692 grown with minisett had the highest bulbil weight 119.83g, while its minisett had an average bulbil weight of 171.73g. Average Bulbil weight was higher than average tuber weight in both whole bulbils grown plants (control) and minisett plants.

Keywords: Inducing, Tuber, Accession, Minisett, Bulbil.

INTRODUCTION.

The pattern of distribution of the photosynthate in a plant is dependent on several factors built around source- sink relationships. This is usually controlled by signal induction mechanism, where need initiates the signal. In plants the product of photosynthesis, sugar is transported from the leaves, the major organ for photosynthesis to storage tissues by turgor pressure (Akari *et al*., 2012). But, when the plant is under stress the plant's resources are channeled to a better adaptative structure.

Dioscorea bulbifera is a perennial vine that produces both underground tuber and aerial bulbils. The possession of these two sinks, bulbils and tubers presents the difficulty of how the plants partitions its photosynthate. As a result, majority of cultivated plant produce only bulbils without underground tubers (Szarek *et al*., 1996). Yet, it has been reported that different portions of yams contain varying proportions of nutrients and important chemical compounds like diosgenin used in contraceptive production. Norimitsu *et al* 2023 observed the production of bubils in *Dioscorea alata* variety in response to water logging stress. Suggesting the production of alternative food storage structure might be in response to stress. Vailant *et al*., 2005 reported tuber formation invitro was in response to a number of factors including: photo-period, thermo-period, sucrose concentration and plant hormones. Therefore, we intend to elucidate the effects of wound stress on tuber formation *Dioscorea bulbifera*.

MATERIALS AND METHODS

This research work was carried out in the University of Port Harcourt staff research farm located between longitude 4° 52' 32" - 4° 55' 0^0 N and latitude 6° 54' 40 - 6° 55' 49"E

*Preparation of Nursery***:** River sand was bought from vendor at Choba River bank. It was then transported to the research site. 2 kg weight of sand was then measured into clean Nursery bags. The bags were then arranged in a completely randomized block design with 3 replicates per accession.

*Minisett preparation***:** whole Bulbils of *Dioscorea bulbifera* was measured on an electronic weighing balance. They were then chopped into 50g weight and put in the treatment medium

Whole tuber: whole tubers weighing between 100 and 150 g was selected and planted in the nursery bags

Measurement of growth: measurement of plant height was done on three (3) plants from each accession and then the average

taken.

Plant height: plant height was measured using meter rule. The height from the surface of the ground to the tip of the plant apex was taken and written in centimeters.

Leaf Area: the Multiple Regression method by Zanetti *et al*., (2017) was used to calculate the leaf area with the formula:

LA= - $69.9346 + 15.0106L + 0.18893k - 0.0264323H$ *equation* 2

Where J= (Lobe length x number of lobes), K==(Lobe length x lobes width), H= (Lobe length x lobes with x number of lobes.

Number of Leaves was Counted using Hands.

Data for shoot dry weight, tuber weight, root weight and bulbil weight was measured using electronic weighing balance.

Data analysis: the data from this research was analyzed using IBM SPSS version 23.

RESULTS AND DISCUSSIONS

Figure 1: Vine length of both control (whole bulbils) and minisetts were not significantly different from one another. Accession TDb3070 minisett had the highest vine length 156cm at week 6, while its whole tuber had a mean vine length of138cm.

