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Original Research Article

Influence of foliar application of Zinc, Calcium and GA_3 on fruit drop, yield and quality attributes of aonla cv. NA-7

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A B S T R A C T

An experiment was laid out during the year 2017-18 on the Seventeen year old orchard of aonla cv NA-7, in the Horticulture department, C. S. Azad University of Agriculture and Technology, Kanpur for studying the Influence of foliar application of Zinc, Calcium and GA3 on fruit drop, yield and quality attributes of aonla cv. NA-7. The soil of orchard was sandy loam in texture with good organic matter content, slightly acidic (pH 6.5) in nature and well drained. The 10 treatments viz. T_1 : Zinc Sulphate @ 0.2%, T_2 : Zinc Sulphate @ 0.4%, T_3: Zinc Sulphate @ 0.6%, T_4 : Calcium Chloride @ 0.5%, T_5 : Calcium Chloride @ 1.0%, T_6 : Calcium Chloride @ 1.5%, T_7 : GA_3 @ 25ppm, T_8 : GA_3 @ 50ppm, T_9 : GA_3 @ 100ppm, and T_{10} : Control (water spray) with 3 replications were used in RBD design. Plants treated with $ZnSO_4$ @ 0.6 % significantly reduced fruit drop (67.20 %) and increases fruit retention (32.80 %) and recorded higher specific gravity (1.079). Application of GA_3 @ 50 ppm recorded significantly higher fruit yield (83.27kg/plant), fruit weight (33.10g), fruit volume (31.35cc), pulp weight (31.66g), pulp: stone ratio (21.94%). However, lowest stone weight (1.42g) and highest T.S.S. (15.25^0Brix) were recorded in fruit treated with GA_3 @ 25ppm. However, higher ascorbic acid (625.67mg/100g) found in fruit which treated with $CaCl_2$ @ 1.5%. The higher length (4.52cm) and width (4.60cm) of aonla fruits cv. NA7 were obtained with sprayed of GA_3 @ 100 ppm concentration.

Keywords

Aonla, Calcium, fruit drop, GA_3, yield, quality and Zinc

Introduction

The Indian gooseberry or Aonla (*Emblica officinalis* Gaertn.), a native of tropical South-East Asia, particularly central and south India, is grown in India since the ancient times. The trees are also common in mixed deciduous forest of India ascending to 1300 meter on hills. It is also naturally occurring in other tropical countries of the world viz. SriLanka, Cuba, PuetroRico, USA (Hawaiiand Florida), Iran, Iraq, Pakistan, China, Malaysia, Thailand, Viatnam, Philippines, Trinidad, Panama and Japan. The myrobalam has vast potential and wider adaptability to grow in a variable range of soils and climatic conditions. However, the traditional cultivation of aonla is predominantly occupied in Uttar Pradesh particularly in Pratapgarh and its

surrounding districts. It is rapidly spreading in the semi-arid regions of Maharashtra, Gujrat, Rajasthan, Andhra Pradesh, Karnataka, Tamil Nadu and Arawali ranges in Haryana, Kandi area in Punjab and in Himachal Pradesh (Goyal *et al.*, 2008). In India, it is being cultivated in 91000ha area with 989000 MT production and 10.87 MT /ha productivity (Horticultural Statistic At A Glance-2017).

It belong to family Euphorbiaceae and is known as Amla or Aura in hindi, Amla or Amalaki in Bengali and Uriya, Nelli in Malayalam and Tamil, Dhatri in Sanskrit, Amlkumi in Telugu, Amolphal and Punjabi, Amlay in Arabic, Amlet in Persian and Emblic Myrobalam and Indian Goose Berry in English in different parts of the world. It is more popular as backyard fruit throughout the country, owing to its hardy nature, suitability to wastelands, high productivity per unit area, high nutritive and therapeutic value, it has become an important fruit of India (Chadha, 2001). It can successfully grown under marginal wasteland, sodic soil, ravine land, arid and drought prone areas. In these crops flowering and fruit set takes place in spring and soon after the fruit enter dormancy without any growth throughout the summer till the monsoon break. Therefore, Plants do not require irrigation during summer and this makes aonla the most ideal crop for arid region (Bajpai and Shukla, 2002).

