

FOLIAGE AND FRUITING RESPONSE OF ZIZYPHUS VARIETY (DEHLI GOLA) TO DIFFERENT PRUNING TIME

ABSTRACT

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In order to ascertain the effect of various pruning times on the tree spread and fruit yield of jujube variety Dehli Gola, a study was carried out at Arid Zone Research Institute (PARC), Umerkot during the year 2012-2013. Four pruning periods were examined (100% pruning in 4th week of March, 100% pruning in the 1st week of April, 100% pruning in the 2nd week of April and 100% pruning in the 3rd week of April). The results revealed that time of pruning of *Zizyphus* sp. trees has significant ($P < 0.01$) effect on average length of stem, spread of tree, number of branches tree⁻¹ and fruit yield tree⁻¹, while non-significant effects were observed on the stem circumference. The pruning of trees in the first week of April proved most appropriate time which resulted 121.50 cm length of stem, 70.75 cm stem circumference, and 7.13 meters tree spread, 22.65 branches tree⁻¹ and 163.68 kg fruit yield tree⁻¹. Similarly, the pruning of trees in the fourth week of March ranked second resulting 136.25 cm length of stem, 64.06 cm stem circumference, 6.86 meters tree spread, 21.08 branches tree⁻¹ and 152.29 kg fruit yield tree⁻¹. The delayed pruning in second week of April produced 116.00 cm length of stem, 65.61 cm stem circumference, 6.54 meters tree spread, 20.04 branches tree⁻¹ and 139.45 kg fruit yield tree⁻¹. However, the least effective pruning time was third week of April, which produced 140.25 cm stem length, 64.77 cm stem circumference, 6.40 meters tree spread, 18.48 branches tree⁻¹ and 135.73 kg fruit yield tree⁻¹. Considering the above results, it was concluded that *Zizyphus* sp. fruit yield decreased significantly when the pruning was delayed upto second or third week of April and there was no advantage when pruning was done in the last week of March. Hence, 1st week of April was considered as the proper time for pruning, because the trees pruned in this week produced significantly greater fruit yields than other pruning times.

Key words: *Zizyphus*, pruning time, tree spread, fruit yield

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INTRODUCTION

The jujube (*Zizyphus jujuba* Mill.) is originated in China where they have been cultivated for more than 4,000 years and where there are over 400 cultivars. It belongs to the family Rhamnaceae, is an indigenous fruit of China and South Asia, produced in

temperate regions such as China, India, Pakistan, Syria, Australia and Malaysia. It is cultivated to some extent throughout its natural range but mostly in India where it is grown commercially and has received much horticultural attention and refinement despite the fact that it frequently escapes and becomes a pest. It was introduced into Guam about 1850 but is not often planted there or in Hawaii except as an ornamental (Rhodes, 1995). The jujube can withstand a wide range of temperatures; virtually no temperature seems to be too high in summertime. The jujube is a small, deciduous tree, growing upto 40 feet tall; naturally drooping tree is graceful and ornamental. The fruit is a drupe, varying from round to elongate and from cherry-size to plum-size depending on cultivar. The fruit has been used medicinally for millennia by many cultures (Reich, 1991; Morton, 1997; Yoo and Li, 2011).

In Pakistan, jujube is extensively cultivated, but thrive best under ecological conditions of Hyderabad, Khairpur, Multan, Sargodha and Lahore Divisions. Hyderabad is famous for producing quality fruit for export to Middle East. The tree is hard, drought-resistant and can thrive in poor alkaline tracts without much irrigation and care, and survive on soils where other fruit trees cannot (Khushk, 2002). It tolerates many types of soils, but prefers sandy, well-drained soils and does less well in heavy, poorly drained soil (Martinuzzo, 2006). No work has been reported on proper NPK requirements for jujube. However, it was concluded from the experiments that 1.0-0.5-1.0 NPK nutrients kg tree^{-1} given as $\frac{1}{2}$ N + all P and K in August remaining and $\frac{1}{2}$ N in December remained the optimum level for maximum jujube fruit production. Traditional manure and ash as fertilizer has been in use for jujube, but, in recent years, each tree has been given annual treatments of 10 kg FYM with 0.500 kg ammonium sulphate for every year of age up to the 5th year. More advanced farmers utilize only commercial fertilizer (NPK) in larger amounts, twice annually, the first at the rate of about 110 kg ha^{-1} and the second at about 172 kg ha^{-1} (Morton, 1997).

