PalArch's Journal of Archaeology of Egypt / Egyptology

BUDDING SUCCESS OF RUBBER (HEVEA BRASILIENSIS MUELL ARG) AS INFLUENCED BY BUDWOOD DEFOLIATION AND NUTRIENT APPLICATION ON ROOTSTOCKS

Ganih I. Sappalani

Tawi-Tawi Regional Agricultural College

ganihsappalani@gmail.com

Ganih I. Sappalani. Budding Success of Rubber (Hevea brasiliensis Muell Arg) as Influenced by Budwood Defoliation and Nutrient Application on Rootstocks. – Palarch's Journal of Archaralogy of Egypt/Egyptogy 17(1), 164-172. ISSN 1567-214X

Keywords: Budding Success, Rubber, Defoliation, Budwood, Rotstock.

ABSTRACT

An experimental study was conducted to determine the budding success of rubber in Influenced by budwood defoliation and nutrient application on rootstock. This study was laid out in 3 x 4 factorial arrangements in Randomized Complete Block Design (RCBD) with three defoliation duration as Factor A. The rates of fertilizers application serve as Factor B. All treatments were replicated three times with ten samples. Results revealed that defoliation of budwood one to two weeks before budding had significantly increased the budding success of (71.15%) compared with nondefoliated scion used gave the lowest budding success for only (39.60%). Likewise, defoliation also enhanced the early sprouting of scion shouts (12.83 days) after cutback. It produced more leaves (22.40) per budded seedling and developed longer sprouted shouts 17.85 to 18.1 cm, which statistically differed. Organic nutrient applied significantly affects all parameters after cutback. The budded seedlings used with chicken dung and vermicast exhibited similar budding success ranging from 63.24% to 69.72%, respectively. Likewise, seedlings that applied the same treatment sprouted early at 12.11 and 13.11 days showed the most number of leaves, 22.93, and induced the longest shouts17.74 to 18.87 cm. However, the lowest result was seedling treated with 16-20-0 and control for only 16.44 and 15.39 cm, which significantly differed.

INTRODUCTION

Rubber is an economically important crop, scientifically known as *Hevea brasiliensis Muel Arg*. It is a perennial plant that develops into a productive tree about five years after establishing a budded planting stump. The crop had a wide range of tropical adaptability and suitable for varied farming systems across ecological zones and the Philippines' climatic conditions, particularly Mindanao. It can also improve the ecosystem since rubber trees are good forest trees which are effective carbon sequesters. These trees also help conserve our watershed, control soil erosion and provide a haven for birds and beneficial fauna.

Rubber production in the Philippines has great potentials due to the vast areas for planting, fertile soil, and favorable climates, particularly in Bukidnon, sheltered by its mountains from typhoons. Likewise, the availability of skilled and cheaper labor as well as its proximity and accessibility to international markets are comparative advantage our over other Asian countries engaged in rubber production

The natural rubber is a primary product of the tree. It has a high demand in both local and export markets due to its various industrial, technological, and domestic uses. It is estimated that there are 50,000 manufactured articles derived from rubber that people use every day (Universityloft, 2010).

Budding is one method for vegetative multiplication of planting materials, which requires an appropriate physiological stage of both green and brown budwood, and rootstocks that lead to bud-take of rubber seedling.

Some propagators disclosed that defoliation of budwood one to two weeks before budding could improve the budding success, rapid union of stock and scion to grow as one plant and enhance early sprouting of buds (Personal communication, 2012). However, defoliation is not often practiced in some nurseries considering the time and cost of labor involved. Moreover, limited studies and information are available on the effects of defoliation and organic nutrients on rubber's budding success, particularly on ‘RRIM 600’, hence this study.

Objectives of the study

Generally, this study was conducted to determine the budding success as influenced by budwood defoliation and nutrient application on rootstocks. Specifically, this study aimed to:

1. Compare the effects of different budwood defoliation technique on the budding success of rubber;

2. Evaluate the budding success of rubber in response to the application of nutrient on rootstocks; and

3. Identify the budwood defoliation treatment and nutrient applications that give the highest budding success of rubber.

Review of related literature

Rubber tree or *Hevea bransiliensin* is a tall, erect tree with a straight trunk and bark, usually relatively smooth and grey (hvcc.da.gov.ph, 2010). According to Orwa (2009), rubber tree height will range from 15 to 20m tall, but wild trees of over 40m have been recorded. He added that leaves of rubber are alternate, palmate, and each leaf with three leaflets. The inflorescence is in the form of pyramidal-shaped axillary panicles produced

simultaneously with new leaves and arrange in a cymose way. The seed is large, oval, slightly compressed, shiny, 2-3.5 x 1.5-3 cm, testa grey and pale brown with irregular dark brown dots, lines, and blotches. The testa is derived from the female parent, and the seed shape being derived by the capsule's pressures. It is possible to identify any seed's female parent by its marking and shape, which is the most reliable of identifying clonal seeds. The endosperm is white in viable seeds, turning yellow in older seeds.

