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COMPARISON OF THE EFFECTIVENESS OF LIQUID AND GRANULE FERTILIZER MIXTURES ON RUBBER PLANTS RAISED BY YOUNG BUDDING TECHNIQUE

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ABSTRACT

Effectiveness of granule fertilizer mixtures was compared with currently used liquid formulations on plants raised by young budding technique. Granule formulations are agronomicaly effective provided that they are applied in small quantities. Urea based mixtures was found to be comparatively more detrimental than sulfate of ammonia based mixtures when used at concentrations higher than the recomended levels. Currently recommended fertilizer schedule with liquid formulations was the most effective programme for young budding among the treatments tested. Reduced frequency of application increases the deiback percentage significantly. However, it could be applied at two-week intervals instead of weekly intervals equally effectively, thereby reducing the application cost almost by half.

Key words: granule fertilizers, liquid fertilizers, young budding

INTRODUCTION

Young budding, owing to its advantages over other planting techniques (Leong & Yoon, 1985; Seneviratna, 1995) is now becoming popular in rubber plantations in Sri Lanka. It involves grafting a small bud slip on to a very young seedling of 2-3 months of age raised in poly bags (Leong, *et al.*, 1985). Vigourous growth of the plant is maintained by the continuous application of proper manuring schedule before and after bud grafting.

Application of N, P, K and Mg in the form of inorganic fertilizers is essential for the growth of seedling plants (Yogaratnam & Karunaratne, 1972; Dissanayake & Mitrasena, 1986). In the present practice fertilizers are applied to young budding plants in liquid form using completely water soluble fertilizers, which are very costly. There are reports indicating that the conventional fertilizer mixtures in granule form could be used in young budding (Kewi *et al.*, 1989) and this is also in practice (Yoon *et al.*, 1987; Yoon *et al.*, 1988) although their agronomic effectiveness is doubtful. This study was therefore, initiated to compare the effectiveness of applying fertilizers in liquid and solid form on young budding *Hevea* plants, including the optimum frequancy of application.

MATERIALS AND METHODS

Experiment 1

This experiment was carried out to evaluate a low cost fertilizer schedule for young budding. Six treatments (Anexture I) were allocated in a randomized complete block design with 75 single polybag plants per treatment with 3 replicates.

Experiment 2

Based on the results of experiment 1, this experiment was planned to study the effectiveness of granule fertilizers over the liquid fertilizers. Ten treatments (Anexture II) were allocated to plots of 25 single polybag plants, in a randomized complete block design with 3 replicates.

Experiment 3

The currently used liquid formulation was further evaluated for the optimum frequancy of application. Fertilizers were applied at weekly, biweekly and monthly intervals with no fertilizer control. These four treatments were allocated in a randomized complete block design with a plot size of 40 single plant polybags with 4 replicates.

Except for type of fertilizers and their frequancy of application, all other management practices were followed as recommended by the Rubber Research Institute of Sri Lanka. Experiment 1 and 2 were conducted using Agalawatta series soils and experiment 3 using Boralu series soils. Plant diameters at the base of the plant was measured at 2 or 3 weeks intervals. Buddable % (BB), Budded % (BD), Budding Success % (BS), Dieback % (DB) and recovery % at planting were calculated at the end of the experiment. Results in percentages were analysed after arcsin transformation.

RESULTS

Experiment 1

All teratments except treatment No.3 performed better than the no fertilizer control on all aspects evaluated (Table 1). All plants in treatment 3 died before 14 weeks. More than 90% of the plants in treatment 5 and 6 have come to the buddable stage by 12 weeks and plants in all other treatments except 1 and 4 came to that stage only after 4 months. In treatments 1 and 4 only 63.5% and 60.2% plants have come to buddable stage respectively (Fig. 1). Budded % was always less than the buddable %. The budding succes of all the treatments was very low and it has not been affected by the treatments. Granule fertilizers (treatment 2 and 6) were found to be as effective as the liquid fertilizers (treament 5) giving significantly high buddable % and low die back %, compared with the other treatments. A significantly high dieback % was observed

in treatments 1 and 4.

