J Agric. Res., 2025, Vol. 63(1):39-47
www.jar.com.pk
Agriculture Department
Government of Punjab

ISSN: 2076-7897 (Online) / ISSN: 0368-1157 (Print)
DOI: https://doi.org/10.58475/2025.63.1.2049

Crossref

HORTICULTURE

STANDARDIZATION OF PRUNING INTENSITY OF POMEGRANATE FOR ITS QUALITY PRODUCTION

Ammara Noreen*[1], Muhammad Ikhlaq[2], Muhammad Azhar Bashir[3], Kashif Shabir[4], Mohsin Abbas[5], Naseem Sharif[6], Muhammad Zahid Rashid[7] and Zubaida Hamid[8]

[1,4]Scientific Officer (Horticulture), Horticultural Research Station, Bahawalpur, [2]Principal Scientist (Horticulture), Horticultural Research Station, Bahawalpur, [3]Principal Scientist (Horticulture), Mango Research Station, Shuja Abad, Multan, [5]Principal Scientist (Horticulture), [6]Senior Scientist (Horticulture), [7]Scientific Officer (Horticulture) Horticulture Research Institute, Faisalabad, [8]Senior Scientist, (Agri. Economics), Agriculture Department, Lahore.

*Corresponding author's email: ammaranoreen91@gmail.com
Article received on: 03/05/2023
Accepted for publication: 18/04/2025

ABSTRACT

Pomegranate, being hardy fruit plant can grow well climatically in tropical to temperate region. Training of pomegranate is practiced to train the frame of the plant as single or semi-multi-stemmed and to boost productivity subsequently. The current study was conducted on 3-stemmed trained plant having 5- year age to find out the best pruning intensity for better quality and yield of pomegranate (cv. Golden) during 2020-21 and 2021-22. Four different treatments viz T_1 as control (unprunned) and the other contained pruning of side branches from tip to base upto 20 cm (T_2), 40 cm (T_3) and 60 cm (T_4) was carried out during the 2nd fortnight of November, 2020 and 2021. It was concluded that all pruning levels (20-60 cm) significantly affected fruit productivity, quality and bio-chemical parameters. However, 60 cm pruning (T_4) gave maximum values for averaged yield per plant (56 kg), fruit size (50 cm^2), fruit weight (253g), number of arils per fruit (319), arils weight (170.4 g), rind weight (79.90 g), rind thickness (2.40 mm), total sugars (14.50%), total soluble solids (15.30 °Brix%), juice (39.90%) with minimum number of fruits per plant (186) and minimum fruit acidity (0.23%) from means calculated over two years' data. Unpruned plants (T_1) had minimum values for yield per plant (42 kg), fruit size (39 cm^2), weight of single fruit (172 gram), arils in single fruit (262), arils weight (118.6 g), rind weight (52. 5g), rind thickness (1.90 mm), total sugars (13.2%), total soluble solids (14.1 °Brix), juice (36.1%) with maximum fruits on single plant (238) and the highest acidity of fruit (0.28%). Hence, 60 cm pruning (T_4) of side branches from tip to base can be opted to boost fruit production and quality parameters of Golden variety of pomegranate under semi-arid region of South Punjab, Pakistan.

KEYWORDS: *Punica granatum*; training; pruning; trimming; phenology; productivity; Pakistan

INTRODUCTION

Pomegranate (*Punica granatum* L.) is well known for delicious flavor, medicinal value and nutritive properties. Its high anti-oxidant contents enhanced zeal in fruit growers for pomegranate cultivation on their orchards. Though its extensive cultivation prevailed on coastal land of countries along the Mediterranean Sea, yet its maximum plantation sustains under arid to semi-arid water scarce region of Iran (Ghanbarpour *et al*., 2018). Its quality production is apparent in areas which have distinct winter and summer as region with arid and semi-arid climate. World major production and export of pomegranate comes from Iran that produces quality pomegranate under steppe climate (Sheikh and Manjula, 2012). However, tropical to subtropical region is best suited for its extensive cultivation over the globe. Pomegranate covered an area of 7330 hectares with production of 37613 tonnes denoting a productivity of 5.13 tonnes per hectare in Pakistan . Baluchistan province covered the maximum area 5863 hectares (80%) with production of 27113 tonnes (72 %). Punjab province contributed 1235 hectares (17%) area with production of 8202 tonnes (22%), while KPK shared an area of 232 hectares (3%) with production of 2298 tonnes (6%) during 2018-19 (Anonymous, 2020). From 2014-15 to 2018-19 area under pomegranate fruit and its production reduced by 12.66% and 16% respectively. A number of biotic and abiotic factors along with genetic factors and poor management practices are responsible for the quick reduction in area that led to reduced production. Although, pomegranate may face water scarcity moderately in semi-arid climatic conditions but 10-35% fruit may be cracked (Khattab *et al*., 2012) which is further damaged by fungal / bacterial diseases and environmental / physiological stresses (Galindo *et al*., 2014). Better annual productivity and fruit quality of pomegranate is dependent upon pruning and training techniques, type and intensity of pruning, kind of fruit cultivar and the plant age (Domoto, 2008). Basically, pomegranate develops as a shrub in natural ecosystem, but it can be trained as a single- or multi-stemmed plant in hot areas of the globe. The best option is to leave it as multiple-trunk shrub through training. Bush

