Effect of different Training System on Growth of Pear (*Pyrus communis* L.)

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Abstract: Pear (*Pyrus communis* L.) is an important temperate fruit crop after apple belonging to the family Rosaceae. An experiment was conducted to determine the effect of plant training system on growth of Pear (*Pyrus communis* L.) during the year 2020-2021 with the varieties (V_1-Baggugosha, V_2-Punjab Beauty and V_3-Punjab Gold) and Training systems (T_1-Y-trellis, T_2-Cordon, T_3-Espalier and T_4-Control) at the Horticulture Research centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.). The experiment was laid out in Factorial Randomized Block Design (FRBD) with four replications. The maximum tree height (4.08 m) was observed in control with variety Baggugosha, while the minimum tree height was observed in trellis system with variety Pubjab Gold. The maximum canopy volume (7.04 m^3) was observed in Espalier system with variety Punjab beauty. The maximum number of shoots per tree (103.95), shoot diameter (13.27 cm) and number of flower per tree (277.05) were observed in Espalier system with variety Baggugosha. Whereas, the minimum values for the above parameters were recorded in control with variety Punjab Gold.

Keywords: Growth, Pear, Training system and Varieties.

INTRODUCTION

Pear (*Pyrus communis* L.) is one of the most important temperate fruit crop after apple in the family Rosaceae. It is diploid with chromosome number of 2n=2X=34 and belongs to the sub-family Pomoideae. The most important species of Pear are *Pyrus communis* L. (European pear), *Pyrus pyrifolia* L. (Asian/Japanese pear), *Pyrus nivalis* L. and *Pyrus calleryana* L. Pear is originated from China. Pyrus species are scattered over a large area in countries ranging from north to north west, west and south-Central regions (Sharifani *et al*., 2008). It is next only to apple in importance, production and vertical diversity among the temperate fruit. Pear is a mild sweet fruit with fibrous centre. It is rich in essential antioxidants plant compounds and dietary fibre.The improved pear cultivars in India were introduced in the later part of the 19th century. In India, pear occupies the second place among temperate fruits both in area and production. In India, Pear is grown on

44 thousand hectares area with a production of 318 Metric tons fruits annually (Anonymous, 2018).

Pear is among few fruit crops, which is adaptable to a wide range of agro-climatic condition. Pears can be cultivated in a climate ranging from very cold temperature to humid subtropical and can tolerant temperature as low as -26ºC temperature during dormancy and as high as 45ºC during growing period. Best temperature for its flowering and fruiting is 2ºC in winter and 32ºC in summers. Annual rainfall 100-125 cm is adequate for its growth. Summers should be less humid. Fruits make good growth if sufficient rains are there at maturity stage. Most of the European cultivars need sufficient cold requirement of 1,000-1500 chilling hours (Sharma and Krishna 2017).

However, in other Pear cultivars, it may vary significantly under varied climatic conditions. Hard pear is widely adapted to soil and agro-climatic conditions of India. Low chilling varieties of hard pear require 200-300 chilling hours under Punjab conditions contrasting to 900-1000 chilling hour required by high

chilling varieties grown in states of higher altitudes. The fruit of Pear is mostly used for table purpose. It is the rich source of nutrients like Protein (0.4 gm/100 gm), Carbohydrate (15 gm/100gm), Fat (0.1 gm/100 gm), Dietary fibres (3.1 gm/100 gm), Potassium (116 mg/100gm), Sodium (1 mg/100gm), Iron (1%), Magnesium (1%) and Vitamin C (7%). It reduces the risk of cardiovascular disease, promotes gut health and anti-cancer effects etc. (USDA National Nutrient Data Base).

Pear fruits are recommended for the patients suffering from diabetes because of low sucrose content, helps in lowering blood pressure and regulate heart pulse. It contains a 3.1 gm dietary fibre which is very good for gut health. It is a good source of antioxidants and about 27 to 41 mg phenolics are found per 100 mg of fruit. Pear has also proved to be a vasodilator and anti-arrhythmic properties of its elements generally lowers the blood pressure and regulates the heart pulse. Folic acid is available in the fruits and forms the complex of vitamin B. It contains a glycoside called arbutin which could be used to treat urinary tract infections. It helps in the expulsion of uric acid from the body. The leaves of pear help in the treatment of sores and swelling. They also help in the treatment of fever, anaemia and general debility. Bark of pear trees may be used as a destion. It is commonly processed into drinks (like RTS, squashes), candies, preserved fruits, and jam (Reiland and Slavin 2015).

