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RESEARCH ARTICLE

# EFFECT OF VARIETIES AND FERTILIZER PRACTICES ON YIELD AND QUALITY OF *Capsicum chinense* Jacq UNDER PROTECTED CULTURE

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**Abstract**

***Capsicum chinense*** **Jacq, belongs to the family Solanaceae and is native to Central and South America. It has been widely cultivated in Sri Lanka as a commercial crop. This study was undertaken to identify the most suitable combination of fertilizer and *C. chinense* variety to enhance growth, yield, and fruit quality, aiming to optimize *C. chinense* production, reduce input wastage, and increase profitability for farmers. This experiment was conducted at the Regional Agriculture Research and Development Center, Bandarawela using a Completely Randomized Block Design with a two-factor factorial arrangement, four replications, each with six plants. Two factors were fertilizers: Albert's solution and Kodimix® and five *C. chinense* varieties: Piquante, Hot dragon, Dark green, Light green, and M1HP1. Ten treatment combinations were tested, pairing each variety with one of the two fertilizers for growth yield and quality parameters. The results indicated that the treatment effect was statistically significant (P<0.05) for most measured parameters. The results of the present investigation indicated that, among the treatments, Piquante × Kodimix® yielded the highest per-plant yield (0.92 kg) and was therefore considered the best treatment.**

Keywords: Chilli, Genotype, Growth, Nutrients, Pungency

## INTRODUCTION

*Capsicum chinense* Jacq, also called Carolina Reaper, Habanero, and Habanero Pepper. It is a genus of plants belonging to the family Solanaceae and native to Central and South America. The genus *Capsicum* comprises over 200 species, among which five common cultivated species include *Capsicum annuum* L., *Capsicum frutescens* L., *Capsicum chinense* Jacq., *Capsicum baccatum* L, and *Capsicum pubescens* L. The *C. chinense* species is grouped under the *C. annuum* complex due to similarities in flower characteristics (Balkaya & Tas , 2021).

Under optimal conditions, *C. chinense* grows to a height of 50–100 cm or more. The stem is green with anthocyanin pigmentation visible at the nodes. Its leaves are ovate with a distinctive crinkled appearance. The plant exhibits a pendant growth habit, with creamy white corollas often tinged with light green. It has a clustered flowering habit, typically producing 2–3 flowers per node, although at maturity, there are rarely more than two fruits per node. The anthers are blue, and the filaments are purple. The elongated fruits measure 5–7 cm in length and 2.5–3.0 cm in diameter, with an undulating surface. The fruit colour transitions from light green to green and eventually to bright red or bright orange upon ripening (Sarwa, *et al*., 2012).

*C. chinense* seeds are commonly used for nursery preparation. For optimal growth of seedlings and plants, sterilized, fertile sandy loam soil enriched with organic fertilizers like compost is essential. The seeds typically germinate within a week after sowing them in the nursery. Seedlings require nursery care for approximately 21– 25 days, and

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transplantation is recommended around 30 days after germination. Transplanting stage seedlings typically have 6–7 fully developed leaves and reach a height of about 15.24 cm (Kannangara, 2019).

Flowering and pods emerging usually begin about 2 months after transplanting. *C. chinense* is a cool-season crop, making it challenging to achieve higher yields and desired fruit quality on a year-round basis under open-field conditions in most tropical and subtropical climates. However, utilizing protected structures such as greenhouses, shade nets, and polyhouses enables off-season cultivation, producing high-quality fruits. Its medium height, lateral spreading growth habit, and ability to set fruit at comparatively lower temperatures make it particularly well-suited for greenhouse cultivation.

*C. chinense* a high-valued chilli for its pungency and flavour, is primarily cultivated under protected structures due to its sensitivity to outside environments such as pests and diseases (Ralebhat, *et al*., 2023). However, maximizing its yield and quality within protected environments presents a challenge in the selection of optimized and balanced fertilizer and the selection of high-performing varieties that have high quality. Previous studies show a lack of information regarding *C. chinense* cultivation under protected culture; therefore, this research primarily aimed to address the lack of a comprehensive understanding of the combined effects of varietal selection and fertilizer practices on *C. chinense* production in protected cultivation.

