Research Article

Effect of Pruning Intensity on Growth and Biochemical Properties of Vegetative Shoot in Litchi (*Litchi chinensis* Sonn.)

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Abstract

The trial was conducted to study the growth pattern and biochemical changes in vegetative flush in litchi (*Litchi Chinensis* Sonn.) cv. Purbi as influenced with different degree and time of pruning during the year 2019-20 at Bihar Agricultural College, Sabour, Bhagalpur. The treatments comprised of three pruning level i.e. 15cm pruning, 30cm pruning, 45cm pruning in the month of July and August including unpruned control. Significant effect of treatments were noted in changes in number of leaves per shoot, leaf area, chlorophyll and carotenoid content at different stage of shoot maturity and in flowering panicles. Date of flush emergence varied from 21-07-2019 to 21-09-2019atdifferent pruning level. 15cm pruning in July was the earliest to initiate flush emergence followed by 45cm pruning in August. The pruned shoot had faster leaf growth as compared to un-pruned shoots and the highest leaf area was observed in treatment T_2 (15 cm pruning in July. The maximum flush growth, chlorophyll and carotenoid content in mature shoot was at 15cm pruning in July followed by 30 cm pruning in July and it was minimum in 45cm pruning in August.

Keywords: Pruning, Litchi, growth, chlorophyll, carotenoid

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Introduction

Litchi (*Litchi chinensis* Sonn) is one of the most important subtropical evergreen fruit crops originated in southern china. Litchi is an evergreen, repeatedly flushing and frequently flowering tree and its vegetative characters are susceptible to the environment and may change with difference in climate, soil and cultural practices. Recurrent flush emergence followed by flowering is common in litchi which depends on cultivation, tree size and growing conditions, especially related to nitrogen and water availability. Flowering and fruiting in litchi is highly related to flushing time and shoot maturity along with physiological and biochemical status of shoot such as floral ignition process especially warm subtropical region [1].

In litchi, flowering is affected by the cycle of shoot development and maturity [2]. The maturity of terminal shoots is directly related to floral initiation. If the terminal shoots are not sufficiently mature at the time when conditions are ideally inductive then it causes late bud-break, while if the terminal shoots are fully mature prior to the stage when conditions are ideally inducive, it cause early bud break and flowering is adversely affected. Pruning of shoot after harvest has been found to be effective in regulating flush maturity and flowering in litchi.

Flush growth after harvesting is important for tree recovery and productivity for the next season. New growth of the shoots responds to low temperatures in winter and forms of reproductive flushes [3].New growth occurs only from a fully mature shoot. Pruning is an important horticultural operation affecting the vegetative and floral behaviour of litchi likes in many other fruit crops [4] by manipulating time of flush maturity and physiology. Thus the present investigation was carried out to study the effect of pruning on flush growth and biochemical properties of growing shoots in litchi cv Purbi.

Materials and Methods

The trial was laid out in randomized block design in the Horticulture Garden of B. A. C., Sabour under Bihar Agricultural University, Sabour, Bhagalpur, Bihar with a view to study the growth pattern and biochemical changes in commercial cultivar of litchi. The climate of Sabour, Bihar is sub-tropical with slightly arid in summer, cold in winter and rainfall status is moderate. Six plants of litchi var. Purbi was taken for pruning (Three plants was taken for each date of pruning i.e July and August) with four pruning level i.e. No pruning, 15cm pruning, 30 cm pruning, 45cm pruning in the month of July and August including un-pruned control. Twenty branches were selected for the pruning

