## *Original Research Article*

**Optimizing Nitrogen, Phosphorus, and Potassium Levels for Enhanced Yield and Quality of Custard Apple (*Annona squamosa* L.)**

**ABSTRACT**

The present investigation was conducted to assess the nutrient dose and its impact on the growth, yield, and quality of custard apples. The experiment was performed on a 10-year-old custard apple orchard in Mrig Bahar at the Instructional Cum Research Orchard Arid Zone Fruit Project, Department of Horticulture, M.P.K.V., Rahuri, Dist. Ahmednagar. Treatments comprising combinations of three different levels of nitrogen, phosphorus, and potassium in all possible 27 combinations were split into different growth stages and replicated twice in a Factorial Randomized Block Design. Nitrogen, phosphorus, and potassium were applied in the form of urea, single super phosphate, and muriate of potash, respectively. The application of FYM @ 20 kg + PSB @ 25 g + *Azotobacter* @ 15 g + *Trichoderma* @ 15 g per plant and the treatment N1P2K1 i.e. 250:175:125 g N: P2O5:K2O g/plant dose of inorganic fertilizers with scheduling of nutrient viz., 50 % N, 50 % P2O5 and 50 % K2O as a basal application, 20 % N, 50 % P2O5 and 25 % K2O at fruit set stage, 20% N and 25 % K2O at lemon size fruit stage and 10 % N at one month before harvesting has given 23 % increasing fruit yield (kg/plant) as well as highest number of fruits per plant**,** maximum fruit weight (g) and quality of custard apple.

**KEYWORDS:** Custard apple, Balanced Nutrients, Fertilizer, harvesting

**INTRODUCTION**

Custard apple (*Annona squamosa* L.) is a deciduous, subtropical fruit, consumed in many countries throughout the world. The Custard apple, a member of the family Annonaceae, is believed to have been introduced in India from tropical South America (Beerh, 1972). It has several synonyms such as Sithaphal, Sharifa, Sugar apple, Sweetsop, *etc.,* and more than 70 species come under the genus *Annona,* of which only six of them produce edible fruits. In India, custard apple is grown on hilly rocks with minimum inputs (Rajput, 1985). Among the various factors responsible for increasing crop production, the use of balanced fertilizers at the appropriate time plays a vital role in enhancing productivity. It is generally recognized that out of the total fertilizer application, only about 50 to 60 per cent of the total nutrients enter the plant system, with the rest being wasted by either leaching or volatilization.

The use of various organic manures and fertilizers is a good practice for maintaining the physicochemical and biological properties of the soil. However, the use of organic matter cannot provide the required nutrients, including micronutrients, but it will improve the physical condition of the soil, aeration, and root growth. Likewise, an excessive and indiscriminate use of chemical fertilizers results in considerable deterioration of soil health. It also disturbs the soil microorganisms and reduces the pH of the soil. Nutrient management is a production system that favours the maximum use of organic material and the required quantity of inorganic fertilizers to maintain soil fertility and productivity.

**RESEARCH METHODS**

The research was conducted on a ten-year-old custard apple plant orchard Cv. Balanagar in Mrig bahar during 2017-18 and 2018-19 at Instructional Cum Research Orchard Arid Zone Fruit Project, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri (M.S.). In this experiment, the plants were kept in the rest period (Bahar treatment). The pruning was carried out in the month of February. Manuring and fertilization have been done simultaneously before giving the first light irrigation to the orchard. Experimental plants were supplied with a common dose of limiting micro nutrients as per the soil test + FYM @ 20 kg + PSB @ 25 g + *Azotobacter* @ 15 g + *Trichoderma* @ 15 g/ plant. A single common spray of 0.5 % Borax on 30 days after the first irrigation was given to each plant. The experiment was laid out in a factorial randomized block design with 27 treatment combinations, and each treatment was replicated twice, with four fertilizer application stages.