For farmers and the food industry, *C. chinense* has substantial economic value. Its production can be optimized to ensure a steady supply and possibly increase farmers' profits. Individual factors like organic or chemical fertilizer, genotype, or chemical parameters are frequently the focus of current research on *C. chinense* production in protected environments. There is a lack of thorough knowledge regarding the interactions between these variables. Therefore, this study aims to find combinations that maximize yield while preserving or enhancing fruit quality by analyzing various cultivars and fertilization practices. The results can offer important information for choosing a balanced and optimized fertilizer, as well as the appropriate *C. chinense* variety or varieties to match with such fertilizer for protected cultivation. Improved management techniques in protected areas, higher profitability, and more effective resource allocation can result.

## MATERIAL AND METHODS

### Study site

The experiment was conducted at the Regional Agriculture Research and Development Centre (RARDC), Kahagolla, Bandarawela, Sri Lanka. From July to December in 2024. It belongs to the Up-Country Intermediate Zone (UCIZ). The annual average rainfall of the area ranges from 1200 to 1600 mm. The annual maximum temperature ranges from 23.4 to 27.4 ℃, while the lowest ranges from 13.9 to 16.8 ℃ (Department of Agriculture, 2024).

### Materials and methods

Five *C. chinense* varieties were used in this study: Piquante, Hot Dragon, Dark Green, Light Green, and M1HP1. Two types of fertilizers, Albert's solution and Kodimix®, were applied as nutrient sources. The nutrient composition of these fertilizers is presented in Table 1.

**Table 1: Nutrient compositions of Albert's solution and Kodimix® fertilizers**

| Nutrients | Weight/Weight % (Wt/Wt) | |
|---|---|---|
| | Kodimix® | Albert's solution |
| Nitrogen (Total Nitrogen) | 10.83% | 10.5% |
| Phosphate ($P_2O_5$) | 4.14% | 9.1% |
| Potassium ($K_2O$) | 13.247% | 16.4% |
| Magnesium (Mg) | 0.9% | 0.86% |
| Calcium (Ca) | 10.26% | 9.5% |
| Sulphur (S) | 2.846% | 1.00% |
| Zinc (Zn) | 0.144% | 0.014% |
| Boron (B) | 0.0085% | 0.003% |
| Copper (Cu) | 0.0065% | 0.0004% |
| Iron (Fe) | 0.06% | 0.065% |
| Manganese (Mn) | 0.012% | 0.012% |

The experimental materials and instruments included a digital balance, electrical conductivity (EC) meter, pH meter, polythene bags, RHS colour chart, plant labels, and a SPAD meter.

**Nursery preparation and study settings**

Seeds of five *C. chinense* varieties (Piquante, Hot dragon, Dark green, Light green, M1HP1) were sown in plastic trays and transplanted after 25 days, as recommended by (Kannangara, 2019). A planting medium composed of burnt rice husk and coir dust in a 1:1 ratio on a volume basis. Transplants were placed in 16x16 cm poly bags, arranged in a zigzag pattern. There were 4 replicates, each containing 6 plants. Plants were arranged with 100 cm between rows and 75cm between plants in a 2000 $ft^2$ polytunnel.

During the study period, fertilization, weeding, and application of pesticides were performed manually following the conventional recommendations and the same for all the treatments.

**Application of fertilizers**

Both Kodimix® and Albert's solution fertilizers were applied one day after transplanting. The application schedule was as follows.

First Week: 0.25 grams per 250 ml per plant.
Second and Third Weeks: 0.5 grams per 500 ml per plant.
Fourth and Fifth Weeks: 1.00 gram per 750 ml per plant.
Sixth Week Onwards: 1.50 to 2.00 grams per 1l per plant.

**Data collection parameters**

Plant media testing

The pH and EC values of planting media were obtained using a pH meter and EC meter, using 10 g of media and 50 ml of distilled water (The University of Western Australia , 2009).

