THE INFLUENCE OF BASAL PLATE ATTACHED TO A PROPAGULE ON FLOWERING AND YIELD OF TUBEROSE (*Polianthes tuberosa* L.)

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ABSTRACT

The propagule for commercial cut tuberose production is critical for earlier flowering and yield of plants. Variation in the number of flowering shoots per plant and low yields as a result of diversity of propagules the plants are raised from is experienced in commercial production.

This experiment examined how the size of pre-existing basal plate attachment to a propagule influences flowering and yield of plants. Basal plate material was excised from propagules in the proportions of 0, 1/3 and 2/3 by cutting perpendicularly through the sides. The propagules were disinfected in a fungicidal solution and planted in greenhouse pots. There were significant differences in flowering time, number of flowers produced and spike length among plants with differing proportions of basal plate attached to the propagules. Propagules that had whole basal plate attached resulted in earlier flowering and higher yield of stems per plant. The dry matter in floral stems was significantly increased with the size of the basal plate. When no basal plate was removed, 50% of dry matter was recovered in flower stems, compared to 30% when 2/3 of basal plate was removed. Daughter bulb weight gain was also significantly higher with high proportion of basal plate retention, showing that basal plate presence results in higher yields and quality of tuberose cut flowers.

Keywords: *Basal plate, propagule, flowering, yield.*

1.0 INTRODUCTION

Variation in the number of flowering shoots per plant and low yields as a result of diversity of propagule (propagative material) the plants are raised from (Anon 2001) is experienced in commercial production of tuberose. Propagules growers commonly use a unit clump consisting of 5 – 10 lateral buds and averaging approximately 3.5 cm in circumference. Separation of a single unit clump at planting represents problems in itself. Therefore, ensuring uniformity at flowering of the plants in the grower farms become rare with resultant low yields. In modern cut flower enterprises, improving efficiency at all stages of production is imperative for one to remain competitive in the industry. This is proving elusive to most local tuberose growers and there is an urgent need to address the problem of variability of plants at flowering and poor yields. Shillo (1992) reported that the percentage flowering could be greatly improved by growing clumps instead of individual bulbs. However, it would be preferable to explore the feasibility of individual bulb planting for production efficiency in tuberose. Individual bulb planting may ensure high densities at planting and could also lend itself to mechanisation if exploited for improved efficiency, and to reduce costs in tuberose production.

The results reported here therefore are experiments carried out to investigate how the size of pre-existing basal plate attachment to the propagule influences flowering and yield of tuberose. The propagules used were individual bulbs.

2.0 MATERIALS AND METHODS

About 800 propagules were harvested from the departmental nursery plot of Jomo Kenyatta University of Agriculture and Technology (JKUAT) on the 14th April 2004. The farm is on 1^0 5'S latitude, 37^0 10'E longitude and 1,520 m above sea level. To study the sink strength of the sprout in comparison to the source, parts of the bulb basal plate were removed just before planting basal plates were excised from the propagules in proportions of 0, 1/3 and 2/3, by cutting perpendicularly through the sides. By removing 1/3 or 2/3 units of basal plate, approximately 33% and 65% of the dry weight (DW) of basal plate were removed respectively. The propagules were disinfected in a mixture of Captan, 0.5%, and Carbendazim, 0.2% for 15 minutes to control soil fungal diseases, and planted in potting medium, 6 propagules per pot. The pot size measured 20.5 cm in diameter and 18.0 cm height. The plants were grown in a greenhouse with an average minimum night temperature of 19.4^{0}C and average maximum day temperature of 25.5^{0}C respectively. The cultivation was carried out in loamy red soil, into which rotted cattle manure and sand were incorporated in the ratio 2:1:1. The pots were randomly positioned in the greenhouse. There were four replicates and each consisted of five pots, giving a total of 120 plants per treatment. Twenty outer rows of plants formed a buffer zone.

Until the sprout emergence, the containers were watered by means of a watering can every other two days. After plant establishment, a basic nutrient solution consisting of 0.37g KNO_3 + 0.36g Ca (NO_3) + 0.06g $MgSO_4$ + 0.0013g (NH_4) SO4 per litre of water was applied at every four weeks interval. This formulation is recommended as balanced regime for pot culture of a wide range of ornamental crops (Roodbol *et al.*, 2002). In the rest of the cultivation period, Amitraz was used against spider mites and Dimethoate against thrips and scales.