**Table 1. Details of the different levels of treatment used in the study.**

#### Nitrogen Phosphorus Potassium

N0 = 0 g N/plant P0 = 0 g P2O5/plant K0 = 0 g K2O/plant

N1= 250 g N/plant P1= 125 gP2O5/plant K1= 125 g K2O /plant

N2= 350 g N/plant P2= 175 g P2O5/plant K2= 175 g K2O /plant

#### Table 2. Details of the different application stages used in the study.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sr.****No.** | **Stages** | **Days after Ist irrigation** | **N %****per plant** | **P2O5 %****per plant** | **K2O %****per plant** |
| 1. | Basal application | 0 | 50 | 50 | 50 |
| 2. | Fruit set | 30 | 20 | 50 | 25 |
| 3. | At lemon-sized fruit | 90 | 20 | - | 25 |
| 4. | One month before harvest | 120 | 10 | - | - |

**Yield and Quality parameters were worked out as follows.**

**Number of Fruit per Plant**

The mature fruits harvested from a plant were counted at each harvest. The total numbers of fruits of all picking were counted and recorded as the number of fruits per plant.

#### Average Weight of Fruit (g)

Total fruits from each treatment combination tree were picked, and the weight of all fruits of each treatment was recorded separately on a digital weighing balance. The average weight (g) of each treatment was computed by dividing the total weight of harvested fruits (g) by the total number of fruits in each treatment.

#### Fruit Rind (%)

The rind percentage was worked out by dividing the average weight of rind per fruit by the average weight of fruit.

 Average weight of rind per fruit (g)

Rind percentage = 100

 Average weight of fruit (g)

#### Fruit Pulp (%)

The pulp percentage was worked out by dividing the average weight of pulp per fruit by the average weight of fruit.

 Average weight of pulp per fruit (g)

Pulp percentage = 100

 Average weight of fruit (g)

#### Fruit Seed (%)

The seed percentage was worked out by dividing the weight of seeds per fruit by the weight of fruit.

 Average weight of seed per fruit (g)

 Seed Percentage = ------------------------------100

 Average weight of fruit (g)

#### Fruit Set (%)

The percentage of fruit set was calculated by dividing the total number of set fruit per plant by the total number of flowers per plant multiplied by 100.

 Total number of set fruit per plant

Fruit Set Percentage = 100

 Total number of flowers per plant

#### Fruit Yield (kg/plant)

The yield of custard apple fruits was calculated by multiplication of average. Number of fruit to av. The weight of fruit and divided by 1000.

Average number of fruit x Weight of fruit (g)

 Yield (kg/plant) = ---------------------------------------------------

 1000

**TSS (0Brix)**

The total soluble solids (TSS) were recorded by the Hand Refractometer (Erma Tokyo A032) by taking a drop of juice on the prism of the Refractometer, and the readings were recorded for respective treatments. The prism of the Refractometer was washed with distilled water and wiped with muslin cloth after recording each observation.

#### Acidity (%)

Acidity of the juice was determined by titration with 0.1N sodium hydroxide as described by Ranganna (1997).

Five mL of juice was taken in a conical flask. About 10 ml of water was added to it and was titrated against standard 0.1 N sodium hydroxide solution using phenolphthalein as an indicator until a permanent faint pink colour developed. Acidity was calculated and expressed in terms of anhydrous citric acid as per percentage.

Reading x Normality of NaOH x Eq. weight of Citric acid Titrable acidity (%) = -----------------------------------------------------------------------

Volume of sample taken x 1000

**RESULT AND DISCUSSION**

The important results have been illustrated with the help of suitable figures. On the basis of the results obtained, an effort has been made to explain the possible reasons for the differences obtained due to different treatments. The results have been discussed in the light of the literature available for the different observations under study.

