EFFECT OF PRE-HARVEST APPLICATION OF GA_3 AND POTASSIUM NITRATE ON YIELD AND QUALITY OF PEACH FRUIT

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ABSTRACT: The research study entitled "effect of pre harvest application of GA_3 and potassium nitrate on yield and quality of peach fruit" was carried out at Horticulture Research Farm, The University of Agriculture Peshawar during 2019. The plots were arranged using Randomized Complete Block Design (RCBD) with two factors. Three replications were used in the experiment. The experiment was conducted on already established peach orchard of almost 14 years old trees of Early Grande cultivar. The uniform size trees were selected and tagged for the experiment. The plants were managed under uniform cultural practices. The selected plants of peach cv. Early Grande were sprayed with various concentrations of Gibberellic acid (GA_3) (0, 20, 40, 60 and 80 ppm) and potassium nitrate (KNO_3) (0, 1000, 2000 and 3000 ppm) at berry stage. Peach plants were sprayed with GA_3 and KNO_3 and compared with control. The analysis of data showed that the foliar application of GA_3 and KNO_3 significantly influenced the yield and quality attributes of peach. Maximum fruit weight (111.98 g), chlorophyll content (51.00 SPAD), TSS (14.60 ^{o}Brix), fruit juice content (85.80 %), Fruit firmness (2.16 $kg.cm^{-2}$), yield $plant^{-1}$ (54.56 kg) and yield ha^{-1} (15.548 tons) were recorded in plants treated with 80 ppm of GA_3. In case of KNO_3 Maximum fruit weight (101.20 g), chlorophyll content (49.46 SPAD), TSS (13.38 ^{o}Brix), fruit juice content (84.86 %), Fruit firmness (2.12 $kg.cm^{-2}$), yield $plant^{-1}$ (51.56 kg) and yield ha^{-1} (14.829 tons) were recorded in plants treated with 3000 ppm of KNO_3. Minimum days to maturity (72.52) and minimum number of fruits kg^{-1} (9.65) were found in plants sprayed with 80 ppm of GA_3 while in case of KNO_3 minimum days to maturity (76.92) and minimum number of fruits kg^{-1} (10.62) were found in plants sprayed with 3000 ppm of KNO_3. Interactive effect of levels of GA_3 and KNO_3 was also found significant for some of the parameters. It is therefore concluded that when peach Early Grande cultivar sprayed with 80 ppm of GA_3 and 3000 ppm of KNO_3 the quality as well as yield of the crop were improved.

Key Words: GA_3, Potassium Nitrate, Peach, Early Grande cultivar, Peshawar.

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INTRODUCTION

Peach (*Prunus persica*) ranked third among the top growing temperate fruits through the world. It belongs to the family Rosaceae which is mostly grown in temperate zone between the 30-40^o N and S latitude. This area is referred as commercial production area for quality peach. It is most likely assumed that it was developed in Persia; however, China is considered as native country [1].

Peach is famous for its delicious taste, flavor and aroma comprised of 10-14 percent sugar, 2% protein and rich in ascorbic acid. Moreover, vitamins like A and B, iron, phosphorus and calcium could also be obtained. Around the world the most important types are free stone type while Early Grande, Florda King 6-A and 8-A are most popular cultivars dominantly grown in Peshawar and Swat region. Whereas in Baluchistan Golden Early, Shah Pasand and Shireen are grown. On the basis of market availability, Swat valley enjoys not only access to national market but international market as well. At present, peach showed adaption to other environments like subtropical and even some of the recent varieties has low chilling requirements for reproductive growth. Besides its good productivity, the peaches grown in subtropical climate reported to be highly perishable, reducing its quality and ultimately export. In order to overcome this situation farmers usually prefer harvesting before the fruit reached to full maturity keeping in mind handling and transport facility. The operation may give some relief financially but these fruits never reach their full flavor, aroma and consumer acceptance A considerable part of the crop was lost at post-harvest. The mayhem could be possibly resolved through extensive trainings of farmers about mixed farming, preparation of pickles from a part of fruits and other handling operations. Excessive bearing of fruits may prefer by grower but this phenomenon severely influences the size and quality causing poor returns or profit [2].

Physiological maturity function plays a key role in the post-harvest quality and shelf life because peach fruits are more susceptible to losses due to a rapid softening after harvest. Some plant growth regulators like gibberellins have the ability to avoid senescence naturally. Which sometimes may also use for prolong harvesting and marketing seasons. Some researchers reported that pre-harvest application of GA_3 promote growth, improve fruit size and extends the shelf life of peaches. Extended post-harvest storage life for prolong marketing season through delaying the picking of fruits and late season cultivars [3]. To achieve this, the possible ways are conventional breeding of potentially prolonged fruit storage cultivars having the characteristic of late ripening or the appropriate use of plant growth regulators to enhance vegetative growth and maturity and fruit development mainly in the indigenous cultivars [4].

