

## Response of cherry tomato (*Lycopersicon esculentum* var. *cerasiforme*) to different magnesium levels under naturally ventilated polyhouse

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### Abstract

The quality of agricultural production and their modulation by fertilizer application has increasingly received attention. However, the importance of magnesium (Mg) as an essential plant nutrient is well established, but its application has not been studied extensively specially in cherry tomato. The experiment was carried out during two successive seasons of 2018 and 2019 in polyhouse under ventilated condition to evaluate the effect of different Mg levels on growth, yield and fruit quality of cherry tomato grown under drip irrigation system. Foliar application of magnesium sulphate was done at three levels (0.2, 0.3 and 0.4 %) on three cultivars viz., Punjab Red Cherry, Punjab Kesar Cherry and Punjab Sona Cherry during vegetative stage at different time interval (at the first fortnight of January, February and March). The vegetative growth, yield and important quality traits of different cherry tomato cultivars, including TSS, titratable acidity were determined. Punjab Kesar Cherry cultivar showed 19 % higher total soluble solids (TSS) than Punjab Sona Cherry and 10 % higher than Punjab Red Cherry and also showed titratable acidity 20 and 9 % higher than the cultivar Punjab Red Cherry and Punjab Sona Cherry, respectively. The TSS and titratable acidity in tomato fruits increased with Mg application rates. A significantly higher yield was recorded with Punjab Sona Cherry (6.96 kg/m<sup>2</sup>) as compared to Punjab Red Cherry (5.63 kg/m<sup>2</sup>) and followed by Punjab Kesar Cherry (5.29 kg/m<sup>2</sup>) with the foliar application of 0.4 % magnesium sulphate.

**Key words:** Cherry tomato, magnesium sulphate, total soluble solids, yield

### Introduction

Cherry tomato (*Lycopersicon esculentum* var. *cerasiforme*) is a small fruited variety of tomato characterized by their small size fruits, with a different bright red, yellow or orange color, having sweet flavor and excellent taste (Charlo *et al.*, 2007). It is becoming popular in the retail chains and marketed at a premium price compared to regular tomatoes as it is beneficial to human health because of its high content of antioxidant and phyto-chemical compounds including lycopene, beta carotene, flavonoids, vitamin C and many essential nutrients (Rosales *et al.*, 2010). It has good productivity, excellent taste and has high commercial value (Osei *et al.*, 2015), and can be grown in open or in protected conditions like in poly- or glass- or shade-house structures. The yield and fruit quality are higher when crop of cherry tomato grown under protected condition. For successful farming practice and optimal crop-nutrient management, fundamental principles of mineral plant nutrition must be considered in an appropriate amount. Nitrogen (N), phosphorous (P), and potassium (K) are essential nutrients for tomato production. Next to N, P, K, Mg is the mineral nutrient required in the largest amount by plants (Chapagain and Wiesman, 2004).

Magnesium, a major constituent of cell walls (Huber and Jones, 2013), mainly helps in photosynthesis in tomato plant and in other physiological processes especially in the synthesis and maintenance of chlorophyll (Gerendas and Fuhrs, 2013). Magnesium deficiency occurs in almost all greenhouse crops grown with all soil types, but more severe deficiencies can be

expected on coarse-textured sandy soils. It is promoted by low pH and high potassium (K) status in the soil, and by inadequate supply in nitrogen fertilizer (Huber and Jones, 2013). Although K, Mg, and calcium (Ca) are essential nutrients required in tomato production and deficiencies of these elements usually occur due to undersupply or antagonistic effects on each other thus decreasing growth, yield, and quality of tomato (Hao and Papadopoulos, 2003). However, there are very few studies on response of tomato to different magnesium levels under natural ventilated polyhouse condition but not extensively on cherry tomato. The present study was therefore conducted to study the effect of foliar application of Mg on yield, yield attributes and quality traits of cherry tomato grown on drip irrigation system under naturally ventilated polyhouse structures.