**Table 3. Fruit yield and fruit rind in different treatments**

|  |  |  |
| --- | --- | --- |
| **Number of Fruit per Plant** | Average Weight of Fruit (g) | Fruit Rind (%) |
| **Treatments** | **2017** | **2018** | **2017** | **2018** | **2017** | **2018** |
| N0P0K0 | 93.50 | 86.50 | 185.43 | 185.18 | 48.56 | 47.95 |
| N0P0K1 | 89.50 | 94.50 | 188.41 | 187.49 | 48.05 | 47.74 |
| N0P0K2 | 90.00 | 96.50 | 193.56 | 191.03 | 47.41 | 47.36 |
| N0P1K0 | 91.00 | 98.00 | 197.46 | 190.81 | 47.07 | 47.07 |
| N0P1K1 | 95.50 | 100.00 | 197.25 | 205.07 | 47.32 | 47.36 |
| N0P1K2 | 90.50 | 98.00 | 206.69 | 206.23 | 47.22 | 47.13 |
| N0P2K0 | 94.50 | 97.00 | 202.56 | 203.33 | 46.90 | 46.86 |
| N0P2K1 | 96.00 | 102.50 | 205.95 | 204.71 | 47.32 | 47.32 |
| N0P2K2 | 99.00 | 82.50 | 209.49 | 208.57 | 46.72 | 47.10 |
| N1P0K0 | 104.50 | 99.00 | 210.09 | 216.74 | 46.16 | 45.81 |
| N1P0K1 | 113.50 | 103.00 | 212.40 | 219.92 | 46.83 | 44.84 |
| N1P0K2 | 103.50 | 104.50 | 215.85 | 220.86 | 46.60 | 44.85 |
| N1P1K0 | 113.50 | 116.50 | 215.27 | 217.89 | 45.30 | 45.57 |
| N1P1K1 | 127.50 | 127.00 | 224.22 | 222.92 | 44.48 | 44.99 |
| N1P1K2 | 120.50 | 124.50 | 229.81 | 229.80 | 44.22 | 43.70 |
| N1P2K0 | 110.00 | 119.00 | 215.51 | 213.94 | 45.90 | 45.53 |
| N1P2K1 | 129.00 | 127.50 | 237.17 | 226.92 | 42.61 | 44.63 |
| N1P2K2 | 122.50 | 122.50 | 240.77 | 231.73 | 42.24 | 44.68 |
| N2P0K0 | 105.50 | 103.00 | 206.40 | 205.07 | 46.72 | 46.35 |
| N2P0K1 | 106.50 | 107.50 | 209.77 | 206.23 | 47.44 | 46.92 |
| N2P0K2 | 110.50 | 105.50 | 208.85 | 208.21 | 46.53 | 45.96 |
| N2P1K0 | 105.50 | 106.00 | 211.89 | 208.57 | 46.90 | 45.86 |
| N2P1K1 | 116.50 | 120.50 | 218.85 | 221.40 | 45.74 | 45.28 |
| N2P1K2 | 115.00 | 117.50 | 219.18 | 222.56 | 45.50 | 45.03 |
| N2P2K0 | 111.50 | 108.50 | 207.33 | 221.86 | 46.72 | 44.95 |
| N2P2K1 | 115.50 | 115.00 | 217.89 | 226.32 | 45.39 | 44.63 |
| N2P2K2 | 115.00 | 114.50 | 218.74 | 226.62 | 45.50 | 44.69 |
| **SE(m) ±** | 1.89 | 1.92 | 2.02 | 1.57 | 0.52 | 0.37 |
| **CD 5%** | NS | 5.39 | NS | 4.41 | NS | NS |
| **GM** | 106.87 | 107.30 | 211.33 | 212.22 | 46.19 | 45.93 |

