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EFFECT OF SHOOT AGE, LIMING AND POTASSIUM APPLICATION FOR SUMMER SEASON LAC CULTIVATION ON *BUTEA MONOSPERMA* TREES

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ABSTRACT

An experiment comprising levels of liming (liming and no liming), potassium application (0, 500 and 1000 g/ tree) and shoot age was conducted in the research farm of Indian Institute of Natural Resins and Gums, Ranchi during 2011-12 to 2013-14 replicated five times to study the effect of soil fertility on *rangeeni* lac yield in the summer season on medium sized trees. Findings of the experiment indicated that lac yield ratio obtained in liming was 71 percent higher compared to no liming in case of 6 months age of shoots. However, analysis of data revealed that liming has got least effect on older shoots. Its effect was also reflected on yield attribute like sticklac yield. Increased soil fertility due to liming might have supplied better nutrition to the host and the host in turn could supply better nutrition to the insect. Lac yield increased significantly (4 to 7 times) if cultivation is done in older shoots. Interaction effect of liming and potassium was found to be significant in case of 6 months old shoots. Effect of potassium application was observed in the absence of liming and the highest dose could increase lac yield 2.8 times than that of control on six months old shoots. Similarly, liming in the absence of potassium application proved to be the best treatment. Applied potassium might have facilitated host to support nutrition of lac insect in a better way which ultimately increased lac yield.

Key words: *Butea*, Liming, Potassium, *Kerria*.

Introduction

Lac (*Kerria lacca* Kerr. Homoptera: Tachardiidae) is a very good cash crop for the growers of Jharkhand, Madhya Pradesh, Odisha, West Bengal and Maharashtra and finds its application in diverse field (Yogi *et al.,* 2013). In Jharkhand, lac cultivation constitutes the second most important source of rural family income (Pal *et al.,* 2007). *Rangeeni* strain of lac is cultivated mainly on *Butea mononperma* (palas) trees, which is found abundantly in the lac growing region. Majority of *rangeeni* lac comes from summer crop either harvested immature or as broodlac. *Rangeeni* lac production was 8463 tons out of total production of 19577 tons at national level (Yogi *et al.,* 2013). In general, productivity of *rangeeni* lac is less in comparison to the other strain of lac insect i.e. *kusmi* strain (Mishra *et al.,* 2000). Poor soil nutrition may be one of the reasons. Manipulation of soil fertility may be an important intervention which can change the scenario considerably, as nutrients have been reported to influence growth of mealy bug (Fennah, 1959) and lac (Thakur, 1932).

Soils of Jharkhand are by and large acidic in nature and requires serious attention (Anon., 2014); Plant growth suffers due to poor root growth (Mandal *et al*., 2004; Tanaka and Navasero, 1966). Due to poor nutrition of the hosts proper growth of shoots cannot be ensured within the short rest period (Anon., 2012). Among the most important soil cations that hydrolyze and contribute significantly to soil acidity are Al^{3+} and Fe^{3+} (Thomas and Hargrove, 1984). Soil acidification is often accelerated by certain cropping practices such as repeated applications of nitrogen (Adams, 1984). Liming is a very good option for maintaining plant growth (Singh *et al.*, 2002) in Jharkhand. Therefore, benefit of liming can be reaped for lac cultivation also. Similarly, there are lot of references of plant nutrients application affecting growth and development of insects harboring on plants. Application of potassium to rice plants decreased adult life and population build up of plant hopper *Sogatella fercifera* (Homoptera) (Salim, 2002 and Kulagod *et al*., 2011). Similar observations were also reported on sesame (Mahmoud, 2013). On the other hand, reports are available on beneficial effect of potassium application and detrimental effect of excess liming on winter season *kusmi* lac yield on *Ziziphus mauritiana* (ber) on acid lateritic soils (Ghosal, 2012). Very scanty information is available on the effect of these nutrients / amendments on lac yield. Considering the abundance of the host, it was felt to validate how far application of potassium and liming improve *rangeeni* lac yield on *Butea monosperma* (palas). Age of shoot plays a significant role in lac production. Normally, lac cultivation is done on 6 months old shoots

Shoots with more than two years of age perform better for *rangeeni* lac production on *B. monosperma* and either liming or potassium application is advocated for better performance.

(Jaiswal *et al*., 2000). But, at times, proper growth of shoots does not take place due to poor soil nutrition.

A field experiment was conducted in the Institute Research Farm, Namkum, Ranchi (23°23'N longitude, 85°23'E latitude and 650 m amsl) during 2011-12 to 2013-14 to evaluate different levels of liming, and potassium on established plantation of *B. monosperma* (*palas*) for *rangeeni* lac production in summer season. Two levels of liming (liming and no liming) and three levels of potassium application (0, 500 and 1000g/ tree) were combined to make six combinations replicated five times. Potassium imparts resistance to plants against disease and pest attack for which rate of potassium application was much less during first year (0, 200 and 400 g/tree). After analysis of preliminary results rate was increased from next year. Agriculture lime @ 200 g/ m^2 was added and mixed with soil every year under tree canopy (3.6x3.6 m^2) two months before fertilizer application.