2.1 Data Collection and Analysis

Information data collected on growth and yield included days to first flower, number of inflorescences harvested and spike length, percentage dry matter accumulation in grams for flower stem and daughter bulb, dry weights of stem and leaves and dry weight gain of mother and daughter bulb.

Statistical analysis was performed using GenStat (Roger *et al.*, 2001). Duncan's Multiple Range Test (DMRT) was used to test for significance of differences between mean values.

3.0 RESULTS

3.1 Vegetative Growth

There were significant differences in stem dry weight among treatments (Table 1). Similar observations were obtained with leaf dry weight. Dry weight gain in mother and daughter bulbs was significantly reduced in plants whose 2/3 of basal plates were removed, while no significant differences were detected in dry weight gain among plants having 1/3 or no removal of basal plates (Table 1). Dry weight gain for partial removal of basal plate was significantly reduced, compared to whole bulbs for both mother and daughter bulbs (Table 1).

Table 1: The effect of varying degrees of basal plate removal on the dry weight of tuberose at first harvest

Basal plate removed	*Dry weight (g)*		*Dry weight gain (g)*	
	Stem	*Leaf*	*Mother bulb*	*Daughter bulbs*
0^{w}	52.5 a ^{y}	1.3 a ^{z}	10.01 a	9.82 a
1/3	46.8 b	0.9 b	8.97 a b	8.31 a b
2/3	33.0 c	0.6 c	4.32 c	4.10 c

n = 20 plants.

y = Mean separation within columns by Duncan's multiple range test, 5% level.

z = Different letters per column indicate significant differences.

0^{w} = No basal plate exercised (whole bulb)

The amount of dry weight (DW) recovered in floral stems and daughter bulbs from planting to flowering is shown in Figure1. Basal plate removal significantly reduced the amount of DW in daughter bulbs compared to floral stems. The distribution of DW over the various organs was affected considerably. The daughter bulbs accounted for only a small part of the total DW, not exceeding 10% (Figure 1) at the time of flowering, depending on the size of basal plate. If 1/3 of basal plates were removed, about 30% of dry matter was recovered, particularly in the flower stem. In the case of whole basal plate retained, this percentage increased to approximately 50%.

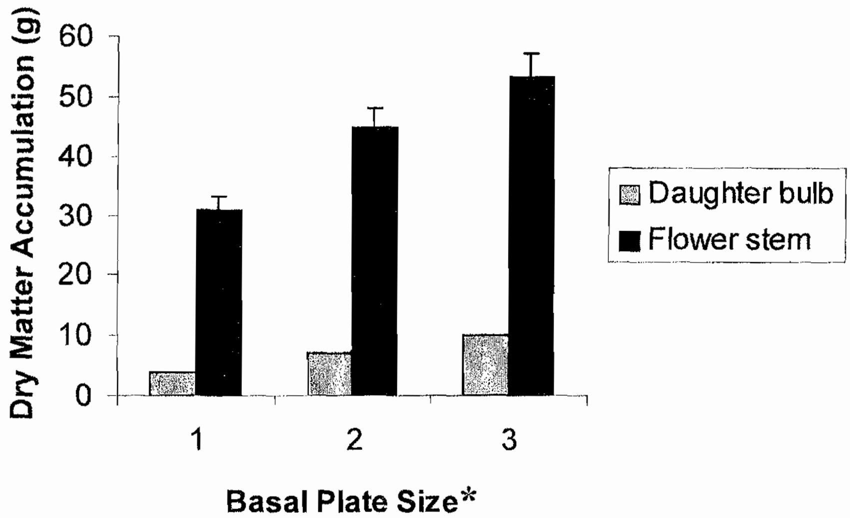

Figure 1: Distribution of DW over different organs at the time of first flowering as influenced by basal plate size. Vertical bars indicate S.E at P = 0.05. Each point is a mean of 20 plants

* = Basal plate size represents 1 = 2/3, 2 = 1/3 removal or 3 = no removal respectively