In the manufacturing industry, it has been found that there are about 50,000 uses of rubber (Universityloft 2010). Natural rubber is preferred due to its durable, adhesive, and impermeable characteristics. The most popular product derived from the rubber is automobile tires, which accounts for up to 70% of the rubber industry that supplies the tire sector (Wikipedia 2011).

Edna (2000) reported that rubber seeds fall in Nigeria between August and September. Fresh seeds from early seeds fall are best from optimum germination because fresh seeds lose 50% of the moisture content within a few days and caused short viability.

Tolentino (2008) also recommended using TJIRI or GTI rubber clones for rootstocks or, in the absence of these clones, suggested to use RRIM 600, RRIM 605, and RRIM 501 and but not PB 86 because it produces weak and albino seedlings. Although Edna (2000) recommends GTI Java clones with the best general characteristics and can be planted with safety anywhere except where moisture levels are low, other clones like PRION Java, RRIM 600 Malaysia, and PB5/51 Malaysia can also be used.

Rubber is best propagated by budding. They are first grown in the nursery as seedlings called rootstock before transplanted in the field (RAFID DA-10, 2006). Seedlings can get advantages of good establishment, early maturity, and shortened field growing period (Aquaah, 2002) if they are grown first in a nursery.

Budding is a method of asexual propagation involving a strip of bark with a bud from the budwood of the desired clone into the stock (Tolentino, 2008).

Purbiati, Widodo, and Supriyanto (1987) found that the grafted tree's successful graft and growth rate propagated by defoliated budwood ten (10) days before grafting was higher than those of undefoliated budwood.

Marciales (1980) explained that defoliation prepares the scion and bud to swell and be in the stage of readiness for resumptive and active growth. It is also believed that defoliation eliminates substance present in the leaves, which may inhibit or delay graft union.

In the study of Rubber Economics presented by Dr. Hiddee Smit, Secretary-General of the International Rubber Study Group (IRSG) based in London, he reported that the Philippine rubber industry would be soaring high in the world market by the year 2020 compared to other rubber producing countries in Asia and other parts of the world if the country could expand the rate and area of rubber production. A group of planters, including the Bureau of Plant Industry (BPI) and University of Southern Mindanao (USM), identified 500,000 hectares of suitable rubber areas in the Philippines on top of the existing 85,000 hectares (BAR, 2010).

One of the rubber production problems is only a few registered and established nurseries in the local areas. Most nurseries are distant away from the production site of rubber farms. There are only a few registered and operating rubber nurseries in Mindanao, such as Bukidnon Agricultural Productive Center (BAPC, Barongcot, Dangcagan, Bukidnon). Talakag Rubber Nursery (St. Nino, Talakag Bukidnon), and Philippine Rubber (USM, Kabacan, South Cotabato). In this case, farmers tend to transport the recommended

clones of bud wood from the nearby and accessible nurseries to the site of production (bpi.da.gov.ph)

Since bud wood nursery areas are far from rubber farms, it usually takes many hours and sometimes days of transport to propagate materials to reach their destination. Moreover, the vehicle's road is fully developed, so it is expected that bud wood would be stressed during transit. In the transport of these materials, environmental stress and impact injury cannot be avoided. In most cases, they will contact other foreign materials that may harbor pests and diseases on the bud wood.

During bud wood selection, well-expected, healthy, and mature terminal whorls as a source of budding scions are collected. However, before wrapping/packaging and transport, the two ends of the rubber budwood requires dipping in melted wax to prevent drying (Hartman and Kester, 2000).

MATERIALS AND METHODS

Experimental design and treatments

A study utilized an experimental research method to determine rubber's budding success as influenced by budwood defoliation and nutrient application.