Gibberellic acid (GA_3) is an important and extensively used growth regulator of plants to manipulate the development and ripening of fruits in number of crops including stone fruit [4]. It triggers several processes and pathways, depends on plant development and organs [5]. Recent studied showed that GA_3 is valuable in lowering the flowers density, which subsequently increase size of fruit and decreases the crop load in nectarine and peaches [6]. Gibberellic acid interrupts the development and ripening of internal breakdown in nectarines when applies at pit hardening [7]. However, at the pit hardening stage, it enhances the cell wall and directed maximum percentage of cellulose in the cell wall than the control fruits [8].

Several factors in the pre-harvest stage enhance the fruit quality. Therefore, pre-harvest cultural methods play a vital role in maximizing the fruits quality. One such practice is the use of plant nutrients like potassium, boron and calcium during fruit growth at pre-harvest foliar spray. Potassium increases the fruit firmness [9]. Foliar sprays of K have been successfully tried to improve fruit quality in peach. The use of potassium sulphate during foliar spray improves the fruit appearance and maximize the soluble solid contents of the fruit [10].

The most important and common source of potassium is potash muriate, other sources also work will in comparison with muriate. Excess intake of potassium inhibits magnesium and calcium uptake and is thus undesirable. Mineral nutrition also effects the fruit storing quality in several ways [11].

Potassium nitrate improve the effectiveness of photosynthesis in plants [12]. The increase in fruit size due to KNO_3 treatments may be due to the reason that K helped in increasing the entry of water into the cells by osmotic processes, and increased cell expansion which affected fruit size [13]. The increase in fruit weight with KNO_3 application might be due to the fact that N is extremely mobile and developing fruit acts as a metabolic sink for the nutrient elements. Further, nitrogen has been reported to prolong the phase of fruit cell division resulting in greater number of cells per fruit [14]. The potassium application increased fruit weight and fruit size in 'Kinnow' mandarin. Larger fruit size and fruit weight in 'Valencia' orange with dormant, post bloom and summer foliar application of potassium were reported by Boman [15].

Keeping in view the above-mentioned peach problems and benefits of gibberellic acid and potassium nitrate research is designed to study the effect of pre harvest application of GA_3 and potassium nitrate on yield and quality of peach fruit (cultivar Early Grande).

MATERIAL AND METHODS

Experimental site: An **e**xperiment was conducted to study the performance of foliar application of gibberellic acid and potassium nitrate on yield and fruit quality of peach, at the Horticultural Research Farm, Malakandher, The University of Agriculture Peshawar, during the year 2019.

Experimental design: The experiment was conducted on already established peach orchard of 14 years old trees of Early Grande cultivar. The trees were selected and tagged for the experiment. The plants were managed under uniform cultural practices. Selected plants were sprayed with Gibberellic acid and potassium nitrate separately and in combination**.** The treatments were applied at fruit setting stage in three replicates. Two factorial Randomized complete block design (RCBD) was used for statistical analysis.

FACTOR A (Gibberellic acid ppm): GA0 = 0 ppm (Control), GA1 = 20ppm, GA2 = 40ppm, GA3 = 60ppm and GA4 = 80ppm

FACTOR B (Potassium nitrate ppm): P0 = 0 ppm (Control), P1 = 1000 ppm, P2 = 2000 ppm and P3 = 3000 ppm

Studied Parameters: Fruits from the treated plants were harvested manually in the first week of May and analyzed for various physio-chemical parameters.

Days to maturity: The number of days from fruit setting to physiological maturity were noted to find out days to maturity and their average was calculated.

Single Fruit weight (g): Five randomly selected fruit from the treated tree were collected and their weight was measured in grams with the help of electrical balance and the mean was calculated.

Chlorophyll Content (SPAD): Chlorophyll content was determined in leaves of randomly selected plants of all treatments through SPAD meter then their average was calculated.

Number of fruits kg: One-kilogram fruits from each treatment were selected and their number of fruits were counted and their average was taken for further analysis.

Fruit firmness ($kg.cm^{-2}$): Fruit firmness was measured on two pared sides of each fruit using a penetrometer fitted with an 8-mm diameter plunger.