**Table 4.** **Fruit pulp and fruit seed in different treatments**

|  |  |  |
| --- | --- | --- |
| Fruit Pulp (%) | Fruit Seed (%) | Fruit Set (%) |
| **Treatments** | **2017** | **2018** | **2017** | **2018** | **2017** | **2018** |
| N0P0K0 | 31.40 | 31.95 | 14.33 | 14.82 | 11.11 | 11.46 |
| N0P0K1 | 32.67 | 33.22 | 14.18 | 14.51 | 11.15 | 11.84 |
| N0P0K2 | 32.78 | 33.33 | 13.82 | 14.20 | 11.15 | 11.83 |
| N0P1K0 | 31.45 | 32.00 | 13.80 | 14.02 | 11.15 | 11.85 |
| N0P1K1 | 33.40 | 33.95 | 13.40 | 13.13 | 11.17 | 11.86 |
| N0P1K2 | 33.77 | 34.32 | 12.43 | 12.82 | 11.17 | 11.86 |
| N0P2K0 | 31.84 | 32.39 | 13.05 | 13.16 | 11.17 | 11.86 |
| N0P2K1 | 33.55 | 34.10 | 12.53 | 13.01 | 11.18 | 11.87 |
| N0P2K2 | 34.13 | 34.68 | 12.79 | 12.75 | 11.20 | 11.89 |
| N1P0K0 | 35.01 | 36.44 | 12.11 | 12.45 | 11.17 | 11.30 |
| N1P0K1 | 35.29 | 36.72 | 11.72 | 12.15 | 11.19 | 11.31 |
| N1P0K2 | 35.34 | 36.77 | 11.75 | 11.78 | 11.17 | 11.29 |
| N1P1K0 | 35.73 | 37.16 | 11.49 | 12.01 | 11.30 | 11.29 |
| N1P1K1 | 36.55 | 37.98 | 10.41 | 11.09 | 11.45 | 12.32 |
| N1P1K2 | 36.62 | 38.05 | 10.61 | 10.89 | 11.35 | 12.09 |
| N1P2K0 | 35.39 | 36.82 | 11.16 | 11.88 | 11.29 | 11.20 |
| N1P2K1 | 36.80 | 38.23 | 10.23 | 10.98 | 12.37 | 11.93 |
| N1P2K2 | 37.02 | 38.45 | 9.94 | 10.73 | 12.35 | 11.81 |
| N2P0K0 | 34.49 | 35.63 | 12.34 | 12.83 | 11.96 | 11.89 |
| N2P0K1 | 35.02 | 36.16 | 11.99 | 12.58 | 12.03 | 11.74 |
| N2P0K2 | 35.27 | 36.41 | 12.20 | 12.48 | 12.19 | 11.22 |
| N2P1K0 | 34.62 | 35.76 | 11.61 | 12.34 | 12.24 | 11.23 |
| N2P1K1 | 35.91 | 37.05 | 10.91 | 11.48 | 12.30 | 11.35 |
| N2P1K2 | 36.16 | 37.30 | 10.96 | 11.49 | 12.31 | 11.43 |
| N2P2K0 | 35.02 | 36.16 | 11.98 | 11.78 | 12.08 | 11.17 |
| N2P2K1 | 35.95 | 37.09 | 11.09 | 11.29 | 12.49 | 11.45 |
| N2P2K2 | 36.32 | 37.46 | 10.98 | 11.26 | 12.29 | 11.35 |
| **SE(m) ±** | 0.06 | 0.08 | 0.17 | 0.16 | 0.23 | 0.22 |
| **CD 5%** | 0.17 | 0.24 | NS | NS | NS | NS |
| **GM** | 34.72 | 35.76 | 11.99 | 12.37 | 11.63 | 11.62 |

