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Effect of different pruning date and severity on growth, yield and quality parameters of *Ber* (*Zizyphus mauritiana* Lamk) in arid condition

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Abstract

The research was carried out at experimental field of Agricultural Research Station, Mandor, Jodhpur during April, 2016 to February, 2017 to evaluate the response of pruning time and severity on fruit production, quality and profitability of *Ber* cv. Gola. Six year old grafted trees of *ber* were pruned at intervals, i.e. on 30 April, 15 May, 30 May, 15 June with two pruning severity levels i.e. 30 per cent and 50 per cent removal of previous season growth. The yield improving growth parameters *viz*., comparatively less number of main shoots (21.43 plant^{-1}), maximum number of branches (240.25 plant^{-1}), minimum shoot length (117.60 cm) and girth of shoots (13.26 cm) have been markedly promoted by the 15th June pruning with 30 per cent severity than rest of the treatments. Early pruning (30 April) with highest severity (50%) has been found to increase the vegetative growth like shoot length and girth but yield has been formed inversely proportional supra-optimal level of pruning. Flowering and fruit setting was delay by 15 days in tree pruned on 15th June, which was significantly reduce flower and fruit drop. All the yield parameter and fruit yield *viz*., fruit set per cent (29.40%), fruit retention per cent (29.95%), fruit harvest per cent (8.80%), number of fruits in sq. meter^{-1} canopy of plant (165), fruit yield plant^{-1} (72.09 kg) and fruit yield ha^{-1} (200.41 q) was significantly higher in T_5 treatment. Highest economic performance *viz*., Gross return (Rs. 180368.85), net return (Rs. 134368.51) and B : C ratio (2.92) was recorded maximum in trees pruned on 15th June with 30 per cent severity whereas quality characters of fruits like highest Total Soluble Solids (15.40°Brix), lowest acidity (0.13%), high ascorbic acid (61.41 mg 100g^{-1}), highest fruit surface colour score (8.43), fruit taste score (8.20) and overall quality score of fruits (8.76) was reported in T_2 treatment. Minimum fruit fly infestation (3.93%) was reported in T_9 treatment.

Keywords: *Ber, Day After Pruning, fruit set, fruit retention, growth, shoots, taste score*

Introduction

Ber or Indian jujube (*Ziziphus mauritiana* Lamk) is indigenous to India it belongs to the family Rhamnaceae. Among the sub tropical fruits, it is one of the most common and ancient fruits of India. In last two decades area under *ber* crop is increased and farmers have adopted its commercial cultivation. It is grown extensively in the Madhy Pradesh, Rajasthan, Gujarat, Uttar Pradesh, Haryana, Bihar, Maharashtra, Punjab, Tamil Nadu and Andhra Pradesh under rainfed and irrigated conditions, in almost all the states covering an area of 0.49 million hectares with an annual production of 4.81 million tonnes and productivity of 10.0 tonnes per hectare (Anonymous, 2016). Rajasthan alone covering an area of 714.2 hectares with an annual production of 6732 tonnes and productivity of 9.42 tonnes per hectare (Anonymous, 2015). The fruits are rich in carbohydrate, vitamin C, A, B complex and minerals. Its leaves contain 5.6 per cent digestible crude protein and 49.7 per cent total digestible nutrients, making it a nutritive fodder for animals. Ripe fruits are eaten fresh and utilized in the preparation of jam, jelly, preserve and candy. Ripe fruits can be dried to prepare a product, similar to Chhuhara. *Ber* juice can be prepared from the fresh fruit and can be used for making squash. Annual pruning in *ber* is essential to induce maximum number of new healthy shoots which would bear good quality fruits. The *ber* trees being summer deciduous and are in deep dormancy during May and June and level of reserve metabolites such as carbohydrates starch and sugars is higher during this phase of dormancy. Pruning during this period led to more

growth, higher fruit set, and greater yield. However pruning done during the induction phase (April) and breaking phase (July) resulted in lower yield. Pruning is done during the hot and dry season when the tree sheds leaves and enters into dormancy.