system of pruning in pomegranate not only improves productivity but also provides opportunity to get esteem fruit (Gill *et al*., 2011). Usually, it is advised not to prune during the first year after planting whether it is established as a shrub or tree. Vidhya and Sivakumar (2021) urged that appropriate training plan to create a good framework for optimization of sunlight and promotion of productivity, and later pruning for quality production of fruit in pomegranate is necessary. Usually pomegranate bears fruit terminally on spurs from mature shoots that need pruning to boost new spurs. During dormancy of winter pruning is practiced annually by reducing old shoots to trigger fruiting in pomegranate. Chadha (2002) stated that total fruit, fruit size and yield increased; minimized bending, staking of branches as pruning extent enhanced. Hiwale *et al*. (2006) mentioned that judicious pruning must be opt keeping in view fruit bearing dimension by just detaching unfruitful branches, water shoots and dead branches. In pomegranate, one year old spurs bear fruit and fruit on terminal branches remain under-sized, so 15-20 cm terminal branches should be removed to take away fruit setting on these branches. Kumar *et al*. (2021). Among the different levels of pruning (10-50cm) 50cm and 20cm pruning levels apparently enhanced fruit physical parameters and improves biochemical attributes respectively (Ghatul *et al*., 2019b). Amarnath *et al*. (2020) concluded that 40 cm pruning proved the best with respect to fruit yield, while 30 cm pruning improved quality parameters better than 40 cm pruning. Sharma and Singh (2018) applied 5 pruning treatments by retaining 15, 30, 45 & 60 cm fruiting shoot length as well control (without pruning). They recorded better shoot extension, fruit size, fruit weight, marketable yield and quality parameters where 15 & 30 cm fruiting shoot length was retained. Hiremath *et al*. (2018) compared 3 levels of pruning (0, 15, 30 cm pruning) over soil supplied with farm yard manure or vermicompost. They noted decrease in number of fruit per plant and increase in weight, length and diameter of single fruit as well as yield from single plant with increase in pruning intensity. Winter pruning during dormancy can be bound to just reduction of previous seasonal growth so that fruiting may be boosted (Sonawane, 2017). Chakma (2014) obtained prosperous results from 15 cm fruiting shoots retained after pruning and observed retention of fruit, improvement in fruit size, weight and pysico-chemical attributes as well as minimized bacterial blight infection. Although, literature on pruning benefits, pruning methods, pruning seasons is highlighted, yet very few information regarding the role of pruning, pruning intensity, proper time of pruning with respect to a specific pomegranate variety under steppe climate prevailing in South Punjab (Pakistan) is available. That is why study on pruning intensity suitable for pomegranate was started to find out the best pruning intensity for better growth, yield and quality of pomegranate cv. Golden so that productivity and quality of pomegranate fruit under semi-arid climate could be improved.

MATERIALS AND METHODS

An experiment was conducted on 5 years old 3-stemmed trained plants planted in square system with 5m plant and row wise distance with geo position (105 meter high from sea level, 71.64°East longitude, 29.38°North latitude having typical semi-arid to subtropical climate in the south region of Punjab, Pakistan) during 2020-21 and 2021-22. Sixty healthy, vigorous uniform plants set in RCBD fashion with 3 replications; were selected and four treatments viz

T_1= control / un-prunned
T_2= 20 cm pruning
T_3= 40 cm pruning
T_4= 60 cm pruning

Pruning is of side branches from tip to base; were applied keeping 5 plants per treatment per replication during the 2nd fortnight of November , 2020 and 2021. All plants were supplied uniform irrigation, field operations and plant protection measures except pruning treatments. Methodology of data recording on different productivity, quality and bio-chemical parameters was described as below:

***Average yield per plant (kg)*:** It was calculated from summer crop of pomegranate during the month of August each year by adding all pickings of each plant and then taken as average.

Average number of fruit per plant: It was counted from summer crop of pomegranate during the month of August at the time of harvesting each year by adding all counts from plants under a specific treatment and averaged over number of plants per treatment per replication.

***Average fruit size (cm²)*:** Fruit size was estimated by picking ten fruits randomly from a plant under a specific treatment and measuring the length and width of each fruit using digital Vernier Caliper. Reading of both characters was multiplied mutually as product indicating fruit size (cm^2) and further averaged over number of plants per treatment per replication.

Average weight per fruit (g): Average individual weight of fruit was measured by using electronic digital weighing scale (SF-400A, China) in grams from ten random fruit harvested from the plant under a specific treatment and averaged over number of plants per treatment per replication.

***Average number of arils per fruit*:** It was counted from ten random individual fruit from a plant treated with a specific pruning treatment and averaged over number of plants per treatment per replication.