Table 1. *Effect of different fertilizer mixtures on young budding*

Treatment No.	Buddable %	Budded %	Budding Success%	Die back %
1	63.5[b]	47.8[d]	40.6[a]	17.5[ab]
2	93.2[a]	72.0[b]	58.8[a]	6.7[bc]
3	0.0[c]	-	-	-
4	60.2[b]	43.9[c]	37.1[a]	25.4[a]
5	95.9[a]	90.1[a]	59.7[a]	9.4[bc]
6	98.2[a]	91.0[a]	46.9[a]	2.8[c]

* - values in a column with the same letter are not significantly different at 5% probability level.

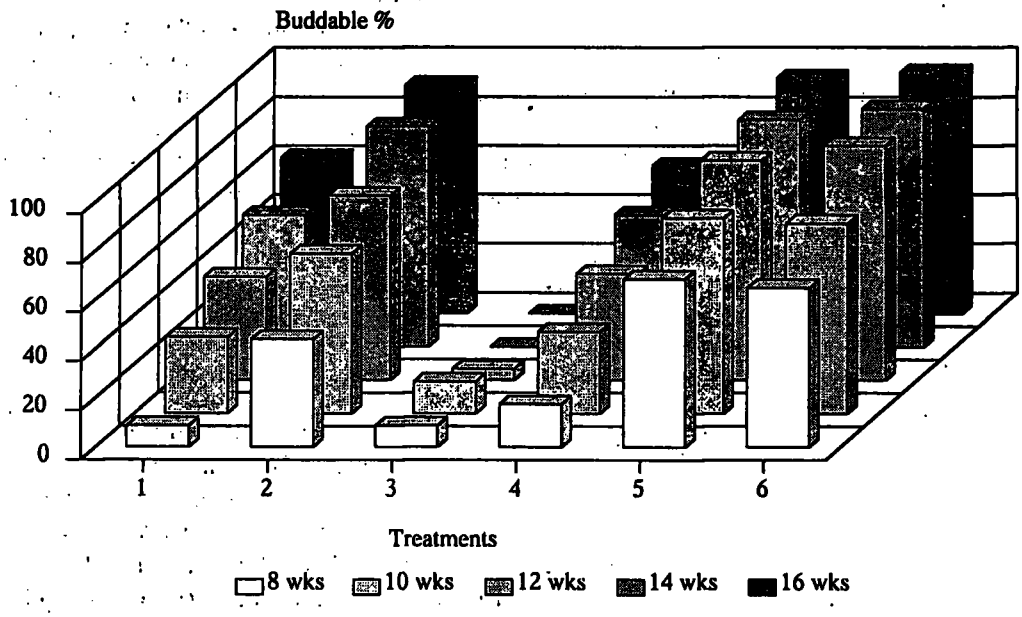

Fig. 1. Buddable percentage at different ages

Experiment 2

More than 80% of the plants reached the buddable stage by 16 weeks. However, initial growth of plants that did not recieve rock phospate as a basal dressing, treatment 9 and 10, was very slow (Fig. 2). Eventhough there were no significant differences in buddable % in all