The *ber* flowers have borne in the axil of leaves on the young growing shoots of the current year. Hence, a regular annual pruning is necessary to induce a good healthy growth which will provide maximum fruit bearing area on the tree. Pruning is an essential operation to maintain vigour of trees, fruit productivity and yield of *ber* (Singh *et al.*, 2004). It is also essential to remove the undesirable, weak, intercrossing, diseased and broken branches to avoid crowding and to encourage healthy growth for maximum fruit bearing. Moreover, annual pruning required to replace old and unproductive wood by new one, in unpruned trees, the old wood goes on accumulating every year and leads to barren centre, reduced productivity and poor fruit yield owing to shading and related problems. Therefore, in *ber* tree, it is essential practice to maintain their vigour and productivity as well as to improve the fruit size and fruit yield. The objective of pruning is to produce more number of fruits with high quality marketable fruits at a low cost. Apart from these, pruning also lead to rejuvenation, better ventilation, and higher penetration of sun light and also become feasible in application of plant protection chemicals and also reduce insect pest infestation. In last six to seven year's *ber* producer of western Rajasthan face a severe problem of flower and fruit drop due to high temperature in the month of September which coincides with the time of flowering and fruit setting. Due to high temperature acceptability duration of stigma was reduce and pollination and fertilization of flower is fail and maximum flower and fruits are dry. It is necessary to standardized date of pruning to minimize the effect of high temperature which was coinciding with the time of flowering and fruit setting. In case of unpruned tree canopy area continue to enlarge year after year, branch lets become very weak, fruit size reduced and tree ultimately become unproductive whereas in case of judiciously pruned tree vigor and shape is maintained and fruit size and quality is improved (Singh and Bal, 2008). Therefore, it is very much essential to ascertain the timing and extent of pruning in particular cultivars. Hence, keeping in the view the above, the present investigation was undertaken.

Materials and Methods

A field experiment was carried out on the six year old *ber* orchard at Agricultural Research Station, Mandor, Jodhpur (Rajasthan), India during April, 2016 to February, 2017. The soil of experimental fields were uniform in fertility, sandy loam in texture, low in organic carbon (0.75%), medium in available P (25.5 kg ha^{-1}) and high in K (270.0 kg ha^{-1}) with saturated extraction electrical conductance of 2.0 $ds.m^{-1}$ and slightly alkaline reaction (pH 8.5) during experimentation. The abiotic factors *viz.*, average minimum and maximum temperatures were 25.0°C ± 5.0°C and 40.0°C ± 5.0°C, average relative humidity of 55.0 ± 15.0 per cent and 350 mm rainfall per annum were recorded. The experiment was conducted in a completely randomized design having nine treatments comprising by different pruning time and severity *viz.*, T_1 (No pruning), T_2 (Pruning on 30th April + 30% removal of previous season growth), T_3 (Pruning on 15th May + 30% removal of previous season growth), T_4 (Pruning on 30th May + 30% removal of previous season growth), T_5 (Pruning on 15th June + 30% removal of previous season growth), T_6 (Pruning on 30th April + 50% removal of previous season growth), T_7 (Pruning on 15th May + 50% removal of previous season growth), T_8 (Pruning on 30th May + 50% removal of previous season growth), T_9 (Pruning on 15th June + 50% removal of previous season growth). All the observations were taken from 5 selected plant of each treatment throughout the investigation period at appropriate time by adopting standard method for growth, development, fruiting behaviour, yield and quality. Days taken for sprouting is calculated by couming the number of days taken for the pruned shoots to sprout, number of shoots emerged was recorded by counting the number of sprouts produced on each pruned tree, shoot burning per cent and number of branches $plant^{-1}$ calculate by simple counting method, shoot length is measured by the help of scale from base of shoot to highest tip of the shoot at the time of flower initiation, girth of primary shoots at base is recorded by counting of five randomly selected primary shoots at a marked point from base which was measured at 120 days after pruning with the help of a vernier callipers and average was calculated. Days taken to first flower initiation, flower density, number of fruits per square meter area of plant, days taken from pruning to first picking of fruit, last picking of fruits and duration of harvesting was calculated by simple counting method. Fruit set per cent, fruit retention per cent and fruit harvest per cent were recorded by following formulas:

