UTILITY OF GRAFTING IN TREE DOMESTICATION PROGRAMME WITH SPECIAL REFERENCE TO *ALLANBLACKIA PARVIFLORA* A. CHEV.

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ABSTRACT

Agricultural biodiversity and provision of alternate livelihoods for farmers have become critical issues for sustainable management of biological resources as well as poverty reduction in rural areas. This is being done through cultivation of a wide range of food crops, vegetables, fruits and medicinal plants. One of such fruit trees being encouraged in agroforestry systems is Allanblackia spp., hence the need for sustainable supply of improved early fruiting planting stock. Grafting was adopted for production of early fruiting high yielding planting stock to satisfy farmers needs. Two methods of grafting tried were side veneer grafting and cleft grafting. The mean grafting success for side veneer grafting (50.21%) was significantly lower than that of cleft grafting (79.8%). Clonal differences in grafting success were quite substantial ranging from 70 to 87.5% for cleft grafting and 42.8 to 57.8% for side veneer grafting. Grafts flowered within 12 months after grafting even though the flowers could not develop into fruits. This suggests that grafting could be a tool for mass propagation of desirable genotypes of A. parviflora with reduced gestation period.

***Keywords*: Fruit tree, agroforestry, domestication, vegetative propagation, clone**

INTRODUCTION

Biodiversity plays a central role in household food security and income generation and hence has a positive impact on human livelihoods (poverty alleviation, nutrition, health, employment, and environmental rehabilitation). However, much of the world's biodiversity especially in the tropics is being irreversibly lost through extinction caused by the destruction of natural habitats (Wilson, 1988). In Ghana for instance, deforestation has claimed an enormous toll on the environment, economic deterioration and human welfare. For various reasons such as logging and clearing for cash crop cultivation, the rainforest in Ghana has dwindled from 8.2 million ha to 1.62 million ha over the past 100 years with a deforestation rate of 0.77 to 1.4% per annum. Currently only about 20% of the original forest remains (MES, 2002), with these forest fragments mostly surrounded by subsistence and commercial agricultural lands, most of which are devoid of trees. These warrant an integrated approach for balancing conservation needs with livelihoods and development priorities.

There is therefore, the need to diversify farmer's livelihood options through the development of sustainable poverty reduction and forest management strategies.

In order to stabilize fragile small-holder farming systems, incorporation of biodiversity and environmental conservation practices should be considered within/around the remnant forest fragments. Incorporation of agroforestry tree products (AFTPs) in farming systems as an alternative livelihood as well as contributing to landscape connectivity and environmental conservation is becoming a hot issue of late. For maximum benefit of increased tree diversity on farm lands for sustained productivity, there is a need to update the list of priority species and develop methods for propagation of desirable genotypes as well as methods for their integration into farming systems (Atangana *et al.*, 2006, Tchoundjeu *et al.*, 2006). In doing so attention should be paid to high valued AFTPs (wild fruit trees, medicinal plants etc) that provide benefits to small holder farmers (Simons and Leakey, 2004, Tchoundjeu *et al.*, 2006). This is in accordance with the participatory domestication of high-valued fruit trees, nuts and medicinal plants adopted by World Agroforestry Centre (ICRAF) that has been on-going in West and Central Africa since 1998 (Tchoundjeu *et al.*, 1998, 2006)

Allanblackia parviflora, an indigenous fruit tree species is being accepted by farmers for use in agroforestry systems with both environmental and economic benefits. It is a medium sized tree reaching about 40 m high with narrow crown thereby casting minimum shade on the companion crops. It has other uses such as timber and medicinal purposes (Ofori *et al.* 2006; Abbiw, 1990). Several wildlife species such as Brush-tailed porcupine, Squirrel and Giant rat also depend on it for their survival (Siaw *et al.*, 2003). The seed oil is of prime importance as a foreign exchange earner and is being developed as a rural based enterprise in many African countries notably Ghana, Nigeria, Cameroon and Tanzania (Shrestha and Akangaamkum, 2008). Currently Unilever requires 2000 tons of *Allanblackia* seeds from Ghana but only 100 tons (only 5%) are supplied annually on average (Oppong, 2008). Up-scaling of the supply of *Allanblackia* seeds might result in the species becoming another 'Golden tree' for Africa in the near future.

