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Effect of exogenous application of amino acids on fruit quality and productivity of peach (*Prunus persica*)

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ABSTRACT

The present investigations were carried out at Fruit Research Farm, Punjab Agricultural University, Ludhiana during 2016-17 to study the effect of exogenous application of amino acids (Peptone) on fruit quality, maturity and productivity of peach (*Prunus persica* L. Batsch) in sub-tropics of north India. The 6-year-old peach trees of cv. Florida Prince were sprayed with 0.25% and 0.50% of amino acid (Peptone P1 023), 7 and 14 days after full bloom and the sprays were repeated after 15 and 30 days. The highest yield (53.92 kg/tree) was recorded in T_8 treatment (0.50% amino acid applied 14 days after full bloom and repeated after 15 days) while lowest in T_{12} treatment sprayed with triple spray of amino acids. All the double spray treatments of amino acids advanced fruit maturity by 4 days as compared to control. The mean maximum fruit weight (78.23 g) was recorded in T_8 (0.50% amino acid applied 14 days after full bloom and repeated 15 days later) and minimum in the plants sprayed with triple sprays of amino acids (T_{12}). The double spray treatments (T_5 to T_8) recorded lower fruit firmness indicating early maturity than control and other treatments. Maximum fruit TSS (12.10°Brix), highest total sugars content (5.12%) and lowest mean juice acidity (0.70%) was recorded in T_8 treatment. Therefore, the double spray treatments of amino acids advanced fruit maturity, increased yield and improved fruit quality in peach.

Key words: Amino acids, Fruit quality, Peach, Yield

Peach (*Prunus persica* L. Batsch) is an important fruit crop of temperate and sub-tropical regions of the world. It has a wide climatic adaptability, grown commercially between 24^0 N and 45^0 S. Globally, it is cultivated on an area of 14.99 lakh ha, with production of 21.08 lakh tonnes (Anonymous 2017). In India, its cultivation is circumscribed to warm temperate and sub-tropical parts of Himachal Pradesh, Jammu & Kashmir, Punjab, Haryana, Uttarakhand, Uttar Pradesh, north-eastern states and Tamil Nadu. In India, annual production of peach is 112000 MT from an area of 18000 ha (Anonymous 2017). In Punjab, it is grown on an area of 1723 ha with a production of 30,525 MT fruit annually (Anonymous 2017).

Area under this crop is increasing rapidly in the state because of higher returns and availability of suitable cultivars and their production technology. Peach tree under sub-tropical climate tends to grow vigorously and also set fruits very heavily, which results in production of small sized fruits. Besides this, excessive crop often leads to early decline of trees and production of poor quality fruit. Florida Prince is a promising early maturing and high yielding peach cultivar of Punjab. But, the major problem is that the fruit size remains small at the time of fruit harvest due to short fruit development period. The bumper crop also results in smaller and mishappened fruits of low quality which do not bring good returns to the grower.

In recent past, foliar application of certain bioregulators and chemicals like CPPU and potassium is another practice which is gaining popularity for increasing fruit size, yield and improving quality of fruits in temperate fruit plants. Foliar application of bio-stimulants like amino acids have been found effective in improving quality and increasing the size as well as yield of pear (Koksal *et al.*1999). Amino acids are constituents and precursors of the proteins which are substantial for cell growth (Rai 2002) and regulate physiological and biochemical functions within the plant resulting in improved stress resistance (Kauffman *et al.* 2005). Exogenous amino acid application resulted in enhanced growth and yield and improved biochemical quality of squashes and grapes (Khan *et al.* 2012, Abd El-Aal *et al.* 2010). Keeping this in view, the current study was planned to investigate the effect of amino acids on fruit quality and productivity of peach in the sub-tropical climate of north India.

MATERIALS AND METHODS

The present investigation was conducted at Fruit Research Farm, Punjab Agricultural University, Ludhiana