Aonla fruit is valued for its high nutritive values, medicinal properties, processing of value added products and herbal drugs. Due to its importance and medicinal use, it is known as "AmritPhal" and "Wonder drug". It is important ingredient of 'Triphala', Chavanprash, Amritkalash, Trilax, Amlaplex, Neutrale and Tylophoraplus. Fruits are commonly used for making preserve (murabba), pickle, candy, jelly, sauce, dried chips etc. The processing potentiality of fruits is yet to be fully tapped (Chadha, 2001).

Under the present changing scenario of degradation of prime natural resources viz., land, water, and vegetations, the promotion of plantation of most hardy fruit species specially aonla, is very helpful in rehabilitation and greening Of waste land/degraded lands, which resulted to blanching of eco-system. Among the different traditional grown clonal varieties and land races of aonla have their variation in flowering, fruiting yield and quality of fruits. The bearing behavior is also adversely affected due to variable range of moisture of soil, temperature, rain fall and atmospheric humidity, In addition to these the yield in highly associated with variable sex ratio, fruit set, fruit drop, fruit retention maturation and physiological disorders.

The foliar application of plant bio-regulator and micro nutrients have immense important role in improving fruit set, productivity and quality of fruits. It also has beneficial role in recovery of nutritional and physiological disorder in fruit trees. Various experiments have been conducted earlier on foliar spray of plant bio-regulator and micro-nutrients in different fruit crops and shown significant response with improvement in yield and quality of fruits (Kumar *et al.*, 2004). Zinc is required for synthesis of tryptophan, a precursor of Auxin and help in reducing fruit drop, zinc is directly or indirectly required for protein synthesis and lack of Auxin due to Zn deficiency results in the failure cellwall growth thereby causing high osmotic pressure and restricting water uptake. Indian goose berry being minor fruit crops, no systematic research work has been carried out for improving fruit set, yield and quality of aonla fruit by foliar spray of micro nutrients. The intensity of damage caused by

fruits dropping can be minimized by the foliar application of nutrients, which also helps in improving yield and fruit quality of aonla.

Calcium plays an important role in maintaining quality of fruits and Calcium treatments helps to retain fruit firmness, increase vitamin-C content, decreased storage break down, rotting and also decreased browning in apple. It also protects from disorganization of membrane and prevents the increase of apparent free space in the tissue. This is generally associated with senescence and maintains the protein synthesizing ability of cell.

Numerous effects of gibberellins on different aspect of plant suggest that this hormone can be used commercially for the benefit of human welfare. Gibberellins have found great use in increasing stalk length and production, including uniform crop emergence, increasing fruit size by cell division and cell elongation, improving fruit quality and storage delaying maturity period, controlling cracking of fruits and fruit drop problem, producing seedlessness and increasing sugar content in different fruit crops at different concentration (Pandey and Sinha1995).

GA_3 are used for improving the flowering, fruit set, size and quality of fruits as well as yield. GA_3 has also been found to improve fruit retention and quality of fruit in ber (Yadav *et al.*, 2004).

There are different research works have been carried out so far to overcome the problem of heavy pre-harvest fruit drop, improving the fruit yield and quality of aonla cv. NA-7 grown under having different soil fertility levels. Thus, keeping in view, the problem of fruit drop, poor yield and poor fruit quality of aonla, the present investigation entitled "Influence of foliar application of Zn, Calcium and GA_3 on fruit drop, yield and quality attributes of aonla cv. NA-7"