Fruit juice content (%): Fruits from each treatment were weighted through electric balance, their juice were extracted with juicer, the juice were weighted and juice content was found out by using the given formula.

$$\text{Juice content} = \frac{\textit{Juice weighted (g)}}{\textit{Fruit weighted (g)}} \times 100$$

Total soluble solids (°Brix): A wedge-shaped slice (approx. 5 g) was removed from each fruit. Slices were passed through an electric juicer for the measurement of total soluble solids by using hand refractometer.

Yield $tree^{-1}$: All the yield of fresh fruits were weighed through electronic balance. The yield was calculated in kg $plant^{-1}$ after taking weight of individual plant tree yield.

Yield ha^{-1}: The yield per hectare was found by using the following formula:

Yield ha^{-1} = *Number of plants* ha^{-1} *x yield* $plant^{-1}$

Statistical analysis: A computer package statistic version 8.1 was used for analyzing field and laboratory data by ANOVA technique and the means were compared by LSD-test of significance, when the F-values was found significant [16].

RESULTS AND DISCUSSION

Results of the studied parameters were analyzed, compared and discussed with the results of other researchers in this chapter. Tables from 4.1 to 4.09 represent the mean data while Tables from 4.1a to 4.09a shows analysis of variance (ANOVA). Original replicated data of the studied parameters in research are given in Appendices from I. IX.

Days to maturity: Data regarding days to maturity of peach are presented in mean table 4.1 whereas ANOVA is shown in table 4.1a. Original replicated data are given in Appendix-I. The analyzed data showed that days to maturity of peach was significantly affected by foliar application of gibberellic acid and potassium nitrate. The interaction of GA_3 and KNO_3 was found non-significant for days to maturity of peach.

The foliar application of GA_3 significantly affected number of days to maturity of peach at various concentrations. Data pertaining GA_3 reveal that less number of days to maturity of peach (72.52) was noted in plants sprayed with 80 ppm of GA_3 which was statistically different from days to maturity (77.17) of peach when plants were sprayed with 60 ppm of GA_3. The highest days to maturity (85.92) was recorded in plants of control treatment.

Data regarding KNO3 shows that minimum days to maturity (76.92) were noted when plants were sprayed with 3000 ppm of KNO3 which was significantly different from days to maturity (79.32) when KNO3 was sprayed on plants with 2000 ppm. The maximum days to maturity (83.94) was recorded in control treatments.

The above results are supported by the findings of Sankar *et al.* [17] who noted early maturity of fruits during their work effect of plant growth regulators on growth and yield of "Le Conte" Pear. This might be due to the fact that GA_3 and KMNO3 stimulates the conversion of starch into sugar and ripen the fruits earlier.

Chlorophyll content (SPAD): Data pertaining chlorophyll content of peach are shown in mean table 4.2 whereas ANOVA is shown in table 4.2a. Original replicated data are given in Appendix-II. The analyzed data showed that chlorophyll content of peach was significantly affected by foliar application of Gibberellic acid and potassium nitrate. The interaction of GA_3 and KNO_3 also significantly influenced the chlorophyll content of peach.

Data regarding GA_3 reveal that chlorophyll content of peach was found higher (51.00 SPAD) when plants were sprayed with 80 ppm of GA_3 which was statistically different from chlorophyll content (48.40 SPAD) when plants were sprayed with 60 ppm of GA_3. The low chlorophyll content (43.65 SPAD) was recorded in plants received no $GA_{3.}$

Data regarding KNO_3 shows that maximum chlorophyll content (49.46 SPAD) was noted when plants were sprayed with 3000 ppm of KNO_3 which was significantly different from chlorophyll content (47.90) when KNO_3 was sprayed on peach plants with 2000 ppm. The minimum chlorophyll content (44.50 SPAD) was recorded in control treatments.

The interaction of GA_3 and KNO_3 for chlorophyll content was significantly affected. The highest chlorophyll content (55.80) was found when plants received 80 ppm GA_3 and 3000 ppm KNO_3. The minimum chlorophyll content (42.10) was noted in control treatments.

The enhancement of chlorophyll content with increasing GA_3 and KNO_3 may be due to the fact that these plant growth regulators play role in improving vegetative growth of the plant which improve the green pigment in plant leaves and increase in chlorophyll content take place. Findings of the present results are supported by the findings of Ahmad and Sharma [18] who performed their experiment on influence of GA_3, KNO_3 and I.A.A on performance of strawberry. Increase in chlorophyll content was also noted by Ingram *et al.* [19] when they carried experiment on peach.

Table 4.1. Days to maturity of peach as affected by application of GA_3 and potassium nitrate.