Average arils weight per fruit (g)*:** Arils weight of a single fruit was taken (after taking out all arils from the fruit) with the help of electronic digital weighing scale (SF-400A, China) from ten random fruit harvested from the plant under a specific treatment and averaged over number of plants per treatment per replication. ***Average rind weight per fruit (g)*:** Rind weight of a single fruit was measured (after excluding all arils from the fruit) with the help of electronic digital weighing scale (SF-400A, China) from ten random fruit harvested from the plant under a specific treatment and averaged over number of plants per treatment per replication. ***Average fruit rind thickness (mm): Rind thickness of a single fruit was measured (after excluding all arils and rag from the fruit) with the help of electronic digital Caliper in millimeters from ten random fruits and then averaged. ***Average total sugars (%):*** Total sugars including reducing and non-reducing sugars were measured from the juice extract by using the method referred by Shafiq *et al*. (2011). ***Average total soluble solids (°Brix)*:** Soluble solids contents were recorded using the Refractometer (BX-1 Atago, Japan) from ten random fruit taken from the plant treated with a specific treatment and averaged over number of plants per treatment per replication. ***Average juice (%)*:** Juice percentage was calculated by weighing juice extract in grams and total fruit weight also in grams by digital scale (SF-400A, China) through the formula as under.

$$\text{Juice (\%)} = \frac{\text{Juice extract weight (g)}}{\text{Total weight of respective fruit (g)}} \times 100$$

Calculation further expanded to ten random fruits harvested from the plant treated with a specific treatment and averaged over number of plants per treatment per replication. ***Average fruit acidity (%)*:** Fruit acidity was determined from aliquot of juice extract of individual fruit by using Pocket Brix-Acidity Meter (Atago, Japan). Calculations further expanded to ten fruit harvested randomly from the plant under specific pruning treatment and averaged over number of plants per treatment per replication. Data recorded on different parameters were statistically analyzed through computer software Statistix 8.1 for analysis of variance (ANOVA) and comparison of treatment means was calculated by applying Least Significant Difference (LSD) test at 0.05 probability (Steel *et al.,* 1997).

RESULTS AND DISCUSSION

Results of two years, regarding the productivity, quality and bio-chemical parameters were collected, averaged and shown in Table 1, 2 and 3, respectively to come up to a logical conclusion. Treatments consisting of various pruning levels and unpruned (control) influenced both the productivity and quality parameters of pomegranate cv. Golden. About all pruning treatments enhanced the productivity and quality of fruit in contrast to unpruned plants. However, high pruning level was more prominent than the lower pruning levels as indicated from analysis of 2 years data and their average. **Average yield per plant:** Data based on two years mean exposed maximum pomegranate fruit yield (56 kg/plant) in those plants which were prunned 60 cm in comarison with unpruned plants (control) which exhibited minimum pomegranate fruit yield (43 kg/plant). About 30% increase in yield was recorded by pruning of 60cm as compared to unpruned plants. Pruning 40cm (T_3) gave fruit yield (51 kg/plant) ranked 2nd and pruning 20cm (T_2) ranked 3rd with fruit yield (47 kg/plant). Yield per plant seems to be directly proportional to pruning intensity. However, yield per plant during 2021 under pruning of 40 cm side branches (T_3) with 48 kg/plant remained at par with yield of plants (45 kg/plant) in which 20 cm side branches (T_2) were pruned. In the year 2022, the highest yield (58 kg/plant) stick to pruning of 60cm (T_4), followed by pruning of 40cm (T_3) with 54 kg/plant. Both pruning levels were statistically same and the later shared similarity with yield of T_2 (49 kg/plant) and T_2 was not different in yield (44 kg/plant) from unpruned plants (Fig. 1(A)). The outcome is in lines with findings of Hiremath *et al*. (2018) who reported that plant yield was affected significantly with changing pruning intensities and 30 cm pruning of apical shoots results into maximum yield over other pruning intensities in pomegranate cv. Super Bhagwa. Pruning may overcome apical dominance, thereby release lateral buds and initiate flower buds from these lateral buds ultimately enhance yield per plant (Chakma, 2014; Kumar *et al*., 2021). Retaining ample volume of bearing shoot/spur post pruning might have boosted the availability of metabolites necessary for fruit development ultimately yield increase as reported by Ghatul *et al*. (2019a) and Bhuva *et al*. (2018). ***Average number of fruit per plant*:** The averaged maximum number of fruits per plant (238) were found in unpruned plants, followed by plants pruned to 20 cm (T_2) with 220 fruits per plant and it was similar to T_3 (40 cm pruning) with 214 fruits per plant. Hence, 20-40 cm pruning (T_2-T_3) has similar effect on fruit count from single plant. While, the least fruit count from single plant (186) was attained by those plants in which 60cm prunning was done. Influence of pruning intensity was significantly different from one treatment to other during 2021 and 2022 with maximum number of fruits in control (240) and (236) as compared to 60cm pruning (T_4) that produce lowest (180 fruits) and (191 fruits) respectively (Fig. 1 (B)).