Materials and Methods

An experiment was laid out during the year 2017-18 on the Seventeen year old orchard of aonla cv NA-7, in the Horticulture department, C. S. Azad University of Agriculture and Technology, Kanpur for studying the Influence of foliar application of Zinc, Calcium and GA3 on fruit drop, yield and quality attributes of aonla cv. NA-7. The soil of orchard was sandy loam in texture with good organic matter content, slightly acidic (pH 6.5) in nature and well drained. The 30 trees having uniform growth were selected randomly before foliar application of micro-nutrients. The standard cultural operations and basal application of manures and fertilizers were applied as per recommended schedule for aonla plantation. The 10 treatments viz. T_1 : Zinc Sulphate @ 0.2%, T_2 : Zinc Sulphate @ 0.4%, T_3: Zinc Sulphate @ 0.6%, T_4 : Calcium Chloride @ 0.5%, T_5 : Calcium Chloride @ 1.0%, T_6 : Calcium Chloride @ 1.5%, T_7 : GA_3 @ 25ppm, T_8 : GA_3 @ 50ppm, T_9 : GA_3 @ 100ppm, and T_{10} : Control (water spray) with 3 replications were used. The foliar sprays of macro and micro-nutrients were applied once after fruit set and applied during 8 August 2017 at the time of fruit bud developmental stage. Each tree was sprayed with 10 litres of solution which was found adequate to drench entire foliage and the spraying was done in the afternoon from 4.00 pm to 5.00 pm by using pneumatic foot sprayer fitted with nozzle. High legged stool was used for spraying top of tree and it was fully ensured that all side of the tree was drenched completely. Polythene sheets were spread under the trees so that surplus spray drops may not reach to the soil. The observations were recorded as:

Per cent fruit drop

The four bearing branches in four directions on each treated tree were tagged and total numbers of fruit buds/fruit lets were counted. The number of fruit buds/fruit lets dropped on each branch were counted at 15th day's interval. The average numbers of fruits dropped from each branch were calculated in per cent of fruit drop by using following formula as,

$$\% \text{ fruit drop} = \frac{\text{No of fruitlets at initial} - \text{No of fruits retention at harvest}}{\text{No of fruitlets at initial stage}} \times 100$$

Per cent fruit retention

The percentage of fruit retention was calculated by recording number of initial fruits set and remaining fruits after fruit shedding in each treatment at the time of harvesting. It was calculated by using the following formula as,

$$\text{Fruit retention } (\%) \frac{\text{Total no of fruits retained per determinate shoot till maturity}}{\text{Total no of fruits set per determinate shoot}} \times 100$$

Fruit Size (length and width of fruits)

The fruit size was measured at fruit maturity/harvesting stage. The fruit size *i.e.* length and width were measured in centimetre with the help of calibrated Vernier Callipers. The 20 fruits collected from each treatment were measured for average size of fruit.

Weight of the fruit

The average weight of fruit was recorded at full maturity stage. The 20 fruits were collected from each treatment and weighed on the top loading electrical balance and average fruit weight was recorded in gram (g) as,

$$\text{Average fruit weight } (g) = \frac{\text{Total number of fruits}}{\text{Total weight of fruits}}$$

Fruit volume (cc)

The corresponding volume of the previously selected fruits was recorded. For the purpose, a known amount of water was taken in the measuring cylinder (2 liter capacity) and the sample of 10 fruits was placed gently one by one into the cylinder.

The final reading of the water level was recorded. The difference between the initial reading and the final reading gave the volume of these 10 fruits. From this the average volume of a fruit was calculated.

Stone and pulp weight

The weight of stone was recorded by physical balance and the average stone weight was calculated and expressed in gram (g). Pulp weight was obtained by deducting the weight of seed (stone) and peel and expressed in gram (g).

Pulp: stone ratio

The pulp: stone ratio was calculated in relation to pulp and stone weight. The pulp: stone ratio was calculated using following formula:

$$\text{Pulp : stone ratio} = \frac{\text{Total weight of fruit (g)} - \text{Weight of stone (g)}}{\text{Total weight of stone (g)}}$$

Specific gravity:

The harvest specific gravity of fruit was determined with the use of following formula (g/cm^3).

$$\text{Specific gravity of fruit} = \frac{\text{average Weight of fruit (g)}}{\text{average Volume of fruit (cc)}}$$

Fruit yield

The total fruit yield per tree was recorded after harvesting of fruits. The average fruit yield (kg per tree) was recorded as per treatments.