$$\text{Fruit set per cent} = \frac{\text{Total number of fruits set plant}^{-1}}{\text{Total number of flowers plant}^{-1}} \times 100$$

$$\text{Fruit retention per cent} = \frac{\text{Total number of fruits gets maturity plant}^{-1}}{\text{Total number of fruits set plant}^{-1}\text{ (at initially stage)}} \times 100$$

$$\text{Fruit harvest per cent} = \frac{\text{Total number of harvested fruits plant}^{-1}}{\text{Total number of normal flowers plant}^{-1}} \times 100$$

The total fruit yield plant^{-1} and hectare^{-1} was calculated by weighing total marketable fruits on digital balance and average fruit yield of each plant was calculated and has been expressed in kilogram and quintal respectively. Market rate of fruits was taken from fruit market (Phal Sabji Mandi, Jodhpur) during the period harvesting (December, 2016 to February, 2017). The gross return was calculated from yield multiplied by average market rate during the period of investigation. Further, the net return was calculated by subtracting cost of each treatment from gross return. The benefit cost ratio was calculated by dividing net return to total cost of cultivation. Total soluble solids (TSS) of the fruit pulp was determined by Zeiss Hand Juice Brix Refractometer, values corrected to 20^{0}C and expressed as ^{0}Brix. Acidity (as citric acid) was determined by using standard N/10 NaOH solution in the presence of phenolphthalein as an indicator, AOAC (1984). The ascorbic acid (vitamin C) content of the juice was estimated by visual titration method with 2, 6-dichlorophenol-indonenol dye solution (AOAC, 1984). The overall quality (pulp colour, pulp: seed ratio, skin colour, size and shape of fruits), colour score and fruit taste or consumer preference of fruits was done by a panel of five semi-trained judges using 10 point hedonic scale (Amerine *et al.*, 1965). Per cent incidence of fruit fly was measured by visual inspection of five member team of crop experts at fruit harvesting. All data were subjected to analysis of variance (ANOVA) to determine significant differences followed by critical difference (CD) with in the treatment was calculated in order to compare the treatment at $P \leq 0.05$ level of significance only.

Results and Discussion

Plant growth parameters

Observations regarding number of days taken for sprouting after pruning were recorded and data thus obtained were analysed statistically it is clear from the table-1 that 50 per cent pruning of previous year shoot growth on 15th June (T_9) showed significantly earlier sprouting (21.60 days) which was *at par* with T_5 (25.4 days) and T_8 (24.7 days) treatments, whereas in control (no pruning) took relatively more number of days for sprouting (40.17 days). Number of main shoots emerged after pruning were counted and data obtained the mean values are summarized in table-1 which indicated clearly that maximum number of main shoots emerged under T_6 treatments (32.83). It was however noted that all the treatments other than control remained *at par* when compared among themselves. The number of shoots ranged from 10.63 to 32.83 under different treatments. The lowest number of main shoots was emerged under control (10.63). Shoot burning also effect significantly by time and intensity of pruning. Highest shoot burning (10.47%) was reported in T_1 treatment whereas minimum shoot burning was observed in T_5 treatment (1.23) which was significantly lower than all other treatments. It may be dne to early sprouting concurring with high temperature and hot dry wind with high velocity (10-30km h^{-1}) in the month of May and June. Length of *ber* shoots were recorded at time of flower initiation and data obtained with the mean values displayed in table-1. Treatments T_5 include significantly smaller shoots (117.6 cm) as compared to all other treatments whereas treatment T_4, T_3 and T_1 are *at par* with T_5 treatment. The highest length of shoot was reported in T_9 treatment. The mean values of *ber* shoots girth presented in table 1 that all the treatments produced significantly greater diameter of shoots when compared with control (8.33 cm) the maximum values (16.63 cm) in this regards were noted under T_2 treatment. Shoot length and diameter also appreciably increased in early pruning (30th April) with moderate severity (30%) because it cause lower inter branch competition and have sufficient time for growth before on set of reproductive phase. The days taken for sprouting, number of shoots emerged, shoot length, girth of shoots and fruit yield have been markedly promoted by the 30 per cent pruning intensity (Harit Kumar *et al.*, 2014).

