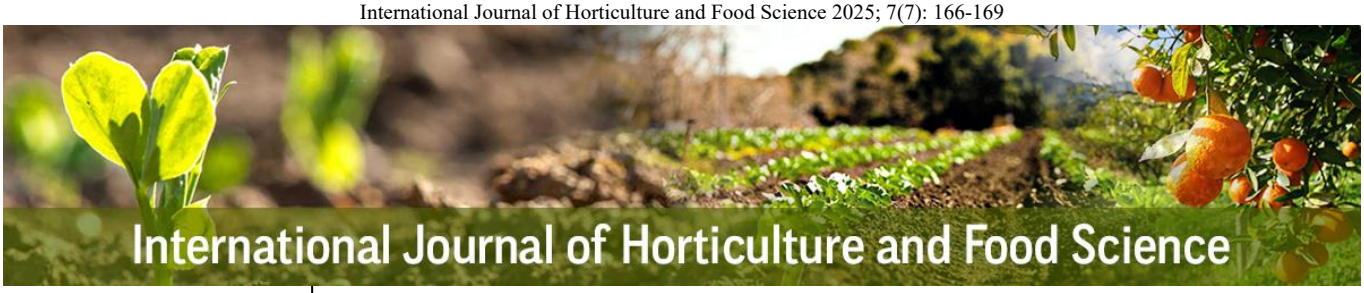


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# Effect of nano urea and fruit thinning on quality of muskmelon (*Cucumis melo* L.)

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**Abstract**
The present study entitled "Effect of nano urea and fruit thinning on quality of muskmelon (*Cucumis melo* L.)" was carried out at Polytechnic in Horticulture, ASPEE College of Horticulture, Navsari Agricultural University, Paria, Valsad, Gujarat (India) during the summer seasons of 2023 and 2024. The experiment was laid out in Randomized Completely Block Design with factorial concept (FRBD), which included sixteen treatment combinations comprising two factors *i.e.* Nano Urea treatments namely, $N_0$: No spray, $N_1$: 2 ml $L^{-1}$, $N_2$: 4 ml $L^{-1}$, $N_3$: 6 ml $L^{-1}$ and fruit thinning treatments *i.e.* $F_0$: No thinning, $F_1$: Maintaining three fruits per vine, $F_2$: Maintaining four fruits per vine and $F_3$: Maintaining five fruits per vine. All the sixteen treatment combinations repeated thrice.
The result revealed that significantly the maximum TSS (13.09 °Brix), total sugar (12.60%) and fruit firmness (12.31 kg $cm^{-2}$) was noted in $N_1$ treatment (Nano Urea spray @ 2 ml $L^{-1}$).
According to the study, maintaining three fruits per vine treatment ($F_1$) recorded significantly the maximum TSS (12.88 °Brix), total sugar (12.06%) and fruit firmness (12.04 kg $cm^{-2}$).

**Keywords:** *Cucumis melo* L., quality of muskmelon, nano urea, fruit thinning

## Introduction
Vegetables are widely recognized as a vital component of a balanced diet due to their role as a major source of essential vitamins, minerals, antioxidants and dietary fibers. Among horticultural crops, vegetables have gained significant importance, not only for their ability to provide higher per-unit economic returns but also for their contribution to nutritional security and health improvement (Anon., 2022) [1].
Among vegetable crops, cucurbit vegetables hold a prominent place due to their significant nutritional and economic value. They form an essential part of a balanced diet, rich in vitamins, minerals and bioactive compounds. Cucurbits, such as cucumber, pumpkin, bottle gourd, bitter gourd, musk melon and watermelon, are excellent sources of hydration, given their high-water content, making them ideal for maintaining proper fluid balance in the body. These vegetables are rich in vitamins like vitamin C, which boosts immunity and promotes healthy skin and vitamin A, which supports vision and enhances the body's natural defenses.
Among them muskmelon (*Cucumis melo* L., 2n=2x=24), commonly referred to as melon, is a highly valued fruit crop that belongs to the family Cucurbitaceae. It is believed to have originated in regions of Africa or the Middle East and its cultivation has spread widely across tropical and subtropical climates. Muskmelon thrives in sandy loam soils with good drainage and requires ample sunlight and moderate irrigation for optimal growth. Muskmelon comes in a wide variety of cultivars with diverse shapes, sizes and flavors. The sweet varieties, such as honeydew and cantaloupe, are particularly popular and consumed fresh, in salads, as juices and desserts. The flesh is either sweet or without a musky aroma and the rind can be smooth (Honeydew), ribbed (European cantaloupe), wrinkled (Casaba melon) or netted (Muskmelon). In North America, the sweet-flesh varieties are often collectively called muskmelon, including the musky netted-rind varieties and the inodorous smooth-rind varieties and cantaloupe usually means the former type.
Chemical fertilizer needs could be substituted by introducing organic sources *viz*., farm yard manure, vermicompost, crop residues and nano fertilizers. In this context, IFFCO has introduced its nanotechnology-based product *i.e.,* liquid Nano-urea fertilizer, which is the alternative to urea fertilizer to meet the nitrogen requirement during growth stages of the crop. Nano-structured fertilizers are characterized by high surface area owing to smaller size