The Need for Grafting *Allanblackia* in the Domestication Process

Extensive research studies have been conducted by the Forestry Research Institute of Ghana in collaboration with the World Agroforestry Centre on methods of domestication as well as provision of improved genotypes for multiplication (Ofori *et al.* 2008a). This was achieved through collection of *Allablackia parviflora* fruits throughout the distribution zone in Ghana. The fruits and seeds were characterized and 58 trees were selected on the basis of high yielding (Peprah *et al.*, 2008) and were therefore recommended for mass propagation. Workshops on domestication of *Allanblackia* have been organized by World Agroforestry Centre (WAC) (WAC, 2006), Forestry Research Institute of Ghana (FORIG) and WAC (Ofori *et al.*, 2008b) and Novel Development Nigeria (Ofori, 2008). Some of the most critical questions emerging on domestication of *Allanblackia* are:

- How can *Allanblackia* be propagated?
- How do farmers obtain improved planting stocks?
- How long does *Allanblackia* take to flower and fruit?

Four-year old seedlings being monitored at FORIG have not shown any signs of flowering and it is anticipated that seedling-grown *Allanblackia* may not flower until 10 years. Secondly, the species is dioecious and seedlings

will grow to be either male or female. In order to avoid these problems, vegetative propagation has been adopted to mass produce the desired genotypes (right proportion of elite females and males) as well as capturing quicker genetic gains. Grafting was adopted since most agricultural fruits grafted have been found to flower earlier than seedlings. The question raised with this approach was whether the phenomenon of maintenance of ontogenetic age (maintenance of the reproductive maturity) will occur in scions of *Allanblackia* after grafting and if yes, to what extent will grafting reduce the gestation period?

MATERIALS AND METHODS

Scions were collected from the branches of 15 mature trees (fruit bearing trees located at Afosu, Kwame Nkrumah University of science and Technology - Kumasi and New Edubiase) and then grafted onto one to two years old seedlings of *A. parviflora* in a greenhouse at FORIG, Kumasi, Ghana. Grafting methods used were cleft grafting and side veneer grafting. For each tree 60 grafts were made; 30 grafts each for side veneer grafting and cleft grafting methods. The scions were enclosed in clear polythene bags for the first week after grafting to prevent them from excessive loss of water. The grafts were inspected weekly and final assessment was made at week four at which time grafts were clearly labeled as successful or unsuccessful. The grafting success (Gs) was expressed in percentages as Gs = [(n/y) 100], where n is the number of successful grafts and y is the number of grafts made. The data were analysed to find the differences between the two grafting methods using T-test with each clone as one experimental unit.