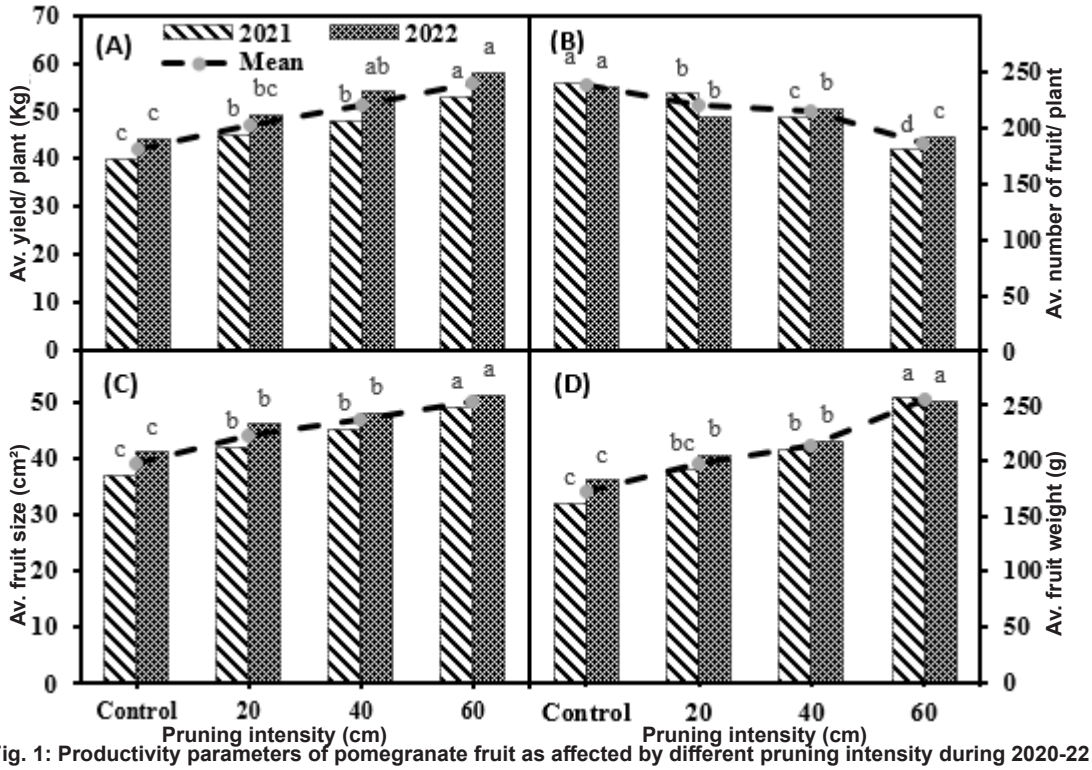


Fig. 1: Productivity parameters of pomegranate fruit as affected by different pruning intensity during 2020-22

The results corroborate findings of Hiremath *et al*. (2018) and Ghatul *et al*. (2019a), both explained that increased bearing area in the form of spurs or current growth in unpruned plants because of leaving pruning in bearing areas might added number of fruits per plant. Previously, Pawar *et al*. (1994) found that number of better grade fruit increased as per severity of pruning in pomegranate. ***Average fruit size*****:** From mean of two-year data the large sized fruit (50 cm^2) were attained by the plants pruned at 60 cm intensity (T_4), followed by intensity of 40 cm (T_3) gaining (47 cm^2) fruit size. Both treatments were at par statistically and the later also remained alike to T_2 (47 cm^2). As for as yearly data concern, maximum fruit size was recorded by T_4 (49 & 51 cm^2) and minimum fruit size by control (37 & 41 cm^2) during the year 2021 and 2022 respectively. However, 20-40 cm pruning (T_2-T_3) was found similar in effect on fruit size during the both years (Fig. 1(C)). Results coincided with the findings of Ghatul *et al*. (2019b) who recorded the lowest fruit volume in unpruned plants and the highest one by the maximum pruning intensity. They attributed it to reduction in crop load in heavy pruned plants which translocated more metabolites to left over fruit, thereby increased fruit size. ***Average weight per fruit*****:** Average of two years data indicated maximum fruit weight (255g) from plants pruned under intensity of 60 cm and minimum fruit weight (172g) by unpruned plants. However, 20 cm and 40 cm pruning were similar in effect on weight per fruit (198 & 214g respectively). During 2021, the maximum weight per fruit (256 g) was observed at maximum intensity (60 cm), followed by T_3 (210 g) that remained at par with T_2 (192 g) and T_2 was statistically similar to T_1 (161g). However, pattern of statistical significance for all pruning treatments during the year 2022 was same as noted from average of both years (Fig. 1(D)). Our findings corroborate the results reported by Ghatul *et al*. (2019a) who obtained maximum fruit weight (276 g) with the highest pruning intensity (50 cm) and minimum one (173 g) by unpruned plants in pomegranate cv. Super Bhagwa. The same reason could be endorsed as enhanced fruit weight would be result of full utilization of photosynthesis in fewer fruit of severe pruned plants (Hiremath *et al*., 2018). ***Average number of arils per fruit:*** The averaged highest arils count per fruit (319) by 60 cm pruning and the least arils count per fruit (262) was found in unpruned plants. Number of arils per fruit (300) and (280) was counted in 40cm and 20cm respectively. During the year 2021, pruning up to either 60 cm or up to 40 cm had statistically similar effect on this parameter and the later 40 cm further remained at par with 20 cm pruning which had statistically the same effect as did un-pruned plants. However, during the year 2022, pattern of statistical significance for all pruning treatments remained similar to the pattern as