Training is started from nursery stage of plant. Training means developing a desired shape of the tree with particular objectives by controlling habit of growth. The main goal of tree training is to promote favourable growth patterns, whereas training is used to bring trees into production earlier, develop a strong structural frame work that will support heavy crop loads without breaking, promote good sun light penetration through the canopy, and make the trees easier to manage (Hassan *et al.,* 2010).

Training helps to establish a strong framework of scaffold limbs capable of supporting regular annual succession of crops, expose maximum leaf surface to the sun, direct the growth of trees so that various cultural operation like spraying and harvesting become economical, protect the tree from sunburn and promote early production (Kaiths *et al.*, 2011).

In Pear training system is appropriate choice for high density planting in Pear cultivars rather than use of dwarfing root stock or cultivars. Various training systems like Open vase, Espalier, Cordon, Palmette, Fuestoo, Free spindle and Y-Trellis are uses in Pear for quality production of fruits.

MATERIALS AND METHODS

The experiment was conducted at Horticulture Research Center of Sardar Vallabhbhai Patel University of Agriculture and Technology, Modipuram, Meerut, Uttar Pradesh during the year 2020-2021. The experimental materials consist of 48 Pear trees and the Experiment was conducted with different training system and varieties. The experiment was laid out in Factorial Randomized Block Design (FRBD) consisting of 12 treatments and four replications.

Treatment details
Factor A: Variety,
V_1= Baggugosha, V_2= Punjab Beauty, V_3= Punjab Gold
Factor B: Training System,
T_1= Y-trellis, T_2= Cordon, T_3= Espalier, T_4= Control
Treatment combinations
T_1=$V_1T_1$$T_5$=$V_2T_1$$T_9$=$V_3T_1$
T_2=V_1T_2 T_6=$V_2T_2$$T_{10}$=$V_3T_2$
T_3=$V_1T_3$$T_7$=$V_2T_3$$T_{11}$=$V_3T_3$
T_4=$V_1T_4$$T_8$=$V_2T_4$$T_{12}$=$V_3T_4$

RESULTS AND DISCUSSION

In present investigation, a significant difference has been observed in terms of growth parameters among all the treatments as compare to control and presented in Table 1.

Tree height (m). The maximum tree height (3.26 m) was observed with variety V_1 (Baggugosha) which was found significantly superior over the treatments and the average minimum plant height (2.60 m) was recorded with variety V_3 (Punjab Gold). Training system had non-significant impact on tree height. The average maximum tree height (3.20) was found without training system (Control), whereas the average minimum value (2.39 m) was found to be lower with T_1 (Trellis).The interaction impact of training system and variety for tree height was found non- significant. The average maximum tree height (4.08 m) was observed with control (V_1T_4). While, the minimum tree height (2.04 m) was recorded with trellis (V_3T_1). Similar results were also reported by Singh *et al.* (2012); Cean and Stanica (2013); Choi *et al.* (2014); Bhat and Dhillon (2015); Walsh *et al.* (2015); Sharma, Y. (2016).
Canopy Volume (m^3)
The maximum canopy volume (4.53 m^3) was observed with variety V_1 (Baggugosha), which was found significantly superior over the treatments and the average minimum (4.19 m^3) was recorded with variety V_3 (Punjab Gold). Training system has the significant impact on canopy volume. The average maximum canopy volume (6.09 m^3) was found to be significantly higher with T_3 (Espalier). Whereas, the average minimum (3.13 m^3) was found to be lower with T_4 (Control).The interaction impact of training system and variety for canopy volume was found significant. The average maximum canopy volume (7.04 m^3) was found to be significantly higher with Espalier (V_2T_3). However, the average minimum canopy volume (2.77 m^3) was recorded with Control (V_3T_4). Similar findings have been reported by Bianco *et al.* (2007); Kiprijanovski *et al.* (2009); Gill *et al.* (2011); Lukic *et al.* (2012); Rufato *et al.* (2014).

Table 1: Effect of training system on different growth observations of Pear.

