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Effect of chemical thinning on yield and quality of peach cv. Flordasun

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A field trial was conducted at experimental farm of the Division of Horticulture, ICAR Research Complex for North Eastern Hill Region, Umiam, Meghalaya, India during 2009 to 2010 to evaluate the effect of chemical fruit thinning and their effect on yield and quality of peach cv. Flordasun. Four chemical thinners *viz*. Thiourea at 2.5 and 5%, GA_3 at 75 and 100 ppm, Urea at 4 and 6% and Ethrel at 100 and 150 ppm after fruit set were applied. All the thinning treatments increased fruit drop and fruit colour but reduced the fruit firmness. All the chemical treatments except (GA_3 75 ppm and Urea 4%) after fruit set advanced the time of harvesting. Ethrel at 150 ppm and thiourea at 5% reduced the crop load and improved the physico-chemical characteristics of fruits and fetch premium price in the market due to their attractive colour appearance than control.

Key words: Peach cv. Flordasun, chemical thinning, fruit quality.

INTRODUCTION

Peach (*Prunus persica*. Batsch L.) belonging to the family Rosaceae and sub- family Prunoideae is the third most widely distributed temperate fruit in the world. It is basically a temperate zone plant and its commercial production area is confined between the latitude of 30 and 40° N and S. In India, however, its cultivation is confined to mid hill zone of Himalayas extending from Jammu and Kashmir, Himachal Pradesh, Punjab, Haryana and parts of Uttar Pradesh, Tamil Nadu to North eastern Hill region. Low chilling peaches are grown in sub mountainous region and western Uttar Pradesh. In sub tropical climate of NEH region, peach is being grown in limited scale and has a great potential for its cultivation due to its diverse topography, altitude and climatic condition. In Punjab, introduction of low chilling, high yielding and early ripening cultivars of superior quality traits has brought about miraculous change in peach cultivation (Nijjar, 1977). Due to early access to the commercial markets, peach cultivation has become a highly economic proposition and area under this crop has increased at a faster rate since it is being planted in solid blocks as well as a filler tree in orchards of mango, litchi, pear, etc.

It is well established that heavy bearing of peach trees adversely affects the size and quality of fruits resulting in poor returns to the growers. In addition, breakage of limbs under heavy crop load and increasing susceptibility to late winter frost particularly in the temperate zones are the other adverse effects of heavy bearing. Fruit thinning is essential commercial practices to optimize fruit size, maximize crop value, improve fruit colour, shape, and quality, promote return bloom and to maintain tree growth and structure (Byers et al., 2003). The practice of fruit thinning often leads to improvement in the quality and size of the fruits. Thinning of the peach fruit, advanced the fruit maturity by 4 to 7 days increase the fruit size by

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20 to 35% in different cultivars as compared to unthinned fruits (Chanana et al., 2002).

To accomplish the job of thinning, various methods such as hand thinning, mechanical thinning and chemical thinning are used. Hand thinning fruitlets at 45 to 50 days after bloom is the standard commercial practice in most peach producing areas. Hand thinning of peach is the single most expensive management practice of growing peach (Stover et al., 2004). The horticulturists all over the world have been trying to evolve some chemical treatments to thin out the excessive crop load so that the quality of the remaining fruits are improved. Continuous efforts have established suitability of number of chemicals which could be applied to thin out the fruits economically and without deleterious effect in the tree or fruit quality. However, such chemicals had been observed to be specific as regard to their efficacy in different agro-climatic conditions and also differential response of different cultivars. In recent years, use of chemical thinners in various fruit crops like apple, peach, plum and apricot etc. have been advocated. Out of various chemicals employed to thin out the excessive fruit load in different fruit plants, gibberallic acid, NAA, ethephon (ethrel), CCC, 3- chlorophenoxy propionic acid, MH, DNOC, 2,4,5- Trichloro - phenoxy acetic acid, thiourea, savin etc. have somepromising results in different fruit plants. Considering the above facts in view, the present investigation was undertaken to evaluate the effect of chemical fruit thinning on fruit yield and quality of Flordasun peach grown under mid hill sub tropics of Meghalaya

MATERIALS AND METHODS

Study site

The present investigation was carried out at Horticultural Research Farm of ICAR Research complex for North Eastern Hills Region Umiam, Meghalaya, India during 2009 to 2010. The experimental site was situated at 25° 41'-21" North latitude and 91° 55'-25"East longitude and at an elevation of 1010 m above mean sea level. The climate of the site can be characterized as subtemperate with minimum and maximum temperatures ranging from 6 to 29° C and with average annual rainfall of 2841 mm.