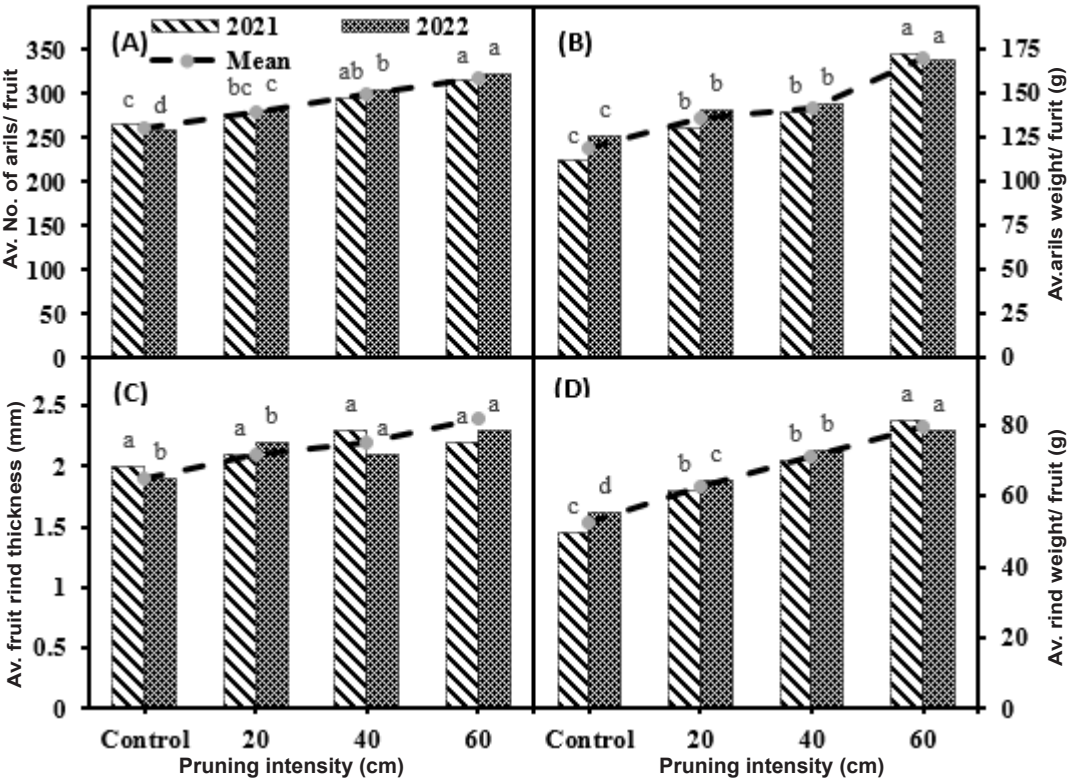


Fig. 2: Quality parameters of pomegranate fruit as affected by different pruning intensity during 2020-22

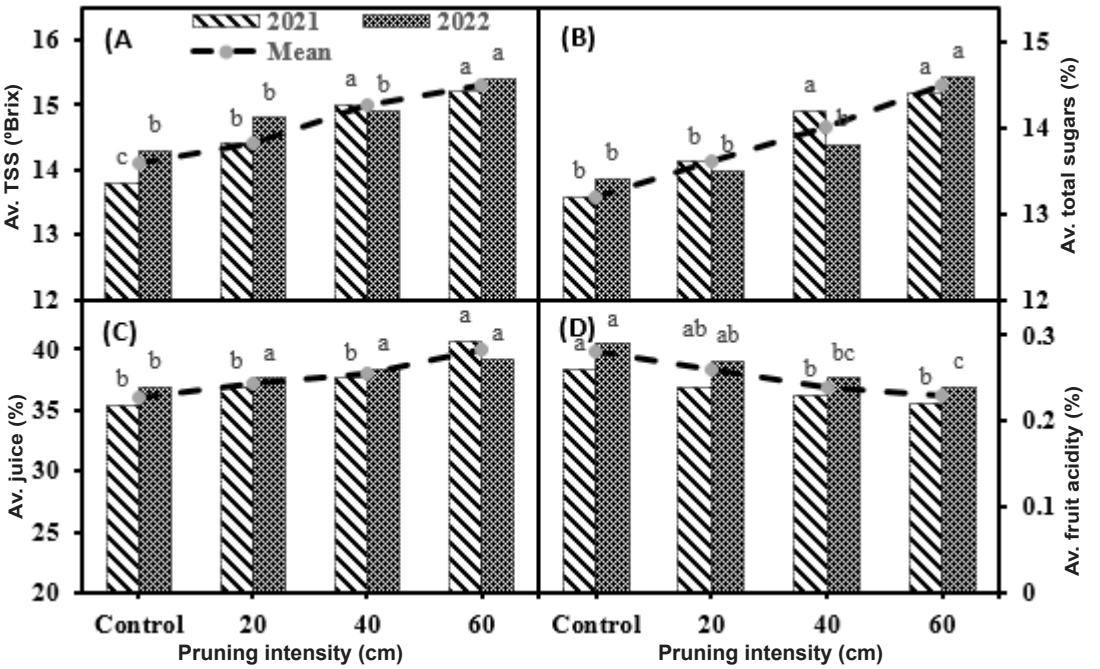


Fig. 3: Bio-chemical parameters of pomegranate fruit as affected by different pruning intensity during 2020-22