Total soluble solids (TSS)

At harvest total soluble solid (T.S.S.) of the juice was determined by using a hand refractor meter of 0-32 range. The values were corrected at 20^0C with the help of temperature correction chart (A.O.A.C., 1975) and expressed as ºBrix.

Ascorbic acid (Vitamin C)

Ascorbic acid content of the fruits was determined as per the method given by A.O.A.C., (1975) using standardized 2, 6-dichlorophenol indophenols dye.

Results and Discussion

Fruit drop

Fruit drop of anola are commercial loss to the farmers as the drop occurs from fruit setting to physiologically maturity. Bajpai (1968) reported that flower and fruit drop in aonla occurs at three stages. The first drop of flowers is the highest within three weeks of flowering due to degeneration of the egg apparatus and lack of pollination. The second drop occurs from June to September due to lack of pollination and fertilization. The third drop consists of fruits of various stages that occur from third week at August until October probably due to embryological and physiological factors (Table 1).

It was observed that fruit drop percentage was significantly reduced by the spray of macro and micro-nutrients as well as GA_3. Significantly reduced amount of drop (67.20%) was recorded by the application of Zinc Sulphate @ 0.6%, followed by $CaCl_2$ @ 1.5% (68.17 %), whereas, the maximum fruit drop percentage was recorded under control (81.33 %). The improvement in fruit drops 21.03% was with 0.6% $ZnSo_4$ over control (81.33%). Zinc application in present experiment might have encouraged endogenous production of auxin these by reduced the fruit drop. Various workers have also been reported to reduced fruit drops in different fruit crops like; Sinha *et al.,* (1999) reported in litchi, Singh *et al.,* (2001) in ber.

Fruit retention

It was observed that fruit retention percentage was significantly improved by the foliar application of macro and micro-nutrients as well as GA_3 when compared to control. Significantly higher fruit retention (32.80%) was observed in the plants treated with $ZnSO_4$, at higher concentration (0.6 %), whereas, minimum (18.67) fruit retention was observed in plants under control in anola cv. NA-7. Thus 75.68% more retention was expressed with 0.6% zinc sulphate (T_3) over control (18.67%). Zinc sulphate at higher level increased the foliar zinc content which ultimately encourages the endogenous production of auxin which reduces fruit drop and encourage fruit retention (Krishnamoorthy, 1992). The results are in line with the finding Kamble *et al.,* (1994), Sharma *et al.,* (2011) in ber.

Fruit yield

The foliar application of GA_3 as well as macro and micro-nutrients treatments significantly influenced the fruit yield per plant over to control. Foliar application of GA_3 proved more effective than Zn and $CaCl_2$ treatments. 50ppm GA_3 concentration enhanced the yield significantly over control and the yield of 83.27 Kg/ plants was recorded.

Table.1 Effect of foliar application of Zinc, Calcium and GA_3 on fruit drop (%), fruit retention (%), yield (kg/plant), length (cm), width(cm), fruit weight(g), fruit volume (cc) and specific gravity (g/cm^3)in aonla cv. NA-7