Growth parameters

Height was measured from the base to the topmost growth point at 11 weeks after transplanting. The length between the first and second internodes was measured in centimeters using a ruler, and the angles of the first and second branches were measured with a protractor. SPAD readings were taken from leaves at the same maturity stage across upper, middle, and lower sections.

Yield parameters

The fruits of the selected plants from each replicate were collected into labelled polythene bags, then weighed and divided by the number of plants to calculate the yield per plant. The yield per plant was summed to obtain the total yield per plant over six harvests. The number of fruits was counted on selected plants in a replicate and divided by the number of selected plants to obtain the number of fruits per plant. The yield per plant was divided by the number of fruits per plant to obtain the average fruit weight. The fruit length and width were measured using an automated vernier caliper.

Quality parameters

The skin color of the fruits was observed for each variety using the Royal Horticultural Society (RHS) color chart (sixth edition). A taste panel was conducted to evaluate the flavour, heat, aroma, and overall acceptance of "*Lunu-miris*" (a paste made with onion and chilli) prepared from the fruits of five varieties using a 5-point hedonic scale. The Total Soluble Solids (TSS) percentage was measured in degrees Brix using a hand refractometer. For this, *C. chinense* fruits were blended using a mortar and pestle, and the juice was extracted by pressing the blended fruit. The juice was then filtered using Whatman No. 1 filter paper, and a drop of the filtered juice was placed on the refractometer to measure the TSS content (Ralebhat, *et al*., 2023). The Titratable Acidity (TA) was determined by using Equation 1 by neutralizing 10mL of juice with 0.1N NaOH, using 1 per cent phenolphthalein as an indicator. The acidity was calculated based on the methodology proposed by the AOAC (1990) by using the equation below and expressed as a percentage of citric acid (Ralebhat, *et al*., 2023).

$$TA\,\% = \frac{V \times N \times 64.04\ g}{10mL} \times 100 \qquad \text{(Eq. 1)}$$

Where; TA: Titratable Acidity, V: Volume of NaOH, and N: Normality of NaOH

**Experimental design**

To evaluate the performance of five *C. chinense* varieties with two types of fertilizers, the study was laid out in a completely randomized block design with 10 treatments and 4 replicates. Table 2 shows the treatments scheduled for the *C. chinense* pot experiment.

**Table 2: Treatment details for experiment**

| Treatment | Treatment details |
|---|---|
| **T1** | Piquante x Kodimix® |
| **T2** | Hot dragon x Kodimix® |
| **T3** | Dark green x Kodimix® |
| **T4** | Light green x Kodimix® |
| **T5** | M1HP1 x Kodimix® |
| **T6** | Piquante x Albert's solution |
| **T7** | Hot dragon x Albert's solution |
| **T8** | Dark green x Albert's solution |
| **T9** | Light green x Albert's solution |
| **T10** | M1HP1 x Albert's solution |

**Data analysis**

Parametric tests were analyzed using ANOVA. The effects of different fertilizers on a variety were tested using DMRT. Data were analyzed statistically using the newest version of Statistical Analysis Software SAS version 9.4 (SAS Institute Inc., Cary, NC, USA) with a 95% confidence level. Sensory data were evaluated by the Friedman test. Linear correlation analysis was performed to determine the strength of the relationships between measured growth and yield parameters.

## RESULTS AND DISCUSSION

**Plant media testing**

The pH values ranged from 6.27 to 6.35 in the planting media for different *C. chinense* varieties, indicating that all the media were slightly acidic (Figure 1). Among the samples, the media of M1HP1 has the highest pH of 6.35, while the media of Piquante, Hot Dragon, and Light Green share the same pH of 6.27, with Dark Green slightly higher at 6.32. The EC values show greater variation. The media Hot Dragon has the highest EC (0.74 mS/cm), suggesting it contains more nutrients or salts, while M1HP1 has the lowest EC (0.37 mS/cm), indicating fewer nutrients. The remaining media, including Piquante, Dark Green, and Light Green media, have intermediate EC values ranging from 0.42 to 0.59 mS/cm. Overall, the media exhibit slight differences in acidity and significant variation in EC values. Thennakoon *et al*. (2020) stated that chilli can grow successfully at pH 5.5–7.0. Therefore, the pH of the planting media was within the preferred range for chilli.