3.2 Flowering, Inflorescence Yield and Spike Length

The results of experiments clearly indicate that presence of basal plate markedly accelerated flowering (Table 2). Propagules with 2/3 of basal plates removed flowered after 108.3 days, compared to 100.3 days for whole basal plate (Table 2). There were significant differences in flowering time between plants with different proportions of basal plate. Also, the numbers of inflorescences were higher, 104.2 for whole basal plates, compared to 81.8 for 2/3 basal plate removal. This showed that there were significant differences in the number of inflorescences harvested among plants originating from propagules which had different proportions of basal plates. Thus, propagules that had whole basal plate resulted in faster flowering and higher yield per plant. There were also significant differences in spike length between the populations of plants with minimal or reduced amounts of basal plates (Table 2). The proportion of plants producing longer spikes increased (29.5 cm) with increase in the size of the retained basal plate. The results indicate that basal plate size is crucial to the propagule and has influence on the quality and thus marketability of the cut flowers of tuberose.

Table 2: The effect of basal plate removal on days to first flower, number of inflorescences harvested and spike length of tuberose

Basal plate removed	*Days to first flower*	*Number of inflorescences harvested*	*Spike length (cm)*
2/3	108.3 c^{y}	81.8 c	21.5 c
1/3	102.8 b	95.3 b	25.3 b
0^{w}	100.3 a	104.2 a^{z}	29.5 a

n = 20 plants.
y = Mean separation within columns by Duncan's multiple range test, 5% level.
z = Different letters per column indicate significant differences.
0^{w}= Whole bulb

4.0 DISCUSSION AND CONCLUSION

The presence or absence of basal plate on the propagule was found to be important in plant establishment, with the removal of basal plate producing a significant difference in quality parameters. It is suggested that the basal plate and damage sustained by the propagule during splitting prior to planting are more important for the successful establishment of tuberose plants. The removal of the basal plate from the propagule confirmed the importance of the whole basal plate system to the propagule as far as vegetative growth and flowering is concerned. After planting the propagule, roots arise from the basal plate. When about 1/3 or 2/3 of the basal plate is excised from the propagule, new root formation is interfered with. The major concern at this stage appears to be that new root production, at least initially, lags considerably behind the production of aerial shoots. Consequently, uptake of water and nutrients into the new re-growths does not match the requirements for the growth of aerial shoots already formed, thus fewer number of inflorescences harvested and with shorter spikes.

Depending on basal plate size used, dry matter is lost during growth due to respiration, resulting in a slightly higher loss of dry weight (DW). Ho and Rees (1976), and Franssen and Voskens (1997) reported a high rate of respiratory loss in tulips during this period due to scale removal. Wounding due to basal plate tissue removal not only leads to increased respiration, but may also cause evolution of ethylene. However, removal of basal plate, just like the removal of developing lateral bulbs (Brundell and Steenstra, 1985), unequivocally leads to damage and probably also affects sink strength. Apparently, the stress due to cutting of basal plate also affected sink strength of daughter bulbs indirectly, as the percentage DW transported into the daughter bulbs was always lower in bulbs of which basal plates were removed than in uncut bulbs (Figure 1). The sink strength of the floral sprouts exceeded the sink strength of the daughter bulbs till the time of flowering. Ohyama *et al.* (1988), studying the behaviour of carbohydrates in the daughter bulbs of tulips in culture solution, also described an increase in carbohydrates content in the daughter bulbs only after flower removal, a phenomenon also observed by (Le Nard and De Hertogh, 1993).

A certain minimal amount of dry matter in the main bulb is necessary to produce a good quality flower, as shown by significant differences in spike length with various proportions of basal plate. Some comparisons can be made, however, between basal plate removal and different sizes of planting material. The reduced basal plate is analogous to small sized planting material, in which even smaller bulbs eventually flowered, a phenomenon also observed by Sharga (1982).

The present results confirmed that the basal plate are important storage organs for development of tuberose plants, since a certain minimal amount of dry matter in the mother bulb was necessary to produce a good quality flower. The plant can grow and survive when the propagule bears only condensed leaf bases and minimal basal plate. In conclusion, however, the basal plate plays an important role in the growth and flowering of the tuberose plant. The results showed that more basal plate per propagule result in a higher yield of inflorescences and longer spike length.

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