Fertilizer application and lac cultivation operations were done following recommended practices. Harvesting was done in the month of July for summer season crop. For recording sticklac yield, two samples of broodlac of measured length from each treatment was sampled randomly, scrapped and weighed. To get a comprehensive picture of different years on different growth and yield attributes, data were subjected to statistical analysis following Randomized Block Design in factorial mode assuming year as the third factor. In the first year of study the shoots were older (more than two years) and in following two years shoot were six months old. Therefore, effect of year grossly gives a picture for age of shoot. For easy understanding, data were pooled for all the three years for getting over all effect. Besides, data were also pooled for last two years where shoots were of six months old. For getting a comprehensive picture of response of different factors on lac production, these two sets of analyzed data were compared. Each year soil samples were collected at the end of season and subjected to chemical analysis (Ghosh *et al.,* 1960).

Results and Discussion

Sole effect of liming was significant in respect to 6 months old shoot *i.e.* on two year pooled data. Lac yield ratio obtained under liming was 71 per cent higher compared to no liming. However, no significant difference in lac yield ratio was observed when pooled over three years. Its effect was reflected on yield attribute like sticklac weight per 100 g broodlac. Therefore, result indicated that liming failed to show any effect on lac yield when lac culture was done on older shoots. In one hand, liming increases availability of many macro and micronutrients which finally improves shoot growth of hosts of acid soils and on the other hand it can facilitate deposition of calcium on selected tissues and increases resistance of hosts against insect attack. It was observed that liming affect lac production only when soil calcium carbonate content reaches 3.25 per cent (Ghosal, 2012). Since rate of liming was kept moderate and calcium carbonate content of existing soil was also moderate (Table 1), only beneficial effect on plant growth was observed due to liming. Research has confirmed that higher soil pH promoted greater respiration rates and greater microbial biomass carbon in lime-treated than in non-limed soils (Fuentes, 2006). Increased soil fertility due to liming might have supplied better nutrition to the host and the host in turn could supply better nutrition to the insect.

Application of potassium could not influence lac yield solely either on six months or on older shoots. However, interaction effect of liming and potassium was found to be significant in case of 6 months old shoots. Effect of potassium application was observed in the absence of liming and highest level could increase lac yield 2.8 times than that of control. Similarly, liming in the absence of potassium application proved to be the best treatment and response of liming decreased steadily with increase in level of potassium (Fig. 1). Effect of interaction was not significant in case of more than 2 year old shoots. Older shoots, due to its reserved food materials can supply nutrition to the insects; but tender shoots fail to do so and requires fertilization for sustained supply of food to lac insect. Potassium plays important roles in translocation of assimilate from source to sink. Applied potassium might have facilitated host to support nutrition of lac insect in a better way which ultimately increased lac yield (Ghosal, 2012).

But, potassium application in the presence of lime had reduced lac yield significantly. Simultaneous application of lime and potassium has increased

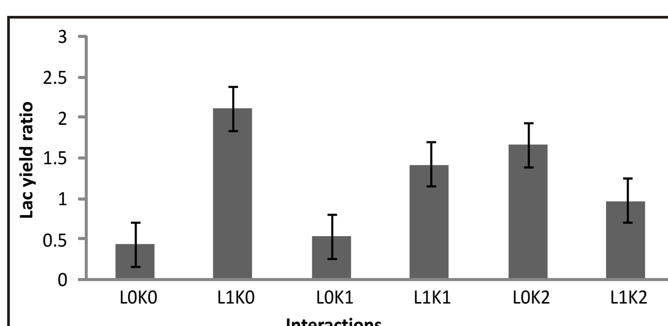

Fig. 1: Pooled lac yield ratio affected by liming and potassium rates during 2012-13 and 2013-14

L0/L1: No liming and liming; Ko/K1/K2: Three doses of potassium

Table 1: Pooled lac yield and yield attributes affected by liming and potassium rates and shoot age.

Factors	Lac yield ratio		Broodlac wt per 10 cm (g)		Sticklac wt per 100 g		Final Soil available K_2O (kg/ha)	Final soil $CaCO_3$ level (per cent)
	Y-III	Y-II	Y-III	Y-II	Y-III	Y-II		
L0	2.63	0.88	4.86	3.45	21.31	12.76	244.67	0.45
L1	2.92	1.51	5.08	3.76	23.71	17.89	254.87	0.61
$CD_{(0.05)}$	0.84	0.47*	0.82	0.48	3.02	2.34*	26.74	0.16*
K0	2.93	1.28	4.69	3.32	21.43	13.66	224.60	0.55
K1	2.38	0.98	5.06	3.75	21.60	13.85	268.56	0.49
K2	3.01	1.32	5.16	3.74	24.50	18.47	256.14	0.55
$CD_{(0.05)}$	1.03	0.58	1.00	0.58	3.69	2.87*	32.75*	0.20
Y1	5.93		7.70		36.89			
Y2	0.87	0.87	4.08	4.08	11.69	11.69		
Y3	1.52	1.52	3.13	3.13	18.96	18.96		
$CD_{(0.05)}$	1.03*	0.47*	1.00*	0.48	3.69*	2.34*		