The study was conducted in a 3 x 4 Factorial Arrangement in Randomized Complete Block Designed (RCBD). Factor A consisted of defoliation duration: No defoliation (control), one-week defoliation before Budding (1WBB) and two weeks defoliation before budding (2WBB); While Factor B is the rates of fertilizers application: Control – no fertilizer, 2 grams per hill of ammonium phosphate (16-20-0), 10 grams per hill of Chicken Dung and Vermicast. All treatments were replicated three times with ten sample plants.

Preparation of area

Land preparation was done two weeks before uprooting of seedlings. The area was plowed twice at one-week interval using a carabao drawn plow to produce a fine soil tilth. Three main blocks were constructed containing 36 plots per block to accommodate all treatment combinations within each block. Each plot measured 2x5 meters or a total area of 10 square meters per plot for each treatment.

Transplanting of germinated seedlings

Rubber seedlings with a fully developed root system were uprooted carefully with the cotyledons intact and placed in a container half-filled with water to avoid desiccation, root damage, and detachment of the cotyledons. A pointed peg of about 10 cm in diameter was used to make a hole with four rows at a distance of 45 cm between rows and 30 cm distance between hills. Seedlings were planted at about 10 to 15 cm deep and carefully placed into the hole, and the soil was firmly pressed around the base of the seedlings to cover the whole root system and the cotyledon.

Care and management practices

Watering, weeding, and pest and disease management was done regularly or as necessary with more or less water to prevent the soil media from drying and compacting and ease removing the weeds. Prevention of pests and diseases on the newly germinated seedlings were also observed.

Fertilizer application

At planting, ammonium phosphate (16-20-0), chicken dung, and vermicast fertilizers were applied as basal nutrients. Chicken dung and vermicast were used at 10 grams, while ammonium phosphate at two grams per hill based on the rate practiced at CMU commercial Nursery.

Preparation of rootstocks

Rubber seedlings as rootstocks of similar sizes grown in the field were standardized based on leaves' height and color. Identified sample plants were tagged correctly.

Preparation of budwood

Semi-mature budwoods (with green color clone RRIM 600) were obtained from the established rubber nursery. Defoliation of budwoods was made one and two weeks before budding to induce buds' dormancy but ready to sprout after budding.

For nondefoliated budwoods, their leaves were removed only at the time of budding. Both defoliated and nondefoliated budwood were collected early in the morning on the day of budding. Budwoods were wrapped with banana bracts to protect their bud eye from physical impact or bruises during transport.

Budding operation

The green budding method was employed in this experiment. Budding was done at about six inches above the ground. Two vertical and parallel cuts at about two inches in length were made on the rootstock. Then the upper and lower portions of the parallel cuts were lifted-up with the budding knife and the forefinger to expose the budding panel leaving only one cm as a tongue where the bud was inserted. The bud eye was immediately pulled and slipped off the budstick or budwood, making a similar size to the rootstock's incision. After which, the green bud patch beneath the flap of the stock was inserted.

The budded portion was wrapped with polyethylene plastic strips in a spiral manner, starting from the budded portion going upward with the tape's edges overlapping. Budded seedlings were tagged, indicating the dates of budding and budwood defoliation treatment.

The budded portion was opened by loosening the polyethylene strips above and below the patch bud 21 days after budding to expose the patch and allow the shoots to sprout. Budded seedlings with green bud patches were successful, while those brown bud patches indicated a failure. The cutback was done seven days after opening or successful budded seedlings at five inches from the patch bud. Successful budded seedlings were uprooted after six weeks, and the lateral and tap-roots were pruned before planting in polyethylene bags.

Data gathering

Percentage Budding Success, Number of Days to Sprouting of Shoot, Number of Leaves, and Length of Shoots per Budded Seedling were collected properly according to treatment and replication. After which, they were adequately recorded according to the arrangement of the statistical design.

Statistical analysis

Data gathered were subjected to Analysis of Variance (ANOVA) in Factorial Arrangement in Randomized Complete Block Design (RCBD). Significant differences among treatment means were compared using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Percentage budding success

The percentage budding success of 'RRIM 600' rubber in response to budwood defoliation and nutrient application is reflected in Table 1. Budding success at 60 days after budding was highly affected by budwood defoliation and nutrient application's independent and interaction effects.