Fruit yield and yield parameters

The yield and yield parameters was strongly influenced by pruning dates and severity. Pruning on 15th June and 30 per cent removal of previous season growth was more productive over the other dates of pruning and severity (Table 2). Minimum days required in flower initiation after pruning (115.4 days) was reported in T_5 treatment which was statically *at par* with T_1 treatment (121.46 days), T_4 treatment (120.30 days), T_8 treatment (117.40 days) and T_9 treatment (115.70 days) whereas maximum days required for flower initiation (137.13 days) in T_2 treatment. The flower initiation started earlier in treatments where early pruning was done. The initiation of flowering took place by 6th September where pruning was done on 1st May and flower initiation was delayed by 30th September when pruning was done on 28th July (Singh and Bal, 2008). Pruning was significantly effective for increasing the number of flower clusters/primary, secondary and tertiary branches. The maximum flower density (3123.12 sq. meter^{-1} canopy) on each type of branches were observed under pruning on 15th May with 30 per cent intensity (T_3 treatment) whereas lowest number of flowers density (1662.26 sq. meter^{-1} canopy) was reported in T_2 treatment. It was due to that flower production in *ber* mainly takes place on the secondary and tertiary shoots of optimum vigour. As 30 per cent pruning on 15th May could induce more number of both types of branches, it could thereby increase the number of flower clusters on all type of shoots. Similar types of results were reported by Singh and Bal, (2008), Harit Kumar *et al.*, (2014) in *ber*.

Maximum fruit set (29.40%), highest fruit retention (29.95%), uppermost fruit harvest (8.8%) was observed in T_5 treatment which was significantly superior from all other treatments, whereas least fruit set (15.17%), minimum fruit retention (7.46%) and lowest fruit harvest per cent (1.13) was recorded in T_1 treatment. Least

number of fruits square meter^{-1} area of plant^{-1} (20.24) was reported in T_1 treatment, whereas mean highest number of fruits square meter^{-1} area of plant^{-1} (165.0) was reported in T_5 treatment, which was significantly superior to all other treatment. Fruit set and retention increased in light pruning treatment than in severely pruned shoots and obtained higher yield by light pruning since fruit set and retention decreased with severity of the pruning. However the early pruned trees retained less fruit as compared to late pruned tree. The highest initial fruit set exhausted the trees due to coincide with high temperature thus reducing the final retention in early pruned trees. It might be due to delay pruning (15th June) of *ber* helps in delay emerging new sprouts and flower initiation which assist in avoiding coincide with high temperature of late summer months which major cause of flower and fruit drop. Similar results were also reported by Singh and Bal (2008) and Bhardwaj *et al.* (2015) in *ber*.