recorded for average of two years (Fig. 2(A)). Ghatul *et al*. (2019b) attributed increase in 100 arils weight to reduction in crop load on severely pruned plants as a result of diverted translocates to remaining fruit, thereby increased fruit size along with arils weight. The same reason may be endorsed to increased arils count per fruit as a result of various pruning intensities in comparison with unpruned plants. Somewhat matching results were also reported by Sheikh and Rao (2002) in pomegranate. Although larger fruits may yield more arils in single fruit, but selection of fruit size will not contribute in the percentage of edible yield from single fruit (Lal *et al*., 2013). ***Average arils weight per fruit*****:** Maximum arils weight per fruit (170.4 g) form average of two years was observed in plants pruned up to maximum intensity (60 cm), while minimum arils weight per fruit (118.6 g) was recorded in control plants. However, pruning up to 20 cm and 40 cm, both were alike in their effect on arils weight per fruit (135.4 & 142.0g respectively). Pattern of statistical significance for all pruning treatments during the year 2021 & 2022 was same as noted from average of both years (Fig. 2 (B)). Arils weight seems to be directly proportional to individual fruit weight. Same factors may involve in enhancement of arils weight in response to various pruning intensities as involved in enhancement of individual fruit weight as reported by Ghatul *et al*. (2019a) in pomegranate cv. Super Bhagwa and enhanced arils fruit weight might be due to more utilization of photosynthates in less number of fruit from severely pruned plants (Hiremath *et al*., 2018). ***Average rind weight per fruit*****:** From means of two-year data the maximum rind weight (79.9g) was observed in 60 cm pruning while minimum one (52.5g) was taken by plants kept unpruned (T_1). However, pruning of side branches either by 20 cm or 40 cm had statistically same effect over rind weight (62.80 g & 71.30 g respectively). During 2021, treatments significance pattern of fruit rind weight was similar to that of average of two years, however, every treatment remained significantly different from the other one during 2022 (Fig. 2 (C)). The results supported the findings of Ghatul *et al*. (2019b) who recorded the highest weight of rind per fruit (118.63 g) in pruned and the lowest one (79.61 g) in unpruned plants. Reduction in crop load in severely pruned plants might have diverted more translocates to the remaining fruits thereby increased rind weight. ***Average fruit rind thickness*****:** The averaged maximum and minimum rind thickness (2.4mm) and (1.9mm) was observed in 60 cm and in plants under control respectively. Pruning up to 20 cm and 40 cm fluctuate in between the both treatments with 2.1 & 2.2 mm rind thickness respectively and remained at par with control. During the year 2022, pruning up to 60 cm (T_4) resulted into maximum rind thickness (2.3 mm) and remained statistically alike with 20 cm (2.2 mm) and 40 cm (2.1mm) and the lowest (1.9 mm) in control (Fig. 2(D)). The results are in conformity with the report of Ghatul *et al*. (2019b) who observed maximum rind thickness (4.98 mm) at 50 cm pruning and the minimum one (3.49 mm) in unpruned plants. Similarly, Niazi *et al*. (2020) noticed maximum rind thickness (2.19 mm) at 30 cm pruning and the minimum one (2.08 mm) in unpruned plants. ***Average total sugars*****:** Average maximum total sugars (14.5%) were recorded in fruits of plants pruned up to 60 cm, followed by 40 cm with 14.0%. Fruits of plants pruned up to 20 cm and un-pruned plants showed 13.6% and 13.2% total sugars respectively. During the year 2021 and 2022, the fruit from plants pruned up to 60 cm showed maximum total sugars (14.4 & 14.6%, respectively), while the minimum total sugars (13.2 & 13.4 % respectively) was found by plants under control. Pruning up to 20 cm and control remained statistically at par during both years, however 40 cm pruning shared statistical similarity with 20 cm pruned plants and control as well during the year 2021 (Fig. 3 (A)). Similarly, sugar contents of pomegranate cv. Bhagwa were significantly affected by different levels of pruning. The treatment containing pruning at 30 cm, recorded the highest total sugars (15.41%), followed by 10 cm (14.01%). However, the lowest total sugar (13.60%) was observed in control also reported by (Niazi *et al*., 2020). ***Average total soluble solids*****:** Maximum total soluble solids (15.3°Brix) were found by 60 cm, followed by 40 cm (15.0°Brix), 20 cm (14.4°Brix) and un-pruned plants (14.1°Brix). During the year 2021 and 2022, the fruit from the plants pruned up to 60 cm (T_4) exhibited maximum total soluble solids (15.2 & 15.4°Brix respectively), while the minimum total soluble solids (13.8 & 14.3°Brix respectively) by plants under control (T_1) (Fig. 3 (B). Total soluble solids would increase as pruning severity increase in pomegranate (Pawar *et al*., 1994; Sheikh and Rao, 2002; Vidhya and Sivakumar, 2021). It might be due to maximum available reserved carbohydrates in pruned plants compared with unpruned plants (Ghatul *et al*., 2019b). Niazi *et al.* (2020) observed the highest soluble solid contents (16.52°Brix) at 20 cm and the lowest soluble solid contents (15.80°Brix) in unpruned plants. However, it contradicted findings of Nagar *et al*. (2019) who reported that soluble solid contents were not affected by different pruning levels. ***Average juice percentage*****:** Maximum average juice percentage (39.9%) was recorded by fruits from plants pruned to 60 cm (T_4), followed by plants pruned up to 40 cm (T_3) with 38% remained at par. The latter further shared similarity with 40 cm (38.4%), 20 cm (37.6%) and the control (36.1%). During the year 2021, 60 cm pruning resulted into maximum (40.6%). However, during 2022,