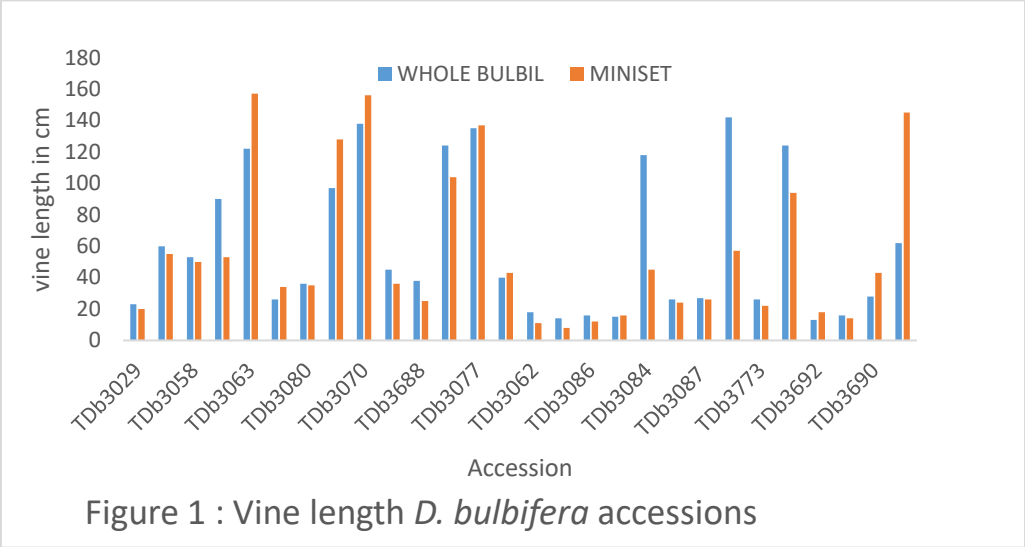


Figure 1 : Vine length *D. bulbifera* accessions

Figure 2: Number of leaves of *D. bulbifera* accession. Control plants (whole bulbils) had more leaves than the minisett treatment. Accession TDb3077 whole bulbil treatment had the highest number of leaves at 6 weeks after planting.

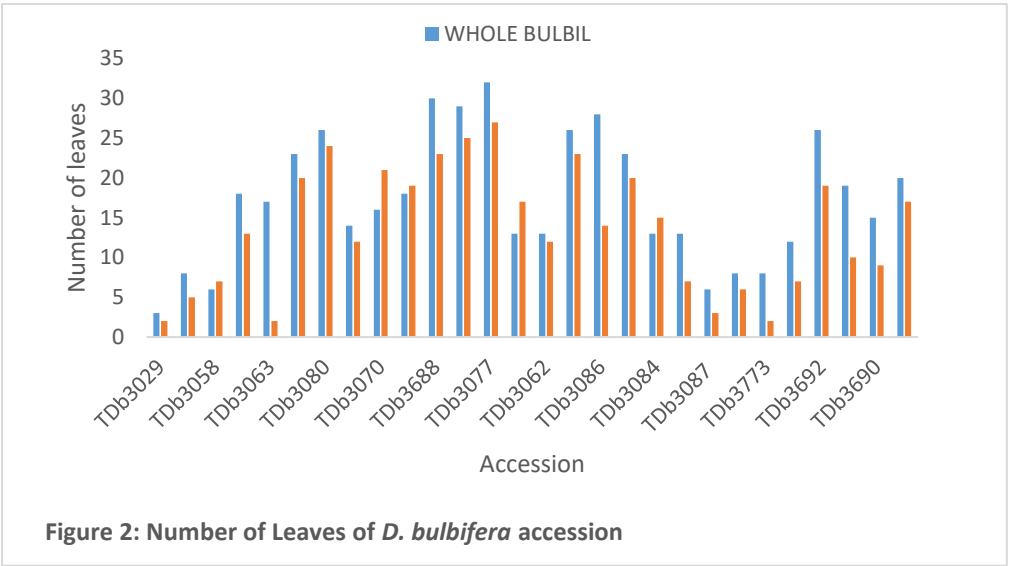


Figure 2: Number of Leaves of *D. bulbifera* accession

Figure 3: Stem diameter of *D. bulbifera* accessions. Accession TDb3688 control had the highest stem diameter 7.89 mm while its minisett had a diameter of 7.44 mm. whereas accession TDb3029 minisett treatment had the smallest stem diameter 1.32 mm and its control 1.48 mm.