**Table 5. Fruit yield, TSS and acidity assessment in different treatments**

|  |  |  |
| --- | --- | --- |
| Fruit Yield (kg/plant) | **TSS (0Brix)** | Acidity (%) |
| **Treatments** | **2017** | **2018** | **2017** | **2018** | **2017** | **2018** |
| N0P0K0 | 17.35 | 16.02 | 19.72 | 19.98 | 0.38 | 0.38 |
| N0P0K1 | 16.85 | 17.72 | 19.91 | 20.11 | 0.38 | 0.38 |
| N0P0K2 | 17.43 | 18.44 | 19.99 | 20.18 | 0.38 | 0.38 |
| N0P1K0 | 17.96 | 18.69 | 19.88 | 20.07 | 0.38 | 0.38 |
| N0P1K1 | 18.84 | 20.50 | 20.22 | 20.41 | 0.38 | 0.38 |
| N0P1K2 | 18.70 | 20.21 | 20.36 | 20.55 | 0.38 | 0.38 |
| N0P2K0 | 19.16 | 19.73 | 19.93 | 20.12 | 0.38 | 0.38 |
| N0P2K1 | 19.77 | 20.98 | 20.60 | 20.79 | 0.38 | 0.38 |
| N0P2K2 | 20.74 | 17.21 | 20.74 | 20.93 | 0.38 | 0.38 |
| N1P0K0 | 21.95 | 21.45 | 22.11 | 22.43 | 0.38 | 0.38 |
| N1P0K1 | 24.10 | 22.65 | 22.98 | 23.33 | 0.38 | 0.37 |
| N1P0K2 | 22.34 | 23.07 | 23.14 | 23.48 | 0.38 | 0.37 |
| N1P1K0 | 24.43 | 25.38 | 22.49 | 23.81 | 0.38 | 0.37 |
| N1P1K1 | 28.59 | 28.31 | 24.57 | 24.93 | 0.37 | 0.37 |
| N1P1K2 | 27.61 | 28.61 | 22.56 | 24.89 | 0.37 | 0.37 |
| N1P2K0 | 23.70 | 25.46 | 24.46 | 23.02 | 0.38 | 0.37 |
| N1P2K1 | 30.59 | 28.93 | 24.52 | 24.78 | 0.36 | 0.37 |
| N1P2K2 | 29.50 | 28.39 | 24.42 | 24.22 | 0.36 | 0.37 |
| N2P0K0 | 21.77 | 21.12 | 20.43 | 21.18 | 0.38 | 0.38 |
| N2P0K1 | 22.35 | 22.17 | 22.04 | 22.29 | 0.38 | 0.37 |
| N2P0K2 | 23.08 | 21.97 | 22.66 | 22.91 | 0.38 | 0.37 |
| N2P1K0 | 22.35 | 22.11 | 21.96 | 22.21 | 0.38 | 0.37 |
| N2P1K1 | 25.49 | 26.68 | 23.94 | 24.19 | 0.37 | 0.36 |
| N2P1K2 | 25.21 | 26.15 | 23.91 | 24.16 | 0.37 | 0.36 |
| N2P2K0 | 23.12 | 24.07 | 22.38 | 22.63 | 0.38 | 0.37 |
| N2P2K1 | 25.16 | 26.02 | 23.85 | 24.10 | 0.36 | 0.36 |
| N2P2K2 | 25.15 | 25.94 | 23.96 | 24.21 | 0.36 | 0.36 |
| **SE(m) ±** | 0.48 | 0.40 | 0.12 | 0.14 | 0.00 | 0.01 |
| **CD 5%** | 1.38 | 1.15 | 0.34 | 0.38 | NS | NS |
| **GM** | 22.72 | 22.89 | 22.14 | 22.44 | 0.37 | 0.37 |

The NPK interaction was not significant during 2017, as well as in the pooled analysis, but in the year 2018 analysis was found to be significant. The N1P2K1 combination with N1-250 g N /plant, P2-175 g P2O5/plant, and K1-125 g K2O/plant, which recorded a maximum number of fruits/plant of 127.50 in the year 2018. However, a significantly minimum number of fruits /plant of 86.50 in year 2018 were recorded in N0P0K0 combination with N0-0 g N /plant, P0-0 g P2O5/plant, and K0-0 g K2O/plant.

The increasing number of fruits depends on other factors such as pollination, flower formation, and fruit set. The balanced nutrient dose has to be maintained soil-crop system, and it also has to take care of all other factors of production and make allowances for residual effects of past fertilizer applications. Too much nitrogen fertilizer results in excess vegetative growth and reduces the reproductive growth, which is otherwise needed to maintain a large yield of fruits (Ganeshamurthy *et al.,* 2015). The balanced dose of fertilizer was presumed to be more effective in controlling physiological parameters.