Significant at 5% level
L0/L1: No liming and liming; Ko/K1/K2: Three doses of potassium; Y1/Y2/Y3: Three years
Y-III : 3 year pooled data (2011-12 to 2013-14)
Y-II : 2 year pooled data (2012-13 to 2013-14)

significantly the potassium and $CaCO_3$ level of soil (Table 1). As a result, intensity of both has increased significantly which has contributed in enhanced uptake of potassium. Similar findings were also cited in acid soils (Khandakhar *et al*., 2004) and reverse trend was observed in alkali soils (Ranjha *et al*., 2001). Higher availability of potassium to the host might have imparted resistance against lac insect and yield level had gone down. Moreover, application of lime in acid soils could increase soil pH considerably which eventually increases the pH dependent charges of soil particles causing more retention of potassium in clay complex. This phenomenon can reduce loss of soil potassium and can ensure supply of the nutrient for a longer time. This could be the reason why negative effect of potassium in presence of liming was observed on summer crop, though fertilizers were applied during rainy season.

Experimental findings suggested that lac yield can be increased significantly (4 to 7 times) if rest period is increased for such trees (Table 1). Average lac yield ratio in first year (more than two year old shoots) was recorded to be 5.9 and that for rest two years was 1.2 only.

Conclusion

Rangeeni lac yield on *B. monosperma* is being non-remunerative day by day. A section of scientists consider poor plant nutrition to be one of the important factors behind the phenomena. Present study concludes that soil fertility management of *B. monosperma* trees and selection of higher shoot age can increase lac yield considerably. Interaction study suggested that only liming (200g/m^2) or only potassium application (upto 1000 g/tree) are best treatments enhancing lac yield in acid soils. As far as shoot age is concerned, higher shoot age *i.e.* more than two years can produce lac yield more than 4 times than that of 6 months old shoots. The study brings forth new factors for attention of researchers and farmers for increasing lac yield on *B. monosperma* trees in acid soils.

_ब्यूटीया मोनोस्पर्मा_ वृक्षों पर गरम मौसम में लाख खेती के लिए प्ररोह आयु, लाइमिंग एवं पोटेशियम अनुप्रयोग का प्रभाव

एस. घोषाल

सारांश

भारतीय प्राकृतिक राल एवं गौंद संस्थान, राँची के अनुसंधान फार्म में 2011-12 से 2013-14 के दौरान चूना (चूना एवं गैर-चूना), पोटेशियम अनुप्रयोग (0, 500 और 1000 ग्रा. प्रति वृक्ष) एवं प्ररोह आयु के विभिन्न स्तरों को मिलाकर एक प्रयोग किया गया, जिसे पांच बार दोहराया गया ताकि मध्यमाकार वृक्षों पर गरम मौसम में *रंगीनी* लाख उत्पादन पर मृदा उर्वरता के प्रभाव का अध्ययन किया जा सके। प्रयोग के परिणामों ने दर्शाया कि 6 माह के प्ररोहों के मामले में गैर लाइमिंग की तुलना में लाइमिंग में प्राप्त लाख उत्पादन अनुपात 71 प्रतिशत उच्च था। तथापि, आँकड़ों के विश्लेषण ने दर्शाया कि लाइमिंग का पुराने प्ररोहों पर न्यूनतम प्रभाव पड़ा। इसका प्रभाव स्टिकलैक जैसे उत्पाद गुण पर भी परिलक्षित हुआ। लाइमिंग के कारण वर्धित मृदा उर्वरता ने परपोषी को बेहतर पोषक की आपूर्ति की और बदले में परपोषी कीट को बेहतर पोषक की आपूर्ति कर सका। लाख का उत्पादन उस समय महत्वपूर्ण रूप से बढ़ा (4 से 7 गुना), जब पुराने प्ररोहों में खेती की गई। 6 माह के प्ररोहों के मामले में लाइमिंग और पोटेशियम का पारस्परिक क्रिया

प्रभाव महत्वपूर्ण पाया गया। लाइमिंग की अनुपस्थिति में पोटेशियम अनुप्रयोग का प्रभाव देखा गया तथा उच्चतम मात्रा छः माह के प्ररोहों पर नियंत्रण की अपेक्षा 2.8 गुना लाख उत्पादन में वृद्धि कर सकी। इसी प्रकार, पोटेशियम अनुप्रयोग की अनुपस्थिति में लाइमिंग सर्वोत्तम उपचार सिद्ध हुआ। प्रयुक्त पोटेशियम ने परपोषी को सुसाध्य बनाया कि वह बेहतर तरीके से लाख कीट को पोषण की आपूर्ति कर सके जिसके फलस्वरूप वर्धित लाख उत्पादन हुआ।

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