Asian J. of Adv. Basic Sci.: 2(3), 28-32
ISSN (Online): 2347 - 4114
www.ajabs.org

Effect of girdling and thinning on fruit maturity and quality of Satluj Purple plum

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ABSTRACT: The effect of girdling and thinning on fruit maturity and quality of plum cv. Satluj Purple was investigated on twelve year old trees being grown on sandy loam soil planted at a distance of 6x6m.Uniform cultural practices were followed throughout the course of investigation. Limb girdling and thinning was done at full bloom and 7,14,21,28 and 35 days after full bloom. All the girdling and thinning treatments advanced fruit maturity as compared to control. Least number of days taken for maturity were recorded when limb girdling and thinning was done 14 days after full bloom. Yield was found to increase and fruit drop was reduced in all the treatments. Maximum yield, fruit weight and size, pulp/stone ratio, colour and better fruit quality in terms of higher TSS, TSS/acid ratio, β-carotene with lower acidity and firmness were also observed when limb girdling and thinning was done 14 days after full bloom. Healing of the girdle was satisfactory and there was no detrimental effect noticed in any of the treatments. Leaf nitrogen and chlorophyll content were decreased and total carbohydrates were increased with girdling and thinning treatments.

Keywords: Girdling, maturity, Satluj Purple plum, thinning.

INTRODUCTION

Plum holds a prominent position among the temperate fruits and in Punjab (India), Japanese cultivars (*Prunus salicina* L.), having low chilling requirement are cultivated on small scale. These cultivars have tendency towards over-bearing which leads to limb breakage, reduced fruit size and inferior quality. Girdling and thinning techniques have been found to improve the fruit quality and induce earliness in fruit maturity. Thinning of flowers or fruits must be done at the right time for maximum benefit. Removal of part of the crop enables the remaining crop to receive a greater share of the food material synthesized by the leaves. Although thinning reduces the total number of fruits, yet it improves the fruit size and quality thereby increasing the value of the fruits (Sharma *et al* 2003). Girdling (removal of a strip of bark tissue) is a horticultural practice to advance maturity and to improve fruit size and quality. Its most immediate effect to stop the basipetal movement of assimilates through the phloem, which results in accumulation of carbohydrates above the girdle (Roper and Williams, 1989, Di Vaio *et al* 2001). Keeping in view these advantages, the present study was conducted to enhance the fruit size, quality and to advance maturity time in cv. Satluj Purple.

MATERIAL AND METHODS

The experiment was conducted on 12-year old trees of plum cv. Satluj Purple growing on sandy loam soil and planted at a distance of 6x6m in the New Orchard, Department of Horticulture, PAU Ludhiana during the year 2009 and 2010. Plants were selected on the basis of their uniform size and vigour. Uniform cultural practices were followed throughout the course of investigation. Limb girdling and thinning of flowers and fruits were performed at six stages viz. full bloom, 7,14,21,28 and 35 days after full bloom (DAFB) and was compared with control (ungirdled and unthinned). The trees under each treatment were observed regularly and when no gummy secretion was noticed and bark had completely covered the ring, the stage was noted as complete healing of the ring. Four shoots evenly distributed in all the directions

were selected. The number of flowers and fruits on each shoot was counted at full bloom and after fruit set respectively. Per cent cumulative periodic fruit drop was calculated by making subsequent counts of fruits dropped at 10 days interval. The number of days from full bloom to the date of first harvest was recorded and was used to denote the time of maturity. Fruit yield per tree was calculated by multiplying the number of fruits after the physiological drop with mean fruit weight. Fruit samples from each treatment were collected at harvest and analysed for physico-chemical characteristics as per the standard methods. Leaf samples were collected in June for the analysis of nitrogen, chlorophyll and total carbohydrates. The data was analysed according to the Randomized Block Design (RBD) as described by Singh *et al* (1998).

RESULTS AND DISCUSSION

Fruit maturity was advanced by both girdling and thinning treatments (Table 1). Least number of days taken for maturity was recorded when girdling and thinning was performed 14 days after full bloom (78.75 days).Fruit maturity with girdling and thinning at full bloom (80.50 days), 7 days after full bloom (81.00 days) and 28 days after full bloom (81.75 days) were statistically at par with each other. Fruits in other treatments also matured earlier than control (85.00 days). The advancement in fruit maturity with girdling might be due to more availability of metabolites for the development of fruits. Similar results have also been reported by Day and Dejong (1990) and De Villiers *et al* (1990) that girdling peach trees at stage II enhanced fruit maturity. Thinning is known to advance fruit maturity by faster accumulation of minerals and metabolites, availability of more light and reduced competition among the developing fruits. Chanana and Gill (2006) also observed that thinning at full bloom or 15 days after full bloom advanced fruit maturity by 6 days in peach cv. Florda Prince.