of nano particles (1-100 nm) and have high reactivity, solubility in water and enhance the fertilizer response, crop yield and quality parameters with nutrient use efficiency while minimizing the cost of production and the potential negative effects associated with overdosing which reduces the frequency of the application, thus, contribute towards agricultural sustainability (Lakshman *et al*., 2022) [4].

Fruit thinning is a potential strategy allowing fruits to reach size, shape and mass desired by consumers/market (Ferreira *et al.,* 2018) [3]. To get muskmelon's maximum potential, solar radiation and photo assimilate production for fruit formation must be efficient. Thus, managing the number of fruits per vine is crucial for getting desired size and quality. Fruit thinning is a potential strategy, it diverts larger quantities of photo assimilates towards fruits retained on plant, allowing fruits to reach proper size, shape and mass desired by consumers.

## Materials and Methods

A field experiment entitled "Effect of nano urea and fruit thinning on quality of muskmelon (*Cucumis melo* L.)" was carried out at Polytechnic in Horticulture, ASPEE College of Horticulture, Navsari Agricultural University, Paria, Valsad, Gujarat (India) during the summer seasons of 2023 and 2024 on var. Kundan to assess the effect of nano urea and fruit thinning on quality. The experiment was conducted in Randomized Completely Block Design with factorial concept (FRBD) with three replications. The experiment was arranged with sixteen treatment combinations comprising of 4 levels of Nano Urea treatments namely, $N_0$: No spray, $N_1$: 2 ml $L^{-1}$, $N_2$: 4 ml $L^{-1}$, $N_3$: 6 ml $L^{-1}$ and 4 levels of fruit thinning treatments *i.e.* $F_0$: No thinning, $F_1$: Maintaining three fruits per vine, $F_2$: Maintaining four fruits per vine and $F_3$: Maintaining five fruits per vine.

Five plants of muskmelon from each net plot area were selected randomly in the beginning and tagged with the labels for recording different field observations. Some of the observations for various traits were recorded during the growth period of crop while, some were recorded after harvesting the crop.

## Results

### 1. TSS (°Brix)

#### Effect of nano urea

Based on the data presented in Table 1, it was evident that Nano Urea treatments had a significant impact on TSS during both the years (2023 and 2024) studied and in pooled analysis. The Nano Urea spray @ 2 ml $L^{-1}$ treatment ($N_1$) resulted in the maximum TSS of 12.88 °Brix in 2023, 13.31 °Brix in 2024 and 13.09 °Brix in the pooled analysis. This performance was on par with Nano Urea spray @ 4 ml $L^{-1}$ treatment ($N_2$) in the respective years and pooled analysis. The Nano Urea spray @ 6 ml $L^{-1}$ treatment ($N_3$) had the minimum TSS of 10.99 °Brix in 2023, 11.32 °Brix in 2024 and 11.16 °Brix in the pooled analysis.

#### Effect of fruit thinning

The data (Table 1) indicated that there was significant difference in TSS due to fruit thinning treatments during 2023, 2024 and pooled analysis. Superior TSS was observed with maintaining three fruits per vine treatment ($F_1$) in both years and pooled analysis (12.70, 13.05 and 12.88 °Brix, respectively). However, the inferior TSS of was recorded in no thinning treatment ($F_0$) of 11.46 °Brix in 2023, 11.89 °Brix in 2024 and 11.68 °Brix in pooled analysis.