Selection of plant

Eight year old peach cv. Flordasun planted at a spacing of 5×5 m was selected from the peach orchard of the Experimental Farm. The selected trees were marked with metal tag for recording observation.

Experimental design

The experiment was laid out in Randomized Block Design with eight treatments viz., T_0 (Control -water sprayed), T_1 (Urea 4%), T_2 (Urea 6%), T_3 (Thiourea 2.5%), T_4 (Thiourea 5%), T_5 (GA_3 75 ppm), T_6 (GA_3 100 ppm), T_7 (Ethrel 100 ppm), T_8 (Ethrel 150 ppm). Three trees was the unit of treatment and each treatment was replicated three times and the 5 m distance was maintained between treatments.

Preparation and application of solution

Fresh solutions of the chemicals were prepared in the field by dissolving the required quantity of Urea, Thiourea, GA_3 and Ethrel in water. Three liters of respective solutions were applied per tree in the form of fine spray at the time of fruit setting through Knapsack hand sprayer during evening. All other cultural operations were followed as suggested by Patel et al. (2008).

Statistical analysis

The data were subjected to statistical analysis as per the method of Gomez and Gomez (1984). Least significant of difference (LSD) at 5% level was used for finding the significance differences if any, among the treatment means.

Fruit drop

Four shoots which were evenly distributed on all the directions were randomly selected on each tree and tagged. Number of fruit on each shoots was counted at the time of fruit set, before application of chemical thinners. Fruit drop was calculated by making subsequent count of fruit dropped after application of thinning treatments.

Days taken from fruit setting to fruit maturity

Number of days from fruit set to the date of first harvest was recorded. The maturity was adjudged when the shoulder near the suture line of the fruit lost firmness and showed highest total soluble solid content (TSS).

Fruit yield

Fruit yield per tree was calculated by multiplying the number of fruits with mean fruit weight and expressed in kg/tree.

Fruit weight

Weight of 10 fruits was recorded with the help of electronic pan balance and weight of individual fruit was calculated and expressed as mean fruit weight in gram.

Fruit size (length and breadth)

Length and breadth of 10 fruits was measured with the help of Digital Vernier calliper and their mean fruit size (length and breadth) was expressed in millimeters.

Fruit colour

An arbitory four-point system was followed to evaluate the fruit colour as 1 to 2 (poorly coloured), 2 to 3 (moderately coloured) and 3 to 4 (highly coloured). An average score of ten fruits was calculated in each replication keeping in mind the characteristic colour. The fruits were subjected to a panel of judges for colour rating.

Fruit firmness

Firmness of fresh five fruits was measured using a Stable Micro System TA-XT-plus texture analyzer (Texture Technologies Corp., UK) fitted with needle. Firmness value was considered as mean peak compression force and expressed in kg. The studies were conducted at a pre test speed of 1 mm/s, test speed of 2 mm/s, distance of 5 mm and load cell of 50 kg.

Pulp weight and stone weight

Weight of pulp and weight of stones of fresh five fruits was recorded with the help of an electronic pan balance and expressed as mean weight in gram.

Pulp to stone ratio

Weight of pulp and stone of fresh five fruits was recorded with the help of electronic pan balance and pulp: stone ratio was determined by dividing the pulp weight by stone weight.

Total soluble solids

Total soluble solids of the fresh fruits were recorded by using a digital refractometer at room temperature and expressed in ^{0}Brix. The refractometer was cleaned with distilled water after each observation.

Acidity

Total titratable acidity of fresh fruits was estimated by taking 10 ml of juice which was diluted with distilled water to make the final volume 100 ml. 10 ml of this sample was titrated against N/10 NaOH using phenolphthalein as the indicator (Ranganna, 1997).

