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Influence of branch angles on branch diameter and fruit expansion of apricot

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ABSTRACT

Branch radial growth was register maximum in 60° angle, whereas 90° angle resulted minimum growth. Cultivar Gilgit Sweet had the maximum radial growth (40.02 mm), least growth (20.11 mm) and (17.23 mm) was recorded in Australian at 60° and 90° branch angle respectively, however, Roundel showed minimum growth at 30° angle. Progressive trend in branch radial growth was registered irrespective of angles and cultivars from May to September. At 60° angle, Gilgit Sweet showed highest radial growth (42.25 cm), whereas Conian Italy least at same angle. Cultivar Conian Italy showed least radial expansion, in all the branch angles. Cultivar Kaisha showed the maximum fruit diameter and Charmagz minimum irrespective of branch angles. At 30° branch angle, the greatest fruit expansion (27.46 mm) was noted. In combined effect of cultivar and branch angle, Kaisha had the maximum fruit expansion at 30°, 60° and 90° branch angles.

Key words: Apricot, branch angle, crotch angle, cultivar, fruit growth, *Prunus armeniaca*.

INTRODUCTION

The apricot is an important stone fruit very rich in vitamin A (3,600 IU/ 100 g FW). Its several wild and commercial species are available in Caucasus, the Himalayas, China and Japan. The highest production is contributed by Turkey, Iran, Algeria and Pakistan. However, Austria record highest productivity (28 t/ha). In India, it is mainly grown in Jammu and Kashmir, Himachal Pradesh and Uttarakhand. The average productivity of apricot in India is very low (4.16 t/ha). This is mainly due to non-availability of well adapted climate-specific varieties and traditional canopy management, the branches if left undisturbed grow long without fruiting. Though the nature of apricot tree is such that it respond poor to canopy manipulation. But tree can be developed in good shape by training the scaffold branches immediate after planting. The crotch angle influences not only the vegetative growth but also reproductive growth of tree. It has influence in flowering, fruiting and fruit growth. The proper branch angle results good light interception within the canopy. Wareing (6) reported, in apple that the shoot angle by re-orientation to the horizontal position is known to increase the number of lateral flowers. Therefore, the present experiment was carried out to standardized branch orientation in apricot cultivars to increase fruit density and quality.

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MATERIALS AND METHODS

The present experiment was conducted at experimental farm of Division of Pomology, SKUAST-K, Shalimar, Srinagar for three consecutive years. The sapling of eight cultivars namely Charmagz, Quetta, Roundel, Conian Italy, Amba, Gilgit Sweet, Australian and Kaisha were planted in the field at 4 m × 4 m spacing in February and March (2002-03) and the branches were trained at 30°, 60° and 90° angles at all directions. The treatment was replicated thrice with single plant per unit. The experiment was laid out in the factorial randomized block design. The data with regard to radial branch growth and fruit expansion was recorded. The radial growth of branch was recorded at monthly interval for the three consecutive years and at termination of growth and fruit expansion was recorded at the maturity by digital Vernier callipers. The data recorded were pooled and analyzed as per statical procedure using S-Plus software.

RESULTS AND DISCUSSION

The branch angle and cultivar influenced the branch diameter significantly. Maximum mean branch diameter 28.73 mm was registered in 60° branch angle followed by 30° angle (27.98 mm), whereas least branch diameter (24.46 mm) in 90° angle. Cultivar Australian resulted maximum (35.60 mm) diameter followed by Gilgit Sweet (30.94 mm), whereas, Conian Italy had least branch diameter (20.14 mm). Similarly, cultivar Austrialian at 30° branch diameter followed by Gilgit Sweet (32.22 mm), cultivar Roundel had least

(22.43 mm) diameter, however, at 60° branch angle Gilgit Sweet had significantly maximum (40.02 mm) diameter, followed by Amba (32.46 mm) and Australian (30.57 mm) branch diameter followed by 30° branch angle (29.20 mm), whereas, least growth (27.38 mm) noted at 90° angle (Table 1A).

Interaction effect of cultivar, branch angle and growth period for the branch diameter was found significant. Australian cultivar at 30° branch angle exhibited maximum radial growth (44.30 mm) followed by Gilgit Sweet (33.39 mm), whereas least growth (24.54 mm) was registered in Roundel at same angle. Gilgit Sweet registered maximum radial growth (42.25 mm) at 60° angle followed by Amba (33.75 mm), which was statistically at par with Australian (33.73 mm) and Kaisha (32.25 mm) at 60° branch angle, however, Australian at 90° angle registered maximum radial growth (33.95 mm) followed by Amba (32.40 mm) which was statistically at par, the growth in Quetta (31.45 mm) was statically at par with Amba cultivar. However, lowest growth in diameter (22.50 mm) was recorded in Gilgit Sweet cultivar at 90° branch angle closely followed by Roundel (22.96 mm), Charmagz (23.95 mm) and Conian Italy (23.98 mm). These values are statically at par with each other. Irrespective of growth period, cultivar Conian Italy showed least radial growth of branch at 30°, 60° and 90° branch angle. Cultivars Australian and Kaisha, Quetta and Roundel were at par in respect of diameter at 60° branch angle. At 90° branch angle cultivar Australian had maximum diameter (33.24 mm) followed by Amba (30.24 mm) and Kaisha (26.86 mm), whereas Conian Italy registered minimum (17.23 mm) branch diameter (Table 1B).