### Material and methods

The experiment was conducted under natural ventilated polyhouse unit, Krishi Vigyan Kendra, Sri Muktsar Sahib, Punjab during rabi season of 2018 and 2019. In the experiment, three cultivars viz., Punjab Sona Cherry, Punjab Kesar Cherry, Punjab Red Cherry were evaluated for their performance under natural ventilated polyhouse with foliar application of magnesium sulphate at three levels (0.2, 0.3 and 0.4 %) at the first fortnight of January, February and March. The seeds were procured from Department of Vegetable Science, Punjab Agricultural University, Ludhiana. For the experiments seedlings were raised in 98 celled protrays using coco peat as media under protected condition in the month of October. Uniform, healthy, disease free 25 days old seedlings

were transplanted in polyhouse. The seedlings were planted in two rows with spacing of 60 x 45 cm on one meter wide bed having 50 cm path between beds. The plants were trained vertically with the help of plastic wire.

The recommended dose of major nutrients (N,P,K) was applied through fertigation. The harvesting of fruits started 79 days after transplanting of seedlings and total crop duration was seven months. Observations on six randomly selected plants were recorded for various growth, yield and quality attributing traits as per standard procedure. Total soluble solids (TSS) of the cherry tomato fruits were determined by hand refractometer and acidity of the fruit juice was determined by adopting the standard methods of AOAC (1990). The experimental design was split plot design with three replicates. Data of the experiment were subjected to statistical analysis of variance (ANOVA) according to Snedecor and Cochran (1980). When significant differences occurred, the means were separated using least significant difference test ( $P \leq 0.05$ )

## Results and discussion

**Effect of different magnesium levels on morphological characters of three cherry tomato cultivars:** The effect of magnesium levels on three cherry tomato cultivars and interaction between them on morphological characters of different cultivars Punjab Red Cherry, Punjab Kesar Cherry and Punjab Sona Cherry are shown in Table (1 & 2). Generally, vegetative growth *i.e.*, plant height after 45, 60 and 90 days responded positively to increasing magnesium concentration with all three cultivar in both seasons and was highest in cultivar Punjab Sona cherry 381 cm and 375 cm after 90 days. Early 50 % flowering was noticed in Punjab Sona Cherry cultivar after 40 days and early fruit harvesting was also observed in Punjab Sona Cherry cultivar after 104 days and 107 days in both seasons respectively, whereas cultivar Punjab Red Cherry took maximum days to first fruit harvest (after 108 and 113 days) (Table 1). These results were statistically significant in both seasons. The results in Table 2 indicated an increase in

Table 1. Morphological characters of different cherry tomato cultivars during 2018 and 2019 seasons

| Cultivar             | Plant height 45 days (cm) | Plant height 60 days (cm) | Plant height 90 days (cm) | Days to 1 <sup>st</sup> flowering | Days to 50 % flowering | Days to 1 <sup>st</sup> harvest |
|----------------------|---------------------------|---------------------------|---------------------------|-----------------------------------|------------------------|---------------------------------|
| First season (2018)  |                           |                           |                           |                                   |                        |                                 |
| Punjab Red Cherry    | 170.7                     | 241.0                     | 376.8                     | 45.3                              | 60.6                   | 108.6                           |
| Punjab Kesar Cherry  | 159.3                     | 228.8                     | 361.2                     | 45.0                              | 56.6                   | 106.3                           |
| Punjab Sona Cherry   | 185.5                     | 254.1                     | 381.6                     | 40.6                              | 54.3                   | 104.6                           |
| LSD at 0.05 %        | 4.28                      | 3.51                      | 4.32                      | 0.95                              | 1.23                   | 2.05                            |
| Second season (2019) |                           |                           |                           |                                   |                        |                                 |
| Punjab Red Cherry    | 168.6                     | 235.3                     | 369.6                     | 49.3                              | 64.6                   | 113.3                           |
| Punjab Kesar Cherry  | 157.3                     | 230.6                     | 362.0                     | 47.3                              | 60.6                   | 109.3                           |
| Punjab Sona Cherry   | 183.2                     | 250.6                     | 375.2                     | 45.7                              | 57.0                   | 107.6                           |
| LSD at 0.05 %        | 4.45                      | 4.21                      | 3.87                      | 0.78                              | 1.82                   | 2.63                            |

