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Pruning for tree vigour and lac productivity of Palas Variant Swadi (*Buteamonosperma*) in Chhotanagpur platue of Jharkhand

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Abstract
Pruning provides suitable ground (tender shoots) for the lac insect to feed. Pruning of host plant is an important and foremost requirement for lac cultivation which determines successof lac crop. *Swadi palas*, a morphological variant of common palas (*Buteamonosperma*) prefers *kusmi* strain. Farmer prefers to prune*swadipalas* trees in the mid-month of December to prevent loss of lac resin due to shattering of lac encrustation from petiole and harvest *ari* (i. e. immature) lac. Owing to this untimely pruning-cum-lac harvesting, tree does not produce sufficient healthy tender shoots and alsoreceives low price from selling *ari* scrapedlac. To suggest the appropriate pruning time trees wereprunedin the mid of December, January, February and March and *kusmi* broodlac was inoculated in July for three consecutive years 2014-2017. Inoculable new shoots length was significantly higher in the mid of January and February pruning as compared to farmers practice of pruning in December. Length and width of new shoots had significant and positive correlation with broodlac yield (0.673 and 0.498, respectively) whereas its correlation with number of shoots was significantly negative (-0.344). Broodlac yield ratio was significantly higher in January (6.24) and February (6.28) pruning as compared to December pruning (4.76).Our investigation observed that January and February pruning increased broodlac yield by 18 to 21%.

Keywords: Pruning time, palas variant-swadi, *But eamonosperma*vars*wadi*, *Kusmi*, lac

Introduction
The purposes of pruning a plant or tree varied from training growing pattern, restricting growth, maintaining or improving plant health or the quality of flowers, fruit and foliage. The appropriate amount of pruning of live tissue from a tree will depend on the size, species and age as well as the pruning objective. Proper pruning is essential in developing a tree with a strong structure and desirable form. It includes the removal of dead, dying, diseased, crowded, weakly attached and low vigour branches from the trees crown. The selective removal of branches is done to increase light penetration and air movement throughout the crown. The removal of the lower branches from a tree provides clearance. Pruning reduces the size of a tree for maintaining the form and structural integrity of a tree.

Lac, the raw material for industries, is the scarlet resinous secretion of a number of species of lac insects, of which the most commonly cultivated species is *Kerrialacca* Kerr. It has two strains *viz*, *kusmi* and *rangeeni*. Based on this specificity of hosts to complete their life cycle. *Kusmi*strain of lac insect survives on kusum (*Schleicheraoleosa*), ber (*Ziziphusmauritiana*), semialata(*Flemingia semialata*) and *rangeeni* strain on *ber*andcommon*palas* (*Buteamonosperma*) in Jharkhand. *B. monosperma* (Lam.) Taub commonly known as 'Flame of the forest' is also known by various names in India viz., *'dhak'* or *'Palas'*, *Palash*, *Mutthuga*, *Bijasneha*, *Khakara*, *Chichara*, *Bastard teak*, *Bengal kino.* It is one of the important host trees for *K. lacca*lac insect, exploited commercially for *rangeeni* lac cultivation in India. *Swadi palas*, a variant of common *palas*differed significantly on plant statured, leaf shape, flower size and colour, flowering and fruiting time, time of defoliation, biochemical profile etc. However they are yet to be differentiated on genomic/ chromosomal level. This variant was identified from Putadag village in Angarha block, Ranchi district of Jharkhand state. Standard pruning time has already been established for common palas for *rangeeni* strain lac insect. Since this variant prefers*kusmi* strain of Indian lac insect the harvesting-cum-pruning time differs from common palas which is in April.Moreover, farmers prefer to prune *swadipalas* trees in mid-Decemberinstead of late January to early February to avoid loss of lac resindue to shattering of lac encrustation from petiole and harvest *ari* (i. e. immature) lac. Owing to this untimely pruning-cum-lac harvesting, tree does not produce sufficient healthy tender shoots at the time of inoculation during July. Also harvesting of immature lacfetches low price after

selling. Thus the present study was initiated to suggest the appropriate pruning time for*palas*variant '*swadi'* to achieve maximum lac production. Attractive Yet, adoption levels for several components of the improved technology were low, emphasizing the need for better dissemination (Kiresur *et al.* 2001). Several biotic, abiotic and socio-economic constraints inhibit exploitation of the yield potential and these needs to be addressed. The state-wise yields obtained both under improved technology and farmers' practice ranges from 12 to 110% between states.

