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Survival and Growth Response of Regular and Epicormic Shoots of Top Grafted Shea (*Vitellaria paradoxa*) Saplings

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ABSTRACT

Regular shoots arise from active bud-producing tissues, whereas, epicormic shoots develop from dormant buds. In this study, the survival and growth response of regular and epicormic shoots to top grafting of shea (*Vitellaria paradoxa*) saplings were investigated. The two treatments (regular and epicormic shoots) were arranged in a complete randomized design with 150 replications. Three hundred shea saplings were therefore randomly selected as rootstocks while one hundred and fifty each of regular and epicormic shoots obtained from branches of mature shea trees used as scions were top grafted onto the saplings. The data collected were subjected to t-test using Genstat Statistical Package (version 12.1) and treatment means compared at $p<0.05$. The study revealed that regular shoots had higher survival (65 %) compared with epicormic shoots (30 %) in top grafting of shea saplings. However, epicormic shoots gave significantly higher scion girth (4.76 cm) than regular shoots (3.89 cm) at 16 weeks after top grafting (WATG). There were no significant differences between the treatments in terms of growth extension of scion, number of leaves and shoot height at 16 WATG. The results suggest the use of regular shoots in top grafting of shea saplings to achieve higher survival of propagules.

Keywords: Survival, growth response, top grafting, regular shoots, epicormic shoots.

INTRODUCTION

Shea is an indigenous fruit tree of the Sudano-Sahelian zone of Africa (Yeboah *et al*. (2020). It belongs to the family sapotaceae. Shea nuts are considered major commodity particularly in northern Ghana where most of the rural poor women depend on for their livelihood. The thick pulp covering the fruit is eaten as a delicious meal. Medicinally, the bark is used in various mixtures for the treatment of stomach aches, chest pains and body swellings (Bennette-Lartey and Asare, 2000; Yidana, 1994). Shea nut contain fat commonly called shea butter which has characteristic similar to that of cocoa butter and is used locally as cooking oil (Adomako, 1974). Other uses of shea butter include making chocolates, treating skin inflammation, stretch marks and restores skin elasticity. In Ghana, shea populations are mainly found in the interior savannah zone, although small populations are found in the Bono, Ahafo, Ashanti, Eastern and Volta Region (Abbiw, 1990).

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Despite the socio-economic benefits of shea trees, they are in the wild and domestication is still a daunting challenge mainly because of the absence of a reliable propagation technique (Amissah *et al*., 2013). Propagation by seed is the current method used, however, the seed is said to be recalcitrant thereby losing viability quickly after harvest (Amissah *et al*., 2013). Besides, shea trees respond unfavourably to known vegetative techniques like stem cuttings and air layering (Yidana, 2004; Yidana, 1994; Opoku-Ameyaw *et al*., 2002). *Vitellaria paradoxa* has a long gestation period of 16 – 20 years. Even after the long gestation period, the mature tree stands exhibit some irregular pattern of fruiting with some producing poor-quality fruits (Aleza *et al*., 2018). Grafting has been identified as one of the vegetative methods with potential for reducing the gestation period of shea tree from at least 16 years to less than 7 years (Sanou *et al*., 2004). It is not clear whether regular or epicormic shoots would respond better to top grafting. There was therefore the need to investigate which of the two shoots (regular and epicormic) would be more appropriately used as top graft. The objective of the research was to assess the survival and growth response of regular and epicormic shoots to top grafting.

MATERIALS AND METHODS

The experiment was conducted at Zoolanyili, a farming community north-west of University for Development Studies, Nyankpala in the Tolon District of Ghana. The area is within the Guinea Savannah agro-ecological zone and lies within latitude 9^{o} 25$^{'}$ N and longitude 0^{o} 58$^{'}$ W and at altitude 183 m above sea level. The study area has a unimodal rainfall of 1060 mm distributed fairly from April to late November within a uniform mean temperature of 22 ^{o}C during the rainy season and maximum of 30 ^{o}C during the dry season (Savannah Agricultural Research Institute, 2005).