Potassium nitrate (ppm)	Gibberellic acid (ppm)					Mean
	0	20	40	60	80	
0	88.10	87.50	85.00	81.10	78.00	83.94 A
1000	87.10	86.10	83.20	78.30	74.50	81.84 B
2000	85.00	84.70	80.10	76.30	70.50	79.32 C
3000	83.70	82.30	78.30	73.00	72.52	76.92 D
Mean	85.92 A	85.15 AB	81.65 C	77.17D	72.52E	

Means followed by different letters are statistically dissimilar at 1% significance level.
LSD value for levels of GA_3 at 1% level of probability = 3.10
LSD value for levels of KNO_3 at 1% level of probability = 1.90

Table 4.1a. Analysis of variance table for days to maturity of peach as affected by application of GA_3 and potassium nitrate.

Source	DF	SS	MS	F	P
Blocks	2	62.233	31.1167		
GA_3	4	49.400	12.3500	6.99	0.0003
KNO_3	3	8.000	2.6667	1.51	0.0042
GA_3 x KNO_3	12	65.000	5.4167	3.07	0.2175
Error	38	67.100	1.7658		
Total	59	251.733			

CV 2.07%

Table 4.2. Chlorophyll content (SPAD) of peach as affected by application of GA_3 and potassium nitrate

Potassium nitrate (ppm)	Gibberellic acid (ppm)					Mean
	0	20	40	60	80	
0	42.10	42.90	44.00	45.50	48.00	44.50 D
1000	43.50	43.90	46.30	47.80	50.50	46.40 C
2000	44.30	45.00	47.50	49.00	53.70	47.90 B
3000	44.70	47.30	48.20	51.30	55.80	49.46 A
Mean	43.65 E	44.78 D	46.50 C	48.40 B	51.00 A	

Means followed by different letters are statistically dissimilar at 1% significance level.
LSD value for levels of GA_3 at 1% level of probability = 1.11
LSD value for levels of KNO_3 at 1% level of probability = 1.30
LSD value for levels of interaction at 1% level of probability = 0.70

Table 4.2a. Analysis of variance table for chlorophyll content (SPAD) of peach as affected by application of GA_3 and potassium nitrate.

Source	DF	SS	MS	F	P
Blocks	2	27.734	13.8672		
GA_3	4	50.746	12.6864	2.40	0.0068
KNO_3	3	65.475	21.8251	4.13	0.0012
GA_3 x KNO_3	12	100.013	8.3344	1.58	0.0041
Error	38	200.759	5.2831		
Total	59	444.727			

CV 5.16%

Fruit weight (g): Data regarding weight of peach are presented in mean table 4.3 whereas ANOVA is shown in table 4.3a. Original replicated data are given in Appendix-II. The analyzed data showed that the fruit weight of peach significantly affected by foliar application of Gibberellic acid and potassium nitrate. The interaction of GA_3 and KNO_3 was also found significant.

Data regarding GA_3 shows that fruit weight of peach was found higher (111.98 g) when plants were sprayed with 80 ppm of GA_3 which was statistically different from fruit weight (103.88 g) when plants were sprayed with 60 ppm of GA_3. Minimum fruit weight (85.10 g) was recorded in plants received no GA_3 and is statistically similar to fruit weight (87.95 g) of plants that received 20 ppm GA_3.

Data regarding KNO_3 shows that maximum fruit weight (101.20 g) was noted when plants were sprayed with 3000 ppm of KNO_3 which was significantly different from fruit weight (98.10 g) when KNO_3 was sprayed on plants with 2000 ppm while minimum fruit weight (93.06 g) was recorded in control treatments.

The interaction of GA_3 and KNO_3 shows that the fruit weight was significantly affected. The highest fruit weight (119.00 g) was found when plants received 80 ppm GA_3 and 3000 ppm KNO_3. The lowest fruit weight (80.10 g) was noted in control treatments.

The increase in fruit weight with the application of high doses of GA_3 and KNO_3 was recorded in the present experiment which are in agreement with the results of Nomis *et al.* [20] who found improvement of fruits weight during their research on improvement of growth, yield and chemical composition of Apple (*Pyrus malus)* through plant hormones. GA_3 and KNO_3 helps the plants to increase their photosynthesis which improve the availability of food and hence increase fruit weight.

Table 4.3. Fruit weight (g) of peach as affected by application of GA_3 and potassium nitrate.

Potassium nitrate (ppm)	**Gibberellic acid (ppm)**					**Mean**
	0	**20**	**40**	**60**	**80**	
0	80.10	85.70	93.10	99.50	106.90	93.06 CD
1000	83.70	86.90	95.20	102.00	109.00	95.36 C
2000	86.30	88.30	96.90	106.00	113.00	98.10 B
3000	90.30	90.90	97.80	108.00	119.00	101.20 A
Mean	85.10DE	87.95D	95.75C	103.88B	111.98A	

Means followed by different letters are statistically dissimilar at 1% significance level.
LSD value for levels of GA_3 at 1% level of probability = 4.10
LSD value for levels of KNO_3 at 1% level of probability = 2.50
LSD value for levels of interaction at 1% level of probability = 2.10

Table 4.3a. Analysis of variance table for fruit weight (g) of peach as affected by application of GA_3 and potassium nitrate.