Sugars

25 ml of the fresh fruit solution used for the estimation of reducing sugars was taken and 2.5 ml of concentrated HCl was added and kept overnight. Next day, the solution was neutralized with 1N NaOH and the volume was made up to 75 ml. It was then titrated against Fehling's solution A and B (5 ml each) as done in case of reducing sugars. From the following formula, total sugar was calculated (Ranganna, 1997).

$$\text{Total sugar as invert sugar (\%)} = \frac{\text{mg of invert sugar} \times \text{dilution} \times 100}{\text{Titre value} \times \text{Weight or volume of sample}}$$

Ascorbic acid

Ascorbic acid content was determined by using 2, 6-Dichlorophenol-indophenol dye method of Freed (1966). 5 g of the fresh fruit sample was grounded with about 25 ml of 4% oxalic acid and filter through Whatman no. 4 filter paper. The filtrate was collected in a 50 ml volumetric flask and the volume was made up with 4% oxalic acid and titrated against the standard dye to a pink point. The amount of ascorbic acid was calculated using the following formula and expressed as mg/ 100 g.

$$\text{Ascorbic acid (mg/ 100 g)} = \frac{\text{Titre value} \times \text{Dye factor} \times \text{Volume make up} \times 100}{\text{Aliquot} \times \text{Weight of the sample}}$$

Total minerals

Total minerals were estimated as per the method suggested by Srivastava and Kumar (2002). 2 g of the samples was weighed in a previously weighed silica crucible. The crucibles were then heated over a low flame to volatize as much of the organic matter as possible and then heated in a muffle furnace at 600°C for 3 to 4 h. The samples were then cooled in a desiccator and weighed. To ensure complete ashing, the crucible is again heated in the furnace for 30 min, cooled and weighed. Total mineral was determined by using the following formula.

$$\text{Total mineral (\%)} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100$$

Phenol content

Total phenol content was determined using the Folin-Ciocalteu's reagent (Singleton and Rossi, 1965). 0.5 g of fresh sample was crushed with 80% alcohol in crucible and put in tubes. Then the material was centrifuged at 10000 rpm for 20 min and supernatant was transferred to Petridish. Residue was centrifuged again by putting little amount of alcohol in the tubes. Supernatant was transferred to Petridish again and evaporated to dryness. Next day 5 ml of water was added in the petridish. 1 ml of supernatant, 9 ml water and 5 ml folin reagent was transferred to 25 ml volumetric flask. After 3 min sodium carbonate was added and the OD was recorded at 650 nm and total phenol content was calculated by using standard graph.

Anthocyanin content

Total anthocyanin content was estimated by taking 10 g of fresh fruit pulp which was blended with ethanolic HCL. Then transfer to 100 ml volumetric flask and made up the volume up to 100 ml with ethanolic HCL and kept overnight at 4°C. Next day filter through whatman No. 1 filter paper, then the filtrate was taken and its O.D value at 535 nm was measured and recorded (Ranganna, 1997).

$$\text{Total anthocyanins (mg/100 g)} = \frac{\text{O.D} \times \text{volume made up} \times 100}{\text{Weight or volume of samples}}$$

Total carotenoids

Total carotenoids were estimated as per the method described by AOAC (1980). 3 g fresh sample was grounded with 50 ml of acetone-LR. To the separating funnel, 50 ml of petroleum ether was added followed by the coloured acetone extract. Then 300 ml of distilled water was added slowly along the wall of the separating funnel. On a 50 ml volumetric flask, a small funnel was placed and a small quantity of Na_2SO_4 was placed on the cotton and the upper layer was filtered into the volumetric flask. Volume was made upto 50 ml with petroleum ether and optical density was recorded at 450 nm using petroleum ether as blank and expressed in mg/100 g. Total carotenoids were estimated by the following formula.

Table 1. Effect of chemical thinning on fruit drop, days to maturity and fruit yield.