Three hundred (300) shea saplings were randomly selected as rootstocks and were prepared by removing the leaves on it, severing 2 cm of the top part and making a vertical cut of 2 cm in the middle of the rootstocks. Similarly, one hundred and fifty (150) each of regular and epicormic shoots obtained from branches of mature shea trees were used as scions. Scions measuring 20 cm long were also prepared by removing the leaves, making slice cut (V-cut) of 1.5 cm and 2 cm deep and wide respectively, inserted onto the rootstocks and wrapped firmly using grafting tape.

The data were collected on survival rate at four weeks after top grafting. Scion girth, growth extension of scion, number of leaves and shoot height were measured at 4, 8, 12 and 16 WATG. The data collected were subjected to t-test using Genstat Statistical Package (version 12.1) and results presented in figure and tables.

RESULTS

Survival

The results indicated that regular shoots that were top grafted onto the rootstocks had higher survival (65 %) compared with epicormic shoots (30 %; Figure 1).

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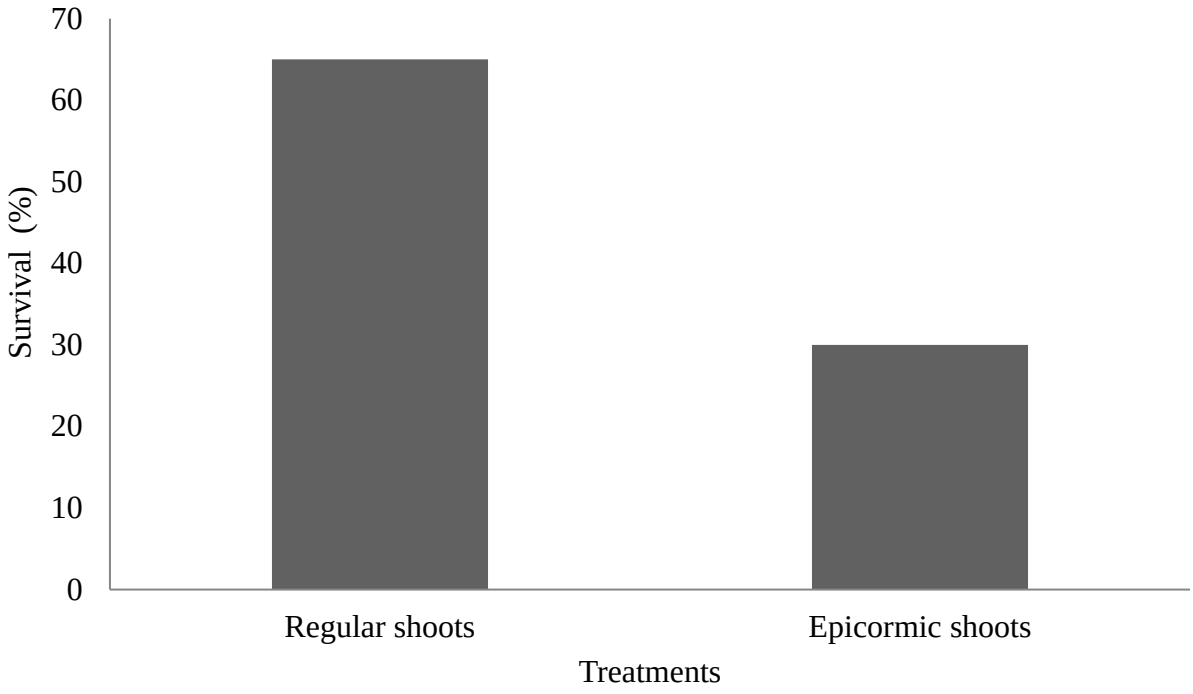

Figure 1: Effect of regular and epicormic shoots on survival of shea saplings at four weeks after top grafting (WATG).