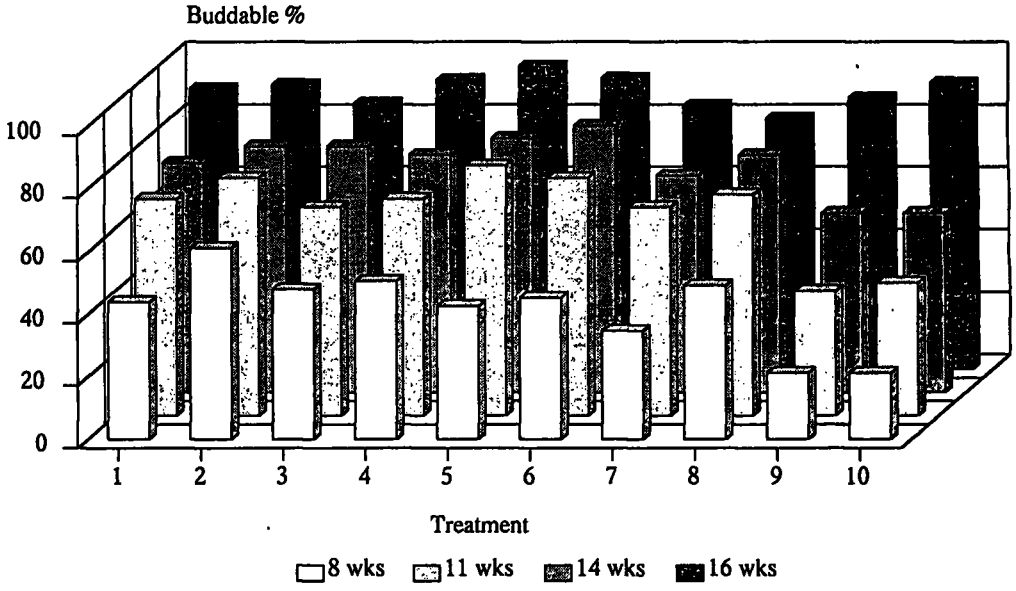

Fig. 2. Buddable percentage at different ages

treatments, a significantly low budded % was recorded in plants that recieved a higher quantity of granule fertilizers *viz.* treatment 7 and 8 (Table 2). Granule fertilizers performed equally well as the liqiud fertilizers when applied at lower concentrations. However a very high dieback % was observed when the concentration of the granule fertilizers were doubled (treatments 7 and 8). Dieback values for all the treatments were very high compared to the generally accepted values.

Experiment 3

Only less than 60% of the plants in the no fertilizer control treatment reached the buddable stage even after 18 weeks where as more than 90% of the plants reached that stage by this age in all other treatments (Fig. 3). Frequency of apllication has not affected the buddability but it affected the budding success and dieback %. There was no significant difference in budding success when fertilizers were applied at weekly and biweekly intervals but the budding success was significantly lower in monthly fertilizer applied plants than in biweekly applied

Table 2. *Effect of different fertilizer mixtures on young budding*

Treatment	Buddability %	budded %	Budding success %	Die back %
1	82.7^{ab}	75.0^{a}	70.2^{b}	43.6^{b}
2	88.0^{ab}	80.0^{a}	76.9^{ab}	30.7^{b}
3	86.7^{ab}	70.7^{ab}	79.5^{ab}	28.9^{b}
4	84.0^{ab}	77.3^{a}	79.5^{ab}	27.1^{b}
5	88.0^{ab}	85.3^{a}	90.6^{a}	11.4^{b}
6	93.3^{a}	86.7^{a}	85.8^{ab}	16.9^{b}
7	80.0^{b}	68.0^{b}	60.8^{b}	64.8^{a}
8	77.3^{b}	62.7^{b}	68.6^{b}	60.9^{a}
9	88.0^{ab}	76.0^{a}	73.5^{b}	38.1^{ab}
10	85.3^{ab}	78.7^{a}	80.6^{ab}	25.3^{b}

* - Values in a column with the same letters are not significantly different at 5% probability level