Treatments	Fruit drop (%)	Days to maturity	Fruit yield (kg/ tree)
T_1: Thiourea (2.5%)	60.86	73	36.69
T_2: Thiourea (5%)	66.14	73	31.73
T_3: GA_3 75 ppm	40.77	73	39.57
T_4: GA_3 100 ppm	45.73	72	33.64
T_5: Urea (4%)	39.78	78	38.67
T_6: Urea (6%)	47.36	74	35.48
T_7: Ethrel 100 ppm	63.58	70	29.62
T_8: Ethrel 150 ppm	68.32	70	28.96
T_0: Control	23.08	75	44.27
LSD $p_{(0.05)}$	2.85	-	1.45

$$\text{Total carotenoids (mg/100 g)} = \frac{A \times \text{Volume} \times 10^4}{A_m^x \times \text{Weight of sample}}$$

Where, A = Absorbance at 450 nm, A_m^x = Absorption coefficient of β- carotene in petroleum ether (2592).

RESULTS AND DISCUSSION

Effect of treatment on fruit drop, days to maturity and fruit yield

It was observed from the findings that all the thinning treatments significantly increased the percent of fruit abscission (Table 1). Amongst the chemical thinners, ethrel at150 ppm (68.32%) sprayed after fruit set (AFS) was found to be the most effective in promoting fruit abscission as compared to other treatments. However, the rate was higher with increase in concentration of chemicals. The increase in percentage of fruit drop could be attributed due to the reduction of the translocation of ^{14}C sucrose from the leaves to the developing fruits after application of these chemicals and also due to the reduction in auxin transport before fruit drop which led to increased ethylene production thereby reducing auxin biosynthesis directly or indirectly by changing the mobilizing ability of the fruits resulting in the abscission of such fruits. Results supporting to these finding were also reported by Retamales et al. (1990) with 3-CPA and CGA-15281(an ethylene releasing compound); Abdel Hamid (1999) with ethrel and Babu and Yadav (2002) with thiourea. From the present investigation it was found that all the treatments reduced the number of days from fruit setting to fruit maturity in comparison to control sprayed after fruit set except urea at 4%. Among chemical thinners, ethrel at 100 ppm and 150 ppm advanced the fruit maturity by 5 days. The advancement in fruit maturity might be due to the increase in ethylene production in the fruit of treated plants during the final growth period which led to increased physiological activity such as climacteria like respiration. On the other hand, fruit maturity delayed by 3 days with the application of urea (4%) after fruit set (AFS) and it could be attributed due to severe phytotoxicity resulting in a large reduction in leaf area and subsequent new growth, which in turn slowed down the rate of fruit development (Durner et al., 1990). Similar observation with respect to enhancement of fruit maturity had been reported by Chahill et al. (1980) with ethephon; Sandhu and Singh (1983) with ethephon; Allan et al. (1992) with ethephon and Sharma et al. (2001) with ethrel. All the chemical thinning treatments reduced the fruit yield per tree. The control (T_0) tree gave the maximum yield (44.27 kg) followed by 39.57 kg in T_3 (GA_3 at 75 ppm), whereas the minimum yield (28.96 kg) was produced by T_8 (Ethrel at 150 ppm). But, lower rate of urea and GA_3 did not affect the fruit yield and it was comparable to control. Reduction in yield could be attributed to decrease in number of fruits per tree under these treatments as a result of higher percentage of fruit drop. The present findings are in agreement with those of Gianfagna (1990) who observed reduction in yield with ethephon treatments.

Effect of treatment on physical characteristics of peach fruit

All the chemical thinning treatments significantly increased the fruit weight in comparison to control (T_0), where it was minimum (43.21 g). The fruit weight was increased with the increase in concentration of chemicals. The fruit weight was maximum (47.48 g) in T_8 (Ethrel at 150 ppm) which was statistically at par with T_2 (46.59 g), T_7 (45.82 g) and T_1 (45.61 g). Increase in fruit weight might be due to the reduction in the number of fruits per tree thereby increasing the leaf to fruit ratio which resulted in increased availability of photosynthates and lesser nutritional competition among the developing fruits, thus improving the fruit weight. These results get support from the findings of Chahill et al. (1980), Vitagliano et al. (1985), Khalil and Stino (1987), Zhang

Table 2. Effect of chemical thinning on fruit weight, fruit size (length and breadth), fruit colour, fruit firmness, pulp weight, stone weight and pulp stone ratio.