The NPK interaction effects on average weight of fruit were found to be significant during year 2018 and pooled analysis, but in year 2017 were found to be non-significant. The N1P2K2 combination with N1-250 g N /plant, P2-175 g P2O5/plant, and K2-175 g K2O/plant, which recorded maximum average weight of fruit of (231.73 and 236.25 g) in year 2018 and pooled analysis results, respectively. The N1P2K2 combination was observed to be at par with N1P1K2, having N1-250 g N /plant, P1-125 g P2O5/plant, and K2-175 g K2O/plant. However, significantly minimum average weight of fruit of (185.18 and 185.30 g) in year 2018 and pooled analysis results, respectively, were recorded in N0P0K0 combination with N0-0 g N /plant, P0-0 g P2O5/plant, and K0-0 g K2O/plant.

The balanced nutrient dose has to be maintained soil-crop system, and it also takes care of all other factors of production and makes allowances for residual effects of past fertilizer applications. Too much nitrogen fertilizer results in excess vegetative growth and reduces the reproductive growth, which is otherwise needed to maintain a large yield of fruits (Ganeshamurthy *et al.,* 2015). The intermediate dose of fertilizer was presumed to be more effective in controlling physiological parameters, resulting in increased average weight of fruit.

The NPK interaction effects on rind percentage of fruits were found to be non-significant during both years, as well as in the pooled analysis. The N1P2K2 treatment combinations were recorded minimum rind percentage of 44.46 per cent. The possible reason for the above trend might be due to the higher potassium levels were mainly due to an increase in pulp weight and pulp percentage, which was the consequence of satisfactory activity of the enzymes involved in starch and protein synthesis under adequate supply of K. Similar findings have also been reported by Shinde *et al.* (2009) in mango.

The NPK interaction effects on pulp percentage of fruits were found to be significant during both the years and in pooled results. The N1P2K2 combination with N1-250 g N /plant, P2-175 g P2O5/plant, and K2-175 g K2O/plant, which recorded maximum pulp percentage of fruit of 37.02, 38.45, and 37.23 per cent in both the years and pooled results, respectively. The N1P2K2 combination was observed to be at par with N1P2K1, having N1-250 g N/plant, P2-175 g P2O5/plant, and K1-125 g K2O/plant. However, significantly minimum pulp percentage of fruit of 31.40, 31.95, and 31.67 per cent in both the years and pooled results, respectively, were recorded in N0P0K0 combination with N0-0 g N /plant, P0-0 g P2O5/plant, and K0-0 g K2O/plant.

The increase in pulp weight and pulp percentage of fruits might be on account of the incorporation of organic manures and biofertilizers, and inorganic fertilizers. Organic manures and biofertilizers have a direct role in nitrogen fixation, production of phytohormone-like substances, and increased uptake of nutrients, hence quality improvement reflected in fruit character (Baviskar *et al.,* 2011). These observations are in agreement with the findings of Madhavi *et al.* (2008) in mango, Patel *et al.* (2010) in sapota, and Baviskar *et al.* (2011) in sapota.

The NPK interaction effects on seed percentage of fruit were found to be non-significant during both years as well as in the pooled analysis. Minimum fruit seed percentage was recorded in N1P2K2 treatment combinations, 9.94, 10.73, and 10.33 per cent in both the years' study as well as pooled analysis, and maximum seed percentage was recorded in N0P0K0.

In custard apple, the fruits having a higher number of seeds would not fetch a higher price in the market as it likely to fail to attract the consumer, therefore lesser of number of seeds per fruit is preferred for Table and processing purposes. The possible reason for the above trend might be due to the organic + inorganic fertilizers dose was presumed to be more effective in controlling physiological parameters, resulting in increased fruit weight, pulp percentage, and fruit quality.