Entire girdling and thinning treatments decreased fruit drop compared to control (Table 1). Girdling and thinning done 14 days after full bloom (T_3) had least fruit drop (27.75%) ,followed by T_4 (21 DAFB) which was at par with T_2 (7 DAFB). Maximum fruit drop was recorded in control (46.50%). Reduced fruit drop due to girdling might be due to the altered distribution of photosynthates that affected the pedicellar attachment and thickness. Winkler (1965) and Dabas *et al* (1979) observed thickened pedicels of grape berries and reduced berry shattering as a result of girdling. Thinning also reduced fruit drop by improving the adherence of the remaining fruits by increasing assimilates supply.

Treatments, girdling and thinning resulted in significant higher fruit yield as compared to control (Table1). Girdling and thinning 14 days after full bloom gave highest yield (18.42 kg/tree) The next best treatment was T_4 and T_2 (21 and 7 DAFB) with an yield of 17.35 and 15.39kg/tree respectively. Fruit yield with girdling and thinning at full bloom, 28 and 35 days after full bloom were statistically similar. The increase in yield with girdling might be due to increase fruit set (Lavee *et al* 1983, Tafazoli 1977) and also due to increased fruit size. Thinning produced larger fruits due to adequate buildup of sink and therefore increased yield in peach (Havis 1962). It was further found that the girdled ring healed up in 83 to 97 days without any ill effect on plant health. Minimum time for healing was recorded in girdling done at full bloom in the present work.

Maximum fruit weight (49.50 g) was observed in treatment T_3 (14 DAFB) and it was statistically at par with T_4 (21 DAFB) whereas minimum (33.24 g) was in control (Table 1). Significant increase in fruit weight in this study may be due to less fruit competition for assimilation early in season and the remaining fruits get more time for gaining weight. The results are in agreement with the findings of Beri (2003) who observed that girdling plus thinning done 2 weeks after full bloom maximized fruit weight in peach. The treatments however reduced fruit firmness (Table 1). Minimum fruit firmness of 1.79 kg/cm^2 was recorded with girdling and thinning 14 days after full bloom while maximum fruit firmness was found in control (4.02 kg/cm^2). The reduction in firmness under different treatments might be due to increase in fruit weight and size and also due to advanced fruit maturity. All the treatments increased the hunter 'a' value (indicate the intensity of red colour) (Table1). The highest 'a' value (23.45) was recorded with girdling and thinning 14 days after full bloom. The change in colour is primarily dependent upon degradation of chlorophyll content and accumulation of coloring pigments like anthocyanin and carotenoids (Kumar 1999). Better accumulation of carbohydrates above the ring, which is the precursor of

anthocyanin, flavonoids and other pigments, may have resulted in increased colour development of fruits. Thinning is also known to improve fruit colour by increasing the availability of light and photosynthates. Agusti *et al* (1998) observed enhancement in fruit colouring of peaches and nectarines by girdling at the beginning of pit hardening and after manual fruit thinning.

Table 1: Effect of limb girdling and thinning on physical parameters of Satluj Purple plum.

Treatment	Fruit maturity time (days)	Fruit drop (%)	Fruit yield (kg/tree)	Days taken for girdle healing	Fruit weight (g)	Fruit firmness (kg/cm^2)	Fruit colour		
							L *	a **	b ***
T_1Girdling+thinning at full bloom	80.50	30.57	13.58	83.00	41.88	3.32	24.38	20.25	5.18
T_2Girdling+thinning 7 DAFB	81.00	27.68	15.39	91.50	44.63	2.17	26.10	18.72	7.30
T_3Girdling+thinning 14 DAFB	78.75	22.75	18.42	87.00	49.50	1.79	29.54	23.45	9.41
T_4Girdling+thinning 21 DAFB	82.25	25.62	17.35	97.25	46.06	2.64	29.36	21.96	8.69
T_5Girdling+thinning 28 DAFB	81.75	31.28	14.04	93.50	39.61	3.53	27.24	18.10	7.28
T_6Girdling+thinning 35 DAFB	83.25	34.44	13.23	85.25	37.96	3.75	27.39	16.72	6.40
T_7 Control	85.00	46.50	11.54	-	33.24	4.02	23.51	15.36	3.92
CD at 5%	1.65	2.60	1.31	1.64	4.21	0.54	1.61	1.30	0.88