the pruning treatments (T_2-T_4) were statistically similar except control (Fig. 3 (D)). Pawar *et al*. (1994) as well as Vidhya and Sivakumar (2021) also reported that fruit juice contents increased according to the severity of pruning in pomegranate. It could be attributed to maximum utilization of photosynthates among fewer fruits of severely pruned plants because of increased aril weight, fruit size and weight (Ghatul *et al*. 2019b). ***Average fruit acidity***: Fruit acidity (0.23%) was recorded the lowest in 60 cm, followed by 40 cm (0.24%). The latter shared statistical similarity with T_2 (0.26%) and T_2 shared similarity with unpruned plants (0.28%). During the year 2021, the pruning treatments (T_2-T_4) were statistically at par with each other and T_2 was also statistically similar to plants under control. During the year 2022, 60 cm or up to 40 cm cast statistically same effect over fruit acidity and 40 cm further shared similarity with 20 cm pruning and the latter was statistically similar to unpruned plants (Fig. 3 (C)). The results conformed to the previous reports (Nagar *et al*., 2019) who stated that severe pruning reduced the fruit acidity compared to light pruning and Niazi *et al*. (2020) observed the high quantity of acidity in fruit (0.71%) from unpruned plants and the lowest acidity (0.67%) at 30 cm pruning intensity. However, Ghatul *et al*. (2019b) reported that fruit acidity is not significantly affected by intensity of pruning in contrast to our results.

CONCLUSION

Pruning is an important practice in orchards to maintain tree structure and a prime tool to attain good production with exportable quality fruit. Extent of pruning may vary according to variety, climate, soil, season and age of the plant. Current study revealed that 60 cm pruning of side branches from tip to base is a better choice to improve fruit productivity and quality in pomegranate cv. Golden with respect to prevailing agro-climate of south Punjab, Pakistan.

REFERENCES

Amarnath, K.S., S. Mishra and R.K. Singh. 2020. Effect of pruning in pomegranate (*Punica granatum* L.) for shoot growth, flowering and fruit yield. Current Journal of Applied Sciences and Technology. 39(30):114-123.

Anonymous. 2020. Fruits, Vegetables & Condiments. Staistics of Pakistan. Ministry of National Food Security and Research, Economic Wing, Govt. of Pakistan, Islamabad.

Bhuva, S.K., R.S. Chovatia, R.F. Baladha. 2018. Standardization of severity of pruning and crop load on growth and yield in pomegranate (*Punica granatum* L.) var. Bhagwa. International Journal of Chemical Studies. 6(6):2900-2902.

Chadha, K.L. 2002. Pomegranate. In: C.S.Viswanath (Eds) Hand book of Horticulture. Directorate of Extension and Publication of Agriculture. ICAR-Krishi Anusandhan Bhavan, Pusa, NewDelhi. P.297-304.

Chakma, J. 2014. Effect of different orchard management practices on the growth, productivity and rejuvenation of declining trees of pomegranate (*Punica granatum* L.) cv. Kandhari Kabuli. M.Sc. Thesis, Dr. Y.S. Parmer University of Horticulture and Forestry, Nauani, Himachal Pradesh, India.

Domoto, P.A. 2008. Pruning and training fruit trees. Iowa State University, Extension and Outreach, U.S.A. pp.1-28.

Galindo, A., P. Rodriguez, J. Collado-Gonzalez, Z.N. Cruz, E. Torrecillas and S. Ondono. 2014. Rainfall intensifies fruit peel cracking in water stressed pomegranate trees. Agric. For. Meteorol. 194:29-35.

Ghanbarpour, E., M. Rezaei and S. Lawson. 2018. Reduction of cracking in pomegranate fruit after foliar application of Humic acid, Calcium-Boron and Kaolin during water stress. Erwerbs-obstbau. 61 (1):29-37.

Ghatul, I.D., V.S. Jagtap, A.A. Solanke and S.J. Ban. 2019a. Effect of different levels of pruning on yield of pomegranate (*Punica granatum* L.) cv. Super Bhagwa. International Journal of Chemical Studies. 7(5):2367-2369.