Various cultural practices are done in zizyphus trees in order to ensure proper vegetation that refers to proper flowering and fruiting. Untrimmed trees must be spaced at 36 to 40 ft (11-12 m), but carefully pruned trees can be set at 23 to 26 ft (7-8 m). Pruning

should be done during the first year of growth to reduce the plant to one healthy shoot, and branches lower than 30 in (75 cm) should be removed. At the end of the year, the plant is topped. During the 2nd and 3rd years, the tree is carefully shaped. Thereafter, the tree should be pruned immediately after harvesting at the beginning of dormancy and 25 to 50% of the previous year's growth may be removed. Sometimes a second lighter pruning is performed just before flowering. There will be great improvement in size, quality and number of fruits the following season (Morton, 1997).

Zizyphus trees respond well to pruning and are believed strictly to be pruned every year regularly. The judicious removal of branches and undesirable parts of the tree to increase its usefulness is termed as pruning (Schneider and Dewolf, 1995). Pruning is the management of plant structure and fruiting wood and involves removal of plant's top and root system to facilitate and increase its usefulness. Pruning is a very important and necessary step towards jujube beneficial growth and increases the aesthetic values like lush green and heavy foliage, profuse flowering, larger fruits and high fruit quality (Anderson, 1991). Pruning intensity has a definite role in regulating fruit production in jujube, it usually done early in the summer (April) before starting new growth in the autumn (Chimonidou *et al.* 2000). Kumar (2002) found that maximum primary branches (4.45) were obtained with 25% pruning, whereas the highest number of secondary (6.70) and tertiary (6.12) branches were obtained with 50% pruning. The length of primary branches (146.77 cm) was greatest in the control. The longest secondary branches (73.74 cm) were obtained with 25% pruning, whereas the longest tertiary branches (31.31 cm) were obtained with 50% pruning. Ponda Safeda had the highest fruit yield (28.94 kg per tree). The highest fruit yield (25.92 kg per tree) was recorded for 50% pruning irrespective of cultivar. Raut and Diware (2005) reported that thicker shoots were produced when trees were pruned lightly in April. The interaction effect of cultivar, pruning time and its severity indicated that Gola and Kadaka produced longer shoots when the trees were pruned severely, while Punjab Chhuara recorded the longest shoot at moderate pruning. The greatest shoot diameter was observed in the medium-pruned trees in April in all the 3 cultivars. The study embodied in this research paper was carried out to examine the foliage and fruiting response of zizyphus variety Dehli Gola to different pruning times.

MATERIALS AND METHODS

The experiment was carried out in the Zizyphus garden of Arid Zone Research Institute (PARC), Umerkot during the year 2012-13. Sixteen zizyphus trees were selected to four pruning practices with four replications. The trees were marked for this experiment by painting the treatment numbers on their stems. The marking of the trees was done in the month of December. All the jujube trees selected for this experiment belonged to variety Dehli Gola. The experimental trees were supplied with necessary inputs at flowering, fruit formation and further fruit development stages. After completion of the harvesting of the jujube fruits of the previous season, the first pruning was carried out on 25th March 2012, while the experimental trees of jujube were pruned second time on 2nd April 2012. The third pruning was carried out on 12th April and the final pruning was done on 19th April 2012. After completion of the pruning practice, the experimental trees growing already in the orchard had 25 feet distance between each tree. For nutrient management, half kg nitrogen in addition to 1 kg potash alongwith 60 kg of farm yard manure were applied in the month of August, 2012 and half kg of nitrogen was applied in the month of December to each experimental tree.

The length of stem and the circumference of the stem were measured at the end of experiment with measuring tape in centimeters for each replication in all the treatment trees. For recording observations on spread of trees, same measuring tape was used and measurement was recorded in meters. For recording the observation on the number of branches, all the main branches sprouted after the pruning of the trees were counted and recorded on the data recording sheet. Finally, the fruit yield for all the pickings in each tree was recorded.

The data thus collected were subjected statistical analysis. The analysis of variance was employed to examine the significance of treatment for each character for overall treatments, while the L.S.D. (Least Significant Differences) test was employed to compare the treatment means, following the statistical methods suggested by Gomez and

Gomez (1984). In view of the results of statistical analysis, the final tables were prepared and such results are presented and interpreted as follows:

RESULTS AND DISCUSSION

Length of stem

The time of pruning had highly significant ($P < 0.01$) effect on the length of stem of zizyphus. The zizyphus trees that were 100 percent pruned in the third week of April had significantly greater length of stem (140.25 cm), followed by the practice of 100 percent pruning in the fourth week of March, where the length of jujube tree stem was 136.25 cm. In case of 100 percent pruning is practiced in the first week of April, the length of stem was 121.50 cm, while the minimum length of stem (116.00 cm) was recorded when zizyphus trees were 100 percent pruned in the second week of April. The results of the experiment for length of stem suggested that though the differences in the length of jujube tree stem were significant, but these differences were probably not due to the pruning treatments, because already growing trees could not improve the length of their stems and hence, these differences were already existed in the trees experimented.