under each treatment. Seven treatments were made at different pruning level i.e.T_1- Control (No pruning), T_2-15 cm pruning in July, T_3-30 cm pruning in July, T_4- 45 cm pruning in July, T_5-15 cm pruning August, T_6-30 cm pruning in August, T_7- 45 cm pruning in August. Observations on flush growth in terms of length and spread, number of leaves, leaf area, chlorophyll content, carotenoid content were noted at 45, 90 and 135 days after pruning and in flowering panicle. Five shoots were randomly selected for recording the observations under each replication**.** The length and spread of flush was measured with the help of measuring scale from the base to apex and at maximum spread at different maturity stage. The individual leaf area was measured with leaf area meter and total leas area was calculated by multiplying it with total number of leaves per shoot and expressed in square centimetre (cm^2). For estimation of chlorophyll and carotenoid middle portion of 3rd leaflet was taken from three shoots of each replication. Estimation of carotenoid was performed by the method of Hendry and Price [5] with little modification. Leaf sample of 0.2 g was homogenized in 80% acetone. As mentioned in the chlorophyll estimation process, carotenoid was extracted and after centrifugation supernatant was used for spectro photometric reading. An absorbance was recorded at three different wavelengths such as 663nm, 645 nm and 480 nm. Carotenoids content was calculated using the formula:

$$[A480 + (0.114*A663) – (0.638 – A645)]*V/1000*W$$

Here, A = Absorption, V = Total volume, W = weight of sample (gram).

Chlorophyll content was determined by Acetone method. 1g fresh sample of leaf was taken and after cleaning in running water crushed it in 20 ml of 80 % acetone, centrifuged the sample at 10,000 rpm for 20 minutes at 4°C temperature and transfer the supernatant and take the absorbance. Absorbance of the extract was measured at 663nm and 645nm wavelength using a spectrophotometer. The amount of total chlorophyll was determined using the formula:

$$\text{Total Chlorophyll} = \frac{[(8.02 \times A663) - (20.2 \times A645)] \times V}{1000 \times \text{weight of Sample}}$$

Concentration of chlorophyll and carotenoid are expressed in mg g^{-1} fr. wt.

Results and Discussion

Flush growth initiation

The data reflected that the number of days taken for flush emergence under different treatment varied from 21 days in T_2 (15cm pruning in July) to 41 days under T_7 (45cm pruning in August) as mentioned in **Table 1**. Among the pruning levels, treatment T_2 was the earliest to initiate new flush after pruning followed by T_3 (30cm pruning in July) and T_5 (15cm pruning in August) that took 29 days to initiate emergence of new flush. Delayed in flush emergence in pruned litchi tree has also been reported by [6] and reported 1-2 months delay in flush emergence as compared to unpruned control. Effect of differential pruning on shoot elongation has also been reported in litchi [2].

Table 1 Date of flush growth initiation under different pruning levels

Treatment	Pruning level	Date of vegetative flush growth initiation
T1	Control	21-07-2019
T2	15 cm July.2019	15-08-2019
T3	30 cm July.2019	19-08-2019
T4	45 cm July.2019	24-08-2019
T5	15 cm August.2019	09-09-2019
T6	30 cm August.2019	15-09-2019
T7	45 cm August.2019	21-09-2019

Changes in flush growth

Significant effect of different pruning levels on increase in flush length has been observed (**Tables 2** and **3**). After 135 days of pruning the highest flush length of 46.08 cm was noted in unpruned control(T_1) followed by T_2 (15cm pruning in July) which was at par with T_3 (30cm pruning in July) and T_5(15cm pruning in August) having flush length of 43.63 cm, 41.15 cm and 40.98 cm, respectively. The investigation conducted by [7] is also in the same tune who reported more shoot growth and early maturation in light pruned shoot as compared to heavy pruning in litchi cv Mauritius. Higher shoot growth in unpruned and less pruned shoot was due to early flush emergence in these shoots.

Similar finding has been advocated by [8] in citrus who reported high shoot growth in unpruned and light pruned citrus plants. Earlier, emergence of leaf with advancement of pruning severity has been enunciated [9].