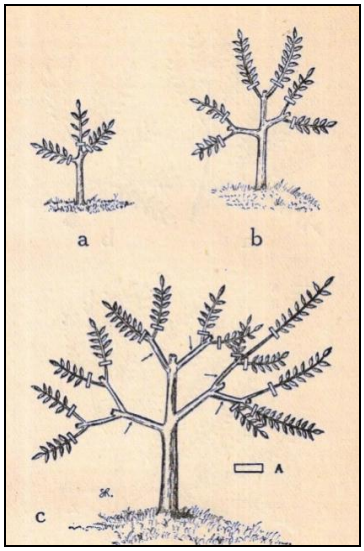


Fig 1: Pruning technique in palas variant

[Diagrams of a lac host showing the correct positions for successive pruning (After Glover 1937, Text fig II.). (a) Position for the original pruning cut, (b) New shoots resulting from the pruning shown in Fig a. Position for the next (second) pruning cuts (c) New shoots resulting from the pruning shown in Fig. b. Position for the pruning cuts to be made at the next (third) pruning. Empty rectangle indicated correct position for pruning. Arrows indicate point at which broodlac should be tied] Cited from Ronwal 1962

Results and discussion

Number of new shoots, its length and broodlac yield ratio had significant variation over pruning time. Number of new shoot emerged after pruning were highest (7.0) in March pruned plants and lowest (4.4) in December pruning. Shoot length and diameter was observed maximum during mid-January and mid-February pruning. Minimum shoot length (48.1 cm) was observed in December and minimum shoot diameter (13.8mm) in March pruning (Table 1). The new shoot diameter was maximum (16.1 mm) in January and minimum (13.8 mm) in March pruning. However variation in shoot diameter was non-significant. Broodlac yield ratio and number of new shoots varied significantly over years also. There is no significant difference in length and width of new shoots over year. The interaction between pruning time and year was significant only for shoot length and diameter. Broodlac yield ratio was significantly higher in mid-January (6.3) and mid-February(6.4) pruning as compared to farmers practice of pruning (4.8) inmid-December (Fig 2). More shoot length and diameter provided more space for insect settlement thus increasing productivity per unit area. Though the number shoots emerged in March pruning was highest it recorded less broodlac yield ratio. This is because during rainy season dense branching reduces aeration which is not suitable for lac insect development and may increase mortality. Our investigation observed that January and February pruning increased broodlac yield by 18 to 21%.

Table 1: Influence of pruning on vegetative growth and broodlac yield in *swadi palas*

Month of pruning	Broodlac yield ratio	Shoot number	Shoot length (cm)	Shoot diameter (mm)
December	4.8	4.4	48.1	15.0
January	6.3	5.9	101	16.4
February	6.4	5.4	97.9	15.9
March	3.9	7.0	70.6	13.8
Factor (month)	0.38	0.39	12.88	N/A
Factor (year)	0.27	0.28	N/A	N/A
Factor (interaction)	N/A	N/A	18.21	3.35

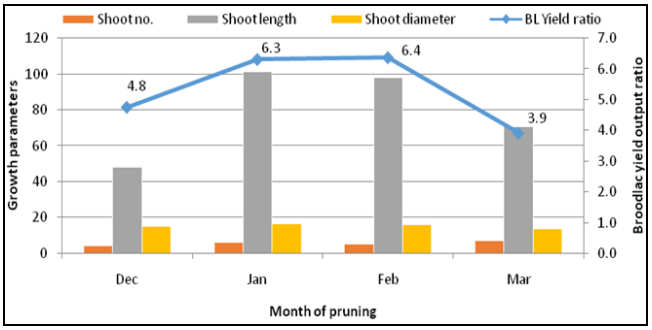


Fig 2: Pruning response of palas variant '*swadi'* for winter *kusmi* lac cultivation

Pruning of fruit varieties of ber in February observed good vegetative growth in almost all varieties and identified some varieties for winter *kusmi* lac production (Ghosh *et al* 2016). Jaishawl *et al* (2011) advocated pruning in palas in middle of February for rainy season (*katki*) and April for summer season (*baisakhi*). Ghosal (2009) explained consequence of lac cultivation under three different pruning time in *ber* and suggested that pruning can be performed even up to mid-April without hampering lac yield. Blazkova, and Drahosova (2012) in a study on impact of pruning time on tree vigour and productivity of three sweet cherry cultivars grown on two semi-dwarf rootstocks observed that specific productivity was mostly higher after tree pruning done in August in initial growth stage but in the subsequent stage generally better to prune in March time. Hevia *et al.* 2016 observed a pruning effect in terms of diameter growth of two major timber conifer species and suggested that pruning is essential towards producing high-quality timber. Singh and Bal 2008 suggested that ber should be pruned during summer month after harvest of crop when the tree sheds their leaves before onset of the new growth (dormant stage). Kunduet. Al. 1994 obtained maximum shoot length, shoot diameter by pruning of the primary branches of ber from base and remaining half at 15 buds in May. Ghosal 2013 in a study on soil fertility management in *ber*, stated that regardless of its use either for fruit or for the cultivation of lac, it has to undergo pruning

operation for successful crop.