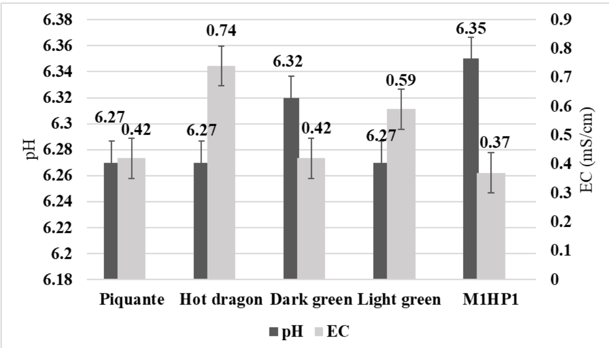


**Figure 1 : Initial pH and EC values of planting media**

**Growth parameters**

The means of the growth parameters under different treatments are presented in Table 3.

**Table 3: Means of growth parameters of different treatments**

| Treatment | Plant height (cm) | Internode length (cm) | Branching angle ($^o$) | Chlorophyll content |
|---|---|---|---|---|
| **T1** | 75.30 ± 4.44$^{cd}$ | 6.74 ± 0.36$^{b}$ | 72.18 ± 4.14$^{a}$ | 39.47 ± 2.98$^{ed}$ |
| **T2** | 100.72 ± 4.35$^{a}$ | 8.43 ± 0.50$^{a}$ | 63.87 ± 5.57$^{cd}$ | 44.67 ± 4.29$^{a}$ |
| **T3** | 84.22 ± 2.98$^{b}$ | 7.11 ± 0.27$^{b}$ | 65.68 ± 2.74$^{bc}$ | 43.72 ± 2.41$^{ab}$ |
| **T4** | 71.47 ± 2.77$^{d}$ | 4.68 ± 0.15$^{d}$ | 64.66 ± 2.79$^{bc}$ | 39.95 ± 2.29$^{cd}$ |
| **T5** | 78.22 ± 3.21$^{bcd}$ | 5.00 ± 0.21$^{cd}$ | 59.41 ± 1.76$^{de}$ | 35.35 ± 1.37$^{f}$ |
| **T6** | 76.72 ± 4.63$^{bcd}$ | 6.69 ± 0.43$^{b}$ | 68.93 ± 2.02$^{ab}$ | 39.42 ± 1.15$^{ed}$ |
| **T7** | 104.92 ± 9.93$^{a}$ | 7.95 ± 0.72$^{a}$ | 57.56 ± 2.50$^{e}$ | 43.82 ± 2.05$^{ab}$ |
| **T8** | 81.55 ± 4.57$^{bc}$ | 6.80 ± 0.39$^{b}$ | 61.01 ± 1.77$^{cde}$ | 42.05 ± 1.06$^{bc}$ |
| **T9** | 74.55 ± 2.80$^{cd}$ | 4.49 ± 0.14$^{d}$ | 56.86 ± 2.13$^{e}$ | 39.65 ± 0.44$^{d}$ |
| **T10** | 81.47 ± 7.73$^{cb}$ | 5.46 ± 0.64$^{c}$ | 56.67 ± 2.69$^{e}$ | 37.20 ± 1.35$^{ef}$ |

The same letters within columns are not statistically different by the DUNCAN at P=0.05

Plant height (cm)

The highest value was observed from T7 (104.92 cm), while T4 recorded the lowest value (71.47 cm) (Table 3). Previous findings indicated that the increase in plant height might be due to rapid nitrogen uptake (Ralebhat *et al*., 2023). Sarker *et al*., (2018) also showed that the variation in the composition of nutrients resulted in variations in heights in *C. chinense*.