Table 2. Effect of different Mg levels on morphological characters of different cherry tomato cultivars during 2018 and 2019 seasons

| Cultivar             | Treatments (Mg) | Plant height 45 days (cm) | Plant height 60 days (cm) | Plant height 90 days (cm) | Days to 1 <sup>st</sup> flowering | Days to 50 % flowering | Days to 1 <sup>st</sup> harvest |
|----------------------|-----------------|---------------------------|---------------------------|---------------------------|-----------------------------------|------------------------|---------------------------------|
| First season (2018)  |                 |                           |                           |                           |                                   |                        |                                 |
| Punjab Red Cherry    | 0.2 %           | 164.7                     | 237.7                     | 372.0                     | 46.7                              | 61.3                   | 110.7                           |
|                      | 0.3 %           | 173.3                     | 241.3                     | 377.3                     | 45.0                              | 60.7                   | 109.0                           |
|                      | 0.4 %           | 175.0                     | 244.0                     | 381.0                     | 44.7                              | 59.3                   | 106.0                           |
| Punjab Kesar Cherry  | 0.2 %           | 156.0                     | 224.0                     | 357.7                     | 45.3                              | 57.7                   | 107.3                           |
|                      | 0.3 %           | 160.0                     | 229.0                     | 362.0                     | 44.3                              | 56.3                   | 106.0                           |
|                      | 0.4 %           | 162.0                     | 233.3                     | 364.0                     | 44.3                              | 56.0                   | 105.0                           |
| Punjab Sona Cherry   | 0.2 %           | 183.3                     | 251.3                     | 380.0                     | 40.7                              | 54.7                   | 106.7                           |
|                      | 0.3 %           | 185.7                     | 253.3                     | 378.7                     | 40.7                              | 54.0                   | 104.7                           |
|                      | 0.4 %           | 187.7                     | 257.7                     | 386.0                     | 40.0                              | 53.3                   | 103.0                           |
| LSD at 0.05 %        |                 | 4.62                      | 3.08                      | 3.88                      | 0.76                              | 0.92                   | 2.34                            |
| Second season (2019) |                 |                           |                           |                           |                                   |                        |                                 |
| Punjab Red Cherry    | 0.2 %           | 164.0                     | 234.3                     | 365.3                     | 50.7                              | 65.3                   | 115.3                           |
|                      | 0.3 %           | 171.3                     | 234.7                     | 370.7                     | 49.3                              | 65.3                   | 112.7                           |
|                      | 0.4 %           | 171.7                     | 238.0                     | 372.0                     | 48.0                              | 63.3                   | 111.3                           |
| Punjab Kesar Cherry  | 0.2 %           | 154.7                     | 228.0                     | 359.3                     | 48.7                              | 62.0                   | 110.7                           |
|                      | 0.3 %           | 158.0                     | 231.3                     | 362.0                     | 46.7                              | 61.3                   | 109.3                           |
|                      | 0.4 %           | 159.3                     | 233.3                     | 365.0                     | 46.0                              | 59.0                   | 108.0                           |
| Punjab Sona Cherry   | 0.2 %           | 182.0                     | 248.0                     | 373.3                     | 46.7                              | 58.3                   | 110.7                           |
|                      | 0.3 %           | 183.7                     | 250.7                     | 375.7                     | 46.0                              | 57.3                   | 107.3                           |
|                      | 0.4 %           | 183.0                     | 254.0                     | 376.7                     | 44.7                              | 55.3                   | 105.3                           |
| LSD at 0.05 %        |                 | 3.96                      | 2.72                      | 2.79                      | 0.98                              | 1.03                   | 1.90                            |