Source	**DF**	**SS**	**MS**	**F**	**P**
Blocks	2	4.93	2.463		
GA_3	4	3946.97	986.744	1429.29	0.0034
KNO_3	3	168.53	56.177	81.37	0.0071
GA_3 x KNO_3	12	3298.50	274.875	398.15	0.0056
Error	38	26.23	0.690		
Total	59	7445.17			

CV 3.85%

Fruit firmness ($kg.cm^{-2}$): Data regarding fruit firmness of peach are shown in mean table 4.4 whereas ANOVA is shown in table 4.4a. Original replicated data are given in Appendix-IV. The analyzed data showed that fruit firmness of peach was significantly affected by foliar application of gibberellic acid and potassium nitrate. The interaction of GA_3 and KNO_3 was found non-significant for fruit firmness.

Data regarding GA_3 shows that fruit firmness of peach was found higher (2.51 $kg.cm^{-2}$) when plants were sprayed with 80 ppm of GA_3 which was statistically different from Fruit firmness (2.00 $kg.cm^{-2}$) when plants were sprayed with 60 ppm of GA_3 while lower fruit firmness (1.27 $kg.cm^{-2}$) was recorded in plants of control treatment.

Data regarding KNO_3 shows that maximum fruit firmness (2.12 $kg.cm^{-2}$) was noted when plants were sprayed with 3000 ppm of KNO_3 which was significantly different from fruit firmness (1.95 $kg.cm^{-2}$) when KNO_3 was sprayed on peach plants with 2000 ppm. Minimum fruit firmness (1.33 $kg.cm^{-2}$) was recorded in control treatments.

In the present study, increase in fruit firmness was noted with the increase in concentrations of gibberellic acid and potassium nitrate. The enhancement of fruit firmness will help to prolong the post-harvest life of peach. These findings are in line with the findings of Shukla *et al.* (2007) who recorded increase in fruit firmness with the increase of concentrations of PGRs after performing an experiment on influence of PGRs on growth, quality and yield of peach (*Pronus persica)* var. Florida king. This might be due to the fact that these PGRs slows down the metabolic process of fruit which enhance their firmness.

Table 4.4. Fruit firmness ($kg.cm^{-2}$) of peach as affected by application of GA_3 and potassium nitrate.

Potassium nitrate (ppm)	Gibberellic acid (ppm)					Mean
	0	20	40	60	80	
0	0.91	0.97	1.30	1.70	1.81	1.33 D
1000	1.00	1.30	1.57	1.90	1.97	1.54 C
2000	1.50	1.83	1.97	2.10	2.35	1.95 B
3000	1.70	1.99	2.10	2.30	2.51	2.12 A
Mean	1.27 D	1.52 D	1.73 C	2.00 C	2.16A	

Means followed by different letters are statistically dissimilar at 1% significance level.
LSD value for levels of GA_3 at 1% level of probability = 0.10
LSD value for levels of KNO_3 at 1% level of probability = 0.12

Table 4.4a. Analysis of variance table for firmness ($kg.cm^{-2}$) of peach as affected by application of GA_3 and potassium nitrate.

Source	DF	SS	MS	F	P
Blocks	2	0.01233	0.00617		
GA_3	4	2.29667	0.57417	12.83	0.0031
KNO_3	3	0.46067	0.15356	3.43	0.0106
GA_3 x KNO_3	12	1.43267	0.11939	2.67	0.0565
Error	38	1.70100	0.04476		
Total	59	5.90333			

CV 14.93%

Number of fruits kg^{-1}: Data regarding number of fruits/kg of peach are presented in mean table 4.5 whereas ANOVA is shown in table 4.5a. Original replicated data are given in Appendix-V. The analyzed data showed that the number of fruits per kg of peach significantly affected by foliar application of gibberellic acid and potassium nitrate. The interaction of GA_3 and KNO_3 was found non-significant for this parameter.

Data regarding GA_3 shows that less number of fruits per kg of peach (9.65) were recorded when plants were sprayed with 80 ppm of GA_3 which was statistically different from number of fruits per kg (10.25) of peach when plants were sprayed with 60 ppm of GA_3. Maximum number of fruits per kg (12.53) of peach was recorded in plants received no GA_3.