Treatments and symbols used	Fruit drop (%)	Fruit retention (%)	Yield (Kg/plant)	Length (cm)	Width (cm)	Fruit Weight (g)	Fruit Volume (cc)	Specific Gravity (g/cm^3)
Zinc Sulphate @0.2% (T_1)	76.96	23.03	75.33	3.23	3.61	27.60	25.82	1.069
Zinc Sulphate @ 0.4% (T_2)	72.60	27.40	77.30	3.47	3.95	29.77	27.60	1.079
Zinc Sulphate @ 0.6% (T_3)	67.20	32.80	78.00	4.11	4.27	31.47	29.55	1.065
Calcium Chloride @ 0.5% (T_4)	76.37	23.63	72.66	3.50	3.82	26.53	25.14	1.055
Calcium Chloride @ 1.0% (T_5)	74.27	25.80	76.57	4.01	4.13	29.43	27.70	1.063
Calcium Chloride @ 1.5% (T_6)	68.17	31.67	74.20	4.32	4.44	31.27	29.64	1.054
GA_3 @ 25ppm (T_7)	77.17	22.83	76.00	3.22	3.30	27.37	25.82	1.060
GA_3 @ 50ppm (T_8)	73.53	25.47	83.27	3.96	4.40	33.10	31.35	1.056
GA_3 @ 100ppm (T_9)	71.53	28.83	81.33	4.52	4.60	31.17	29.63	1.052
Control (water spray) (T_{10})	81.33	18.67	67.90	3.10	2.78	20.13	19.58	1.028
S.E. (d.)±	**0.1571**	**1.354**	**0.673**	**0.184**	**0.085**	**0.9069**	**0.8781**	**0.0063**
CD at 5%	**0.466**	**2.852**	**1.415**	**0.387**	**0.18**	**1.9056**	**1.8456**	**0.091**

Table.2 Effect of foliar application of Zinc, Calcium and GA_3 on pulp weight (g), stone weight (g), pulp:stone ratio (%), TSS and ascorbic acid (mg/100 g) in aonla cv. NA-7

Treatments and symbols used	Pulp weight (g)	Stone weight (g)	Pulp: stone ratio (%)	T.S.S. (ºBrix)	Ascrbic acid (mg/100g)
Zinc Sulphate @0.2% (T_1)	25.95	1.65	15.82	14.47	584.33
Zinc Sulphate @ 0.4% (T_2)	28.16	1.60	17.65	14.34	600.67
Zinc Sulphate @ 0.6% (T_3)	29.73	1.74	17.12	14.88	620.67
Calcium Chloride @ 0.5% (T_4)	24.91	1.62	15.38	14.14	567.67
Calcium Chloride @ 1.0% (T_5)	27.63	1.81	15.32	14.46	590.00
Calcium Chloride @ 1.5% (T_6)	29.73	1.54	19.34	14.60	625.67
GA_3 @ 25ppm (T_7)	25.95	1.42	18.38	15.25	586.00
GA_3 @ 50ppm (T_8)	31.66	1.44	21.94	14.74	605.33
GA_3 @ 100ppm (T_9)	29.46	1.57	18.86	13.86	614.00
Control (water spray) (T_{10})	18.21	1.92	9.49	12.75	544.00
S.E. (d.)±	**0.7839**	**0.0894**	**0.9632**	**0.332**	**5.698**
CD at 5%	**1.647**	**0.185**	**2.024**	**0.70**	**11.9750**

The lowest (67.90kg/plant) fruit yield was found in Control (T_{10}). In GA_3 50ppm showed 22.64% improvement of fruit yield over control. This improvement in yield due to GA_3 application may be ascribed to better photosynthsis and less fruit drop. Results regarding fruit yield are in agreement with report of Bramachchari and Rani (2001-b) in litchi. Tripathi and Shukla (2006) in straw berry Alam and Kumar (2017) in phalsa.

Fruit length and width

In the present investigation fruit size (length and width) was significantly increased by foliar application of GA_3 as well as macro and micro-nutrient over control. Plant treated with foliar application of GA_3@100ppm produced significantly higher length of fruit (4.52 cm) and width of fruits (4.60 cm), whereas the plants under control produced significantly smaller size of fruits (3.10 and 2.78 cm) respectively. With the enhancement of GA3 concentration, fruit size expressed greater significantly over control. The treatment of GA_3 100 ppm concentration revealed 45.81% more length of fruit and 65.45% more greater width of fruit respectively. The improvement in size can thus be attributed to the greater mobilization of food material from the site of their production to the storage organs under the influence of applied GA_3. Which plays an important role in nitrogen metabolism and cell division and cell enlargement, thus it might have increased the fruit size. The results are in agreement with the findings of Singh *et al.,* (1976) in mango, and Shukla *et al.,* (2011) in aonla cv. NA-7.