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during 2016-17. Ludhiana features a humid sub-tropical climate classification, with average maximum and minimum temperatures of 35.8°C and 2.7°C, respectively, and an annual rainfall of 733 mm. The six-year-old uniform trees of peach cv. 'Florida Prince' budded on Floridaguard rootstock and spaced at 6 m × 6 m were pruned in January every year and were given uniform cultural practices during the course of study. The Florida Prince peach trees were sprayed with 0.25 and 0.50% concentrations of Peptone P1 023 i.e. a mixture of amino acids (total amino acids 86% + Free-L amino acids 16% + 14.2% organic nitrogen), which was applied at 7 and 14 days after full bloom and the sprays were repeated after 15 and 30 days. The detail of treatments is as follows: T_1 (0.25% 7 Days after full bloom), T_2 (0.50% 7 Days after full bloom), T_3 (0.25% 14 Days after full bloom), T_4 (0.50% 14 Days after full bloom), T_5 (T_1+ 0.25% after 15 days), T_6 (T_2+ 0.50% after 15 days), T_7 (T_3+ 0.25% after 15 days), T_8 (T_4+ 0.50% after 15 days), T_9 (T_5+ 0.25% after 15 days), T_{10} (T_6+ 0.50% after 15 days), T_{11} (T_7+ 0.25% after 15 days), T_{12} (T_8+ 0.50% after 15 days) and T_{13} (Control).

Observations on yield and fruit quality parameters were recorded in 2016 and 2017. The fruits were harvested manually during morning hours and were immediately transported to laboratory for analysis. The average fruit yield (kg/ tree) was calculated by multiplying total number of fruits per tree with average fruit weight. The fruit weight (g) of five fruits was recorded with the help of simple pan balance for each treatment and their average was worked out. The mesocarp colour parameters of peach fruit were assessed by using Color Flex meter (Hunter 1975). The fruit firmness (kg/cm^2) was measured with help of penetrometer (8 mm plunger) after removing one square cm of skin. The total soluble solids content were determined with the help of hand refractrometer in term of °Brix (%) and the values were corrected at 20°C with the help of temperature correction chart. The total titratable acidity was determined by titrating a known volume of juice with 0.1 N NaOH solution, using phenolphthalein as an indicator. The end point was marked by appearance of pink colour which persisted for few seconds. The estimation of total sugars was done by method suggested by Lane and Eynon (AOAC 1990). The experiment was laid out as Randomized Block Design (RBD) with three replications in each treatment. The data were analyzed for variance using SAS (V 9.3, SAS Institute Inc., USA).

RESULTS AND DISCUSSION

Fruit quality: The data presented in Tables 1 and 2 show that all the double spray treatments of amino acids improved fruit quality as compared to other treatments. Highest mean fruit weight (78.23 g) over a two year period was recorded in T_8 treatment and it was significantly higher than all single and triple spray amino acid treatments. It was statistically at par with T_7, which recorded mean fruit weight (76.23 g). This was closely followed by T_6 and T_5 treatments, which recorded mean fruit weight of 73.53 g

Table 1 Effect of amino acids on weight, firmness and color of peach cv. Florida Prince (Pooled data of 2016-17)

Treatment	Fruit weight (g)	Fruit firmness (kg/cm^2)	Fruit color (L value)
T_1: 0.25% 7 DAFB	67.08	4.73	54.35
T_2: 0.50% 7 DAFB	68.18	4.82	55.13
T_3: 0.25% 14 DAFB	69.43	4.93	54.70
T_4: 0.50% 14 DAFB	70.15	4.80	53.53
T_5:T_1 + 0.25% after 15 days	72.08	4.52	55.88
T_6:T_2 + 0.50% after 15 days	73.53	4.53	56.46
T_7:T_3 + 0.25% after 15 days	76.23	4.33	58.80
T_8:T_4 + 0.50% after 15 days	78.23	4.27	59.71
T_9:T_5 + 0.25% after 15 days	63.82	5.15	51.93
T_{10}:T_6 + 0.50% after 15 days	59.13	5.05	52.39
T_{11}:T_7 + 0.25% after 15 days	61.42	5.22	52.54
T_{12}:T_8 + 0.50% after 15 days	58.45	5.32	52.03
T_{13}: Control	69.25	4.85	48.69
Mean	68.23	4.81	54.01
LSD (P≤0.05)	4.29	0.26	0.12

Table 2 Effect of amino acids on total soluble solids, titratable acidity and total sugars of peach cv. Florida Prince (Pooled data of 2016-17)

Treatment*	Total soluble solid (°Brix)	Titratable acidity (%)	Total sugars (%)
T_1	11.50	0.79	4.73
T_2	11.50	0.79	4.75
T_3	11.47	0.79	4.67
T_4	11.42	0.77	4.75
T_5	11.70	0.76	4.81
T_6	11.73	0.76	4.87
T_7	11.90	0.73	5.01
T_8	12.10	0.70	5.12
T_9	11.00	0.81	4.62
T_{10}	11.10	0.81	4.62
T_{11}	11.00	0.84	4.61
T_{12}	11.10	0.83	4.59
T_{13}(Control)	11.33	0.79	4.77
Mean	11.45	0.78	4.76
LSD(P≤0.05)	0.32	0.04	0.16