Branching angle ($^o$)

The branching angles ranged from 56.67$^o$ to 72.18$^o$ (Table 3). However, the highest branching angle was observed in T1 (72.18$^o$), followed by T6 (68.93$^o$). The lowest branching angle occurred in T10 (56.67$^o$). These differences might be possible due to genotypic variations between different *C. chinense* varieties, which may exhibit a wide range of canopy spreading (Gurung, *et al*., 2020).

Chlorophyll content (SPAD)

SPAD readings of the experiment ranged from 44.67 to 35.35 (Table 3). The highest value was for T2 (44.67); however, the lowest was for T5 (35.35). The present findings are in line with (Chowdhury, *et al*., 2017) who reported that significant variation in chlorophyll content (SPAD values) with different chilli germplasms at the mature stage.

Internode length (cm)

The results regarding internode lengths of different treatments were statistically significant (Table 3). The T2 (8.43 cm) value was the highest and did not differ significantly from T7 (7.95 cm). The lowest value was observed in T9 (4.49 cm). Also, the *C. chinense* database of Wageningen University distinguishes between *C. chinense* varieties with short and long internode lengths (Wageningen University and Research, 2012).

**Yield parameters**

Yield per plant (kg)

The results obtained for yield per plant showed significant ($P < 0.05$) differences among treatments, as presented in Table 4. The obtained yield per plant from all treatments ranged from 0.54 kg to 0.92 kg. The highest yield (0.92 kg) was obtained from T1, while the lowest (0.54 kg) was recorded from T8. The plant yield of chilli can vary with the genotype and composition of the nutrients used as fertilizer (Awasthi, *et al*., 2021).

**Table 4. Means of yield parameters of different treatments**

| Treatment | Yield per plant (Kg) | Fruit count | Fruit weight (g) | Fruit width (cm) | Fruit length (cm) |
|---|---|---|---|---|---|
| **T1** | $0.92 \pm 0.04^{a}$ | $18.21 \pm 1.88^{cd}$ | $9.56 \pm 0.46^{a}$ | $3.27 \pm 0.24^{a}$ | $4.58 \pm 0.21^{bcd}$ |
| **T2** | $0.88 \pm 0.09^{ab}$ | $23.14 \pm 2.81^{b}$ | $7.17 \pm 0.49^{c}$ | $2.75 \pm 0.11^{c}$ | $4.47 \pm 0.23^{bcd}$ |
| **T3** | $0.66 \pm 0.09^{d}$ | $15.24 \pm 2.00^{dfe}$ | $7.67 \pm 0.57^{c}$ | $2.75 \pm 0.11^{c}$ | $3.99 \pm 0.19^{d}$ |
| **T4** | $0.73 \pm 0.06^{cd}$ | $14.46 \pm 1.06^{gfe}$ | $9.30 \pm 0.30^{a}$ | $2.86 \pm 0.43^{bc}$ | $5.36 \pm 0.65^{ab}$ |
| **T5** | $0.67 \pm 0.01^{d}$ | $28.41 \pm 3.78^{a}$ | $5.32 \pm 0.65^{d}$ | $1.75 \pm 0.26^{d}$ | $4.56 \pm 0.27^{bcd}$ |
| **T6** | $0.81 \pm 0.09^{abc}$ | $15.87 \pm 1.48^{cde}$ | $9.82 \pm 0.43^{a}$ | $2.84 \pm 0.32^{bc}$ | $4.53 \pm 0.76^{bcd}$ |
| **T7** | $0.74 \pm 0.06^{cd}$ | $18.49 \pm 2.57^{c}$ | $7.74 \pm 0.58^{c}$ | $2.49 \pm 0.09^{c}$ | $4.27 \pm 0.40^{cd}$ |
| **T8** | $0.54 \pm 0.02^{e}$ | $11.88 \pm 0.92^{g}$ | $8.41 \pm 0.77^{b}$ | $3.29 \pm 0.27^{a}$ | $3.85 \pm 0.24^{d}$ |
| **T9** | $0.67 \pm 0.06^{d}$ | $12.64 \pm 1.22^{gf}$ | $9.40 \pm 0.24^{a}$ | $3.18 \pm 0.23^{ab}$ | $5.93 \pm 0.60^{a}$ |
| **T10** | $0.77 \pm 0.04^{bcd}$ | $30.17 \pm 3.25^{a}$ | $5.47 \pm 0.18^{d}$ | $1.87 \pm 0.23^{d}$ | $4.95 \pm 1.08^{bc}$ |