Table 2 Changes in Flush length at different pruning level (cm)

Treatment	Pruning level	Days after pruning		
		45DAP	90DAP	135DAP
T1	Control	25.94	31.40	46.08
T2	15 cm July.2019	20.33	26.93	43.63
T3	30 cm July.2019	17.81	21.68	41.86
T4	45 cm July.2019	14.80	18.95	34.99
T5	15 cm August.2019	17.42	20.63	41.57
T6	30 cm August.2019	15.95	19.59	40.98
T7	45 cm August.2019	13.58	17.24	33.87
	Mean	17.98	21.92	40.43
	SeM(±)	1.202	1.070	0.750
	CD(P=0.05)	3.70	3.30	2.30
	CV(%)	11.58	8.470	3.201

Table 3 Changes in Flush growth (spread) at different pruning level (cm)

Treatment	Pruning level	Days after pruning		
		45DAP	90DAP	135DAP
T1	Control	18.93	26.43	30.7
T2	15 cm July.2019	16.76	24.7	29.3
T3	30 cm July.2019	15.81	22.3	27.91
T4	45 cm July.2019	13.33	18.2	27.23
T5	15 cm August.2019	15.13	21.93	28.3
T6	30 cm August.2019	13.84	19.36	26.33
T7	45 cm August.2019	11.63	16.13	24.16
	Mean	15.06	21.29	27.71
	SeM(±)	0.753	1.63	1.163
	CD(P=0.05)	2.320	5.02	3.583
	CV(%)	8.66	13.243	7.270

Leaf characters

The perusal of the data reflected significant effect of different pruning levels on increase in leaf number and leaf area and gradual increase was noted under all treatment (**Tables 4** and **5**). The pruned shoot had faster leaf growth as compared to unpruned shoots. After 135 days of pruning the highest number of leaves 9.98 was noted in T_2 (15 cm pruning in July) which was at par with T_3(45cm pruning in August) having 9.74 number of leaves / shoot. Similarly highest leaf area was observed in treatment T_2 (15 cm pruning in July) and it was statistically similar to T_3 (45cm pruning in August) having leaf area of 204.33 cm^2 and 191.6 cm^2, respectively. The least leaf growth was observed in T_7 (45 cm pruning in August). Finding of earlier work is also in the same tune who observed increased leaf area in pruned shoot in guava [10]. Similarly reduced leaf area with delayed pruning was reported by [11] in Kiwi. Contrary to it better growth with heavy pruning in Ber has also been reported [12]. Working in litchi less shoot growth and flowering with delayed pruning has also been advocated [13].

Chlorophyll content

The chlorophyll content increased gradually with increase in age of leaf and became static after maturity and in flowering panicle as well in all the treatments. Similar trend was observed regarding chlorophyll a, b and total chlorophyll content with increasing leaf maturity **(Table 6).** The treatments significantly affected the level of chlorophyll at all stages of maturity. After 135 days of pruning the highest total chlorophyll of 7.13mg/g fresh weight was noted in T_2 (15cm pruning in July) which was at par with T_3 (30 cm pruning in July) and T_5 (15 cm pruning in August). The minimum total chlorophyll of 6.09mg/g fresh weight was observed in T_7 (45 cm pruning in August). Increase in chlorophyll content with increasing leaf maturity have also been corroborated with the findings of [13]

and [14] in litchi. Many fold increase in chlorophyll content has been recorded from young to mature leaves in litchi by [15,16].

Table 4 Change in number of leaves in different pruning levels

Treatment	Pruning level	Days after pruning		
		45DAP	90DAP	135DAP
T1	Control	4.20	7.46	9.74
T2	15 cm July.2019	3.63	7.73	9.98
T3	30 cm July.2019	3.36	7.23	9.55
T4	45 cm July.2019	2.26	6.71	9.10
T5	15 cm August.2019	3.2	7.54	9.64
T6	30 cm August.2019	3.16	7.24	9.52
T7	45 cm August.2019	2.03	6.56	9.28
	Mean	3.12	7.21	9.54
	SeM(±)	0.082	0.204	0.113
	CD(P=0.05)	0.255	0.631	0.34
	CV(%)	4.59	4.92	2.06