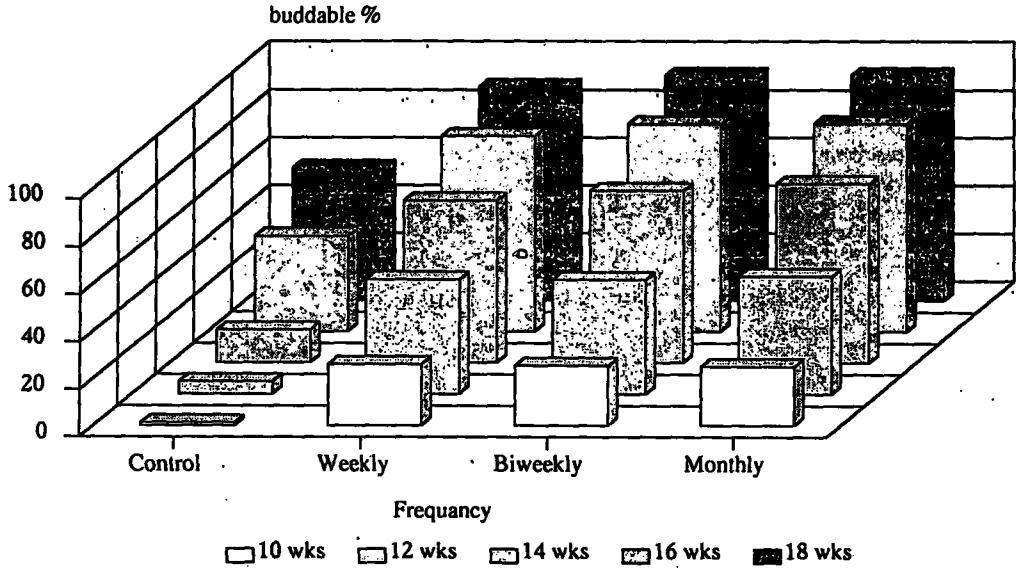

Fig. 3. Buddable percentage at different ages

plants (Table 3). Although there was no statisticaly significant difference in frequancy of application on dieback %, it increased with the reduction of frequancy. However, % of plants recovered at planting was significantly higher in all treatments than the plants in the no fertilizer control and there was no significant difference in the fertilizer applied treatments.

Table 3. *Effect of the frequancy of fertilizer application on young budding*

Treatment	Buddable %	Budded %	Budding Succes %	Die-back %	% recovery at planting
No Fertilizer	52.9[a]	43.1[b]	92.9[a]	0.0[b]	33.5[b]
Weekly	88.4[a]	82.6[a]	78.9[bc]	4.2[ab]	61.8[a]
Biweekly	92.1[a]	85.8[a]	87.6[ab]	8.0[ab]	68.7[a]
Monthly	91.0[a]	87.1[a]	72.6[c]	13.5[a]	56.1[a]

* - Values in a coloumn with the same letter are not significantly different at 5% probability level

DISCUSSION

The importance of applying N, P, K and Mg fertilizers for seedling plants is well documented (Yogaratnam & Karunaratne, 1972; Dissanayake & Mitrasena, 1986; Tiong & Kheng, 1988). Results of the experiments 1 and 3 confirm that this is applicable for young seedlings raised in small polybags, as well. The significance of applying N, P, K and Mg artificially for poly bags becomes more important as fertile top soil is not always available in the vicinity of large scale nurseries. Therefore, in most instances it is the infertile sub soil that is available for polybag filling. The poorer initial growth rate in the plants not supplied with rock phosphate as the basal dressing (treatment 9 and 10 in experiment 2) emphasises the importance of phosphorus during the early stages of grwoth in young budding plants. Yogaratnam and Karunaratna (1972) have also observed the benefit of applying relatively high levels of phosphate fertilizer for young *Hevea* seedlings.

Currently N, P, K and Mg is applied for young budding in liquid form using completely water soluble fertilizers. Results from experiment 1 and 2 clearly indicates that the curently recommended liquid formulation is either more effective or comparable to the other treatments tested, agronomically. Nevertheless, some planters tend to use small amounts of granule fertilizers in the polybags. According to Yoon *et.al.,* (1987,1988) application of solid fertilizers have often resulted in die back of scion shoots. They have also observed dead feeder roots, possibly as a result of plasmolysis due to too concentrated fertilizers. Our results also confirm this, but only when high ammount of solid fertilizers were applied. When 6g of solid fertilizer granules per plant per week was applied (Treatment 3 & 4 of experiment 1), the lowest budded

percentage and highest die back percentage was observed. Moreover, when R/U 12:14:14 was applied at this rate not a single plant survived until the time of budgrafting. Examination of the plant usually showed dead feeder roots and a decayed colar region. In experiment 2 the same two treatments were tested at much lower concentrations (treatments 4 & 5) and they were found to be as effective as the liquid formulation. However, when this quantity was doubled (Treatment 7 & 8) an increase in the die back% of the scion shoots was observed. Kewi *et al.* (1989) have also observed a two-fold higher die back % (5.6) when solid fertilizers in granule form is applied at a rate of 1g per plant per week than when fertilizers are applied in slurry form. This indicate that the solid fertilizers could effectively be used in young budding only when they are applied at lower concentrations.