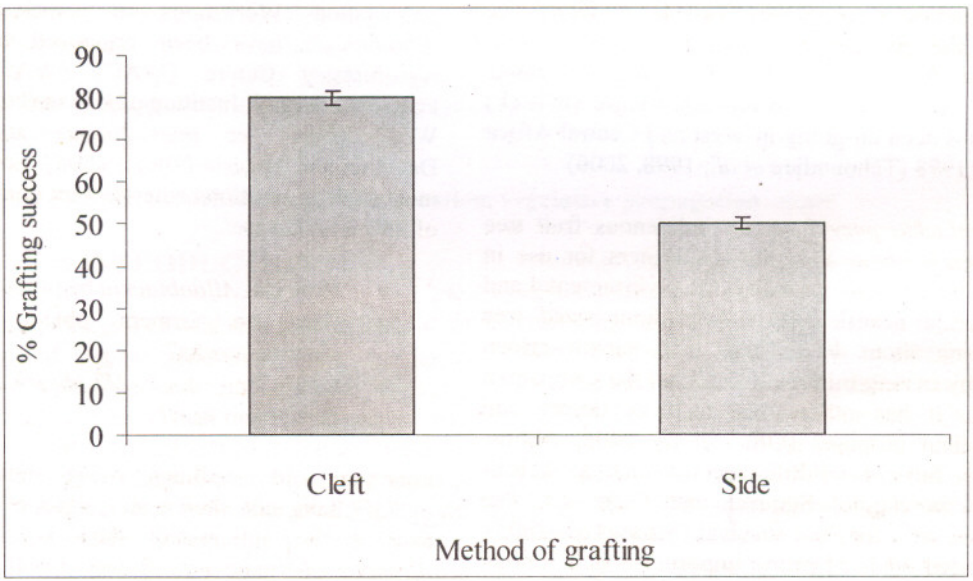

Figure 1: Effect of different grafting methods on grafting success of *Allanblackia parviflora*

RESULTS AND DISCUSSION

There was a significant difference (P = 0.00) in the success rate of the two grafting methods. The grafting success obtained for the cleft grafting was higher than that of side veneer grafting (Figure 1). Clonal differences in grafting success were quite substantial. Grafting success for cleft grafting ranged from 70 to 87.5% (Figure 2) while that of side veneer grafting ranged from 42.8 to 57.8% (Figure 3). The cleft grafting method was then used for mass propagation of the 58 recommended plus trees at two Rural Resource Centres. At 12 months after grafting, five grafts from three different clones started flowering at the Rural Resource Centre at Apeasuman (Plate 1). The flowers aborted after 3 weeks. The abortion of the flowers was not surprising since the plants were too small to support the development of fruits. This phenomenon has also been observed in 2-year old grafts of *Allanblackia floribunda* in Cameroon (Asaah *et al.*, 2008).

Even though none of the flowers developed into fruits, the observation was very exciting since it was an indication of maintenance of reproductive maturity in the scions collected from reproductive matured trees. Farmers should therefore expect that planting *A. parviflora* grafts could drastically reduce the gestation period. Even though grafting is labour intensive compared to cuttings, grafting success has generally been higher than cuttings (Ofori *et al.*, 2008c, Atangana *et al.*, 2006). This coupled with the probable reduction of the gestation period gives grafting a great potential in the domestication process of indigenous fruit trees. Planting grafts in mother blocks as sources of genetic materials for multiplication could also be advantageous in the elimination of frequent trips to the forest for collection of materials for propagation. This is because grafting maintains ontogenetic age thereby reducing the gestation period and hence less cost of operation.