Circumference of stem

The effect of time of pruning on the circumference of tree stem was statistically non-significant ($P > 0.05$). It is obvious from the results that the zizyphus trees that were 100 percent pruned in the first week of April had stems of relatively greater circumference (70.75 cm), followed by the average stem circumference of 65.61 cm recorded in trees practiced with 100 percent pruning in the second week of April, while the zizyphus trees pruned 100 percent in the fourth week of April had the average stem circumference of 64.77 cm. However, the minimum stem circumference (64.06 cm) was noted in zizyphus trees where 100 percent pruning was practiced in the fourth week of March. It was further perceived that there was no linear effect of pruning and its time of practices on the stem circumference and the differences so achieved are associated with the fact that experiment was conducted in an already existing jujube orchard with mature

fruit bearing trees and pruning seldom affect the stem extent and its perimeter in this age of trees.

Tree Canopy

The time of pruning had highly significant ($P < 0.01$) effect on the spread of tree. It is evident from the results that spread of zizyphus tree was remarkably greater (7.13 meters) when 100 percent pruning was carried out in the first week of April, followed by the average tree spread of 6.86 meters recorded in trees that were 100 percent pruned in the fourth week of March, while the trees 100 percent pruned in the second week of April had the average spread of 6.54 meters. However, the least spread of tree (6.40 meters) was recorded when trees were pruned in the third week of April. The results further showed that this greater spread of zizyphus trees pruned in the first week of April might have the association with proper pruning time when there was mild temperature. In case of later pruning the tree spread decreased, probably due to sharp rise in the temperature. However, the differences between spread of trees that were 100 percent pruned in the second and third week of April were statistically non-significant ($P > 0.05$), while significant ($P < 0.01$) when the above treatments were compared with two early pruning treatments.

Table-1. Effect of pruning on growth of *Zizyphus* spp. (Dehli Gola).

Time of pruning	Stem length (cm)	Stem circumference (cm)	Spread of free (meters)
100% pruning in the fourth week of March	136.25a	64.06	6.86b
100% pruning in the first week of April	121.50b	70.75	7.13a
100% pruning in the second week of April	116.00b	65.61	6.54c
100% pruning in the third week of April	140.25a	64.77	6.40c
S.E.±	1.7678	1.7324	0.0398
LSD 0.05	5.30	-	0.1161

Values followed by similar letters do not differ significantly at 0.05 probability level.

Number of branches

The effect of time of pruning on number of branches tree⁻¹ was highly significant ($P < 0.01$). It can be seen from the results that the number of branches tree⁻¹ was significantly higher (22.65) when 100 percent pruning of zizyphus trees was carried out in the first week of April, followed by 21.08 average number of branches tree⁻¹ recorded in trees that were 100 percent pruned in the fourth week of March. The trees that were 100 percent pruned in the second week of April had 20.04 average number of branches tree⁻¹, while the lowest number of branches tree⁻¹ (18.48) was noticed when trees were pruned in the third week of April. The results suggested that this greater number of branches in trees pruned in the first week of April was mainly associated with proper pruning time coupled with the temperature more conducive for sprouting of the branches. The number of branches tree⁻¹ decreased considerably when the pruning was delayed upto second or third week of April. The differences between number of branches tree⁻¹ in trees pruned in the fourth week of March and second week of April were statistically non-significant ($P > 0.05$) and highly significant ($P < 0.01$) when these treatments were compared with remaining pruning times.

Fruit yield

The fruit yield tree⁻¹ was significantly ($P < 0.05$) affected by the time of pruning. It is apparent from the data that the fruit yield tree⁻¹ was significantly maximum (163.68 kg) when 100 percent pruning of zizyphus trees was carried out in the first week of April, followed by 152.29 kg average fruit yield tree⁻¹ recorded in trees that were 100 percent pruned in the fourth week of March. The trees that were pruned in the second week of April had 139.45 kg average fruit yield tree⁻¹, while the minimum fruit yield of 135.73 kg tree⁻¹ was recorded when zizyphus trees were pruned in the third week of April. It was further argued by the results that this greater fruit yield in trees pruned in the first week of April was mainly associated with greater number of branches tree⁻¹ and more spread of trees. The fruit yield tree⁻¹ decreased significantly when the pruning was delayed upto second or third week of April. The differences between fruit yield tree⁻¹ in trees pruned in the second and third week of April were statistically non-significant ($P > 0.05$) while significant ($P < 0.01$) when these treatments were compared with early pruned trees.