Table 1: Percentage budding success of rubber seedlings as influenced by budwood defoliation and nutrient application

Defoliation	Fertilizer				Mean
	Control	16-20-0	Chicken Dung	Vermicast	
Undefoliated	31.40^{f}	33.11^{f}	45.01^{e}	48.89^{e}	39.60^{c}
Defoliated (1 WBB)	46.12^{de}	47.93^{de}	60.26^{c}	69.97^{b}	56.07^{b}
Defoliated (2 WBB)	53.48^{cd}	56.38^{c}	84.44^{a}	90.29^{a}	71.15^{a}
Mean	43.66^{b}	45.80^{b}	63.24^{a}	69.72^{a}	

Note: CV = 7.55%

Means within the same columns and rows followed by a common letter are not significantly different at 5% level DMRT.

Rubber seedlings budded with scion buds from defoliated budwood two weeks before budding (2 WBB) operation produced the highest budding success of 71.15%, which varied significantly from that budwood defoliated at one-week budding which has a budding success of 56.07%.

The undefoliated scion's buds significantly gave the least budding success of 39.60% only. Differences among rubber seedlings' budding success as influenced by nutrient application revealed that vermicast and chicken dung on rootstocks resulted in a statistically similar success with an average of 69.72% and 63.24%, respectively, which were higher compared with the control with 43.66%. However, the application of 16-20-0 gave only 45.80% budding success but showed no statistical difference.

Results showed a high budding success of 90.29% was obtained from rootstocks fertilized with vermicast and where scion budwood was defoliated at two weeks before budding. Although this treatment has relatively higher budding success than the applied with chicken dung (84.44%), their difference was not significant. On the other hand, the unfertilized rootstock whose scion was not from defoliated budwood had the least success of 31.40%.

Number of days to sprouting of scion

Table 2 shows the significant variation in the number of days to the sprouting of scion from a cutback in response to budwood defoliation and nutrient application. It was found that defoliation at 2 WBB from cutback resulted in the earliest sprouting of shoots of 12.83 days from the cutback.

Table 2: Number of days to sprouting of shoots from cutback as influenced by budwood defoliation and nutrient application

Defoliation	Fertilizer				Mean
	Control	16-20-0	Chicken Dung	Vermicast	
Undefoliated	18.33	15.67	14.33	13.00	15.33[a]
Defoliated (1 WBB)	15.33	14.33	13.00	12.67	13.83[b]
Defoliated (2 WBB)	14.33	14.33	12.00	10.67	12.83[c]
Mean	16.00[a]	14.78[b]	13.11[c]	12.11[c]	

Note: CV = 8.03%

Means within the same column and row followed by a common letter are not significantly different at 5% level DMRT.

This was followed by those seedlings whose scion buds were obtained from budwood defoliated at one week before budding (13.83 days). The undefoliated scions significantly had delayed growth of 15.33 days.

Application of chicken dung and vermicast on rubber seedlings significantly induced the earlier sprouting of scion buds in 12.11 to 13.11 days from a cutback, respectively. Seedlings applied with 16-20-0 took 14.77 days to sprout while the control had late shoot emergence of 15.33 days. Although there was no significant interaction effect between the factors,

Number of leaves per budded seedling

The number of leaves per budded seedling of rubber in response to budwood defoliation and nutrient application is shown in Table 3.

Results revealed that defoliation and nutrient application have highly influenced this parameter. However, the interaction effects of these two factors were not observed.

Table 3: Number of leaves per budded rubber seedlings as influenced by budwood defoliation and nutrient application

Defoliation	Fertilizer				Mean
	Control	16-20-0	Chicken Dung	Vermicast	
Undefoliated	18.67	19.67	20.93	21.50	20.11[b]
Defoliated (1 WBB)	19.10	20.53	21.70	22.97	21.07[ab]
Defoliated (2 WBB)	21.30	21.50	22.47	24.33	22.40[a]
Mean	19.69[c]	20.47[bc]	21.70[ab]	22.93[a]	

Note: CV = 8.16

Means within the same column and row followed by a common letter are not significantly different at 5% level DMRT.

Rubber seedlings budded from defoliated budwood 2 WBB had the most 22.40 leaves formed comparable to the defoliated at 1 WBB, which had developed a comparable number of leaves (21.07) with those of 2 WBB. Likewise, seedlings budded with undefoliated scions have a statistically similar number of leaves with those budded seedlings using one week defoliated budwood. Application of vermicast on the rootstock of rubber seedlings exhibited the highest number of leaves developed (22.93), followed by those applied with chicken dung (21.70) and by inorganic nutrient (16-20-0), which gave 20.46 leaves. In comparison, the control had the least of 19.68 leaves.