Radial growth of branch also influnced significantly by cultivar and growth period at monthly interval. The branch radial growth was progressive from May to September. Branch radial growth was significant in all the month, however maximum (29.09 mm) diameter was noted in September. Australian cultivar in the September registered maximum (37.33 mm) diameter, followed by Gilgit Sweet (32.65 mm) and Amba (30.30 mm). Cultivar Conian Italy had least radial growth (23.29 mm) at the end of growth period (Table 1C). Branch angle and growth at monthly interval had significant effect on branch radial growth of apricot. Radial growth was in progressive fashion in the entire branch angle, however, 60° branch angle registered maximum (30.69 mm) diameter followed by 30° branch angle (Table 1C). Branch radial growth was found statically at par at 30° and 60° angles from May to August, however difference was significant at 90° branch angle from May to September and significantly low radial growth was registered in 90° angle at same period (Table 1D).

Significantly maximum fruit expansion was registered in cultivar Kaisha (27.40 mm) and Roundel (24.70 mm), however, diameter was recorded statically at par among Charmagz, Quetta, Conian Italy, Amba, Gilgit Sweet cultivars. Significantly maximum fruit expansion was registered at 30° branch angle (27.46 mm), however, growth was statically at par in 60° and 90° angles. Interaction effect of cultivar and branch angle exhibited maximum fruit expansion (44.21 mm), followed by Kaisha cultivar on 60° and 90° angles. Cultivar Amba also had good fruit expansion at all branch angles. Appropriate branch orientation can be developed by employing optimum branch angle

Table 1A. Branch angle and cultivar influence on branch diameter (mm) in apricot cultivars.

Cultivar	Branch angle			Mean
	30˚	60˚	90˚	
Charmagz (A1)	27.99	29.40	21.93	26.44
Quetta (A2)	25.63	23.12	25.42	24.72
Roundel (A3)	22.43	23.88	20.15	22.15
Conian Italy (A4)	23.09	20.11	17.23	20.14
Amba (A5)	23.79	32.46	30.24	28.83
Gilgit Sweet (A6)	32.22	40.02	20.59	30.94
Australian (A7)	42.89	30.57	33.24	35.60
Kaisha (A8)	25.76	30.32	26.86	27.65
Mean	27.98	28.73	24.46	

LSD (p = 0.05) Cultivar = 0.56
LSD (p = 0.05) Branch angle = 0.35
LSD (p = 0.05) cultivar* Branch angle = 0.72

Table1B. Effect of cultivar and period influence on branch diameter in apricot cultivars.

Cultivar	Branch growth at monthly interval (mm)				
	May	June	July	August	September
Charmagz	20.10	25.98	26.33	26.50	27.35
Quetta	22.88	23.83	24.68	24.70	27.52
Roundel	20.53	21.68	21.86	22.30	25.00
Conian Italy	18.42	19.32	19.72	19.72	23.29
Amba	28.13	28.35	28.60	28.77	30.30
Gilgit Sweet	30.14	30.36	30.67	30.90	32.65
Australian	34.47	35.08	35.42	35.55	37.33
Kaisha	27.05	27.43	26.39	28.08	29.30
Mean	25.96	26.43	26.71	27.10	29.09

LSD (p = 0.05) for cultivar = 0.45
LSD (p = 0.05) for cultivar* branch angle = 1.26

Table 1C. Effect of branch angle and period on branch diameter of apricot cultivars.

Branch angle	Branch growth at monthly interval (mm)				
	May	June	July	August	September
30° (B1)	27.10	27.56	27.83	28.18	29.20
60° (B2)	27.67	28.02	28.55	28.75	30.69
90° (B3)	23.11	23.70	23.75	24.36	27.38

LSD (p = 0.05) for branch angle* period = 0.77

which had great influence on tree strong framework and fruit growth.

Branch angle influenced the vegetative and reproductive growth in fruit plants. Increasing the shoot angle by re-orienting the shoot to the horizontal position is known to increase the number of lateral flowers in apple (Wareing, 6). Bending the branches changes the hormonal status of the branch and creates a desirable effect by eliminating the apical dominance and the bud located at the base of the shoots get break and produce flower. Dann *et al.* (2) in peach observed that that the gradients from root to tip were negative for vegetative growth and time of flowering and positive for flower density, fruit set and fruit growth and angle to the horizontal increased between 15° and 90°, the gradient was negative for flower density and fruit growth. Floral development progress more rapidly on horizontal than on vertical shoots. Ratio of cytokinin to auxin also controlled the apical dominance lateral out growth is promoted when auxin was seemed to decrease and cytokinin increase (Cline *et al.*, 1). Kato and Ito (4) reported lower auxin content in the top of horizontally growing apple shoots as compared to upright growing shoots, gravity influence the endogenous growth regulating substances. The fact behind the hypotheseis is that supply of nutrient to the apex is controlled by auxin in the top meristem (Luckwill, 5). Further, Dann *et al.* (2) observed larger fruits from the low angled rods, indicating that low angled branches may be better adopted to sizing heavy crop load with widening of branch angle minimize shading within tree, which encourage more flower bud formation and more increase in radial expansion of branch and fruit diameter. This also made clear from the shoot re-orientation to the horizontal position influenced sugar concentrations and their related enzyme activities both in the lateral bud and the internodes segment in “Kosui” Japanese pear cultivar (Ito *et al.*, 3).