The NPK treatment combination effects on fruit set percentage were found to be non-significant during both the years of study as well as in the pooled analysis. Maximum fruit set percentages were recorded in N2P2K1 levels 12.49, 11.35, and 11.97 per cent during 2017, 2018, as well as pooled analysis, respectively, and minimum fruit set percentage was recorded in N0P0K0 level.

A higher level of applied nitrogen and phosphorus recorded the maximum number of flowers per shoot with higher fruit set and less fruit drop than at medium level and no application. A similar trend was also observed with potassium application over control. It is seen that NPK interactions had a non-significant effect on the number of flowers and fruit set percentage. The possible reason for the above trend might be due to the fact that nitrogen is a component of chlorophyll, and potash helps in chlorophyll formation, which regulates the build-up of a proper C: N ratio, which controls the flowering and fruiting of the plant (Baviskar *et al*., 2018). These results also confirm the earlier findings of Kumar *et al*. (2008) and Singh *et al*. (2008) in guava.

The NPK interaction effects on fruit yield per plant were found to be significant during both years and in pooled results. The N1P2K1 combination with N1-250 g N /plant, P2-175 g P2O5/plant, and K1-125 g K2O/plant, which recorded maximum fruit yield per plant of 30.59, 28.93, and 29.76 kg in both years and in pooled results, respectively. The N1P2K1 combination was observed to be at par with N1P2K2, having N1-250 g N /plant, P2-175 g P2O5/plant, and K2-175 g K2O/plant, and N1P1K1 having N1-250 g N /plant, P1-125 g P2O5/plant, and K1-125 g K2O/plant. However, significantly minimum fruit yield per plant of 17.35, 16.02, and 16.69 kg in both the years and in pooled results, respectively, were recorded in N0P0K0 combination with N0-0 g N /plant, P0-0 g P2O5/plant, and K0-0 g K2O/plant.

The intermediate levels of N and K doses resulted in better fruit yield of the pear as compared to lower and higher levels of N and K fertilizers (Gill *et al.,* 2017). The greater number of fruits or fruit yield might be due to the role of nitrogen, phosphorus, and potassium in various metabolic processes, which improved fruit bud differentiation, flower intensity, higher fruit set, and fruit retention (Khan *et al.,* 2018). The present investigations are in confirmation with Baviskar *et al.* (2018) in guava.

The NPK interaction effects on the total soluble solids of fruit were found to be significant during both the year and in pooled results. The N1P1K1 combination with N1-250 g N /plant, P1-125 g P2O5/plant, and K1-125 g K2O/plant, which recorded maximum total soluble solid of fruit of 24.57, 24.93, and 24.75 °Brix in both the years and pooled results, respectively. The N1P1K1 combination was observed to be at par with N1P2K1, having N1-250 g N /plant, P2-175 g P2O5/plant, and K1-125 g K2O/plant. However, significantly minimum total soluble solid of fruit of 19.72, 19.98, and 19.85o Brix in both the years and pooled results, respectively, were recorded in N0P0K0 combination with N0-0 g N /plant, P0-0 g P2O5/plant, and K0-0 g K2O/plant.

The significant improvement in quality of traits like TSS, total sugar, and lowest titrable acidity may be due to the known fact that NPK are capable of supplying adequate macro plant nutrients, which play a major role in quality improvement through desirable enzymatic changes taking place during the growth of the plants. Similar results were reported by Waghmare *et al*. (2018b) in custard apple.

The NPK interaction effects on the acidity of fruit were found to be non-significant during both the years and in pooled results. The N2P2K2 combination with N2-350 g N /plant and P2-175 g P2O5/plant, and K2-175 g K2O/plant recorded the lowest acidity, 0.36 per cent. Acidity of fruit juice showed a declining trend with an increase in levels of N and K fertilizers (Gill *et al.,* 2017). Overall, no significant effect due to any of the nitrogen, phosphorus, and potassium levels combinations on the acidity of fruit juice.