Data regarding KNO_3 shows that minimum number of fruits per kg (10.62) of peach was noted when plants were sprayed with 3000 ppm of KNO3 which was significantly different from number of fruits kg^{-1} (10.40) when KNO3 was sprayed on plants with 2000 ppm, whereas maximum number of fruits per kg (11.94) of peach was recorded in control treatments.

It has been noted that less number of fruits were found due to good when high concentration of GA_3 and KNO_3 were sprayed on peach plants. Similar results were found by Mosa *et al.* [21] when they performed their research on quince. The present findings are also similar with records of El-Ese and Finder who worked on effect of plant growth regulators on mango. Foliar application of GA_3 and KNO_3 improved fruit productivity and quality as compared to control [22].

Table 4.5. Number of fruits kg^{-1} of peach as affected by application of GA_3 and potassium nitrate.

Potassium nitrate (ppm)	Gibberellic acid (ppm)					Mean
	0	20	40	60	80	
0	13.10	12.50	12.10	11.30	10.70	11.94 A
1000	12.80	12.30	11.50	10.10	9.60	11.26 B
2000	12.20	11.70	11.10	9.90	9.30	10.40 C
3000	12.00	11.50	10.90	9.70	9.00	10.62 D
Mean	12.53 A	12.00 B	11.40 C	10.25 D	9.65 E	

Means followed by different letters are statistically dissimilar at 1% significance level.
LSD value for levels of GA_3 at 1% level of probability = 0.11
LSD value for levels of KNO_3 at 1% level of probability = 0.13

Table 4.5a. Analysis of variance table for number of fruits kg^{-1} of peach as affected by application of GA_3 and potassium nitrate.

Source	DF	SS	MS	F	P
Blocks	2	0.7000	0.35000		
GA_3	4	11.7667	2.94167	8.40	0.0072
KNO_3	3	3.2500	1.08333	3.10	0.0093
GA_3 x KNO_3	12	45.8333	3.81944	10.91	0.0679
Error	38	13.3000	0.35000		
Total	59	74.8500			

CV 5.95%

Total soluble solids (^{o}Brix): Data regarding total soluble solids (^{o}Brix) of peach are presented in mean table 4.6 whereas ANOVA is shown in table 4.6a. Original replicated data are given in Appendix-VI. The analyzed data showed that the TSS of peach significantly affected by foliar application of gibberellic acid and potassium nitrate. The interactive effect was also found significant.

Data pertaining GA_3 reveal that TSS of peach was found higher (14.60 ^{o}Brix) when plants were sprayed with 80 ppm of GA_3 which was statistically different from TSS of peach (12.58 ^{o}Brix) when plants were sprayed with 60 ppm of GA_3. The minimum TSS (10.37 ^{o}Brix) was recorded in plants received no GA_3 and is statistically similar to TSS (11.01 ^{o}Brix) of plants that received 20 ppm GA_3.

Data regarding KNO_3 shows that maximum TSS (13.38 ^{o}Brix) was noted when plants were sprayed with 3000 ppm of KNO3 which was significantly not different from TSS (12.45 ^{o}Brix) when KNO_3 was sprayed on plants with 2000 ppm. The minimum TSS (10.90 ^{o}Brix) was recorded in control treatments.

In the present study increase in TSS was recorded with increase in conc. of plant growth regulators such as GA_3 and KNO_3. This may be due to the facts that GA_3 and KNO_3 enhance the metabolic conversion of starch and pectin into sugars which improve the TSS. GA_3 and KNO_3 also improve the fast transformation of carbohydrates into sugars as well as rapid metabolites from source to sink such as fruits which ultimately increase the TSS of peach fruits. The same results were found by Shahid and Tariq [23] after performing work on effect of PGRs on Apple where they recorded increase in TSS with increase in conc. of plant growth regulators.

Table 4.6. Total soluble solids (^{o}Brix) of peach as affected by application of GA_3 and potassium nitrate.

Potassium nitrate (ppm)	Gibberellic acid (ppm)					Mean
	0	20	40	60	80	
0	9.83	9.90	10.70	11.50	12.50	10.90 C
1000	9.97	10.15	11.30	12.40	13.73	11.51 BC
2000	10.30	11.50	12.10	12.90	15.45	12.45 AB
3000	11.40	12.40	12.90	13.50	16.70	13.38 A
Mean	10.37 DE	11.01 D	11.75 C	12.58B	14.60A	

Means followed by different letters are statistically dissimilar at 1% significance level.
LSD value for levels of GA_3 at 1% level of probability = 1.12
LSD value for levels of KNO_3 at 1% level of probability = 1.20

Table 4.6a. Analysis of variance table for total soluble sugar (^{o}Brix) of peach as affected by application of GA_3 and potassium nitrate.