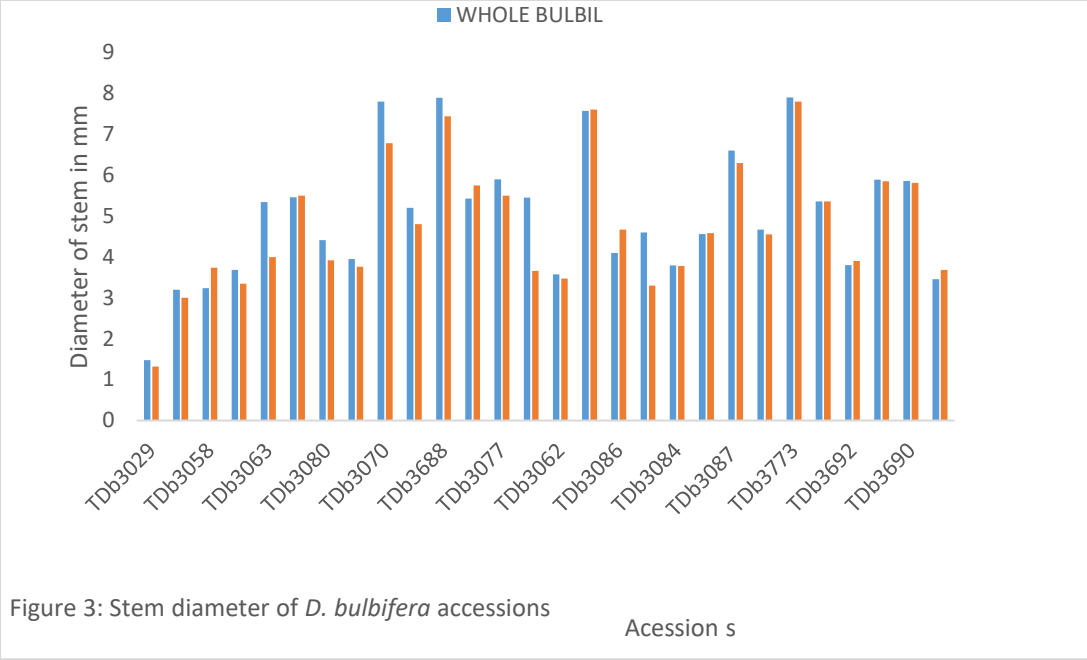


Figure 4: shoot dried weight of whole bulbil grown plants is higher than that of minisett grown plants. Accession TDb3049 grown from whole bulbil had the highest shoot weight 87g, while accession TDb3029 grown from minisett had the lowest shoot dried weight.