**Table 1:** Effect of nano urea and fruit thinning on TSS of muskmelon

| Treatments | TSS (°Brix) | | |
|---|---|---|---|
| | 2023 | 2024 | Pooled |
| Nano Urea (N) | | | |
| $N_0$: No spray | 12.22 | 12.60 | 12.41 |
| $N_1$: 2 ml $l^{-1}$ | 12.88 | 13.31 | 13.09 |
| $N_2$: 4 ml $l^{-1}$ | 12.67 | 13.07 | 12.87 |
| $N_3$: 6 ml $l^{-1}$ | 10.99 | 11.32 | 11.16 |
| S.Em. ± | 0.31 | 0.26 | 0.20 |
| CD at 5% | 0.89 | 0.74 | 0.57 |
| **Fruit Thinning (F)** | | | |
| $F_0$: No thinning | 11.46 | 11.89 | 11.68 |
| $F_1$: Maintaining three fruits per vine | 12.70 | 13.05 | 12.88 |
| $F_2$: Maintaining four fruits per vine | 12.39 | 12.77 | 12.58 |
| $F_3$: Maintaining five fruits per vine | 12.21 | 12.59 | 12.40 |
| S.Em. ± | 0.31 | 0.26 | 0.20 |
| CD at 5% | 0.89 | 0.74 | 0.57 |
| **Interaction effect (N×F)** | | | |
| S.Em. ± | 0.61 | 0.51 | 0.40 |
| CD at 5% | NS | NS | NS |
| CV % | 8.74 | 7.05 | 7.91 |
| Pooled interaction | | | |
| Source | Y×N | Y×F | Y×N×F |
| S.Em. ± | 0.28 | 0.28 | 0.56 |
| CD at 5% | NS | NS | NS |

#### Interaction effect

The data present in Table 1 related to TSS was clearly indicated that interactions between Nano Urea, fruit thinning and year had non-significant effect during individual years as well as in pooled analysis.

### 2. Total sugar (%)

#### Effect of nano urea

Based on the data presented in Table 2, it was evident that Nano Urea treatments had a significant impact on total sugar (%) during both the years (2023 and 2024) studied and in pooled analysis. The Nano Urea spray @ 2 ml $L^{-1}$ treatment ($N_1$) resulted in the maximum total sugar (%) of 12.28% in 2023, 12.93% in 2024 and 12.60% in the pooled analysis. This performance was on par with Nano Urea spray @ 4 ml $L^{-1}$ treatment ($N_2$) in the respective years and pooled analysis. The Nano Urea spray @ 6 ml $L^{-1}$ treatment ($N_3$) had the minimum total sugar (%) of 8.38% in 2023, 9.41% in 2024 and 8.89% in the pooled analysis.

#### Effect of fruit thinning

The data (Table 2) indicated that there was significant difference in total sugar (%) due to fruit thinning treatments during 2023, 2024 and pooled analysis. Superior total sugar (%) was observed with maintaining three fruits per vine treatment ($F_1$) in both years and pooled analysis (11.72, 12.39 and 12.06%, respectively). However, the inferior total sugar (%) of was recorded in no thinning treatment ($F_0$) of 9.48% in 2023, 10.42% in 2024 and 9.95% in pooled analysis.

#### Interaction effect

The data present in Table 2 related to total sugar (%) was clearly indicated that interactions between Nano Urea, fruit thinning and year had non-significant effect during individual years as well as in pooled analysis.

### 3. Fruit firmness (kg cm$^{-2}$)

**Effect of nano urea**

Based on the data presented in Table 3, it was evident that Nano Urea treatments had a significant impact on fruit firmness (kg cm$^{-2}$) during both the years (2023 and 2024) studied and in pooled analysis. The Nano Urea spray @ 2 ml L$^{-1}$ treatment ($N_1$) resulted in the maximum fruit firmness of 11.86 in 2023, 12.76 in 2024 and 12.31 kg cm$^{-2}$ in the pooled analysis. This performance was on par with Nano Urea spray @ 4 ml L$^{-1}$ treatment ($N_2$) in the respective years and pooled analysis. The Nano Urea spray @ 6 ml L$^{-1}$ treatment ($N_3$) had the minimum fruit firmness of 10.12 in 2023, 10.40 in 2024 and 10.26 kg cm$^{-2}$ in the pooled analysis.

**Effect of fruit thinning**

The data (Table 4.34) indicated that there was significant difference in fruit firmness (kg cm$^{-2}$) due to fruit thinning treatments during 2023, 2024 and pooled analysis. Superior fruit firmness (kg cm$^{-2}$) was observed with maintaining three fruits per vine treatment ($F_1$) in both years and pooled analysis (11.61, 12.47 and 12.04 kg cm$^{-2}$, respectively). However, the inferior fruit firmness of was recorded in no thinning treatment ($F_0$) of 10.60 in 2023, 11.03 in 2024 and 10.82 kg cm$^{-2}$ in pooled analysis.

**Interaction effect**

The data present in Table 4.35 related to fruit firmness (kg cm$^{-2}$) was clearly indicated that interactions between Nano Urea, fruit thinning and year had non-significant effect during individual years as well as in pooled analysis.