Minimum days required in start fruit picking after pruning (200.17 days) was reported in T_5 treatment which was statically *at par* with T_9 treatment (202.0 days), whereas maximum days required for start fruit picking after pruning (235.33 days) in T_1 treatment. Minimum days required for last fruit picking after pruning (237.0 days) was reported in T_6 treatment which was statically *at par* with all other treatments other than T_1 treatment (267.0 days). Maximum duration of fruit harvesting (39.83 days) was reported in T_5 treatment, which was *at par* with T_2 treatment (37.83 days). Minimum duration of fruit harvesting (29.83 days) was reported in T_6 treatment. The possible cause of early fruit harvesting and longer duration of fruit harvesting due to pruning of tree at proper time (15th June) with moderate severity pruning help in all over development of plant and fruits, which helps in maximise fruit retention capacity and final yield of the tree comparatively higher those required longer duration for harvesting than the lower yield produces trees. These results were also supported by Dhaliwal and Rajwant (2003) in guava, Gill and Bal (2006) in *ber*, Shaban and Haseeb (2009) in guava.

The maximum fruit yield tree^{-1} (72.09kg) and ha^{-1} (200.41q) has been achieved by employing moderate pruning (30%) intensity on 15th June which proved significantly superior over all other treatments and control. Minimum fruit yield tree^{-1} (25.35kg) and ha^{-1} (70.46q) was reported in T_1 treatment. Significantly higher fruit yield tree^{-1} and yield ha^{-1} might be attributed to increased percentage of both setting and retention of fruit, and also increase fruit harvest per cent, number of fruits square meter^{-1} area of plant, duration of harvesting with the help of 30 per cent pruning intensity on 15th June *i.e.*, all these yields attributing characters paved the way for significant improvement in fruit yield tree^{-1} of *ber*. This increment in number of fruit, size, yield and fruit quality at medium pruning level (30%) on later date (15th June) might be due to the stimulation of optimum vegetative and floral growth, which might have brought about balance between the fruiting wood and leaf area. Total yield was decreased by severe pruning. It is admitted fact that reduction in the fruit yield is due to reduction in number of the shoots which lead to the less number of fruit per tree as bearing area get reduced. Gill and Ball (2006) reported, increase in fruit size and weight might be attributed to better source-sink relationship and lesser competition for assimilates among the fruits in pruned trees. Similar observations were also obtained by Shaban and Haseeb (2009) during the study of effect pruning severity and chemical sprays on guava. Lower yield in dense pruning (50%) on 30th April, the flowering and fruit setting coincide with high temperature which cause lower pollen acceptability and higher flower and fruit drop at initial stage. Another scientific explanation for significantly increasing yield with moderate pruning (30% severity) may be because of more open tree canopy with wider leaf area resulted allowing more light penetration that led assimilation more photosynthetic materials and also less competition for the growth of individual fruit as compared to unpruned tree under optimum time of pruning (15th June) condition. The present findings are in closed agreement with earlier scientist *viz.*, (Singh *et al.*, 2004 and Khan and Syamal, 2004) who reported that medium pruning of 30 per cent produced higher yield in *ber* fruit. As pruning intensity advanced that is severe pruning (50% severity) yield was reduced. The reduction in yield which severe pruning (60%) might be due to admitted fact that reduction in number of bearing shoot results. It is in accordance with Gill and Bal (2006) who observed decreased yield by severe pruning. It is from the data that all the treatments induced significantly varying size of length of shoots when compared among themselves the lowest length of shoots were recorded under control. In case of unpruned tree canopy area continue to enlarge year after year, branch let's become very weak, fruit size reduced and tree ultimately become unproductive.

Economics

The economics of *ber* production was strongly influenced by pruning time and severity. Plant prune on 15th June with 30 per cent severity was more profitable over the other treatments (Table 3). Highest gross return (Rs. 180368.85), net return (Rs 134368.51) and benefit: cost ratio (2.92) was observed in T_5 treatment which was significantly different from all other treatments, whereas market rate of fruits was highest in T_1 treatment those ripe earlier than all other treatments. Lowest gross return (Rs. 105695.6), net return (Rs 65695.6) and benefit: cost ratio (1.64) was reported in T_1 treatment. It is fact that in case of judiciously timely pruned tree produces maximum fruit yield than other treatment which was helpful in fetch maximum gross and net return with highest benefit: cost. Possible explanation of this fact that the annual operation and judiciously pruned tree at proper time improved vigour and fruiting area, which increasing productivity, quality of fruits and ultimately increase profitability of *ber* cultivation. Similar results of *ber* tree pruning on 2nd week of June with moderate severity (25 to 35%) helps in earn more profit in *ber* production under arid condition of western Rajasthan (Bhardwaj *et al.*, 2015). The present study gets ample support from the work Gill and Ball

(2006), Singh *et al.*, (2012) and Harit Kumar *et al.*, (2014) in *ber*.