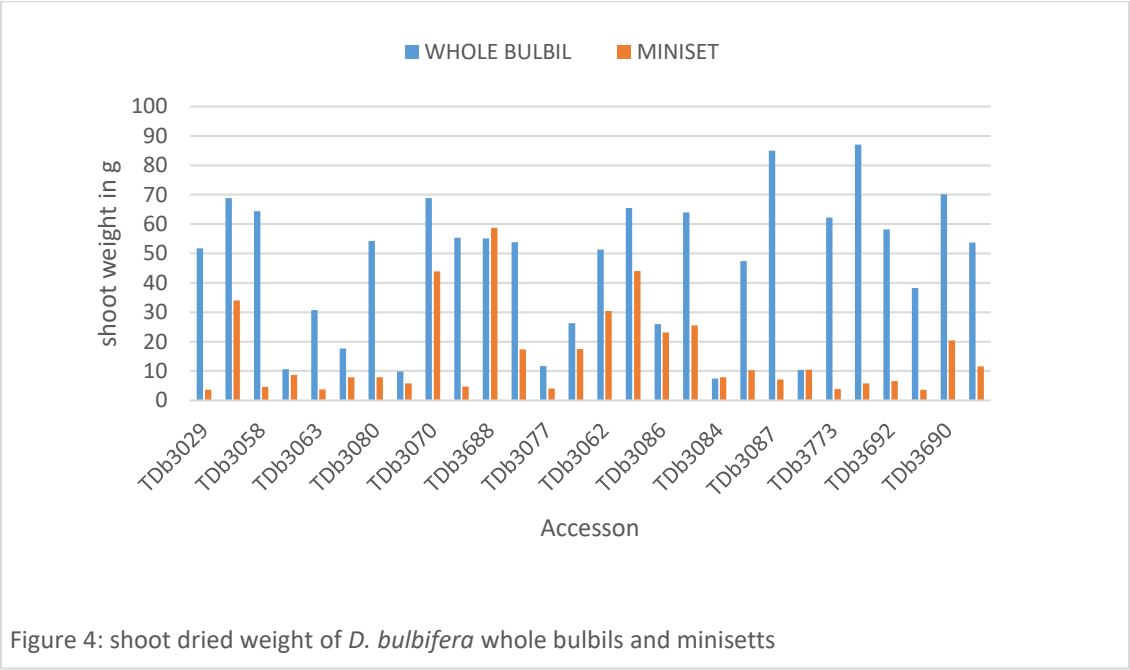


Figure 5: Root dried weight of whole bulbil grown plants is higher than that of minisett grown plants. Accession TDb3691 grown from whole bulbil had the highest root dried weight 168.08g, while accession TDb3082 grown from minisett had the lowest root dried weight of 1.0g.

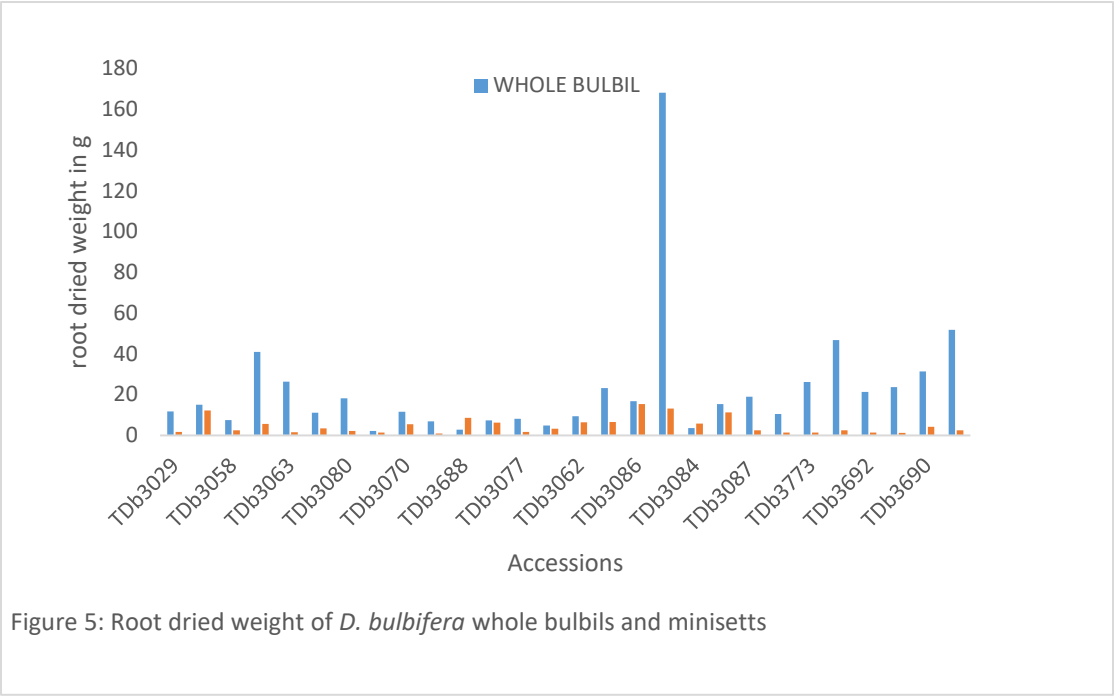


Figure 5: Root dried weight of *D. bulbifera* whole bulbils and minisetts

Figure 6: Tuber fresh weight of whole bulbil grown plants is higher than that of minisett grown plants. Accession TDb3086 grown from whole bulbil had the highest tuber fresh weight 156g, while accession TDb3769 grown from minisett had the lowest tuber fresh weight 1.37g.

