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Growth, flowering fruit set and yield in some cultivars/selections of walnut (*Juglans regia*)

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ABSTRACT

Nine cultivars of walnut (*Juglans regia* L.) were evaluated during 2007–08 for growth, flowering fruit set and yield characters. Comprehensive observations on growth, foliage, floral characters and yield were recorded for each cultivar/ selection and considerable variation was observed among the cultivars for these characters. Tree height, trunk girth, tree volume and shoot extension growth ranged from 24.64 to 51.10 cm, 12.31 to 37.39 cm, 11.89 to 28.05 m^3 and 29.68 to 65.14 respectively. Time of male and female flowering varied from last week of March to second week of April. All the cultivars exhibited protandry. Fruit set, fruit retention and yield varied from 19.74 to 60.57%, 25.29 to 50.82% and 0.77 to 2.15 kg/tree. Cultivar Paynee was found superior to all the cultivars and recorded maximum height, girth, tree volume, fruit set, fruit retention and yield.

Key words: Fruit set, Paynee, Protandry, Walnut, Yield

Walnut (*Juglans regia* L.) is one of the most important fruit crops of temperate regions of the world belonging to family Juglandaceae and is considered native to Persia and North Western Himalayas. It produces nuts having high nutritive value. The major walnut-producing countries are USA, China, France, Turkey and Italy. In India, it is cultivated at an altitude of 1 200–2 200 m above the sea-level. The Western Himalayan region of India comprising the states of Jammu and Kashmir, Himachal Pradesh and Uttarakhand (formerly known as Uttaranchal) are the country's major walnut-producing region. However, in India there are no proper orchards of walnut and trees of mainly seedling origin are grown which exhibit wide variation for tree, foliage and floral characters. More variability is a prerequisite for better selection (Sharma *et al.* 2010).This variation can be utilized for the identification and selection of elite trees with superior characters. These trees with superior and desirable characteristics can be recommended for the commercial plantation.

However, much studies have still been not taken for the identification of cultivars/selections with good characters. Cultivars having desirable traits, like dwarf stature, shorter juvenile period, better fruit retention and high yield are now available and these can be used as planting material instead of seedling trees, which generally are lacking in such desirable traits. At Dr Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, the walnut collection block consists of indigenous seedling selections and exotic cultivars which are not properly characterized and evaluated. Therefore, an attempt was made to properly characterize the cultivars/selections.

MATERIAL AND METHODS

The experiment was carried out in the experimental orchard of the Department of Fruit Science, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India during 2007–08. The walnut experimental block is situated between 31^0N and 77^oE at an altitude of 1 225 m above mean sea level. Uniform, healthy and disease-free bearing walnut cultivars/selections grafted/ budded on seedling rootstock and of same age group of 4-5 years were selected for these investigations. The experiment was laid out in Randomized Block Design (RBD) with nine cultivars/selections and three replications. The experimental trees were subjected to uniform cultural practices during the study. The data were analyzed according to Randomized block design as per the method described by Cochran and Cox (1963).

RESULTS AND DISCUSSION

All the cultivars/selections included in the present study exhibited considerable variation in most of the growth

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Table 1 Growth characters of different walnut selections

Cultivar/ Selection	Tree height (cm)	Trunk girth (cm)	Tree volume (m^3)	Shoot extension growth (cm)	Time of Leaf bud burst
Hartley	29.16	16.5	21.71	29.92	1 Apr 2008
Pieral Lara	33.51	26.17	16.62	42.29	27 Mar 2008
Ronde de Montignac	26.82	15.84	12.77	40.79	20 Mar 2008
Kashmir Selection	24.74	16.24	11.89	30.31	16 Mar 2008
Local Selection 20	30.57	21.3	16.59	52.45	21 Mar 2008
Local Selection 11	40.46	26.14	16.08	49.52	19 Mar 2008
Local Selection 3	24.64	12.31	16.01	29.68	16 Mar 2008
Local Selection 2	26.26	15.80	13.1	41.54	18 Mar 2008
Paynee	51.1	37.39	28.05	65.14	13 Mar 2008
Mean	31.92	20.85	16.98	42.48	
$CD_{0.05}$	1.15	0.65	1.12	1.17	

characters (Table 1). Tree height varied from 24.64 cm (Local Selection 3) to 51.10 cm (Payne) and trunk girth ranged from 12.31cm (Local selection 3) to 37.39 (Payne). Variation was also found for tree volume which ranged from 11.89 m^3 (Kashmir selection) to 28.05 m^3 (Payne). Shoot extension growth varied from 29.92 cm (Hartley) to 65.14 cm (Paynee). Karadag and Akca (2011) reported, trunk height to from 0.8 to 1.9 m and trunk diameter from 0.7 to 4.3 m in some walnut genotypes. Botu *et al.* (2007) evaluated walnut cultivars under Romanian condition and observed average tree height to vary from 3.75 m to 5.98 m and tree crown volume from 6.9 m^3 to 41.8 m^3. Solar and Stamper (2006) studied the leafing time in various walnut genotypes and reported that among them, the most promising ones are the late-leafing genotypes. In the present study, the time of leaf bud burst ranged from 13 March (Paynee) to 1 April (Hartley). Castro *et al.* (2006) and Atefi (2001) also reported Hartley as a late leafing cultivar. Arzani *et al*. (2010) studied some walnut genotypes in Iran and reported that out of the 58 walnut genotypes, 46 were early leafing and eleven were mid-leafing.