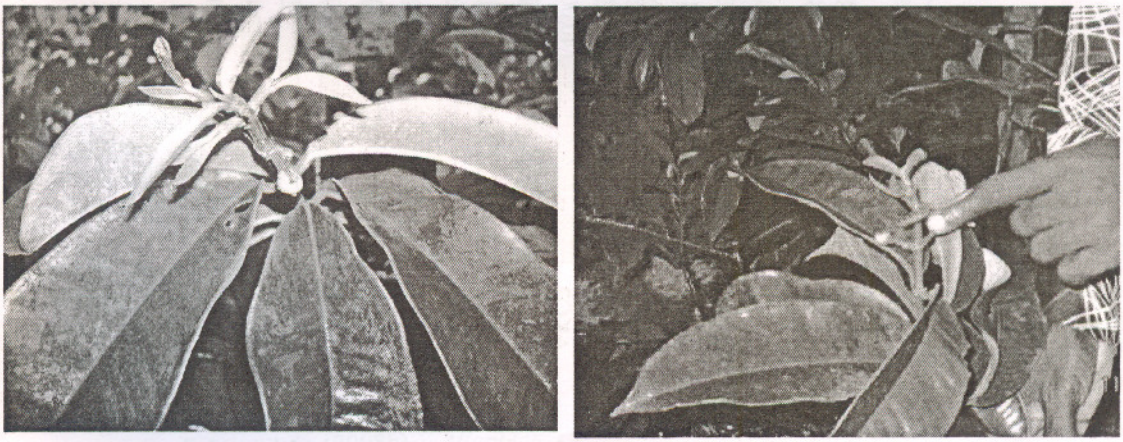

Plate 1: *Allanblackia parviflora* grafts that flowered one year after grafting

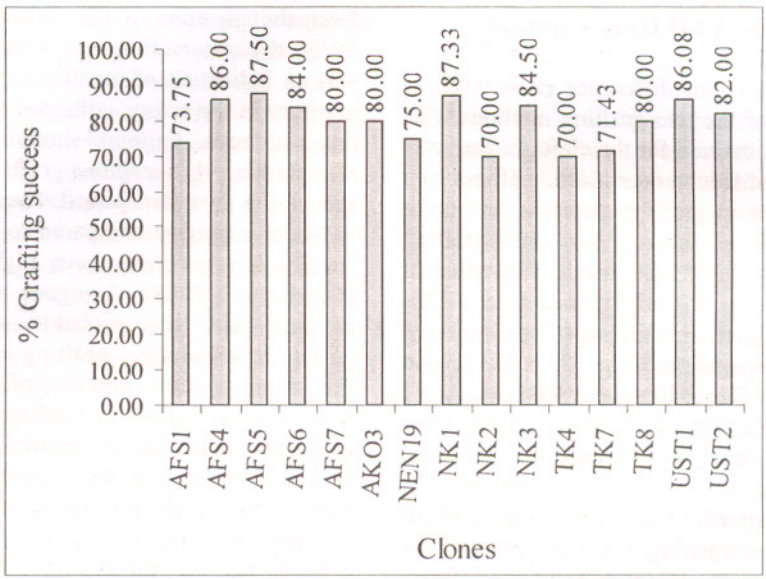

Figure 2: Clonal differences in grafting succes of *Allanblackia parviflora* using cleft grafting method

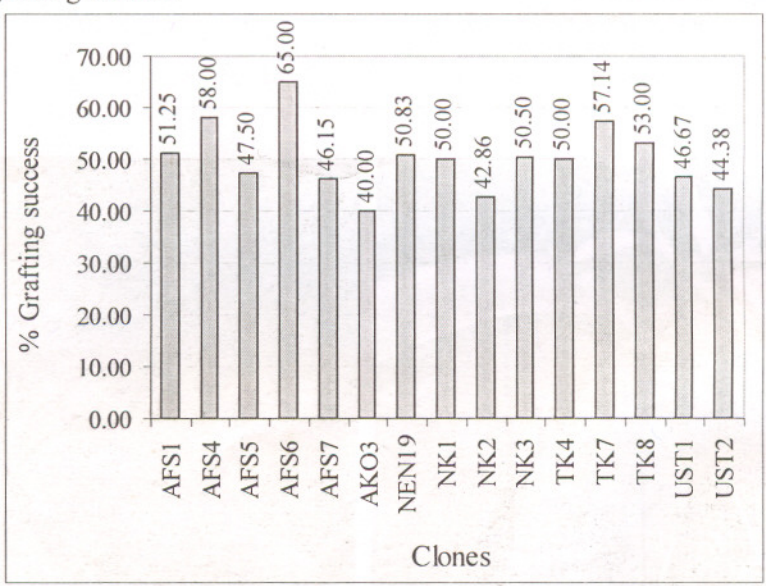

Figure 3: Clonal differences in grafting succes of *Allanblackia parviflora* using side veneer grafting method

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REFERENCES

Abbiw, D. (1990) Useful Plants of Ghana; West African uses of wild and cultivated plants, The Royal Botanic Gardens, Kew, 6-231.

Atangana, A. R., Tchoundjeu, Z., Asaah, E. K., Simons, A. J. and Khasa, D. P. (2006) Domestication of *Allanblackia floribunda*: Amenability to vegetative propagation. Forest Ecology and management, 237: 246-251.