The same letters within columns are not statistically different by the DUNCAN at P=0.05

Number of fruits per plant and fruit weight (g)

T10 recorded the highest fruit count (30.17 fruits), followed by T5 (28.41 fruits). The lowest fruit count (11.88 fruits) was observed in T8 (Table 4). Fruit weights across treatments ranged from 5.32 g to 9.82 g, as shown in Table 4. The highest fruit weight (9.82 g) was obtained by T6 however it’s not significantly different from T1 (9.56 g), T4 (9.30 g) and T9 (9.40 g), while the lowest (5.32 g) was recorded in T5. The findings are in line with the previous studies of Sarker, *et al*., (2018); Karak, *et al*., (2015); Ralebhat, *et al*., (2023) who stated that differences in fruit weight may be due to variations in root proliferation, variations in uptake of nutrients and water, variations plant growth, photosynthesis and food accumulation of different genotypes.

Fruit width and fruit length (cm)

Means of yield parameters differed significantly (P < 0.05) among treatments (Table 4). The maximum fruit width (3.29 cm) was obtained from T8, which is not significantly different from that of T1 (3.27 cm) and T9 (3.18 cm). Minimum fruit width was observed in T5 (1.75 cm).

The results, according to fruit length, are presented in Table 4 and range from 3.85 cm to 5.93 cm. The highest fruit length (5.93 cm) was observed at T9 and was significantly different from the others. T8 showed the lowest fruit length (3.85 cm). (Karak, *et al*., 2015) also observed variations in fruit width and fruit length among different cultivars, while (Sarker, *et al*., 2018) observed variations in terms of fruit width and fruit length among different nutrient compositions.

**Quality parameters**

Titratable acid (TA, % citric acid)

Citric acidity percentage within different treatments was found to be significant. It ranged from 0.161% to 0.226%. According to Table 5, the highest value (0.226%) was observed in T6, and the lowest value (0.161%) was observed in T5. Some *Capsicum spp.* hybrids have been reported to have Titratable acid (TA) values of around 0.32% to 0.45%. TA usually decreases as fruit ripens because organic acids are metabolized during maturation (Grajales & Alvarez, 2019). Also, according to (Zhang, *et al*., 2023), citric acid is the primary organic acid in chili peppers, constituting 39.10–63.55% of total organic acids.

**Table 5: Means of quality parameters of different treatments**

| Treatment | Titratable acid (TA, % citric acid) | Total soluble solid content (Bx°) |
|---|---|---|
| **T1** | 0.219 ± 0.005[a] | 4.20 ± 0.20[b] |
| **T2** | 0.217 ± 0.009[a] | 4.27 ± 0.20[b] |
| **T3** | 0.220 ± 0.014[a] | 4.77 ± 0.35[a] |
| **T4** | 0.217 ± 0.008[a] | 4.32 ± 0.37[b] |
| **T5** | 0.161 ± 0.009[b] | 4.92 ± 0.37[a] |
| **T6** | 0.226 ± 0.023[a] | 4.30 ± 0.09[b] |
| **T7** | 0.223 ± 0.012[a] | 4.32 ± 0.17[b] |
| **T8** | 0.216 ± 0.009[a] | 4.80 ± 0.20[a] |
| **T9** | 0.213 ± 0.001[a] | 4.17 ± 0.26[b] |
| **T10** | 0.164 ± 0.005[b] | 4.92 ± 0.28[a] |

The same letters within columns are not statistically different by the DUNCAN at P=0.05

Sensory evaluation

"*Lunu miris*" (a paste with onion and chilli) out of five varieties was evaluated for heat, flavour, smell, and overall acceptance (Figure 2). The results of the sensory evaluation of "*Lunu miris*" of each variety are given in Table 6. Based on heat, flavour, smell, and overall acceptance, Piquante, Hot Dragon, and dark green had the highest medians. On the other hand, the M1HP1 variety showed the lowest scores for heat, flavour, smell, and overall acceptance. (Zhang, *et al*., 2023) showed that genetic variability between pepper varieties can lead to significant variation in pungency.