Scion girth

Results showed significant differences (t-pr = 0.0073, 0.0123, 0.0126 and 0.0001) in scion girth between the treatments at 4, 8, 12 and 16 WATG respectively. Generally, epicormic shoots performed better in all the measured weeks after top grafting compared with regular shoots (Table 1).

Table 1: Effect of regular and epicormic shoots on scion girth at 4, 8, 12 and 16 WATG.

Treatment	**N**	**WATG**			
		4	8	12	16
Regular shoots	150	3.03	3.27	3.60	3.89
Epicormic shoots	150	3.62	3.83	4.12	4.76
Calculated-t		2.70	2.52	2.51	3.91
t- pr.		0.0073	0.0123	0.0126	0.0001

Growth extension of scion

Rootstocks grafted with regular and epicormic shoots did not differ significantly ($p>0.05$) with respect to growth extension in all the measured weeks after top grafting (Table 2).

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Table 2: Effect of regular and epicormic shoots on growth extension of scion at 4, 8, 12 and 16 WATG.

Treatment	**N**	**WATG**			
		4	8	12	16
Regular shoots	150	12.69	13.42	14.00	14.83
Epicormic shoots	150	11.55	13.18	13.97	14.56
Calculated-t		1.69	0.29	0.03	0.28
t. pr.		0.0920	0.7720	0.9761	0.7797

Number of leaves

Results showed that there were no significant differences ($p>0.05$) in number of leaves between the treatments in all the measured weeks after top grafting (Table 3).

Table 3: Effect of regular and epicormic shoots on number of leaves at 4, 8, 12 and 16 WATG.

Treatment	**N**	**WATG**			
		4	8	12	16
Regular shoots	150	9.80	17.10	21.30	15.20
Epicormic shoots	150	9.10	17.70	23.80	14.30
Calculated-t		0.58	0.33	0.26	0.35
t. pr.		0.5624	0.7416	0.7950	0.72

Shoot height

The treatments showed no significant differences ($p> 0.05$) in shoot height at 4, 8, 12 and 16 WATG (Table 4).

Table 4: Effect of regular and epicormic shoots on shoot height at 4, 8, 12 and 16 WATG.

Treatment	**N**	**WATG**			
		4	8	12	16
Regular shoots	150	51.00	51.70	53.00	55.50
Epicormic shoots	150	55.20	58.20	60.60	63.60
Calculated-t		0.03	1.04	1.21	1.34
t. pr.		0.9761	0.2992	0.2272	0.1813

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DISCUSSION

The results indicated that top grafted regular shoots did better than those of top grafted epicormic shoots in terms of survival (Figure 1). This could probably be due to the fact that regular shoots were less sensitive to the environmental trepidations and stress resulting in rapid healing of the graft union than the epicormic shoots which are much more sensitive to stress and perturbation of the surrounding environment (Burrows, 2008). The high survival rate of regular shoots could also be attributed to better utilization of nutrients compared to epicormic shoots (Meier *et al*., 2012).

In terms of scion girth, top grafted epicormic shoots had higher girth mean values compared with the top grafted regular shoots although there were no significant differences between the treatments (Table 1). Perhaps, the plants treated with epicormic shoots channelled their assimilates into the development and enlargement of the girth.

Plants did not differ significantly in growth extension of scion as depicted in table 2. We found out that both regular and epicormic shoots are equally good when it comes to growth extension of scion. This is perhaps because the scions were obtained from different mature shea trees.

Leaf number did not show any significant differences in all the measured weeks after top grafting (Table 3). Therefore, both regular and epicormic shoots are good in terms of number of leaves. We observed that top grafted regular shoots and top grafted epicormic shoots were severely affected by the prevailing windstorms during the experiment.

Epicormic shoots produced plants with higher shoot height mean values than regular shoots although there were no significant differences at 16 WATG. However, both regular and epicormic are good when it has to do with shoot height.

CONCLUSION

The study revealed that regular shoots did better particularly in survival rate. Epicormic shoots on the other hand, performed well in parameter such as scion girth. The study therefore suggests the use of regular shoots as an option to achieving higher survival in shea propagules.

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