Quality parameters

Data presented in Table 4 be evidence for the pruning of *ber* tree on 15th May with 30 per cent removal of previous season growth exhibited a significant effect on the fruit quality parameter *viz.*, TSS, acidity, fruit colour, taste and overall quality score of fruits but ascorbic acid content of fruits are non significantly effect by pruning date and intensity. In the present investigation, the pruning of *ber* tree on 15th May with 30 per cent removal of previous season growth exhibited superior fruit quality and had a tendency to decrease with delay in pruning dates and increase intensity. The sweetness of *ber*, mainly assessed by TSS (total soluble solids) content and maximum TSS (15.4°Brix) was reported in T_3 treatment which was statistically *at par* with T_2 (15.29°Brix), T_4 (14.39°Brix), T_6 (14.78°Brix), T_7 (14.90°Brix), and T_8 (14.18°Brix), and rest of the treatments was significantly different and lowest TSS (11.34°Brix) was in T_1 treatment. The minimum acidity (0.13%) was observed in T_3 treatment, which was *at par* with T_2 (0.14%) and T_7 (0.14%) treatments, and rest of the treatments was significantly different and highest acidity (0.21%) was in T_1 treatment. Maximum ascorbic acid (61.41%), highest colour score of fruit (8.43), fruit taste score (8.60) and maximum overall fruit quality score (8.76) was also observed in T_3 treatment. The unpruned tree produced more fruit this is because of the reduction of shoots in pruned trees whereas fruit quality in terms of the TSS acidity and vitamin C content improved in moderately pruned tree (30%) hence the quality of the fruit improved due to pruning effects.

This might be due to the fact that *ber* tree pruning on 15th May with 30 per cent removal of previous season growth, which is positive for increased rate of photosynthesis and accumulate more dry matter in fruits which ultimately resulted in higher quality of the fruits. Moreover, lower total soluble solid in late pruned plants may be due to low temperature in favour of less conversion of sugars from starch during fruit ripening. Higher acidity (0.21) in not pruned tree (control) may be due to shade effect where sugar conversion from organic acid is hampered due to lack of sufficient light at internal part of tree. Gill and Ball (2006) reported that low intensity of pruning in *ber* improved the fruit yield and quality. They further reported that early pruning advanced bud sprouting and early harvest and improved fruit quality. The deviation in time of pruning from this phase of dormancy results in the lower yield and poor quality fruits. Similarly maximum TSS and ascorbic acid and minimum acidity were recorded in the fruit of those trees that were pruned on 30th May. (Singh and Bal, 2008). Delayed pruning is suitable for bud burst manipulation, but it may have a negative effect on grape maturation and quality due to the shorter period for ripening (Ratsep *et al.*, 2014).The present study gets ample support from the work of Harit Kumar *et al.*, (2014) in *ber* and Singh *et al.*, (2012) in peach. It is a well established fact that pruning at the right time and to the adequate extent improves the size, colour and quality of fruits by making more sun shine fall on the leaves, fruits and on a larger portion of the plant (Singh 2005). Higher and early yield of quality *ber* fruit with higher total soluble solids, lower acidity and more intense coloured fruit from early pruning might be due to increased nutrient uptake, it also encourages more flow of nutrients and water by the tree and consequently more synthesis of carbohydrates and other metabolites and their translocation to the fruit. Secondly the fruit load is also reduced with medium severity pruning at early stage. These findings are in agreement with those of Dhaliwal and Rajwant (2003) in guava, Gill and Ball (2006) in *ber*.