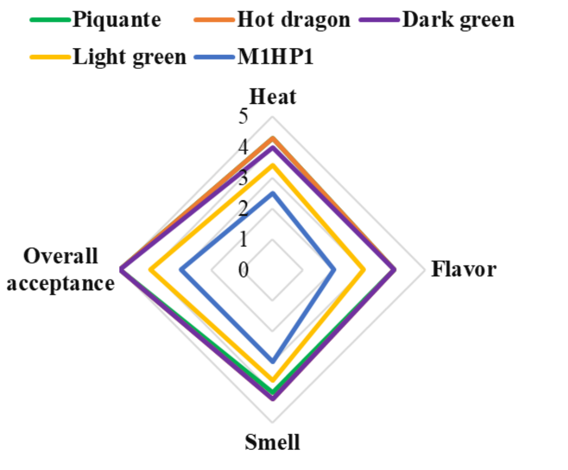


**Figure 2: Radar diagram indicating the results of the Friedman test for sensory evaluation**

**Table 6. Friedman test results for sensory evaluation of different varieties**

| Variety | Heat | Flavor | Smell | Overall acceptance |
|---|---|---|---|---|
| **Piquante** | 4.3 | 4 | 4 | 5 |
| **Hot dragon** | 4.3 | 4 | 4.2 | 5 |
| **Dark green** | 4 | 4 | 4.2 | 5 |
| **Light green** | 3.4 | 3 | 3.6 | 4 |
| **M1HP1** | 2.5 | 2 | 3 | 3 |

Fruit color

Fruit colors of different varieties are found to be significant according to the Royal Horticultural Society (RHS) color chart. Variety Piquante belongs to Yellow – Green group (145) – B, variety Hot dragon belongs to Green group (143) – A, variety Dark green belongs to Green group (143) – C, variety Light green belongs to Yellow – Green group (145) – A and variety M1HP1 belongs to Green group (143). The colors of *C. chinense* fruits range from light green to green within different cultivars (Sarwa *et al*., 2012). The observed color diversity is not only a result of genetic variation but is also influenced by environmental conditions and cultivation practices (Mulathagedara, *et al*., 2021).

Total soluble solid content (TSS, Brix value)

According to TSS results, there is a significant difference between treatments as shown in Table 5. The highest value (4.92 Bx$^{o}$) was obtained from T10, while the lowest value (4.17 Bx$^{o}$) was observed from T9. Among 55 Amazonian *C. chinense* accessions, significant variability in TSS was found, which confirms substantial genetic diversity affecting soluble solids content (Santana, *et al*., 2020). TSS values around 4.7 to 5.67 Bx$^{o}$ have been reported in some chilli fruits, with variations linked to fruit maturity and seasonality (Zerega, 2017).

## CONCLUSION

According to yield parameters, T1 (Piquante × Kodimix®) showed the highest yield per plant, fruit width and the highest values of fruit weight. Therefore, T1 can be concluded as the best treatment. Sensory evaluation results revealed that Piquante, Hot Dragon, and Dark Green scored higher than Light Green and M1HP1, making them preferable for culinary and commercial use. Regarding citric acidity on different treatments, all treatments except T5 and T10 showed higher level of citric acidity percentage without significance differences therefore, Piquante, Hot dragon, Dark green and Light green varieties are recommended for further processing, like making sauces and preservation purposes. Variety M1HP1 had lower citric acid content, resulting in a milder taste and making it ideal for fresh eating.

## AUTHOR CONTRIBUTION

JMDMD conducted the research, analyzed data and drafted the manuscript. KMSK conceptualized the study, supervised the study and contributed to data analysis. CSDS supervised the study and contributed to manuscript drafting, revision and final editing.

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