** L – light , ** a – green to red *** b – blue to yellow*

Chemical quality parameters like TSS, TSS: acid ratio and β-carotene were found maximum and acidity was minimum when girdling and thinning was performed 14 days after full bloom (Table 2). The improvement in fruit quality in terms of high TSS and low acidity in the present study could be attributed to accumulation of more carbohydrates above the girdled ring, favourable leaf/fruit ratio and reduction in inter-fruit competition for water, minerals and other assimilates. Further Deng *et al* (1997) who also reported that the best time of girdling was 15 days after full bloom which significantly increase fruit soluble solids. The higher β-carotene was due to early maturity and better development of the colour. Thinning increased the availability of light and photoassimilalte which enhanced the synthesis like anthocyanin and carotenoids and degradation of chlorophyll in the fruits.

Leaf nitrogen content was low in all the treatments as compared to control and the values ranged from 2.37 to 2.80 per cent (Table 2). Least content (2.37%) was recorded with girdling and thinning 14 days after full bloom, followed by girdling and thinning 21 and 28 days after full bloom. Maximum nitrogen content was in control (2.80%) which differed statistically from all the other treatments. Higher yields with girdling may directly or indirectly have increased the demand of nitrogen for developing fruits and thus reduced the leaf nitrogen content. Decrease in leaf nitrogen content with girdling was earlier reported by Day and DeJong (1990) in peach and Urban *et al* (2007) in mango. Minimum chlorophyll 'a' (1.15mg/g) and total chlorophyll content (1.70 mg/g) were found when girdling and thinning was performed 35 days after full bloom and minimum chlorophyll 'b' was obtained when girdling and thinning was done 21 days after full bloom. Maximum chlorophyll 'a','b' and total chlorophyll were recorded in control (Table 2). Increase in fruit size and higher yield in girdling and thinning treatments might have more stress on vegetative organs and this resulted in low chlorophyll content. It is also evident from low nitrogen in leaves. Moreover, nitrogen is required for the synthesis of the chlorophyll. According to Peng and Rebe (1996) girdling reduced chlorophyll content in Mihowase satsumas. Similar

results were found by Arakawa *et al* (1997) in apple. Maximum carbohydrate content was reduced when girdling and thinning was performed 14 days after full bloom, whereas minimum value was recorded in control (Table 2). Higher carbohydrate content might be due to accumulation of carbohydrates above the girdle and their translocation to the part above it. The results are in agreement with Proiette *et al* (2006) who observed that girdling increased starch and reducing sugar in leaves of olive. Similarly, Nartvarnant *et al* (1999) reported that inflorescence thinning increased reducing sugar content in leaves of mango.

Table 2: Effect of limb girdling and thinning on chemical parameters of Satluj Purple plum.

Treatment	TSS (%)	Acidity (%)	TSS/acid ratio	β-carotene(µ/100g)
T_1Girdling+thinning at full bloom	14.52	0.76	20.84	50.77
T_2Girdling+thinning 7 DAFB	14.80	0.66	22.66	49.25
T_3Girdling+thinning 14 DAFB	15.36	0.58	26.41	52.00
T_4Girdling+thinning 21 DAFB	15.03	0.61	25.27	50.49
T_5Girdling+thinning 28 DAFB	14.14	0.75	19.26	48.24
T_6Girdling+thinning 35 DAFB	13.87	0.72	19.60	47.32
T_7 Control	12.92	1.14	11.49	44.51
CD at 5%	0.95	0.11	3.82	2.47

Table 3: Effect of limb girdling and thinning on leaf nitrogen, total carbohydrate and chlorophyll content in Satluj Purple plum.

Treatment	Nitrogen (%)	Total Carbohydrates (%)	Chlorophyll a (mg/g)	Chlorophyll b (mg/g)	Total chlorophyll (mg/g)
T_1 Girdling +thinning at full bloom	2.64	8.92	1.32	0.54	2.04
T_2 Girdling +thinning 7 DAFB	2.52	9.56	1.58	0.43	2.11
T_3 Girdling +thinning 14 DAFB	2.37	10.84	1.20	0.60	1.87
T_4 Girdling +thinning 21 DAFB	2.41	10.20	1.64	0.28	2.16
T_5 Girdling +thinning 28 DAFB	2.48	8.41	1.29	0.51	1.93
T_6 Girdling +thinning 35 DAFB	2.53	8.03	1.15	0.31	1.70
T_7 Control	2.80	7.25	1.82	0.77	2.89
CD at 5%	0.04	0.10	0.02	0.03	0.23

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