REFERENCES

1. Cline, M., Wessel, T. and Iwamura, H. 1997. Cytokinin/Auxin control of apical dominance in *Ipamoea* Nil. *Plant Cell Physiol.* **38**: 659-67.

2. Dann, I.R., Mitchell, P.D. and Jerie, P.H. 1990. The influence of branch angle on gradients of growth and cropping within peach tree. *Scientia Hort.* **43**: 37-45.

Table 1D. Interaction of cultivar, branch angle and period on branch diameter in apricot cultivars.

Cultivar	Angle	Branch growth at monthly interval (mm)				
		May	June	July	August	September
Charmagz	30˚	27.25	27.60	28.00	28.50	28.60
	60˚	30.00	29.00	29.35	29.15	29.50
	90˚	20.95	21.35	21.65	21.75	23.95
Quetta	30˚	24.75	25.35	25.65	25.90	26.50
	60˚	22.20	22.55	23.00	23.25	24.60
	90˚	21.70	23.60	25.40	24.95	31.45
Roundel	30˚	21.25	21.65	22.10	22.60	24.54
	60˚	21.40	22.35	23.82	24.36	27.50
	90˚	18.95	19.25	19.65	19.95	22.96
Conian Italy	30˚	21.70	22.45	22.93	23.44	24.95
	60˚	18.80	19.75	20.00	20.08	21.95
	90˚	14.75	15.25	16.44	22.97	23.98
Amba	30˚	23.28	23.35	23.65	23.95	24.75
	60˚	31.80	32.10	32.25	32.40	33.75
	90˚	29.32	29.62	29.90	29.98	32.40
Gilgit Sweet	30˚	31.80	31.87	32.00	32.30	33.39
	60˚	38.80	39.25	39.82	39.97	42.25
	90˚	19.84	19.95	20.20	20.47	22.50
Australian	30˚	41.60	42.82	42.87	42.90	44.30
	60˚	28.96	29.50	30.20	30.45	33.73
	90˚	32.85	32.92	33.20	33.30	33.95
Kaisha	30˚	25.24	25.40	25.49	25.95	26.75
	60˚	29.70	29.70	29.95	30.30	32.25
	90˚	26.50	27.20	27.93	28.10	28.97

LSD (p = 0.05) of Cultivar *branch angle *period = 2.20

Table 2. Main and interaction effect of cultivar and branch angle on fruit diameter.

Cultivar	Final fruit expansion (mm)
Charmagz	22.90
Quetta	23.55
Roundel	24.70
Conian Italy	23.55
Amba	23.33
Gilgit Sweet	23.82
Australian	27.40
Kaisha	35.34
LSD (p = 0.05)	1.72

Contd...

Contd...

Branch angle	Final fruit expansion (mm)
30˚	27.46
60˚	26.17
90˚	25.96
LSD (p = 0.05)	0.50
Cultivars and branch angle	**Final fruit expansion (mm)**
A1B1	22.05
A1B2	24.25
A1B3	22.40
A2B1	25.40

Contd...

Contd...

A2B2	24.01
A2B3	21.25
A3B1	25.10
A3B2	24.04
A3B3	24.15
A4B1	23.25
A4B2	26.40
A4B3	21.00
A5B1	29.30
A5B2	28.29
A5B3	27.40
A6B1	22.15
A6B2	25.80
A6B3	23.50
A7B1	28.25
A7B2	24.90
A7B3	29.04
A8B1	44.21
A8B2	30.90
A8B3	30.50
LSD (p = 0.05)	1.41

3. Ito, By. A., Yoshioka, H., Hayama, H. and Kashimura, Y. 2004. Reorientation of shoots to the horizontal position influences the sugar metabolism of laterals buds and shoots internodes in Japanese pear (*Pyrus pyrifolia* (Burm) Nak.). *J. Hort. Sci. Biotech.* **79**: 416-22.

4. Kato, T. and Ito, H. 1962. Physiological factors associated with the shoot growth of apple trees. *Tohoku J. Agric. Res.* **13**: 121.

5. Luckwill, L.C. 1968. The effect of certain growth regulators on growth and apical dominance on young apple tress. *J. Hort. Sci.* **43**: 91-101.

6. Wareing, P.E.1970. Growth and its coordination in trees. **In**: *Physiology of Tree Crops*, Luckwill, L.C. and Cutting, C.V. (Eds.), Academic Press London, pp. 1-21.

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