*Details of treatments are given in Table 1

and 72.08 g, respectively, and was significantly higher than control. Similar trend was observed during both the years. During 2016-17, maximum fruit weight (76.00 g and 80.47 g, respectively) was recorded in T_8 and minimum in the plants sprayed with triple sprays of amino acids (T_9 to T_{12}). The lower fruit weight in the triple spray amino acid treatments may be attributed to excess nitrogen applied leading to more shoot growth as compared to fruit growth, while the optimal amount applied in double sprays resulted in higher fruit weight. Vashisth *et al.* (2017) reported deterioration of fruit quality as the dose of nitrogen applied increased. Also, Khan *et al.* (2012) reported that increase in fruit weight with the application of amino acids in Perlette grapes was due to increased chlorophyll content of leaves, which increased photosynthesis and ultimately overall health of vines. Similar results on increased fruit weight by the application of amino acids were reported in Williams pear (Koksal *et al.* 1999) and Washington Navel orange (Sharaf *et al.* 2011).

The maximum fruit firmness was under triple spray treatments of amino acids during both the years. Highest mean fruit firmness (5.32 kg/cm^2) over a two year period was recorded in T_{12} followed by T_{11}, which recorded fruit firmness of 5.22 kg/cm^2. The fruit firmness recorded under single spray of amino acids (T_1 to T_4) was found to be statistically at par with the control plants. The double spray treatments (T_5 to T_8) recorded the lower mean fruit firmness indicating early maturity than control and other treatments. Similar trend was observed during both the years also. During 2016-17, maximum fruit firmness (5.30 and 5.33 kg/cm^2, respectively) was recorded in T_{12} and minimum in the plants sprayed with double sprays of amino acids (T_5 to T_8). El-Boray *et al.* (2016) reported that application of bio-stimulants significantly increased fruit firmness as compared to control in peach. Similar results were found in apple (Thanaa *et al.* 2016) and pear (Fayek *et al.* 2011).

Double spray amino acid treatments significantly improved fruit color of peach. The maximum mean value over a 2 year period (59.71) was recorded in T_8 treatment and it was significantly higher than all the treatments. The mean color value of control plants (49.69) was significantly lower than all the treatments. The change in fruit color depends upon the degradation of the chlorophyll content and accumulation of the coloring pigments. Significant reduction in red color rating in triple spray treatments of amino acids was due to delayed maturity of the fruits. Thanaa *et al.* (2016) reported that application of amino acids had significant effect on lightness and redness on fruits of apple cultivar Anna. Rombola *et al.* (2001) found that application of bio-stimulant (seaweed extract) improved the fruit color and color distribution in Mondial Gala apple fruits.

The perusal of data presented in Table 2 shows that double spray amino acid treatments recorded significantly higher TSS content and lower juice acidity as compared to other treatments during both the years. Highest mean fruit TSS (12.10^{o}Brix) over a two year period was recorded in T_8 treatment. It was statistically at par with T_7, which recorded mean fruit TSS of 11.90^{o}Brix. The TSS content recorded under single spray of amino acids (T_1 to T_4) and control were statistically at par with each other. The data further shows that TSS content of control plants (11.33^{o}Brix) was significantly higher than the plants sprayed with triple sprays of amino acids (T_9 to T_{12}). Similar trend was observed during both the years of investigations. In both the years, control plants recorded higher TSS content (11.40^{o}Brix and 11.27^{o}Brix, respectively) than the triple spray treatments of amino acids (T_9 to T_{12}).

The minimum juice acidity (0.70%) was recorded in T_8 and highest acidity was recorded in plants sprayed with triple sprays of amino acids. The acidity recorded under single spray of amino acids (T_1 to T_4) and control was statistically at par. The data shows that acidity of control plants (0.78%) was significantly lower than the plants sprayed with triple sprays of amino acids (T_9 to T_{12}), although the difference could not attain the level of significance. Similar trend was observed during both the years. Thanaa *et al.* (2016) observed that amino acids enhanced the synthesis of different proteins, acids and sugars, which increased TSS content in fruits. El-Boray *et al.* (2016) reported that foliar application of bio-stimulants increased TSS and reduced acidity in peach as compared to control. Similarly, Fathy *et al.* (2010) reported that spraying of bio-stimulants reduced acidity on peach trees. Gouble *et al.* (2005) reported that the increase in TSS in apricot during fruit development is linked to changes in color and ethylene production.