The correlation coefficient (r) measures the strength and direction of a linear relationship between two variables on a scatterplot. Length and width of new shoots had significant and positive correlation with brood lac yield ratio (0.67 and 0.50, respectively). It suggests that elongated and thicker tender branches (shoots) favours lac insect to feed on them and secrete more resins to maximize lac production. The negative association (-0.34) between number of new shoot and broodlac yield ratio implies that crowded branches from same cut point disfavour lac production (Table 2).

Table 2: Correlation coefficient between vegetative growth and broodlac yield in *swadi palas*

Correlation	Broodlac yield ratio	Number of new shoots	Length of new shoots
Broodlac yield ratio	1.000		
Number of new shoots	-0.344*	1.000	
Length of new shoots	0.673**	0.221NS	1.000
Width of new shoots	0.498**	-0.276NS	0.577**

Linear regression is a basic and commonly used type of predictive analysis. It examine two things: (1) a set of predictor variables do a good job in predicting an outcome (dependent) variable and (2) variables in particular are significant predictors of the outcome variable, and in what way do they-indicated by the magnitude and sign of the beta estimates-impact the outcome variable. The regression coefficient is highly significant in this model (Table 3). R-squared is a goodness-of-fit measure for linear regression models. This statistic indicates the percentage of the variance in the dependent variable that the independent variables explain collectively. R-squared measures the strength of the relationship between our model and the dependent variable on a convenient 0-100% scale. After fitting a linear regression model, we need to determine how well the model fits the data. Does it do a good job of explaining changes in the dependent variable? Small R-squared values are not always a problem, and high R-squared values are not necessarily good! The model explains 67 percentage of the variance in the dependent variable (number of new shoots, length and width of new shoots) that the independent variables (brood lac yield ratio) explain collectively.

Table 3: Regression coefficient for broodlac yield

SV	DF	Mean Squares
Regression	1	10458.02**
Error	38	332.41

R-square value: 0.453
Multiple R-value: 0.673

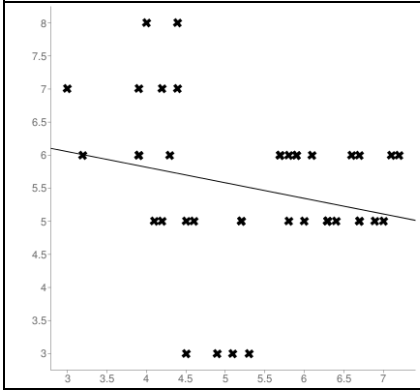
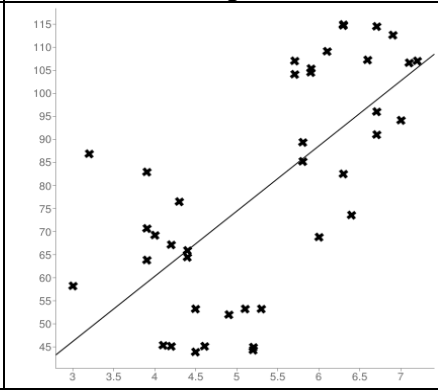
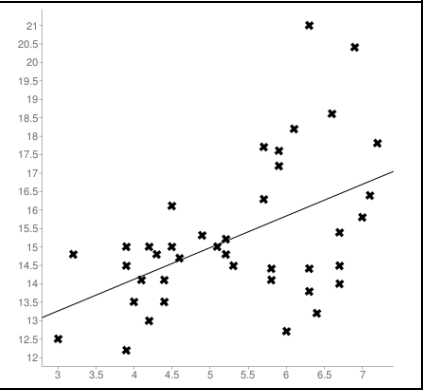
Brood lac vs number of new shoots	Brood lac vs length of new shoots	Brood lac vs width of new shoots
		
Slope (b): -0.2357	Slope (b): 14.1273	Slope (b): 0.8577

Fig 3: Slope of regression line among broodlac yield ratio and independent variables

The slope of a regression line (b) represents the rate of change in y as x changes. Because y (broodlac here) is dependent on x, (number of new shoots, length of new shoots and width of new shoots) the slope describes the predicted values of y given x The slope of a regression line is used with a t-statistic to test the significance of a linear relationship between x and y. Fig 3 (a) shows negative linear relations between number of shoot and broodlac yield ratio. Length and width of new shoots had positive relations with broodlac yield ratio (Fig 3, b, c).

Conclusion

The preference of lac insect in *swadi palas*is different from common *palas* as this variant is good for *kusmi* lac cultivation as against *rangeeni* lac on common palas. Pruning of host plant is an important cultural practice for lac cultivation which determines success of lac crop. By following mid-January and mid-February pruning of palas variant '*swadi'* farmers can be successful in*kusmi* winter lac production.

A B C D

Plate 1. (a) Pod formation in palas variant at the time of flowering in common palas, **(b)** early pruning in December, **(c)** pruning as recommended, **(d)** encrustation of winter kusmi lac on palas variant 'swadi'

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