Occurrence of fruit fly infestation

Occurrence of fruit fly was detected in the month of September and first week of October the investigation period. The minimum infestation of fruit fly (3.93%) was observed in T_9 treatment (Pruning on 15th June + 50% removal of previous season growth), whereas maximum infestation of fruit fly (11.43%) was reported in T_1 treatment (control). Late and heave pruning delay in fruit setting and provide more open area which was significantly reduces fruit fly infestation as well as population at initial stage of fruit setting that is most prone stage of infestation. However, June month pruning with 50 per cent was found to be safer in respect to fruit fly infestation because at that time the fruit fly population and activity was very low due to low temperature and lower density of foliage. Occurrence of fruit fly infestation influenced by different pruning time and intensity was also reported by Singh and Bal (2008) in *ber*. Similarly Bhardwaj *et al.*, (2015) was also observed that, minimum infestation of fruit fly in *ber*, when tree was pruned in the month of June with high intensity (50%).

The time and severity of the pruning determines the vegetative growth, tree canopy and advances the bud sprouting, induces flowering, fruiting and quality of fruits. Low intensity of pruning improves the fruit yield and quality. The *ber* pruning on 15th June with moderate intensity (30%) gave better growth rates and development in concern to increase fruiting area and reduce shoot burning as compared to other treatment combinations. However, first flower initiation, maximum per cent fruit set, fruit retention, fruit harvest, number of fruits per plants, fruit picking duration have been markedly promoted by the tree pruning on 15th June with 30 per cent pruning intensity than rest of the treatments. The early pruning with moderate severity (15th May pruning with 30 per cent intensity) favour in advances bud sprouting and early harvest and improves fruit quality parameters such as TSS, acidity, ascorbic acid, fruit colour score, taste score and overall quality score. Maximum fruit yield plant^{-1} and ha^{-1} with highest gross return, net return and benefit: cost ratio also reported in the *ber* tree pruning on 15th June with 30 per cent pruning intensity than rest of the treatments combination. This treatment combination is much suitable for arid agro-

climatic condition of western Rajasthan but fruit fly infestation per cent was fewer in pruning on 15th June with 50 per cent pruning intensity. From over all experimental results, it is concluded that moderate severity of pruning (30% pruning on previous season growth) on 15th June has been adjudged as optimum level of pruning and time in improving yield of *ber* fruits cv. Gola. Highest severity of pruning (50%) on 15th May has been found to increase the vegetative growth but yield has been found inversely proportional supra-optimal level of pruning.

Table 1. Effect of pruning time and severity on vegetative parameter of *ber*

Treatments	Days taken for sprouting	Number of main shoot	Shoot burning %	Number of branches plant^{-1}	Shoot length (cm)	Girth of shoot (cm)	Flowers density (sq. meter^{-1} canopy of plant)
T_1	32.17	10.63	10.47	71.59	121.97	8.33	1791.15
T_2	34.97	30.73	7.37	181.97	129.27	16.63	1662.26
T_3	30.57	28.93	5.65	197.97	124.07	15.13	3123.12
T_4	27.80	25.03	2.48	225.90	120.80	14.60	2163.46
T_5	25.40	21.43	1.23	240.25	117.60	13.26	1875.00
T_6	32.50	32.83	9.53	165.50	132.60	14.90	1925.47
T_7	27.50	31.80	6.37	160.20	128.40	12.50	3021.39
T_8	24.70	28.90	4.07	195.20	137.30	12.10	2407.05
T_9	21.60	26.40	2.07	205.70	147.70	11.60	2346.28
S. Em. ±	1.646	1.53	0.222	4.342	2.947	0.289	13.78
CD at 5%	4.871	4.556	0.658	12.850	8.724	0.858	40.800

Table 2. Effect of pruning time and severity on yield and yield attributes of *ber*