The data reveals that total sugars contents were also found significantly highest under double spray treatments of amino acids as compared to other treatments. During 2016-17, maximum total sugars content (5.09% and 5.15% respectively) was recorded in T_8 and minimum in the plants sprayed with triple sprays of amino acids. The total sugars content recorded under single spray of amino acids (T_1 to T_4) and control were found to be statistically at par. The total sugars content of control plants (4.77%) was significantly higher than the plants sprayed with triple sprays of amino acids. The enhanced photosynthesis, metabolism and overall health of plants might have resulted in increasing the total sugars contents of peach fruits under different treatments. El-Boray *et al.* (2016) reported that bio-stimulant application increased total sugars content in peach due to enhanced photosynthesis of plants, increased leaf area and increased potassium content which resulted in improved fruit quality.

Fruit yield: The data presented in Table 3 shows that fruit yield was significantly affected by different treatments of amino acids. Highest mean yield (53.92 kg/tree) over a two year period was recorded in T_8 and it was statistically at par with T_7 treatment but significantly higher than all other treatments. The other double spray treatments T_5 and T_6, also recorded higher fruit yield (50.52 kg/tree and 51 kg/tree, respectively) over the control. The fruit yield recorded under the single spray treatments and control were found to be statistically at par. The yield of control plants was also significantly higher than the plants sprayed with triple spray of amino acids. Higher fruit yield in T_7 and T_8 treatments was due to relatively higher fruit weight and lower fruit drop

Table 3 Effect of amino acids on yield and maturity of peach cv. Florida Prince (Pooled data of 2016-17)

Treatment*	Fruit yield (kg)	Time of fruit maturity	
		2016	2017
T_1	46.45	24th April	30th April
T_2	47.54	24th April	30th April
T_3	45.85	23rd April	30th April
T_4	48.24	24th April	29th April
T_5	50.52	23rd April	28th April
T_6	51.00	23rd April	28th April
T_7	52.68	22nd April	27th April
T_8	53.92	21st April	26th April
T_9	41.11	24th April	1st May
T_{10}	40.39	25th April	1st May
T_{11}	43.62	25th April	1st May
T_{12}	38.64	26th April	2nd May
T_{13} (Control)	45.65	24th April	30th April
Mean	46.58		
LSD (P≤0.05)	2.17		

*Details of treatments are given in Table 1

recorded. Thanaa *et al.* (2016) reported that increased yield of Anna apples by bio-stimulant application was due to the positive effect on endogenous levels of growth promoters and nutrients. Similar results on increased yield by amino acids and bio-stimulants application were reported on Le conte pears (Fayek *et al.* 2011), Grand nain banana (El-Shenawi *et al.* 2008) and Flame Seedless grapes (Aisha *et al.* 2006).

Fruit maturity: The data on the effect of amino acids on fruit maturity of peach cv. Florida Prince depicts that the double spray treatments of amino acids advanced fruit maturity by 4 days as compared to control whereas the triple spray treatments delayed fruit maturity than the control plants. The fruits from the trees sprayed with single application of amino acids treatments and control matured at the same time. The treatments which received triple sprays of amino acids took maximum number of days to reach the harvest maturity and matured even later than the control plants. During both the years, earliest maturity was observed in T_8 treatment, i.e. 21st April in 2016 and 26th April in 2017. Whereas in control plants fruits matured on 24th April in 2016 and 30th April in 2017. This acceleration of fruit maturation has a marketing benefit by providing the fruits earlier to market than untreated orchards. El-Boray *et al.* (2016) reported that advancement in fruit maturity by bio-stimulant application was due to the positive correlation between carbohydrates content in fruits, total chlorophyll in leaves and total yield. These results indicating early maturity are also in harmony with that of Igor and Boris (2013) who reported early maturity in strawberry by bio-stimulants (peptone and porcine blood) application. Gurav and Jadhav (2013) also found early maturity in banana by the use of protein hydrolysates.

Exogenous application of amino acids improved fruit yield, fruit weight, fruit color, total soluble solids, total sugars and decreased fruit firmness and acidity as compared to other treatments. These treatments advanced fruit maturity by 4 days as compared to control during both the years. Among the different treatments, double spray treatment of amino acids (@0.50% applied 14 days after full bloom and after 15 days) advanced fruit maturity, increased yield and improved fruit quality in peach cv. Florida Prince.

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REFERENCES

Abd El-Aal F S, Shaheen A M, Ahmed A A and Mahmoud A R. 2010. Effect of Foliar Application of Urea and Amino Acids Mixtures as Antioxidants on Growth, Yield and Characteristics of Squash. *Research Journal of Agriculture and Biological Sciences* **6**: 583-8.