Source	DF	SS	MS	F	P
Blocks	2	1.9923	0.99617		
GA_3	4	2.8427	0.71067	4.89	0.0082
KNO_3	3	0.3040	0.10133	0.70	0.0034
GA_3 x KNO_3	12	20.3493	1.69578	11.67	0.1304
Error	38	5.5210	0.14529		
Total	59	31.0093			

CV 3.87%

Fruit juice content (%): Data regarding fruit juice content of peach are shown in mean table 4.7 whereas ANOVA is shown in table 4.7a. Original replicated data are given in Appendix-VII. The analyzed data showed that the fruit juice content of peach significantly affected by foliar application of gibberellic acid and potassium nitrate. The interaction of GA_3 and KNO_3 was found non-significant.

Data pertaining GA_3 reveal that fruit juice content of peach was found maximum (85.80 %) when plants were sprayed with 80 ppm of GA_3 which was statistically different from fruit juice content (84.65 %) when plants were sprayed with 60 ppm of GA_3. The minimum fruit juice content (80.17 %) was recorded in control treatment plants.

Data regarding KNO_3 indicate that maximum fruit juice content (84.86 %) was noted when plants were sprayed with 3000 ppm of KNO_3 which was significantly different from fruit juice content (84.18 %) when KNO_3 was sprayed on plants with 2000 ppm. The minimum fruit juice content (81.84 %) was recorded in control treatments.

In the current study increase in fruit juice content were found with increase in concentration GA_3 and KNO_3. These results are in line with the findings of Azlan *et al.* [24] who obtained high fruit juice content with increase in concentration of plants growth regulator. GA_3 and KNO_3 helps the plants in the availability of nutrients as a result of which fruits get good size. The improvement in size enhances the pulp of fruits which give high fruit Juice content.

Table 4.7. Fruit juice content (%) of peach as affected by application of GA_3 and potassium nitrate.

Potassium nitrate (ppm)	Gibberellic acid (ppm)					Mean
	0	**20**	**40**	**60**	**80**	
0	79.00	81.30	82.10	82.90	83.50	81.84 C
1000	80.10	83.20	83.90	84.10	85.50	83.36 B
2000	80.70	83.90	84.50	85.30	86.30	84.18AB
3000	80.90	84.10	85.10	86.30	87.90	84.86 A
Mean	80.17 D	83.22 DC	83.90 C	84.65 B	85.80 A	

Means followed by different letters are statistically dissimilar at 1% significance level.
LSD value for levels of GA_3 at 1% level of probability = 1.09
LSD value for levels of KNO_3 at 1% level of probability = 1.10

Table 4.7a. Analysis of variance table for fruit juice content (%) of peach as affected by application of GA_3 and potassium nitrate

Source	DF	SS	MS	F	P
Blocks	2	7.355	3.6775		
GA_3	4	174.025	43.5063	9.98	0.0026
KNO_3	3	28.163	9.3878	2.15	0.0074
GA_3 x KNO_3	12	272.106	22.6755	5.20	0.1027
Error	38	165.589	4.3576		
Total	59	647.238			

CV 2.43%

Yield $tree^{-1}$ (kg): Data regarding yield $tree^{-1}$ of peach are presented in mean table 4.8 whereas ANOVA is shown in table 4.8a. Original replicated data are given in Appendix-VIII. The analyzed data showed that the yield $tree^{-1}$ of peach was significantly affected by foliar application of gibberellic acid and potassium nitrate. The interaction of GA_3 and KNO_3 for yield $tree^{-1}$ was found non-significant.

Data pertaining GA_3 reveal that yield $tree^{-1}$ of peach was found higher (54.56 kg) of peach when plants were sprayed with 80 ppm of GA_3 which was statistically different from yield $tree^{-1}$ (51.73 kg) of peach when plants were sprayed with 60 ppm of GA_3. The minimum yield $tree^{-1}$ (45.80 kg) was recorded in plants received no GA_3.

Data regarding KNO3 shows that maximum yield $tree^{-1}$ (51.56 kg) of peach was noted when plants were sprayed with 3000 ppm of KNO_3 which was significantly different from yield $tree^{-1}$ (50.52 kg) when KNO_3 was sprayed on plants with 2000 ppm. The minimum yield $tree^{-1}$ (48.14 kg) was recorded in control treatments.

It has been found that application of GA_3 and KNO_3 improve the cropping of peach trees and consequently increase the yield [25]. It might be due to the fact that GA_3 and KNO_3 helps in cell elongation and cell wall formation which cause increase in fruit size and hence improve the yield tree$_{-1}$. Similar results were found by Essa *et al.* [26] after doing work on the effect of plants hormones on apple and pear.