Asaah, E., Tchoundjeu, Z. and Alain, T. (2008) *Allanblackia* propagules growth & development updates in Cameroon. *Allanblackia* meeting, Forestry Research Institute of Ghana, Kumasi, Ghana, 11th – 13th November 2008.

Ministry of Environment and Science (2002) National Biodiversity Strategy for Ghana, Ministry of Environment and Science, Pp 55.

Ofori, D. A. (2008) Report on training workshop on propagation of *Allanblckia* species Forestry Research Institute of Nigeria, Benin City, Nigeria, 9-12 July 2008.

Ofori, D. A., Peprah, T., Addo-Danso, S. and Cobbinah, J. R. (2008a) Management of Genetic resources of *Allanblackia parviflora* in Ghana. Annual report 2007, Pp. 9

Ofori, D. A., Peprah, T., Henneh, S. and Bosompem, S. A. (2008b) *Allanblckia* Domestication Project; Report on training workshop on vegetative propagation of *Allanblckia parviflora*, CSIR-Forestry Research Institute of Ghana, Kumasi 25th to 29th February, 2008.

Ofori, D. A., Peprah, T., Vonberg, J. and Henneh, S. (2008c) Status of domestication of *Allanblackia parviflora* in Ghana, *Allanblackia* meeting, Forestry Research Institute of Ghana, Kumasi, 11-13 November 2008.

Ofori, D. A., Peprah, T., Siaw, D. and Cobbinah, J. R. (2006) Domestication of *Allanblackia* in Ghana. In: Muasya, S.; Rutatina, F.; Munjuga, M. and Simons, A. J. Status and Prospects for *Allanblackia* Domestication in Tanzania. CD-ROM Compilation, ICRAF, Nairobi, Kenya, ISBN 92 9059 196 X;

Oppong, K. (2008) *Allanblackia* seed oil supply chain management in Ghana. *Allanblackia* stakeholders' workshop, Sanaa Lodge, Cape Coast, 30th July 2008.

Peprah, T., Ofori, D. A., Siaw, D. E. K. A., Addo Danso, S. D., Cobbinah, J. R., Tchoundjeu, Z., Jamnadass, R. and Simons, A. J. (in review) Reproductive biology and characterization of *Allanblackia parviflora* A. Chev. In Ghana. Genetic Resources and Crop Evolution

Siaw, D. E. K. A., Cobbinah, J. R., Kankam, B. O., Derkyi, S. A., Oduro, K. A., Agyili, J. and Peprah, T. (2003) *Allanblackia floribunda*, final report submitted to Unilever Ghana Limited by Forestry Research Institute of Ghana, Pp 69.

Shrestha R. B. and Akangaamkum, A. D. (2008) Novella partnership, a partnership for poverty reduction through sustainable enterprise development based on Allanblackia, SNV Ghana, Pp 20.

Simons, A. J. and Leakey, R. R. B. (2004) Treedomestication in tropical; agroforestry. Agroforestry Systems 61: 167-181.

Tchoundjeu, Z., Asaah, E. K., Anegbeh, P., Degrande, A., Mbile, P., Facheux, C., Tsobeng, A., Atangana, A. R., Ngo-Mpeck, M. L. and Simons, A. J. (2006) Putting participatory domestication into practice in West and Central Africa, Forests, Trees and Livelihoods 16:53-69.

Tchoundjeu, Z., Duguma, B., Fondoun, J. M. and Kengue, L. (1998) Strategy for the domestication of indigenous fruit trees of West and Central Africa: case for *Irvingia gabonensis* in Southern Cameroon. Cameroon Journal of Biology and Biochemical Sciences 4:21-28.

WAC (2006) SIIT training workshop on *Allanblackia* domestication, Compilation of Workshop proceedings and related documents, World Agroforestry Centre, Nairobi, Kenya, 2327 October 2006.

Wilson, E. O. (1988) The current state of biological diversity. In: Biodiversity (Eds. Wilson, E. O. and Peter, F. M.), National Academy Press, Washington, D. C. 3-18.