Table 3. Yield and quality of fruits of different cherry tomato cultivars during 2018 and 2019 seasons

| Cultivars            | Fruit weight (g) | Yield/plant (kg) | Yield (kg)/ m <sup>2</sup> | TSS (%) | Acidity (%) |
|----------------------|------------------|------------------|----------------------------|---------|-------------|
| First season (2018)  |                  |                  |                            |         |             |
| Punjab Red Cherry    | 9.83             | 1.78             | 5.46                       | 6.93    | 0.54        |
| Punjab Kesar Cherry  | 10.63            | 1.65             | 5.12                       | 9.23    | 0.73        |
| Punjab Sona Cherry   | 10.18            | 2.06             | 6.80                       | 7.9     | 0.64        |
| LSD at 0.05 %        | 0.42             | 0.06             | 0.23                       | 0.45    | 0.04        |
| Second season (2019) |                  |                  |                            |         |             |
| Punjab Red Cherry    | 9.43             | 1.59             | 4.66                       | 6.68    | 0.49        |
| Punjab Kesar Cherry  | 10.11            | 1.62             | 4.32                       | 7.74    | 0.57        |
| Punjab Sona Cherry   | 9.82             | 1.87             | 6.02                       | 7.38    | 0.56        |
| LSD at 0.05 %        | 0.39             | 0.07             | 0.25                       | 0.58    | 0.03        |

Table 4. Effect of different Mg levels on yield and quality of fruits in different cherry tomato cultivars during 2018 and 2019 seasons

| Cultivar             | Treatments (Mg) | Fruit weight | Yield/plant (kg) | Yield (kg)/ m <sup>2</sup> | TSS (%) | Acidity (%) |
|----------------------|-----------------|--------------|------------------|----------------------------|---------|-------------|
| First season (2018)  |                 |              |                  |                            |         |             |
| Punjab Red Cherry    | 0.2 %           | 9.6          | 1.69             | 5.20                       | 6.73    | 0.53        |
|                      | 0.3 %           | 9.9          | 1.80             | 5.53                       | 6.93    | 0.53        |
|                      | 0.4 %           | 10.0         | 1.84             | 5.63                       | 7.13    | 0.55        |
| Punjab Kesar Cherry  | 0.2 %           | 10.5         | 1.61             | 4.95                       | 8.53    | 0.72        |
|                      | 0.3 %           | 10.6         | 1.66             | 5.13                       | 9.27    | 0.73        |
|                      | 0.4 %           | 10.8         | 1.68             | 5.29                       | 9.87    | 0.73        |
| Punjab Sona Cherry   | 0.2 %           | 10.0         | 1.98             | 6.54                       | 7.53    | 0.63        |
|                      | 0.3 %           | 10.1         | 2.08             | 6.89                       | 8.00    | 0.63        |
|                      | 0.4 %           | 10.4         | 2.11             | 6.96                       | 8.33    | 0.64        |
| LSD at 0.05 %        |                 | 0.27         | 0.09             | 0.16                       | 0.48    | NS          |
| Second season (2019) |                 |              |                  |                            |         |             |
| Punjab Red Cherry    | 0.2 %           | 9.2          | 1.53             | 4.40                       | 6.50    | 0.48        |
|                      | 0.3 %           | 9.4          | 1.59             | 4.73                       | 6.80    | 0.48        |
|                      | 0.4 %           | 9.7          | 1.64             | 4.83                       | 6.73    | 0.52        |
| Punjab Kesar Cherry  | 0.2 %           | 9.9          | 1.64             | 4.15                       | 7.60    | 0.57        |
|                      | 0.3 %           | 10.3         | 1.60             | 4.33                       | 7.73    | 0.55        |
|                      | 0.4 %           | 10.2         | 1.65             | 4.49                       | 7.87    | 0.59        |
| Punjab Sona Cherry   | 0.2 %           | 9.6          | 1.82             | 5.74                       | 6.93    | 0.54        |
|                      | 0.3 %           | 9.7          | 1.85             | 6.09                       | 7.53    | 0.54        |
|                      | 0.4 %           | 10.1         | 1.93             | 6.16                       | 7.67    | 0.57        |
| LSD at 0.05 %        |                 | 0.23         | 0.04             | 0.22                       | 0.27    | NS          |

plant height after 45, 60 and 90 days at 0.4 % magnisium level in comparison with the rest of magnesium levels (0.2 % and 0.3 %). At high magnesium level (0.4 %) cv. Punjab Sona Cherry had the highest plant height, early flowering and early harvesting of cherry tomato were observed that was significantly different with other treatments (0.2 and 0.3 %) in both seasons. These results are in agreement with previous investigation indicated by Chapagain and Wiesman (2004) and Arya and Roy (2009). They found that increase in vegetative growth, net photosynthetic rate and chlorophyll content was associated with increase in magnesium levels.