Table 4.8. Yield tree^{-1} (kg) as affected by application of GA_3 and potassium nitrate.

Potassium nitrate (ppm)	**Gibberellic acid (ppm)**					**Mean**
	0	**20**	**40**	**60**	**80**	
0	45.00	46.30	47.70	49.70	52.00	48.14 d
1000	45.70	47.10	49.00	51.00	53.70	49.30 c
2000	46.00	47.90	50.90	52.70	55.10	50.52 b
3000	46.50	48.30	52.00	53.50	57.50	51.56 a
Mean	45.80 e	47.40 d	49.90 c	51.73 b	54.56 a	

Means followed by different letters are statistically dissimilar at 5% significance level.
LSD value for levels of GA_3 at 5% level of probability = 2.00
LSD value for levels of KNO_3 at 5% level of probability = 0.86

Table 4.8a. Analysis of variance table for yield tree^{-1} (kg) as affected by application of GA_3 and potassium nitrate

Source	**DF**	**SS**	**MS**	**F**	**P**
Blocks	2	5.796	2.8982		
GA_3	4	50.094	12.5236	2.96	0.0321
KNO_3	3	3.782	1.2607	0.30	0.0287
GA_3 x KNO_3	12	86.436	7.2030	1.70	0.1057
Error	38	161.030	4.2376		
Total	59	307.139			

CV 4.08%

Yield ha^{-1} (tons): Data regarding yield hac^{-1} of peach are shown in mean table 4.9 whereas ANOVA is shown in table 4.9a. Original replicated data are given in Appendix-IX. The analyzed data showed that yield hac^{-1} of peach was significantly affected by foliar application of gibberellic acid and potassium nitrate. The interaction of GA_3 and KNO_3 for yield hac^{-1} was found significant.

Data regarding GA_3 indicate that yield hac^{-1} of peach was found higher (15.548 tons) when plants were sprayed with 80 ppm of GA_3 which was statistically different from yield ha^{-1} (15.115 tons) when plants were sprayed with 60 ppm of GA_3. The minimum yield hac^{-1} (13.137 tons) was recorded in plants received no $GA_{3.}$

Data about KNO_3 shows that maximum yield hac^{-1} (14.829 tons) was noted when plants were sprayed with 3000 ppm of KNO_3 which was significantly different from yield hac^{-1} (14.637 tons) when KNO_3 was sprayed on plants with 2000 ppm. The minimum yield hac^{-1} (14.206 tons) was recorded in control treatments.

In present research we recorded the increase in yield with the increase in the concentration of GA_3 and KNO_3. These findings are supported by the finding of Maryam and Sana [27] who found the increase in yield per hectare when they carried an experiment on the influence of plant growth regulators on performance of plum. This may be due to the fact that plant growth regulators GA_3 and KNO_3 act as ethylene inhibitor due to which softening of fruit do not occur and fruits get good size and weight which ultimately enhance the yield per hectare.

Table 4.9. Yield ha^{-1} (tons) of peach as affected by application of GA_3 and potassium nitrate.

Potassium Nitrate (ppm)	**Gibberellic acid (ppm)**					**Mean**
	0	**20**	**40**	**60**	**80**	
0	12.87	13.58	14.58	14.90	15.10	14.206D
1000	12.99	13.95	14.79	15.00	15.39	14.424C
2000	13.20	14.07	14.99	15.19	15.73	14.637B
3000	13.49	14.30	15.01	15.37	15.97	14.829A
Mean	13.137E	14.042D	14843.75C	15.115B	15.548A	

Means followed by different letters are statistically dissimilar at 1% significance level.
LSD value for levels of GA_3 at 1% level of probability = 510
LSD value for levels of KNO_3 at 1% level of probability = 170

Table 4.9a. Analysis of variance table for yield ha^{-1} (tons) of peach as affected by application of GA_3 and potassium nitrate.

Source	DF	SS	MS	F	P
Blocks	2	305906	152953		
GA_3	4	2417818	604455	2.23	0.0039
KNO_3	3	48477.9	16159	0.06	0.0086
GA_3 x KNO_3	12	5587395	465616	1.72	0.1014
Error	38	1.03007	271055		
Total	59	1.86607			

CV 3.84%

Conclusions: Keeping in view the results obtained from the experiment, it is concluded that the yield and quality of peach (cv. Early grande) increased with increasing levels of GA_3 and KNO_3. Application of GA_3 at the rate of 80 and 3000 ppm increased the quality and yield of peach.

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