**CONCLUSION**

The application of FYM @ 20 kg + PSB @ 25 g + *Azotobacter* @ 15 g + *Trichoderma* @ 15 g per plant and the treatment N1P2K1 i.e. 250:175:125 g N: P2O5:K2O g/plant dose of inorganic fertilizers with scheduling of nutrient viz., 50 % N, 50 % P2O5 and 50 % K2O as a basal application, 20 % N, 50 % P2O5 and 25 % K2O at fruit set stage, 20% N and 25 % K2O at lemon size fruit stage and 10 % N at one month before harvesting has given highest number of fruits per plant**,** average weight of fruit (g), pulp percentage, fruit set %, yield (kg/plant) and quality of custard apple of Cv. Balanagar.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

**REFERENCE**

Baviskar, M.N., Bharad S.G, Dod V.N and Barne V.G. (2011). Effect of Integrated Nutrient Management on Yield and Quality of Sapota. *Plant Archives.* **11**(2) : 661-663.

Baviskar, M.N., Bharad, S.G. and Nagre, P.K. 2018. Effect of NPK Fertilization on Growth and Yield of guava Under High Density Planting. *Int. J. Chem. Stud .***6**(3) : 359-362.

Beerh, O.P. 1972. Consolidated Project Report on Utilization of Custard apple. *CFTRI. Exp. Station, Hyderabad.*

Ganeshamurthy, A.N., Kalaivanan, D., Selvakumar, G. and Panneerselvam, P. 2015. Nutrient Management in Horticultural Crops. *Indian J. Fertil.* **11**(12) : 30- 42.

Gill, P.P.S., Sharanjit Kaur and Nav Prem Singh. 2017. Effect of N and K Fertilizers on Growth, Yield and Quality of Pear (*Pyrus pyrifolia*). *J. Hort. Sci.* **12**(1) : 49-53*.*

Khan Shahroon, Ashwini Kumar and Jeet Ram Sharma. 2018. Impact of NPK Application on Growth and Yield of Guava cv. Hisar Safeda. *Int. J. Curr. Microbiol. App. Sci.* **7**(7) : 286-290.

Kumar Pankaj, Tiwari, J.P. and Raj Kumar. 2008. Effect of N, P & K on Fruiting, Yield and Fruit Quality in Guava Cv. Pant Prabhat. *J. Hort. Sci.* **3**(1) : 43-47**.**

Madhavi, A., Maheswara Prasad, V. and Girwani, A. 2008. Integrated Nutrient Management in Mango. *The Orissa J. Horti.* **36**(1) : 64-68.

Patel, D.R. and Naik, A.G. 2010. Effect of Pre-harvest Treatment of Organic Manures and Inorganic Fertilizers on Post Harvest Shelf life of Sapota Cv. Kalipatti. *Indian J. Horti.* **67**(3) : 381-386.

Rajput, C.B.S. 1985. Custard apple, In: Fruits of India-Tropical and subtropical, (Ed. T K Bose,) Naya Prakash Pub, Calcutta, India. pp. 479-486.

Ranganna, S. 1997. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. Second Edition, Tata McGraw Hill Publishing Company Ltd. New Delhi, India.

Shinde, A.K., Jadhav, B.B., Dabke, D.J. and Kandalkar, M.P. 2009. Effect of Potassium on Yield and Quality of ‘Alphanso” Mango (*Magifera indiac* L.). *Indian J. Agril. Sci.* **79**(2) : 1007-1009.

Singh, V., Dashora, L.K., Karatha, K.M., Ahalawat, T.R. and Barad, A.V. 2008. Growth, Flowering, Fruiting and Yield of Guava (*Psidium guajava* L.) Cv. Sardar Grown Under High Density Planting System as Influenced by Various Organic and Inorganic Sources. *The Asian J. Hort.* **3**(2): 382-385.

Waghmare, D.B., Bhosale, A.M. and Syed, S.J. 2018b. Effect of Integrated Nutrient Sources on Soil Parameters of Custard apple (*Annona squamosa* L.) Cv. Balanagar. *Inter. J. Che. Stud.* **6**(4): 1422-1425.