Application of very low quantities of granule fertilizers (1-2 g/plant/week) uniformly could be extremely difficult at the estate management level. This may result in high variation among the plants with regard to growth, buddability and dieback %. The ultimate result will be a poor quality planting material with uneven growth.

The currently recommended liquid formulation was considerd the most effective fertilizer schedule for young budding when its agronomic effectiveness, application efficiency and the uniformity in vigour of the planting material were considered. However, with the limited labour resources it is very difficult for a plantation to apply fertilizers for young budding nurseries weekly. The fertilizer application cost alone is around 10 - 12 % of the total cost (Samarappuli, 1994). According to Yoon *et al.* (1987), application of fertilizers in slurry form at fortnightly intervals is possible for young budding. Results of experiment 3, clearly indicates that the liquid formulation can also be applied once in two weeks as effectively as a weekly application. This will reduce the application cost by half. Application frequency can not be reduced further as the deiback % increases to a significantly high level. But monthly application seems possible at least upto buddable stage. Higher deiback % with decreasing frequency of application could be due to the time gap between the last fertilizer application and the bud grafting, which is only two weeks for all the treatments in this experiment, is not enough. It has been reported earlier that the continuous application of fertilizers has resulted in very high die back percentages. This could be due to phytotoxic effect on the scion shoots, due to too concentrated fertilizers.

Further, it was observed that urea based formulations are more dammaging to young seedlings than the SA based formulations when they are applied at higher concentrations. Often granule fertilizers can not be incorporated into soil in small sized polybags to such a depth to minimize volatile ammonia loss. Further, the urease activity in rubber growing soils is high (Dharmakeerthi *et al.*, 1997), and therefore ammonia volatalization from surface applied urea could be expected to be high. Kiss *et al.* (1975) reported the volatile ammonia gas affects the seed germination and the grwoth of young seedlings. The comparatively high detrimental effect of urea based formulations on young rubber seedlings grown in polybags at higher concentrations could be due to this. Therefore, it is important that the dosage is not increased to levels higher than the recommended rates, when urea based formulations are used.

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Fertilizers for young budding

Annexure I

Treatment No.	Basal App.	Formulation*	Quantity/plant (before grafting)	Frequency
1	-	No Fertilizer	-	-
2	75g RP	SA/MOP/KIE (Granule)	500mg	Weekly
3	50g RP	R/U 12:14:14+KIE (Granule)	6000mg	-do-
4	50g RP	R/SA/8:9:9:4 (Granule)	6000mg	-do-
5	50g RP	SA/DAP/SOP/CES (liquid)	620mg	-do-
6	50g RP	SA/TSP/MOP/KIE (Granule)	640mg	-do-

* SA- Sulfate of Ammonia; MOP- Muriate of Potash; KIE-Kiesarite; DAP-Diammonium Phosphate; SOP-Sulfate of Potash; CES-Commertial Epsum Salt; TSP-Tripple Supper Phosphate ; RP-Imported Rock Phosphate

Annexure II

Treatment No.	Basal Appl.	Formulation*	Quantity/plant (before grafting)	Frequency
1	50g RP	SA/DAP/SOP/CES (Liquid)	665mg	Weekly
2	50g RP	SA/TSP/MOP/KIE (Granule)	640mg	-do-
3	75g RP	SA/MOP/KIE (Granule)	495mg	-do-
4	50g RP	R/U/12:14:14 + KIE (Granule)	750mg	-do-
5	50g RP	R/SA/8:9:9:4 (Granule)	1000mg	-do-
6	50g RP	Doubbled treatment 2	1280mg	-do-
7	50g RP	Doubbled treatment 4	1500mg	-do-
8	50g RP	Doubbled treatment 5	2000mg	-do-
9	-	SA/TSP/MOP/KIE (Granule)	1000mg	-do-
10	-	SA/TSP/MOP/KIE (Granule)	2000mg	Biweekly

* SA- Sulfate of Ammonia; MOP- Muriate of Potash; KIE-Kiesarite; DAP-Diammonium Phosphate; SOP-Sulfate of Potash; CES-Commertial Epsum Salt; TSP-Tripple Supper Phosphate ; RP-Imported Rock Phosphate