Treatment	Tree height(m)	Canopy volume (m³)	Number of shoots per tree	Shoots diameter(mm)	Number of Flower per tree
Variety(A)					
Baggugosha (V₁)	3.26	4.53	96.55	11.44	235.35
Punjab Beauty (V₂)	2.98	4.45	88.84	11.19	233.33
Punjab Gold (V₃)	2.60	4.19	84.99	10.98	221.98
S.E.(m)±	0.083	0.14	1.32	0.15	2.39
C.D. at 5%	0.023	0.41	3.84	0.44	6.91
Training System(B)					
Trellis(T₁)	2.39	3.75	85.06	10.87	226.93
Cordon (T₂)	3.03	4.58	96.25	10.91	228.43
Espalier (T₃)	3.15	6.09	98.21	12.36	246.08
Control (T₄)	3.20	3.13	80.99	10.67	219.44
S.E.(m)±	0.096	0.16	1.53	0.17	2.76
C.D. at 5%	0.27	0.48	4.43	0.51	7.98
Variety(A) X Training System(B)					
V₁T₁	2.37	4.17	94.05	11.24	223.93
V₁T₂	3.07	5.04	95.65	10.77	225.68
V₁T₃	3.50	5.37	103.95	13.27	277.05
V₁T₄	4.08	3.52	92.55	10.47	214.75
V₂T₁	2.75	3.23	84.89	10.87	233.43
V₂T₂	3.03	4.42	93.74	11.77	217.12
V₂T₃	3.06	7.04	97.81	11.66	239.75
V₂T₄	3.06	3.09	78.91	10.46	243.00
V₃T₁	2.04	3.85	76.23	10.49	223.43
V₃T₂	3.00	4.27	99.35	10.19	242.50
V₃T₃	2.88	5.86	92.88	12.15	221.43
V₃T₄	2.46	2.77	71.50	11.09	200.56
S.E.(m)±	0.16	0.29	2.65	0.30	4.78
C.D. at 5%	0.47	0.83	7.67	0.88	13.83

Number of shoots per tree. The maximum number of shoots per tree (96.55) was recorded with variety V_1 (Baggugosha) which was found significantly superior over the treatments and the average minimum (84.99) was recorded with variety V_3 (Punjab Gold). Training system has the significant impact on number of shoots per tree. The average maximum number of shoots per tree (98.21) was found to be significantly higher with T_3 (Espalier). Whereas, the average minimum (80.99) was found to be lower with T_4 (Control).The interaction impact of training system and variety for number of shoots per tree was found significant. The average maximum number of shoots per tree (103.95) was found to be significantly higher with Espalier (V_1T_3). While, the average minimum number of shoots per tree (71.50) was recorded with Control (V_3T_4).The above findings are in agreement with the findings of Sharma and Kaur (2006); MA *et al*. (2012); Cean and Stanica (2013).

Shoot Diameter (mm). The maximum Shoot diameter (11.44 mm) was recorded with variety V_1 (Baggugosha) which was found significantly superior over the treatments and the average minimum (10.98 mm) was recorded with variety V_3 (Punjab Gold).Training system has the significant impact on shoot diameter. The average maximum shoot diameter (12.36 mm) was found to be significantly higher with T_3 (Espalier). However, the average minimum (10.67 mm) was found to be lower with T_4 (Control).

The interaction impact of training system and variety for shoot diameter was found significant. The average maximum shoot diameter (13.27 mm) was found to be significantly higher with Espalier (V_1T_3). Moreover, the average minimum Stem Diameter (10.19) was recorded with Cordon (V_3T_2).Similar finding has been also reported by Rathi *et al.* (2003); Demirtas *et al.* (2010); Ikinci *et al.* (2014); Choi *et al.* (2014); Nasar *et al*. (2015).

Number of flowers per tree. The maximum number of flowers per tree (235.35) was recorded with variety V_1 (Baggugosha) which was found significantly superior over the treatments and the average minimum (221.98) was recorded with variety V_3 (Punjab Gold). Training system has the significant impact on number of flowers per tree. The average maximum number of flowers per tree (246.08) was found to be significantly higher with T_3 (Espalier). However, the average minimum (219.44) was found to be lower with T_4 (Control). The interaction impact of training system and variety for number of flowers per tree was found significant. The average maximum number of flowers per tree (277.05) was found to be significantly higher with Espalier (V_1T_3). Moreover, the average minimum number of flowers per tree (200.56) was recorded with Control (V_3T_4). Similar findings have been reported by Khattab *et al.* (2003); Lawande *et al*. (2014).

CONCLUSION

On the basis of results summarized above, it can be concluded that there was a significant effect of training system on growth of Pear in terms of tree height (m), canopy volume (m^3), number of shoots per tree, shoots diameter (mm) and number flowers per tree. The maximum tree height was observed in control with variety Baggugosha. While, the minimum tree height was observed in trellis with variety Punjab Gold. The maximum canopy volume was observed in Espalier system with variety Punjab beauty. The best results were observed for number of shoots per tree, shoot diameter and number of flower per tree in Espalier system with variety Baggugosha. Whereas, the minimum values for the above parameters were recorded in control with variety Punjab Gold. Therefore, Espalier training system with variety Baggugosha and their combination may be suggested for getting higher yield in Pear under western Uttar Pradesh Conditions.

Conflict of Interest. None.

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