Length of scion shoot

Table 4 presents the length of budded seedlings' length of scion shoots in response to budwood defoliation and nutrient application. Statistical analysis showed that defoliation of budwood and nutrient application significantly influenced this parameter. Defoliation at 1 WBB significantly gave the longest shoot of 18.10 cm, comparable to the length of shoot from budwoods defoliated at 2 WBB of 17.85 cm. The shortest bud shoot was obtained from seedlings budded with undefoliated scion with only 15.39 cm. Seedlings applied with chicken dung and vermicast developed longer scion shoots of 17.74 cm and 18.87 cm. This was followed by seedlings fertilized with 16-20-0 with a mean of 16.44 cm comparable with those unfertilized seedlings, which has the shortest shoot of 15.39 cm significantly but similar to the effects of 16-20-0.

Table 4: Length of shoots (cm) at 60 days after cutback of budded rubber as influenced by budwood defoliation and nutrient application

	Fertilizer				
Defoliation	**Control**	**16-20-0**	**Chicken Dung**	**Vermicast**	**Mean**
Undefoliated	14.10	14.98	15.93	16.57	15.39[b]
Defoliated (1 WBB)	15.96	17.93	18.53	19.96	18.10[a]
Defoliated (2 WBB)	16.17	16.43	18.77	20.07	17.85[a]
Mean	15.41[c]	16.44[bc]	17.74[ab]	18.87[a]	

Note: CV = 7.98%

Means within the same column and row followed by a common letter are not significantly different at 5% level DMRT.

CONCLUSIONS

Based on the results of the study, the following conclusions are drawn:

1. Defoliation of budwood one to two weeks before budding had significantly increased budding success enhanced early sprouting of scion shouts, which produced more leaves and developed longer sprouted shouts.
2. The budded seedlings applied with chicken dung and vermicast exhibited similar budding success, the most number of leaves, induced early and longest shouts.

RECOMMENDATIONS

Based on the initial findings of this study, the following recommendations are made:

1. Scion budwood must be defoliated two weeks before budding of rubber seedlings for high budding success and budded seedlings' good growth.
2. Rootstocks should be applied with vermicast in its absence, chicken dung to have high budding success, enhanced the early sprouting of scion shoots after cutback after proper development of long scion shoots the most number of leaves of budded rubber seedlings.

References

ATI Bulletin. 2003, Jan. vermicompost. Greenfields. Pp 37-38

AVRDC, 2001. Annual Report, 2001. Asian Vegetable Research and Development Center, Shanhua, Tainan, Taiwan. Vol. 7. pp 152.

Cabahug, L. M., 2001. Introduction to Horticulture Resource Unit. Department of Horticulture, College of Agriculture, Central Mindanao University, University Town, Musuan, Bukidnon, Philippines.

Dekissa, T., W. W. Hare, and J. R. Allen. 2008. Effect of Pelletized Poultry Manure on Crop Production and Vadose Zone Water Quality. University of the District of New Delhi, pp: 399-406.

Hartman, H.T., and D. E. Kester, 2000. Plant Propagation Principles. 6th Edition. Person Education, Inc. Upper Saddle River, New Jersey.

Marcelino, R., R Ejercito, and J. D. Ortouse. 2005. Performance of Tomato Applied with Exquisite Soil Conditioner and Exquisite Bio-organic Fertilizer. National Agriculture and Research Development System. PCARRD. Los Banos, Laguna, Philippines

Marciales, L., 1980. Epicotyl Grafting and Budding of Carabao Mango (Mangifera indica L.) Graduated Thesis UPLB, Philippines.

PCARRD. 1997. The Philippine Recommends for Rubber. PCARRD, Los Banos, Laguna. 181p.

Purbiati, W., and Supriyanto. 1987. Accessed at http://agris.fao.org/agris-search/search/display.do?f=199014.xml; ID9000101 on September 6, 2010.

Radovich. 2009. Accessed at http://reesis.usda.gov/web/ crisprojectpages/21125. html on October 3, 2009.

Sangatanan, P. D. and R. H. Sangatanan. 1990. Soil Management Quezon City Rex Book Store. 274p.

Silao, J.M., 2009. Personal Communication.

SMIARC Technoguide. 2007. A publication of Department of Agriculture RFU XI. Southern Mindanao Integrated Agricultural Research Center. Bago Oshiro, Tugbok.

Tolentino, I. 2008. Rubber Nursery Management. The regional Applied Communication office Cotabato Agriculture and Resources Research and Development Consortium (CARRDEC). University of Southern Mindanao, Kabacan, Cotabato.