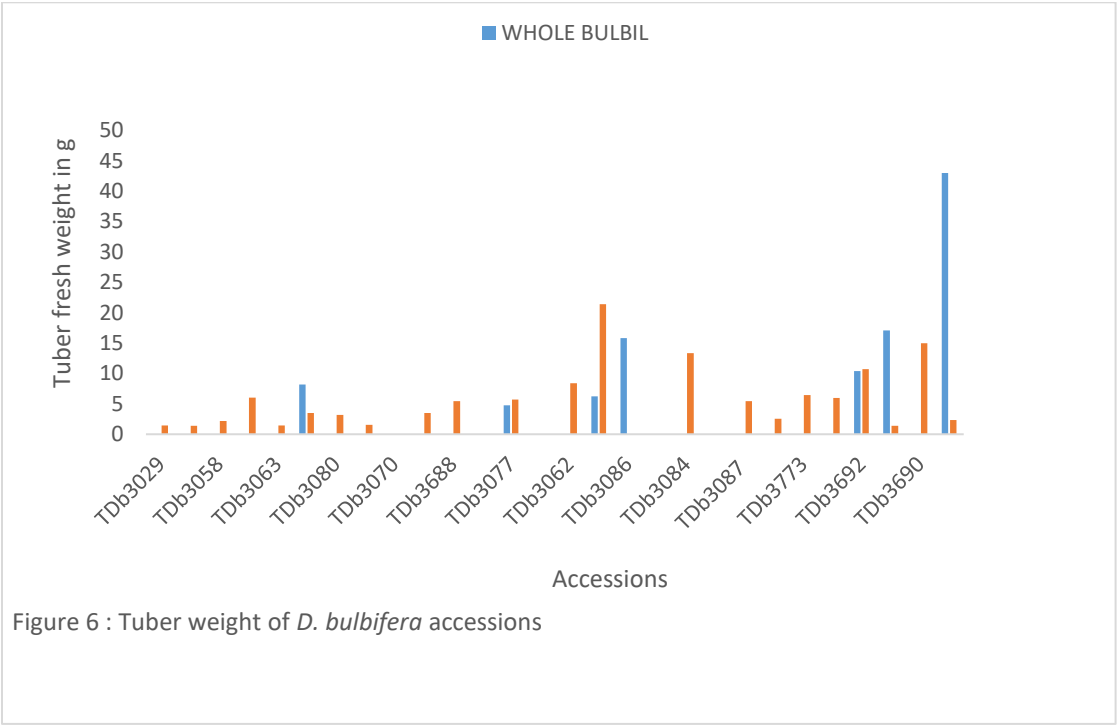


Figure 6 : Tuber weight of *D. bulbifera* accessions

Figure 7: Bulbil weight of whole bulbil grown plants is higher than that of minisett grown plants. Accession TDb3086 grown from whole bulbil had the highest shoot weight 218.71g, while accession TDb3029 grown from minisett had the lowest shoot dried weight 5.03g.