Fruit weight

Fruit weight was significantly influenced by the foliar application of GA_3 as well as macro and micro-nutrient over control. The significantly maximum (33.10) weight of fruit was recorded with the application of 50ppm concentration of GA_3. The minimum (20.13g) fruit weight was obtained with control (T_{10}).The improvement of fruit weight was observed 64.43% more with treatment of 500ppm GA_3 concentration over control. This increase in weight of fruits might be due to better presence of GA_3 which regulates and photosynthates in plants and might have made rapid synthesis of metabolites particularly carbohydrate and their translocation to the fruits causing relatively greater pulp content. The result are in agreement with the findings of Singh and Chauhan (1984) in citrus, Bankar and Prasad (1990), Pandey (1999) in ber, and Jawed *et al.,* (2017) in guava.

Fruit volume

Volume of fruit was significantly influenced by the foliar application of macro and micro-nutrient as well as. The significantly higher volume of fruit (31.35 cc) was recorded in the fruit produced from the plants treated with GA_3@ 50ppm followed by $CaCl_2$ @ 1.5 % (29.44 cc). The minimum (19.58) volume of fruit was recorded under control. Improvement of volume (60.11%) GA 50 ppm concentration (T_8) while Calcium Chloride at 1.5 % concentrations also enhanced 51.38 % more volume over control (19.58 cc). These findings are in line with the reports of Masalkar and Wavhal (1991), Pandey (1999) in ber and Shukla *et al.,* (2011) in aonla. Thus, there are more accurate reasons are involved to hasten of fruit volume in present investigation. These increases in volume of fruits might be due to directly involvement of GA_3 promotes growth due to cell elongation and other hand more accumulation and translocation of food materials which ultimately increase in size of fruits.

Fruit specific gravity

Specific gravity was significantly influenced by the foliar application of macro and micro-nutrients as well as GA_3 treatment. It is observed over control that highest (1.079g/cm^3) specific gravity was produced with the plants, under $ZnSo_4$ @ 0.4 % treatments; the poorest specific (1.028g/cm^3) gravity was recorded under control. Thus, further improvement (4.96%) was observed when plants were treated with 0.4% zinc sulphate concentration when compared with control (1.028 g/cm^3). This increase in specific gravity was recorded with the use of zinc might be due to the incensement in fruit pulp and decrease in stone weight which promotes specific gravity ultimately. These finding are in accordance with the results of Verma *et al.*, (2008) in aonla.

Fruit pulp weight

Pulp weight was significantly improved by the foliar application of GA_3 as well as macro and micro-nutrient. Significantly maximum weight (31.66 g) of pulp was recorded in the fruits which were harvested from the treated plants with the GA_3@ 50ppm treatment closely followed by 1.5 % $CaCl_2$ and 0.6 % $ZnSo_4$ producing 29.74 g pulp weight. Whereas, the minimum (18.21 g) pulp weight was found in untreated plants (control). Remaining all other treatments also significantly increase pulp content in the fruits as compared to control. Incensement in pulp weight was hastened 73.86% more due to GA_3 50ppm concentration over control (18.21g). This increase in fruit pulp weight with the application of GA might be due to the directly involvement in acceleration of biochemical activities in plant parts and translocation of mineral nutrients during the process of fruit development. These finding are in agreement with the reports of Masalkar and Wavhal (1991) in ber Brahmchari and Rani (2001-b) in litchi (Table 2).

Fruit stone weight

Fruit stone weight was reduced by the use of GA_3, macro and micro nutrients as compared to control. Minimum weight of stone (1.42 g) was recorded in the fruits produced from the plants treated with GA_3 @ 25ppm, whereas, maximum weight of stone was recorded under control (1.92 g). The deprivation in fruit stone weight was found 13.94% when compared with control. These finding in line with the reports of Masalkar and Wavhal (1991) in ber.