Treatments	First flower initiation (DAP)	Fruit set (%)	Fruit retention (%)	Fruit harvest (%)	No of fruits sq. meter^{-1} canopy of plant	Picking of fruits		Duration of harvesting (days)
						First (DAP)	Last (DAP)	
T_1	121.46	15.17	7.46	1.13	20.24	235.33	267.00	31.67
T_2	137.13	18.27	11.60	2.12	35.24	225.33	260.00	34.67
T_3	130.83	22.07	17.43	3.85	120.24	215.33	252.00	36.67
T_4	120.30	26.80	23.30	6.24	135.00	205.17	243.00	37.83
T_5	115.40	29.40	29.95	8.80	165.00	200.17	240.00	39.83
T_6	132.50	16.40	9.85	1.61	31.00	215.17	245.00	29.83
T_7	126.50	20.59	18.14	3.74	113.00	210.00	243.00	33.00
T_8	117.40	25.10	20.37	5.11	123.00	207.00	241.00	34.00
T_9	115.70	26.60	23.24	6.18	145.00	202.00	237.00	35.00
S.Em. ±	2.541	0.845	0.541	0.251	2.912	1.302	9.913	0.976
CD at 5%	7.520	2.501	1.602	0.744	8.618	3.854	29.337	2.889

DAP- Days after pruning

Table 3. Effect of pruning time and severity on yield and yield attributes and economics of *ber*

Treatments	Yield plant^{-1} (kg)	Yield ha^{-1} (q)	Market Rate of fruits (Rs kg^{-1})	Gross Return (Rs.ha^{-1})	Net Return (Rs.ha^{-1})	B C ratio
T_1	25.35	70.46	15.00	105695.60	65695.60	1.64
T_2	33.45	92.98	14.00	130174.43	84174.43	1.80
T_3	46.55	129.40	12.00	155279.68	109279.68	2.38
T_4	63.39	176.22	10.00	176223.87	130223.53	2.83
T_5	72.09	200.41	9.00	180368.85	134368.51	2.92
T_6	35.19	97.83	14.00	136959.15	90958.81	1.98
T_7	42.90	119.25	12.00	143098.61	97097.95	2.11
T_8	52.70	146.49	10.00	146492.73	100492.07	2.18
T_9	60.10	167.07	9.00	150358.19	104357.53	2.27
S.Em. ±	**1.736**	**3.869**	**0.133**	**6117.63**	**6117.63**	**0.112**
CD at 5%	**5.140**	**11.452**	**0.395**	**18105.16**	**18105.16**	**0.332**

Table 4. Effect of pruning time and severity on quality attributes and fruit fly infestation of *ber*

Treatments	TSS of fruit °Brix	Acidity of fruits (%)	Ascorbic acid (mg 100g^{-1} plup)	Colour score of fruit (10 marks)	Fruit taste score (10 marks)	Overall score of fruits	Fruit fly infestation (%)
T_1	11.34	0.21	57.65	7.43	7.90	7.91	11.43
T_2	15.29	0.14	60.31	8.23	8.20	8.46	7.83
T_3	15.40	0.13	61.41	8.43	8.60	8.76	9.06
T_4	14.39	0.16	58.14	8.00	8.00	8.00	6.05
T_5	13.89	0.17	57.30	7.80	7.80	7.80	4.39
T_6	14.78	0.17	55.28	8.23	8.00	8.12	6.14
T_7	14.90	0.14	60.00	8.30	8.40	8.35	8.50
T_8	14.18	0.18	54.89	7.53	7.70	7.62	4.53
T_9	13.28	0.19	53.99	7.03	7.30	7.17	3.93
S.Em. ±	**0.428**	**0.006**	**1.247**	**0.088**	**0.800**	**0.162**	**0.346**
CD at 5%	**1.269**	**0.018**	**NS**	**0.263**	**0.237**	**0.480**	**1.026**

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