Ghatul, I.D., V.S. Jagtap, V.D. Padekar and S.B. Ghorpade. 2019b. Effect of different levels of pruning on quality of pomegranate (*Punica granatum* L.) cv. Super Bhagwa. International Journal of Chemical Studies. 7(5):2899-2902.

Gill, P.P.S., W.S. Dhillon and N.P. Singh. 2011. Influence of training systems on growth, yield and fruit quality of pomegranate 'Kandhari'. Acta Hort. 890:305-310.

Hiremath, A., S.N. Patil, K. Hipparagi, K. Gandolkar and S.G. Gollagi. 2018. Influence of pruning intensity on growth and yield of pomegranate (*Punica granatum* L.) cv. Super Bhagwa under organic conditions. Journal of Pharmacognosy and Phytochemistry 7(2):1027-1031.

Hiwale, S. S., D.G. Dhandhar and B.G. Bagle. 2006. Rejuvenation of pomegranate orchards through non-selective pruning. In: national symposium on production, utilization and export of under fruits with commercial potentiality. DCKV, Kalyani, West Bengal, 22- 24, November. pp. 174-176.

Khattab, M.M., A.E. Shaban, A.H. El-Shrief and A.E.D. Mohammed. 2012. Effect of humic acid and

amino acid on pomegranate trees under deficit irrigation1: growth, flowering and fruiting. J. Hortic. Sci. Ornam. Plants. 4(3):253-259.

Kumar, R., H. Krishna, S. Rajan, M. Alizadeh and P. Barman. 2021. Understanding phenological stages of pomegranate vis-à-vis flowering and fruiting regulation. Journal of Horticultural Research. 29(2):1-22.

Lal, S. N. Ahmed and M.K. Verma. 2013. Pomegranate fruit size contributing traits in pomegranate (Punica granatum) cv. Dholka under temperate condition. Indian J. Agric. Sci. 83(5):66-72.

Nagar, D., K.K. Meena, S. Mukherjee and S. Garg. 2019. Influence of pruning intensity, crop load and fertigation on quality attribute of pomegranate cv, Bhagwa. Int. J. Curr. Microbiol. App. Sci. 8(12):1663-1668.

Niazi, Z., T.S. Kumar, A.K. Kumar, V. Joshi and N. Sunil. 2020. Effect of pruning and growth regulators on quality of pomegranate cv. Bhagwa. Journal of Pharmacognosy and Phytochemistry. 9(6):352-357.

Pawar, S.K., U.T. Desai and S.M. Choudhari. 1994. Effect of pruning and thinning on growth, yield and quality of pomegranate. Annals of Arid Zone. 33:45-47.

Sharma, D.P. and N. Singh. 2018. Effect of rejuvination pruning on the growth, productivity and disease incidence in declining trees of pomegranate (*Punica granatum* L.) cv. Kandhari Kabubli. Journal of Applied and Natural Science. 10(1):358-362.

Shafiq, M., A.S. Khan, A.U. Malik, M. Shahid, I.A. Rajwana, B.A. Saleem, M. Amin and I. Ahmad. 2011. Influence of pollen source and pollination frequency on fruit drop, yield and quality of date palm (Phoenix dactylifera L.) cv. Dhakki. Pak. J. Bot. 43(2):831-839.

Sheikh, M.K. and N. Manjula. 2012. Effect of chemicals on control of fruit cracking in pomegranate (*Punica granatum* L.) var. Ganesh. In: Melgarejo P. (ed.), Valero D. (ed.). 2nd International Symposium on the Pomegranate, p.35:133-135.

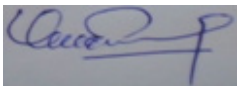
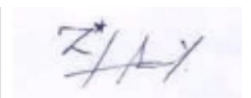
Sheikh, M.K. and M. M. Rao. 2002. Effect of pruning on fruit load on yield and quality in pomegranate (*Punica granatum* L.) var. Ganesh. Karnataka J. Agric. Sci. 15(3): 549-555.

Sonawane, M.S. 2017. Recent advances in the production of pomegranate fruit crop. Agriculture Update 12(4):657-665.

Steel, R.G.D., Torrie, J.H. and Dickey, D.A. 1997. Principles and procedures of statistics: A biometrical approach. (3rd Ed.). McGraw Hill Book Co. Inc., New York, pp. 400-428.

Vidhya, D. and V. Sivakumar. 2021. Canopy management in pomegranate (*Punica granatum* L.). *Vigyan Varta*. 2(11):7-11.

CONTRIBUTION OF AUTHORS

Sr. No.	Author's name	Contribution	Signature
1.	Ammara Noreen	Performed and laid out the experiment and collected data and wrote the manuscript	
2.	Muhammad Ikhlaq	Designed and supervised the research work	
3.	Muhammad Azhar Bashir	Performed the statistical analysis	
4.	Kashif Shabir	Reviewed the manuscript	
5.	Mohsin Abbas	Assisted in the manuscript write-up	
6.	Naseem Sharif	Proof read the manuscript	
7.	Muhammad Zahid Rashid	Reviewed the manuscript	
8.	Zubaida Hamid	Analyzed the data