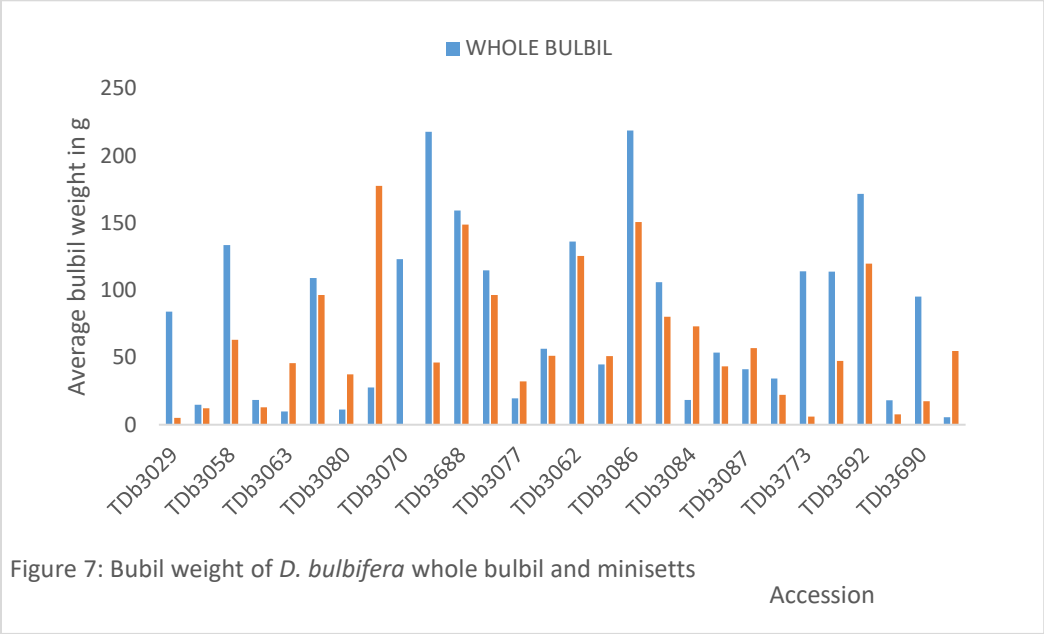
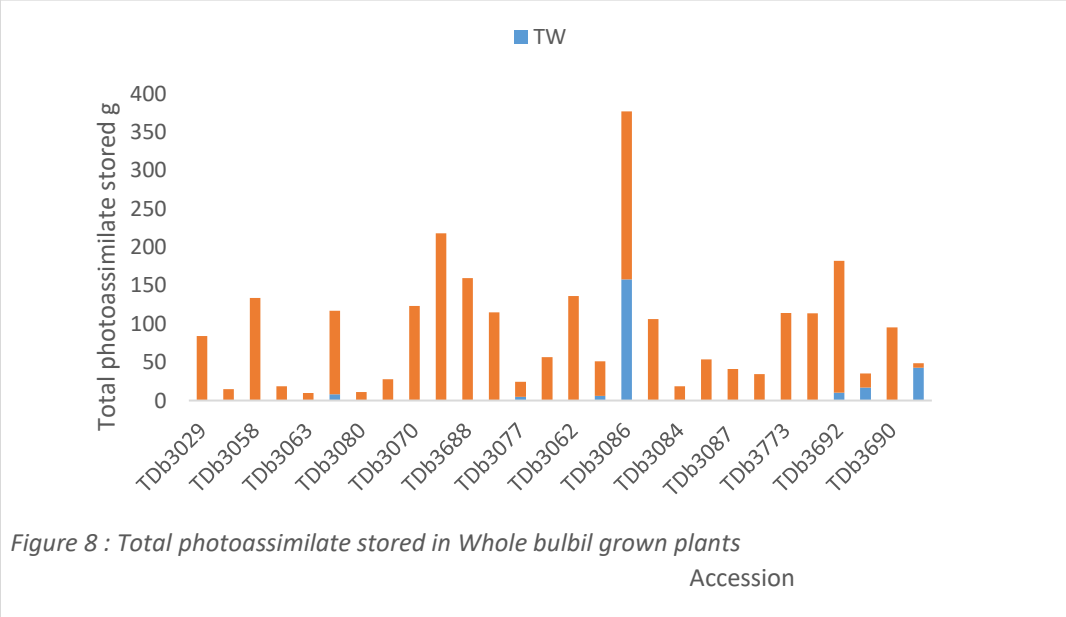
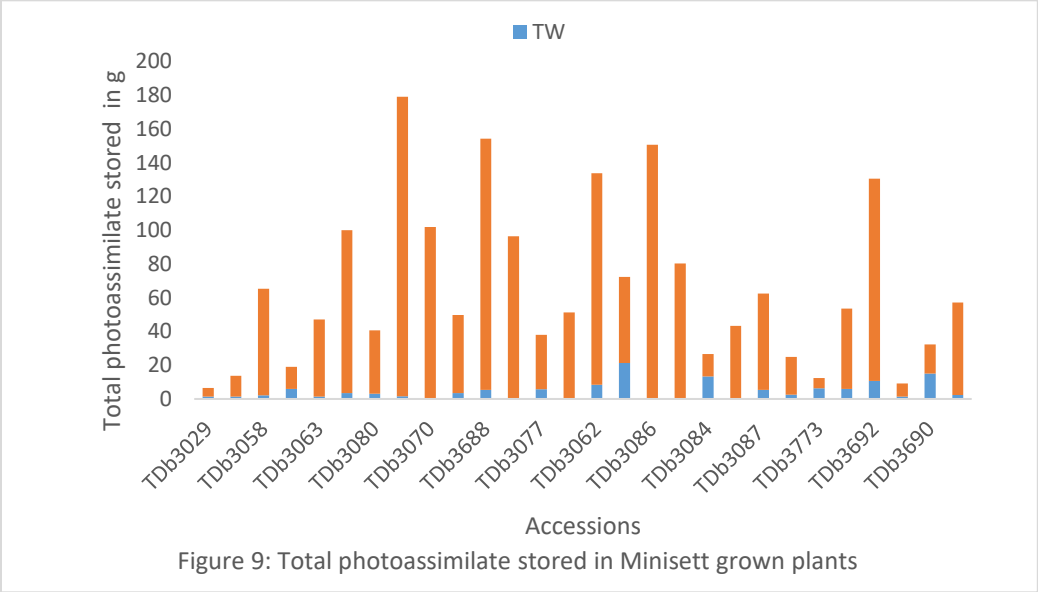