Treatments	Fruit weight (g)	Fruit length (mm)	Fruit breadth (mm)	Fruit color (4 point basis)	Fruit firmness (kg/cm^2)	Pulp weight (g)	Stone weight (g)	Pulp to stone ratio
T_1: Thiourea (2.5%)	45.61	44.86	44.26	2.83	0.1323	41.72	3.92	10.64
T_2: Thiourea (5%)	46.59	45.93	44.36	2.91	0.1316	42.64	4.01	10.63
T_3: GA_3 75 ppm	43.76	43.61	42.32	2.48	0.1413	39.86	3.79	10.52
T_4: GA_3 100 ppm	44.56	44.23	43.72	2.74	0.1358	40.65	3.83	10.62
T_5: Urea (4%)	43.78	43.21	42.82	2.41	0.1382	39.92	3.80	10.51
T_6: Urea (6%)	44.91	44.62	43.21	2.62	0.1346	40.72	3.84	10.60
T_7: Ethrel 100 ppm	45.82	45.56	44.68	2.96	0.1321	41.92	3.95	10.61
T_8: Ethrel 150 ppm	47.48	46.82	45.64	3.06	0.1278	43.69	4.04	10.81
T_0: Control	43.21	43.12	42.81	2.36	0.1432	38.54	3.71	10.39
LSD $p_{(0.05)}$	2.11	1.28	1.45	0.14	0.004	2.03	0.18	0.21

(1990) and Abdel Hamid (1999).

All the chemical thinning treatments significantly increased fruit length and breadth as compared to control. There was progressive increase in fruit length and breadth with the increase in concentration of chemicals. Maximum fruit length (46.82 mm) and breadth (45.64 mm) was found in T_8 (Ethrel at 150 ppm) which was at par with T_2 (Thiourea at 5 %) and T_7 (Ethrel at 100 ppm), whereas minimum fruit length (43.12 mm) and breadth (42.81 mm) were observed in control (T_0). Increase in fruit size could be attributed due to increase in leaf to fruit ratio as a result of thinning, thus increasing the availability of photosynthates and nutrients to the remaining fruits thereby increasing the size of individual fruits. Increase in fruit size was also observed by Chahill et al. (1980) with ethephon, Li et al. (1991) with GA_3 and Sharma et al. (2001) with ethrel. The fruit colour was improved by all chemical thinning treatments. There was a progressive increase in fruit colour with the increase in concentrations of all the chemical thinners (Table 2). Highest concentrations of ethrel (150 ppm) when applied after fruit set produced maximum fruit colour (3.06) compared to other treatments. Since higher concentrations of these chemicals suppressed the vegetative growth, the fruits on the trees remained better exposed to sunlight and aeration, thereby resulting in better colour development. Change in fruit colour depends upon the degradation of chlorophyll and accumulation of colouring pigments like anthocyanins and carotenoids. There was a positive correlation between fruit colour and photo synthetically active radiation (Correlli-Grappadelli and Coston, 1991). These findings are in line with the findings of Sandhu and Singh (1983), Sinha et al. (1983) and Modic (1989). All the chemical thinning treatments reduced the fruit firmness but significant reduction was observed only with ethrel at 150 ppm (0.1278 kg/cm^2). Firmness had been reported to decrease with increase in fruit size (Von Mollendorg et al., 1992). Generally, the decrease in fruit firmness under chemical thinning treatments might be due to higher accumulation of nitrogen in the fruit resulting in fruit softening via activation of cell wall softening enzymes. These findings are in line with Trevisan et al. (2000) who observed the fruit firmness with increasing NAA concentration and Saini et al. (2003) also observed that fruit firmness was reduced by chemical thinning.