Table 5 Change in leaf area in different pruning level (cm^2)

Treatment	Pruning level	Days after pruning		
		45DAP	90DAP	135DAP
T1	Control	123.10	179.6	183.33
T2	15 cm July.2019	113.00	189.4	204.33
T3	30 cm July.2019	100.30	186.0	191.60
T4	45 cm July.2019	79.30	175.6	183.67
T5	15 cm August.2019	93.00	176.3	184.33
T6	30 cm August.2019	89.60	172.3	180.00
T7	45 cm August.2019	75.66	169.0	172.30
	Mean	96.30	178.34	186.20
	SeM(±)	4.95	6.99	5.621
	CD(P=0.05)	15.27	NS	17.321
	CV(%)	8.92	6.79	5.22

Table 6 Change in total chlorophyll (mg/g fresh weight) in different pruning level

Treatment	Pruning level	Days after pruning			Flowering panicle
		45DAP	90DAP	135DAP	
T1	Control	2.24	7.07	6.87	7.18
T2	15 cm July.2019	2.15	6.96	7.13	7.64
T3	30 cm July.2019	2.21	6.41	6.97	7.38
T4	45 cm July.2019	2.10	6.06	6.65	6.84
T5	15 cm August.2019	2.32	5.13	6.93	7.29
T6	30 cm August.2019	2.07	4.76	6.56	6.89
T7	45 cm August.2019	2.09	4.56	6.09	6.47
	Mean	2.17	5.34	6.63	6.93
	SeM(±)	0.08	0.07	0.26	0.11
	CD(P=0.05)	0.26	0.21	0.41	0.35
	CV(%)	6.70	2.20	6.76	2.85

In flowering panicle also the highest chlorophyll of 7.64mg/g fresh weight was noted in T_2 (15 cm pruning in July) which was statistically at par with T_3 (30 cm pruning in July). Significantly minimum chlorophyll was noted in T_7 (45 cm pruning in August). Similar trend of change in chlorophyll content with maturity of leaves has also been reported by Huang and Chen [17]. The shoots pruned during July in the present experiment became mature enough to have high chlorophyll content and shoots pruned with high intensity during August could not become mature enough to reach to the maximum level of chlorophyll content in these shoots. These shoots started new flush after more than 30 days and probably were not sufficient mature till panicle emergence.

The close examination of data reflected gradual increase in carotenoid content in litchi leaves with maturity period (**Table 7**). Treatment effect was found significant in initial stage of leaf growth but no significant variation among treatments in carotenoind contents were noted in mature leaf and in flowering stage also.

Table 7 Change in carotenoid content (mg/g fresh weight) in leaf in different pruning level

Treatment	Pruning level	Days after pruning			Flowering panicle
		45DAP	90DAP	135DAP	
T1	Control	0.078	0.085	0.121	0.124
T2	15 cm July.2019	0.062	0.091	0.116	0.122
T3	30 cm July.2019	0.058	0.099	0.104	0.114
T4	45 cm July.2019	0.071	0.085	0.106	0.117
T5	15 cm August.2019	0.069	0.084	0.110	0.120
T6	30 cm August.2019	0.070	0.098	0.119	0.122
T7	45 cm August.2019	0.072	0.079	0.103	0.111
	Mean	0.067	0.085	0.111	0.119
	SeM(±)	0.003	0.004	0.26	0.11
	CD(P=0.05)	0.011	0.12	NS	NS
	CV(%)	3.30	2.20	4.76	2.85

Conclusion

Thus, on the basis of the finding it may be concluded that pruning in litchi may be applied to regulate flush growth, maturity and bio chemical properties of litchi shoots in order to regulate flowering. Post-harvest shoot pruning at 15cm in the month of July has been found to be the most effective in increasing shoot length, leaf area and chlorophyll content in litchi.

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Publication History
Received 22.12.2020
Revised 10.06.2021
Accepted 11.06.2021
Online 30.06.2021