Aisha G S, Hanaa AA and Abd El-Wahab M A. 2006. Effect of yeast doses and time of application on growth, yield and fruit quality of Flame Seedless grapevines. *Egyptian Journal of Applied Science* **21**: 661–81.

Anonymous. 2017. FAO Statistics Division 2017. Retrieved from http:// faostat.fao.org /site /339/default.aspx.

Anonymous. 2017. Area and production of horticulture crops. Retrieved from http://www. agricoop.nic.in.

Anonymous. 2017. *Area and Production of Fruits in the Punjab*. Directorate of Horticulture, Punjab, Chandigarh.

AOAC. 1990. *Official Methods of Analysis*, 15th Ed. Association of Official Analytical Chemists, Arlington.

El-Boray M S, Shalan A M and Khouri Z M. 2016. Performance of peach trees cv. Florida Prince under different foliar concentrations of NPK-humate in presence of absence of adjuvants. *Trends in Horticultural Research* **6**: 5–17.

El-Shenawi M R, Aly H S and Mohamed B A F. 2008. Response of Grand naine banana to humic acid, potassium and magnesium fertilization. *Alexandria Science Exchange Journal* **29**: 244–51.

Fathy M A, Gabr M A and El Shall S A. 2010. Effect of humic acid treatments on 'Canino' apricot growth, yield and fruit quality. *New York Science Journal* **3**: 109–15.

Fayek M A, Yehia T A, El-Fakhrany E M M and Farag A M. 2011. Effect of Ringing and Amino Acids Application on Improving Fruiting of Le Conte Pear Trees. *Journal of Horticultural Science and Ornamental Plants* **3**: 1–10.

Gouble B, Bureau S, Grotte M, Reich M, Reling P and Audergon J M. 2005. Apricot postharvest ability in relation to ethylene production: Influence of picking time and cultivar. *Acta Horticulturae* **682**: 127–34.

Gurav R G and Jadhav J P. 2013. A novel source of biofertilizer from feather biomass for banana cultivation. *Environmental Science and Pollution Research* **20**: 4532–9.

Hunter S. 1975. *The Measurement of Appearance*. Wiley, New York.

Igor B and Boris D. 2013. Application of animal origin biostimulators in strawberry production. (In) 2nd International Strawberry Congress, Antwerpen, Belgium, September 4-6, 2013.

Kauffman G L, Kneivel D P and Watschke T L. 2005. Growth regulator activity of Macro-Sorb Foliar in vitro. *Plant Growth Regulation Society of America* **33**: 134–41.

Khan A S, Ahmad B, Jaskani M J, Ahmad R and Malik A U. 2012. Foliar application of mixture of amino acids and seaweed (*Ascophylum nodosum*) extract improve growth and physico-chemical properties of grapes. *International Journal of Agriculture and Biology* **14**: 383–8.

Koksal A L, Dumanoglu H, Gunes N T and Aktas M. 1999. The Effects of Different Amino Acid Chelate Foliar Fertilizers on Yield, Fruit Quality, Shoot Growth and Fe, Zn, Cu, Mn Content of Leaves in Williams Pear Cultivar (*Pyrus communis* L.). *Turkish Journal of Agriculture and Forestry* **23**: 651–8.

Rai V K. 2002. Role of amino acids in plant responses to stress. *Biologia Plantarum* **45**: 471–8.

Rombola A D, Malaguti D, Gerin M, Simoni G, Tagliavini M and Marangoni B. 2001. Effect of seaweed extracts-based leaf sprays on the growth, yield and fruit quality of apple trees. (In) International Symposium on Foliar Nutrition of perennial Fruit Plants.

Sharaf M M, Bakry K A and El-Gioushy S F. 2011. The influence of some bio and organic nutritive addenda on growth, productivity, fruit quality and nutritional status of Washington Navel orange trees. *Egyptian Journal of Applied Sciences* **26**: 253–68.

Thanaa S M, Fatma K M S, Morsey M M and El-Nagger Y I. 2016. Study on the Effect of Pre-harvest Treatments by Seaweed Extract and Amino Acids on Anna Apple Growth, Leaf Mineral Content, Yield, Fruit Quality at Harvest and Storability. *International Journal of ChemTech Research* **9**: 161–71.

Vashisth T, Olmstead M A, Olmstead J, Colquhoun T A. 2017. Effects of Nitrogen Fertilization on Subtropical Peach Fruit Quality: Organic Acids, Phytochemical Content, and Total Antioxidant Capacity. *Journal of the American Society for Horticultural Science* **142**: 393–404.