**Table 2:** Effect of nano urea and fruit thinning on total sugar (%) of muskmelon

| Treatments | Total sugar (%) | | |
|---|---|---|---|
| | 2023 | 2024 | Pooled |
| **Nano urea (N)** | | | |
| $N_0$: No spray | 10.94 | 11.66 | 11.30 |
| $N_1$: 2 ml l$^{-1}$ | 12.28 | 12.93 | 12.60 |
| $N_2$: 4 ml l$^{-1}$ | 11.80 | 12.46 | 12.13 |
| $N_3$: 6 ml l$^{-1}$ | 8.38 | 9.41 | 8.89 |
| S.Em. ± | 0.26 | 0.27 | 0.19 |
| CD at 5% | 0.76 | 0.78 | 0.53 |
| **Fruit thinning (F)** | | | |
| $F_0$: No Thinning | 9.48 | 10.42 | 9.95 |
| $F_1$: Maintaining three fruits per vine | 11.72 | 12.39 | 12.06 |
| $F_2$: Maintaining four fruits per vine | 11.21 | 11.98 | 11.59 |
| $F_3$: Maintaining five fruits per vine | 10.98 | 11.66 | 11.32 |
| S.Em. ± | 0.26 | 0.27 | 0.19 |
| CD at 5% | 0.76 | 0.78 | 0.53 |
| **Interaction effect (N×F)** | | | |
| S.Em. ± | 0.53 | 0.54 | 0.38 |
| CD at 5% | NS | NS | NS |
| CV % | 8.42 | 8.08 | 8.24 |
| **Pooled interaction** | | | |
| Source | **Y×N** | **Y×F** | **Y×N×F** |
| S.Em. ± | 0.27 | 0.27 | 0.54 |
| CD at 5% | NS | NS | NS |

**Table 3:** Effect of nano urea and fruit thinning on fruit firmness (kg cm$^{-2}$) of muskmelon

| Treatments | Fruit firmness (kg cm$^{-2}$) | | |
|---|---|---|---|
| | 2023 | 2024 | Pooled |
| **Nano urea (N)** | | | |
| $N_0$: No spray | 11.21 | 11.91 | 11.56 |
| $N_1$: 2 ml L$^{-1}$ | 11.86 | 12.76 | 12.31 |
| $N_2$: 4 ml L$^{-1}$ | 11.67 | 12.47 | 12.07 |
| $N_3$: 6 ml L$^{-1}$ | 10.12 | 10.40 | 10.26 |
| S.Em. ± | 0.18 | 0.29 | 0.17 |
| CD at 5% | 0.53 | 0.83 | 0.48 |
| **Fruit Thinning (F)** | | | |
| $F_0$: No thinning | 10.60 | 11.03 | 10.82 |
| $F_1$: Maintaining three fruits per vine | 11.61 | 12.47 | 12.04 |
| $F_2$: Maintaining four fruits per vine | 11.40 | 12.11 | 11.76 |
| $F_3$: Maintaining five fruits per vine | 11.25 | 11.92 | 11.59 |
| S.Em. ± | 0.18 | 0.29 | 0.17 |
| CD at 5% | 0.53 | 0.83 | 0.48 |
| **Interaction effect (N×F)** | | | |
| S.Em. ± | 0.37 | 0.57 | 0.34 |
| CD at 5% | NS | NS | NS |
| CV % | 5.66 | 8.38 | 7.23 |
| **Pooled interaction** | | | |
| Source | Y×N | Y×F | Y×N×F |
| S.Em. ± | 0.24 | 0.24 | 0.48 |
| CD at 5% | NS | NS | NS |

## Discussion

Maximum TSS, total sugar (%) and fruit firmness (kg $cm^{-2}$) was recorded in $N_1$ treatment (Nano Urea spray @ 2 ml $L^{-1}$) it might be due to This boost's chlorophyll content and photosynthetic efficiency, increasing the production and translocation of carbohydrates to developing fruits. These carbohydrates are stored as sugars and soluble solids, raising TSS and total sugar percentage (Suman *et al*., 2021) [9].

The $F_1$ treatment (maintaining three fruits per vine) recorded the highest values for TSS, total sugar (%) and fruit firmness (kg $cm^{-2}$). This may be attributed to improved light penetration and air circulation around the fruits under reduced fruit load, which enhances the microclimate around the plant canopy. Improved light availability promotes higher rates of photosynthesis, thereby increasing the accumulation of sugars in the fruit (Lins *et al.,* 2013) [6]. These findings are in close agreement with the observations reported by Campos *et al*., (2019) [2], Presman *et al*., (2020) [7] and Sawant (2021) [8] in muskmelon, as well as by Lins and Ehret (1991) [5] in cucumber.

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