Fruit pulp: Stone ratio

Fruit pulp: stone ratio was significantly influenced by the foliar application of macro and micro-nutrients as well as GA_3 over control.

The plants sprayed with GA_3 @ 50ppm produced maximum (21.94%) pulp: stone ratio followed by $CaCl_2$@ 1.5% revealing 19.34% pulp stone ratio. The minimum pulp: stone ratios (9.49%) were recorded under control. The enhancement of pulp stone ratio in aonla fruit was recorded 131.19% and 105.46% due to $GA_3$50ppm and $CaCl_2$ @1.5% concentration respectively over control. The increase in pulp: stone ratio might be due to the acceleration in biochemical activities and accumulation of metabolites in plant parts, which is probable due to synergistic effect of GA_3 and $CaCl_2$ on conversion and translocation of total sugars and minerals during the process of fruit development and fruit maturation. These finding are in accordance with the results of Masalkar and Wavhal (1991) in ber and Bramchari and Rani (2000-b) in litchi.

TSS

The maximum(15.25 ^{o}Brix) total soluble solids was recorded with the foliar application of GA_3 @ 25ppm followed by $ZnSO_4$ at 0.6% concentration, producing 14.88 ^{o}Brix T.S.S, whereas, the minimum total soluble solids content was recorded with untreated plants (12.75^{0}Brix). The improvement in T.S.S. were 19.61% and 16.70% due to GA_3 25 ppm and $znso_4$ 0.6% concentration over control. These finding are in accordance with the results of Kale *et al.,* (2000), Singh *et al.,* (1982), Yadav *et al.,* (2004) in ber and Shukla *et al.,* (2011) in aonla.

Ascorbic acid

Vitamin-'C' is a powerful antioxidant and is an important part of human feed. It helps to save the human from many serious diseases and scavenges the reactive oxygen species (ROS) produced in the body. The maximum ascorbic acid contents (625.67 mg/100g) were recorded in the fruits produced from the plants treated with $CaCl_2$ @ 1.5 %, whereas, the minimum ascorbic acid content was obtained in control (544.00 mg/100g).Increase in ascorbic acid was 15.01% more over control (544mg/100g). Singh *et al.,* (2002) have recorded an increase in ascorbic acid content in peach when they applied 1.0 per cent of calcium nitrate. This increase in ascorbic acid content with calcium nitrate application may be due to uninterrupted synthesis of its precursor like glucase-6-phosphate during conversion of starch into various sugars and low rate of oxidation. The finding is in accordance with the results of Kumar *et al.,* (2005), Shukla and Tripathi (2011) in aonla.

On the basis of above findings it is concluded that plants treated with $ZnSO_4$ @ 0.6 % significantly reduced fruit drop (67.20 %) and increases fruit retention (32.80 %). This treatment also enhanced specific gravity(1.079), Significantly higher fruit yield (83.27kg/plant), fruit weight(33.10g), fruit volume(31.35cc), pulp weight (31.66g), pulp: stone ratio (21.94%), were recorded in fruits produced from the plants treated with GA_3 @ 50ppm. However, lowest stone weight (1.42g) and highest T.S.S. (15.25^{0}Brix) were recorded in fruit produce from the plants treated with GA_3 @ 25 ppm. However, higher (625.67mg/100g) ascorbic acid found in fruit which treated with $CaCl_2$ @ 1.5%. The higher length (4.52cm) and width (4.60cm) of aonla fruits cv. NA7 were obtained with sprayed of GA_3 @ 100 ppm concentration. It is recommendation of aonla grower for central up to obtained quality yield spraying of GA_3 should be applied in month of August, as well as in same time checking of fruit drop and promote retention of fruit spraying of zinc sulphate @ 0.6% is also recommended.

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