Table-2. Effect of pruning ton branches and yield of Zizyphus spp. (Dehli Gola).

Time of pruning	Number of branches tree ⁻¹	Fruit yield tree ⁻¹
100% pruning in the fourth week of March	21.08b	152.29b
100% pruning in the first week of April	22.65a	163.68a
100% pruning in the second week of April	20.04b	139.45c
100% pruning in the third week of April	18.48c	135.73c
S.E.±	0.3490	1.4836
LSD 0.05	1.046	4.448

Values followed by similar letters do not differ significantly at 0.05 probability level.

DISCUSSION

The present study suggested that though the differences in the length of zizyphus tree stem were significant, but these differences were probably not due to the pruning treatments, because already growing trees could not improve the length of their stems and hence, these differences were already existed in the trees experimented. On the other hand there was no linear effect of pruning and its time of practices on the stem circumference and the differences so achieved are associated with the fact that experiment was conducted in an already existing zizyphus orchard with mature fruit bearing trees and pruning seldom affect the stem extent and its perimeter in this age of trees. Tree spread was greater in pruning during first week of April and this might have the association with proper pruning time when there was mild temperature. In case of later pruning the tree spread decreased, probably due to sharp rise in the temperature. However, the differences between spread of trees pruned in the second and third week of April were statistically non-significant ($P>0.05$), while significant ($P<0.01$) when the above treatments were compared with two early pruning treatments.

Similarly, number of branches were remarkably greater in first April pruned trees and this happened mainly associated with proper pruning time coupled with the temperature more conducive for sprouting of the branches. The number of branches tree⁻¹ decreased considerably when the pruning was delayed upto second or third week of April. The differences between number of branches tree⁻¹ in trees pruned in the fourth week of March and second week of April were statistically non-significant ($P>0.05$) and highly significant ($P<0.01$) when these treatments were compared with remaining pruning times. Similar was the situation for fruit yield per tree and greater fruit yield in trees pruned in the first week of April was mainly associated with greater number of branches tree⁻¹ and more spread of trees. The fruit yield tree⁻¹ decreased significantly when the pruning was delayed upto second or third week of April. The differences between fruit yield tree⁻¹ in trees pruned in the second and third week of April were statistically non-significant ($P>0.05$) while significant ($P<0.01$) when these treatments were compared with early pruned trees. Extensive research has been carried out on the time of pruning of zizyphus in various parts of the world. From India, Bharad and Tayde (1998) suggested pruning on 25 March or 25 April in variety Gola. Raveendra and Ganiger (2000) reported that ber trees were pruned during 15 and 30 April and 15 May and performance of all the cultivars was optimum when pruning was conducted on 15 April. Moreover, in India Jawadagi *et al.* (2001) assessed pruning treatments in ber and found that performance of all the cultivars was optimum when pruning was conducted on 15 April. However, total soluble solids content of the fruits was highest when pruning was done on 30 April. Dandan exhibited the highest fruit yield among the cultivars. Kumar (2002) investigated different ber cultivars including Gola and reported that maximum number of branches was obtained with 50% pruning and the highest fruit yield (25.92 kg per tree) was recorded for 50% pruning irrespective of cultivar.

Considerable research work on this aspect has been reported in India, such as Singh *et al.* (2002) experimented 15 and 30 April, 15 and 30 May, and 15 June pruning dates in ber and suggested pruning during the third week of April, while from Pakistan Khan *et al.* (2004) studied effects of pruning jujube trees and reported that the insect pest infestation to *Ziziphus jujuba* (ber) was reduced in the jujube gardens due to pruning.

Similarly Raut and Diware (2005) determined the optimum time of pruning, its severity and interaction for 3 commercial cultivars of ber, namely Gola, Punjab Chhuara and Kadaka. They reported that vegetative growth of the plant as indicated by shoot length, diameter and number of shoots on pruned branches were better in trees pruned moderately in May and it was superior in producing longer and higher number of secondary shoots. The findings regarding the appropriate time of pruning in jujube as reported in different parts of the world are well comparable with the results obtained in the present investigation and particularly in India, where the soil and climatic conditions are much in similarity to our conditions have completely supported the findings of the present research.

Conclusions

After going through the results of the present study, it was concluded that zizyphus fruit yield decreased significantly when the pruning was delayed upto second or third week of April and there was no advantage when pruning was done in the last week of March. Hence, 1st week of April was considered as the proper time for pruning zizyphus trees, because the trees pruned in this week produced significantly greater fruit yields than other pruning times.

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