**Effect of different magnesium levels on yield and quality parameters of three cherry tomato cultivars:** The effect of magnesium levels on three cherry cultivars and interaction between them on yield and quality parameters of different cultivars are shown in Table (2 & 3). Yield per plant 2.06 and

1.86 kg and total yield 6.80/m<sup>2</sup> and 6.02/m<sup>2</sup> was found highest in both the seasons, whereas average weight of fruit 10.63 g and 10.11 g was found highest in cv. Punjab Kesar Cherry.

In Table 2, data revealed that by increasing the magnesium level from 0.2 to 0.4 %, yield/plant, yield/m<sup>2</sup> were significantly increased among the magnisium treatments. The cultivar Punjab Sona Cherry recorded significantly higher yield (6.96 kg/m<sup>2</sup>) as compared to other cultivars. TSS increased with increasing in magnesium levels in all three cultivars. Punjab Kesar Cherry showed the highest TSS content compared with the mean of the other cultivars. The titrable acidity (TA) was influenced by magnesium levels while cultivars had no effect on TA. Balibrea *et al.* (2006) reported that an increase of TSS and acidity in tomato fruits may depend on the higher sugar import and accumulation.

It could be concluded that total yield of cherry tomato fruits was significantly influenced by increase in magnisium levels.

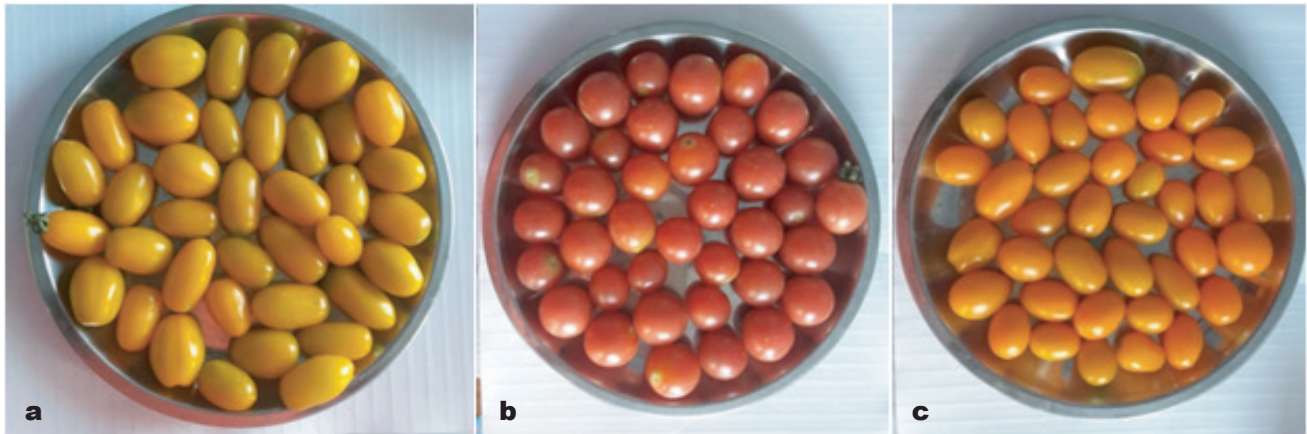


Fig.1. Fruits of a: Punjab Sona Cherry, b: Punjab Red Cherry, c: Punjab Kesar Cherry

Furthermore, concerning the analysed genotype, Punjab Sona Cherry had the highest yield whereas, Punjab Kesar Cherry showed good quality of fruits.

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