Pulp weight is the important quality characters for assessing the effect of different treatments. The data (Table 2) revealed that all the chemical thinning treatments had increased the pulp weight in comparison to control. Maximum pulp weight (43.69 g) was recorded in T_8 (Ethrel at 150 ppm), whereas minimum pulp weight (38.54 g) was found in control (T_0). The data presented in Table 2 showed that all the treatments significantly increased the stone weight of the fruit. Maximum stone weight (4.04 g) and pulp to stone ratio (10.81%) was found in T_8 (Ethrel at 150 ppm), whereas minimum stone weight (3.71 g) pulp to stone ratio (10.39 %) was recorded in control (T_0). The increase in pulp weight, stone weight and pulp to stone ratio could be attributed to the fact that fruit thinning increased fruit size which resulted in higher proportionate pulp weight and marginal increase in stone weight. These results get support from the findings of Chahill et al. (1980) and Khalil and Stino (1987) with ethephon (100 ppm).

Effect of treatment on chemical characteristics of peach fruit

It was found that the total soluble solids, reducing sugars, non-reducing sugars and total sugars were increased by increasing concentrations of all the chemical thinners when applied after fruit set (Table 3). Amongst all the chemical thinners the maximum increase in total soluble solids (13.22°Brix), reducing sugar (1.86%), non-reducing

Table 2. Effect of chemical thinning on fruit weight, fruit size (length and breadth), fruit colour, fruit firmness, pulp weight, stone weight and pulp stone ratio.

Treatments	Fruit weight (g)	Fruit length (mm)	Fruit breadth (mm)	Fruit color (4 point basis)	Fruit firmness (kg/cm^2)	Pulp weight (g)	Stone weight (g)	Pulp to stone ratio
T_1: Thiourea (2.5%)	45.61	44.86	44.26	2.83	0.1323	41.72	3.92	10.64
T_2: Thiourea (5%)	46.59	45.93	44.36	2.91	0.1316	42.64	4.01	10.63
T_3: GA_3 75 ppm	43.76	43.61	42.32	2.48	0.1413	39.86	3.79	10.52
T_4: GA_3 100 ppm	44.56	44.23	43.72	2.74	0.1358	40.65	3.83	10.62
T_5: Urea (4%)	43.78	43.21	42.82	2.41	0.1382	39.92	3.80	10.51
T_6: Urea (6%)	44.91	44.62	43.21	2.62	0.1346	40.72	3.84	10.60
T_7: Ethrel 100 ppm	45.82	45.56	44.68	2.96	0.1321	41.92	3.95	10.61
T_8: Ethrel 150 ppm	47.48	46.82	45.64	3.06	0.1278	43.69	4.04	10.81
T_0: Control	43.21	43.12	42.81	2.36	0.1432	38.54	3.71	10.39
LSD $p_{(0.05)}$	2.11	1.28	1.45	0.14	0.004	2.03	0.18	0.21

Table 3. Effect of chemical thinning on TSS (^{0}Brix), acidity, reducing sugars, non-reducing and total sugars of peach.

Treatments	TSS (^{0}Brix)	Acidity (%)	Total sugars (%)	Reducing sugars (%)	Non – reducing sugars (%)
T_1: Thiourea (2.5%)	12.97	0.68	6.19	1.81	4.38
T_2: Thiourea (5%)	13.18	0.66	6.28	1.83	4.45
T_3: GA_3 75 ppm	12.52	0.71	6.03	1.73	4.30
T_4: GA_3 100 ppm	12.61	0.70	6.11	1.76	4.35
T_5: Urea (4%)	12.47	0.73	6.05	1.71	4.34
T_6: Urea (6%)	12.49	0.77	6.10	1.74	4.40
T_7: Ethrel 100 ppm	13.15	0.67	6.24	1.84	4.41
T_8: Ethrel 150 ppm	13.22	0.64	6.42	1.86	4.56
T_0: Control	12.26	0.71	5.71	1.69	4.02
LSD $p_{(0.05)}$	0.58	0.03	0.20	0.08	0.19