In the present investigations earliest male flowering was recorded in Paynee (23 March to 6 April) and late in Hartley (3 April to 15 April) while earliest female flowering took place in Local Selection 20 (28 March to 8 April) and late in Hartley (6 April to 13 April) and Local selection 2(6 April to 14 April) (Table 2). Similar to above findings Thiesz *et al.* (2009) during his studies on walnut populations in Romania reported that 89% of the walnut trees had a mean flowering time in April. Walnut being a heterodichogamous species demonstrates protandry, protogyny and homogamy in

Table 2 Flowering in different walnut selections

Cultivar/ selection	Time of male flowering	Time of female flowering	Nature of dichogamy
Hartley	3 Apr – 15 Apr 2008	6 Apr – 13 Apr 2008	Protandry
Pieral Lara	30 Mar–10 Apr 2008	5 Apr–10 Apr	Protandry
Ronde de Montignac	24 Mar–4 Apr 2008	5 Apr–14 Apr 2008	Protandry
Kashmir Selection	26 Mar–7 Apr 2008	5 Apr–12 Apr 2008	Protandry
Local Selection 20	25 Mar–11 Apr 2008	28 Mar – 8 Apr 2008	Protandry
Local Selection 11	30 Mar–14 Apr 2008	5 Apr–13 Apr 2008	Protandry
Local Selection 3	29 Mar–12 Apr 2008	3 Apr–10 Apr 2008	Protandry
Local Selection 2	28 Mar–10 Apr 2008	6 Apr–14 Apr 2008	Protandry
Paynee	23 Mar–6 Apr 2008	3 Apr–9 Apr 2008	Protandry

Table 3 Observations on fruit set, fruit retention and yield in different selections of walnut

Cultivar/Selection	Fruit set (%)	Fruit retention (%)	Yield (kg/tree)
Hartley	37.63 (37.84)*	39.76 (39.09)*	0.93
Pieral Lara	39.64 (39.02)	40.59 (39.58)	0.86
Ronde de Montignac	36.10 (36.93)	36.07 (36.91)	0.78
Kashmir Selection	42.45 (40.66)	40.39 (39.46)	0.96
Local Selection 20	30.85 (33.74)	40.54 (39.55)	1.02
Local Selection 11	40.31 (39.41)	41.72 (40.23)	1
Local Selection 3	21.57 (27.67)	29.56 (32.93)	0.65
Local Selection 2	19.74 (26.38)	25.29 (30.19)	0.77
Paynee	60.57 (51.10)	50.82 (45.47)	2.15
Mean	36.54 (36.97)	38.3 (38.16)	1.01
$CD_{0.05}$	0.94 (0.57)	0.99 (0.59)	0.07

different genotypes. Dichogamy of walnut genotypes is of protandrous type (59.7%), protogynous type (33.1%) and a few genotypes are of homogenous type (7.2%) (Comulescu and Botu 2012). In the present study all the cultivars/selections studied exihibited protandry. Similarly, Cerovic *et al*. (2010) in his studies on walnut genotypes in Serbia, reported that most types (80%) were protandrous.

The maximum fruit set (60.57%) and fruit retention (50.82%) was recorded in Paynee and the minimum fruit set (19.74%) and fruit retention (25.29%) in Local Selection 2 (Table 3).The lower values of fruit set and fruit retention observed under present study may be attributed to younger age of the plants, genetic makeup of the varieties/selections and also to the climatic and environmental factors which led to flower and fruit set.

Kumar *et al.* (2005) reported that mean fruit retention in different cultivars/selections of walnut was 52.93% under open pollination, 68.02% under self pollination and 64.44% under cross-pollination.

Nut yield (kg/tree) in the present investigations ranged from 0.65 kg per tree (Local Selection3) to 2.15 kg/tree (Paynee) (Table 3). The lower yield in the present investigations may be attributed to the less age of the walnut trees. Joolka and Sharma (2006) recorded variation in yield ranging from 5.25 to 80.73 kg in different strains of walnut trees in a study on genetic resources of walnut in some parts of North Western Himalayas. Mamadjanov (2006) carried out studies in the natural seedling population of high-yielding, high quality walnuts in walnut-fruit forests located in the south of Kyrgyzstan, and reported yield ranging from 40 kg to 350 kg from one hectare.

Walnut cultivars studied varied considerably for growth and flowering characters. Due to the young age of the cultivars studied yield/tree was relatively less. However, among all the studied cultivars Paynee performed better in all the aspects, i.e. growth, fruit set, fruit retention and yield, and thus can be recommended for cultivation.

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