Figure 8: Total weight of photo-assimilate store in whole bulbil grown plants. Accession TDb3086 had the highest photo-assimilate stored 376.71 g, while accession TDb3063 had the lowest amount of photo-assimilate stored.



Where TW= Tuber weight, BW= Bulbil weight.

Figure 9: Total weight of photo-assimilate store in minisett bulbil grown plants. Accession TDb3048 had the highest photo-assimilate stored 177.63 g, while accession TDb3063 had the lowest amount of photo-assimilate stored 5.03 g.



Where TW= Tuber weight, BW= Bulbil weight.

There was no significant difference between control treatment and minisett treatment in number of leaves, vine length and stem diameter. According to Beatrice *et al*., 2020 wide variation in the weight of minisetts used as planting material contributes slightly to a difference in plant height, number of leaves and number of vines. They observed 90 g minisetts was only slightly better than 30 g in growth and other agronomic traits. Minisetts only showed slight variations. It is observed that in *Dioscorea* newly sprouted plant depend on the food reserve for growth and only begin the process of producing their own food, when the food reserve is exhausted. Ware tubers mainly exhibit a more vigorous sprout and emergence than minisetts (Law- Ogbomo and Remison 2009).

Miniset treatment produced more tubers than whole tuber treatment. Bulbil formation in *Dioscorea alata* in plants waterlogging treatment was observed to be at the rate of 1.7 in Ctrl and 10.8 in WL ($p < 0.001$) between 2 and 3 weeks after treatment. Waterlogged (WL) plants, produced significantly more bulbils than control from 7 DAT to 42 DAT than in Ctrl ($p < 0.001$). Norimitsu *et al*., 2023 observed that when 13C was fed to *D. alata* plant in waterlogged soil. Photo-assimilate was reported to bes transferred more to the bulbils than to the tuber in waterlogged plants than in control between 30 DAT and 50 DAT. This indicate stress might be responsible for the development of a new sink. On the other hand meristematic tissues at the base of the vine must have been triggered by wound signal to proliferate and act as the sink.

Conclusion: Wound stress in the form of minisetting can induce tuber formation in *D. bulbifera*, but the use of whole bulbils yields more than growing *D. bulbifera* from minisetts.

RECOMMENDATION

Minisetting should be used to cultivate *D. bulbifera* as it will help to reduce the number of ware bulbils used in growing the plant and promotes the production of more tubers.

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