sugar (4.56%) and total sugar (6.42%) was recorded in ethrel at 150 ppm when applied after fruit set. Improvement in total soluble solids, reducing sugar, non-reducing sugars and total sugars might be attributed to reduced crop load due to thinning, consequently increasing the leaf to fruit ratio, which resulted in more synthesis, transport and accumulation of sugars in the remaining fruits, thus improving the total soluble solids and sugars. The increase in total soluble solids and reducing sugars had been reported by Sandhu and Singh (1983) with ethephon; Abdel Hamid (1999) with ethrel and Saini et al. (2003), whereas increase in total sugars had also been reported by Bhullar et al. (1981) with pre-harvest calcium nitrate application; Sandhu and Singh (1983) with ethephon; Zhang (1990) with paclobutrazole; Gupta and Kaur (2004) with ethrel in plum.

All the chemical thinning treatments decreased the acidity of the fruit except urea (4 and 6%); however, thinning with ethrel at 150 ppm was most effective in reducing the acidity as compared to other treatments. Maximum increase in acidity (0.77%) was recorded in urea at 6% (T_6) treatment, whereas minimum reduction in acidity (0.64%) was recorded in ethrel at 150 ppm when applied after fruit set (Table 3). Reduction in acidity under chemical thinning treatments might be due to conversion of organic acids into sugar. The present findings are in close conformity with the findings of Chahill et al. (1980) who had also reported decrease in acidity with 100 ppm ethephon treatment, whereas increase in acidity under chemical thinning might be due to the increase in biosynthesis of organic acid with slower rate of nitrogen application.

The ascorbic acid, total minerals, phenols, anthocyanin and carotenoids content were increased by increasing concentrations of all the chemical thinners when applied after fruit set (Table 4). Amongst all the chemical thinners the maximum ascorbic acid (52.87 mg/100 g), total minerals (1.62%), phenols (150.43 mg/100 g), anthocyanin (4.81 mg/100 g) and carotenoids (10.87 mg/100 g) was recorded in ethrel at 150 ppm when applied after fruit set. Increase in anthocyanin and carotenoid content might be due to the fact that fruit

Table 4. Effect of chemical thinning on ascorbic acid, minerals, phenols, anthocyanin and carotenoid of peach.

Treatments	Ascorbic acid (mg/100 g)	Minerals (%)	Phenol content (mg/100 g)	Anthocyanin content (mg/100 g)	Carotenoid (mg/100 g)
T_1: Thiourea (2.5%)	52.34	1.52	149.85	4.58	10.64
T_2: Thiourea (5%)	52.56	1.59	150.22	4.67	10.73
T_3: GA_3 75 ppm	50.87	1.29	148.86	4.22	10.39
T_4: GA_3 100 ppm	51.43	1.38	149.32	4.36	10.50
T_5: Urea (4%)	50.95	1.27	148.87	4.23	10.41
T_6: Urea (6%)	51.59	1.35	149.46	4.34	10.52
T_7: Ethrel 100 ppm	52.49	1.55	149.91	4.65	10.69
T_8: Ethrel 150 ppm	52.87	1.62	150.43	4.81	10.87
T_0: Control	50.69	1.23	148.50	4.15	10.25
LSD $p_{(0.05)}$	1.25	0.08	0.95	0.17	0.32

thinning resulted in reducing the inter-fruit competition for minerals, metabolites and precursors, which increased the faster accumulation of colouring pigments, thus anthocyanin and total carotenoids content of the fruit were increased, whereas increase in ascorbic acid might be due to the lower rate of conversion of ascorbic acid to dehydro-ascorbic acid. These results are in line with the findings of Abdel Hamid (1999) who reported increase in anthocyanins content with ethrel 100 or 200 ppm treatment when applied after fruit set, on the other hand increase in ascorbic acid had also been reported by Babu and Yadav (2002) with GA_3 and thiourea treatments when applied at full bloom stage in peach.

Conclusion

From the study it could be inferred that ethrel at 150 ppm and thiourea 5% found most effective chemical thinner to reduced the crop load and improved the physico-chemical characteristics of peach cv. Flordasun. Hence, ethrel at 150 ppm and thiourea at5% may be applied to thin out the fruits without deleterious effect in the fruit quality and to fetch the premium price in the market due to their attractive colour appearance than control.

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