Pak. j. life soc. Sci. (2012), 10(2): 102-105 E-ISSN: 2221-7630;P-ISSN: 1727-4915

Pakistan Journal of Life and Social Sciences

www.pjlss.edu.pk

RESEARCH ARTICLE

Assessment of various growth and yield attributes of tomato in response to pre-harvest applications of calcium chloride

Chauhadry Muhammad Ayyub*[1], Muhammad Aslam Pervez[1], Muhammad Rashid Shaheen[1], Muhammad Irfan Ashraf[1], Muhammad Wasim Haider[1], Shabbir Hussain[1] and Nasir Mahmood[2]

[1]Institute of Horticultural Sciences, University of Agriculture, Faisalabad

[2]Pakistan Science Foundation, Islamabad, Pakistan

ARTICLE INFO

Received: Jul 15, 2011
Accepted: Jan 25, 2012
Online: Mar 30, 2012

Keywords
Calcium chloride
Growth
Preharvest
Tomato
Yield

***Corresponding Author:**
cmayyub91@yahoo.com

ABSTRACT

A field trial was conducted to investigate the effect of pre-harvest application of calcium chloride in tomato cv. Sahil. Different concentrations of calcium chloride (0.1, 0.2, 0.3, 0.4 and 0.5 M respectively) along with control were evaluated during the experiment. Control plants were sprayed with water without calcium chloride. A significant improvement in growth and yield of tomato fruit was observed with application of calcium chloride. The highest fruit set (69.3 %) was obtained with 0.5 M calcium chloride (T_6) along with maximum number of compound leaves per plant (40.33), maximum number of flowers (9.66), number of fruits per plant (95.33) and fruit weight per plant (6.00 kg). The results of the study indicated a positive correlation between plant growth and application of calcium chloride.

INTRODUCTION

The health benefits of eating generous amounts of vegetables, whether fresh, frozen, canned, juiced or dried, are unquestionable (Anjum et al., 2008). Among these, Tomatoes (*Lycopersicon esculentum* L.) have become one of the most popular and widely grown vegetables in the world (Chohan and Ahmad, 2008). It is one of the most important vegetable crops of Pakistan, was grown on an area of 5.34 thousand hectares and average yield of 10.52 tons ha^{-1} was obtained in Pakistan annually (FAOSTAT, 2009). It is an important condiment in most diets and a very cheap source of vitamins (A, C, E), calcium, Niacin and minerals (Olaniyi et al., 2010). The tomato is moderately sensitive to salinity. Salinity is considered as the most significant ecological factor affecting growth and metabolic activities of the various plants.

Tomato fruit quality is associated with a change in colour, texture, flavour, nutritive value and its wholesomeness. Among all divalent cations, calcium plays a significant role in maintaining fruit quality. It plays a vital role in maintaining cell integrity, membrane permeability and fruit growth. It is an essential part of the cell wall. The role of calcium is important in cell membrane stability, ion uptake and other metabolic processes (Rashid, 2000). Calcium is reported to increase nitrogen, potassium and phosphorous absorption in roots, stimulates photosynthesis, increases the plant size and improves fruit quality in various vegetables like tomato and sugar beat etc (Fenn et al., 1991). The involvement of calcium in the regulation of fruit maturation and ripening processes has been well established (Ferguson, 1984). Previous studies have indicated that increase in level of calcium in tomato fruit may inhibit fruit ripening by preventing breakdown of cell walls and associated release of wall-bound enzymes, as well as by directly inhibiting the respiration (Salunkhe et al., 1974).

Tomato production depends on many abiotic and biotic factors. Among them adequate supply of plant nutrients is a very important factor to produce the best quality tomato fruit (Iqbal et al., 1999). Exogenous application of $CaCl_2$ to the culture medium alleviated the toxic action induced by salinity (Naggar et al., 2005).

Minami and Bovi (2000) carried out an experiment on the application of $CaCl_2$ on tomato seedlings and concluded that tomato plants gave positive response to foliar spray. Hao and Papadopoulos (2003) studied the effect of calcium sprays to improve fruit quality of tomato and reported that foliar spray of $CaCl_2$ (0.1M) applied biweekly increased fruit yield. Wojcik (2001) concluded that differences in growing conditions, environmental factors and fruit development can influence the amount of calcium concentration in fruit. He reported that foliar applications of calcium compounds should be made in late fruit growth stages.

It also resulted in reduced physiological weight loss and delayed fruit ripening. Calcium starvation is considered as a major contributing factor for blossom-end-rot in tomato; a major physiological disorder of tomato. For this reason, pre or post harvest applications of Ca have been made to prevent physiological disorders and improve fruit quality (Adam et al., 1999).

The aim of the present study was to determine the effect of pre-harvest foliar application of calcium chloride on growth and yield of tomato fruit.

MATERIALS AND METHODS

The experiment was carried out in tunnels at the vegetable experimental area, Institute of Horticultural Sciences, University of Agriculture, Faisalabad to evaluate the effect of calcium chloride on fruit quality of the tomato. Tomato seedlings were raised by raising nursery under plastic tunnel, in which seeds of tomato cv. Sahil (the most prominent and commonly used variety of the area) were sown on medium consisted of FYM, soil and sand in the ratio of 1:1:1. NPK (19:19:19) was used, half dose of which was applied as a basal dose at the time of transplanting and remaining half dose was applied through drip irrigation at fortnightly intervals. When seedlings attained a height of 10-15 cm, these were transplanted in tunnels on beds at a distance of 45 cm, whereas, distance between lines maintained was 65 cm. A digital thermometer and humidity meter was placed in the tunnels for temperature and humidity measurement. The temperature was recorded 28±2ºC during the day time and 21±2ºC during the night time, while the relative humidity level was observed between 60-70%. The doors of the tunnels were kept open from 11:00 a.m. to 3:00 p.m. to improve the ventilation. Experiment comprised of six treatments, replicated thrice. Each treatment consisted of ten plants. Uniform cultural practices were adopted for all the treatments. Treatments included were T_1 (Control) and T_2 to T_6 consisting of a molar solution of $CaCl_2$ (0.1, 0.2, 0.3, 0.4 and 0.5 M respectively). Molar solution of $CaCl_2$ was prepared and applied to the plants after fruit set in the first cluster and two more sprays were done at weekly intervals. Experiment was laid out according to completely randomized design (CRD). Data were analyzed statistically by using analysis of variance techniques and significance among treatment means was compared using DMR test at 5% probability level.

RESULTS AND DISCUSSION

Effect of $CaCl_2$ on growth components

Growth parameters observed during the experiment (Fig. 1) like plant height and number of compound leaves plant^{-1}; responded positively to foliar application of $CaCl_2$ applied at different growth stages of the tomato crop. Maximum height of plant was recorded with T_4, followed by T_6. Whereas, minimum height of tomato plant was noted with T_1 (control). As calcium is an important component of cell wall and plays important role in cell elongation (Rashid, 2000), therefore, application of $CaCl_2$ at higher concentrations might have increased plant height.

The maximum number of compound leavers plant^{-1} (40.33) were noted with T_6. While, minimum number of leaves plant^{-1} (33.67) was produced by control. Higher number of leaves might be due to increased calcium level and vice versa. As calcium directly improves cell permeability which in turn enhances photosynthetic process and results in more number of leaves (Hussain et al., 2003).

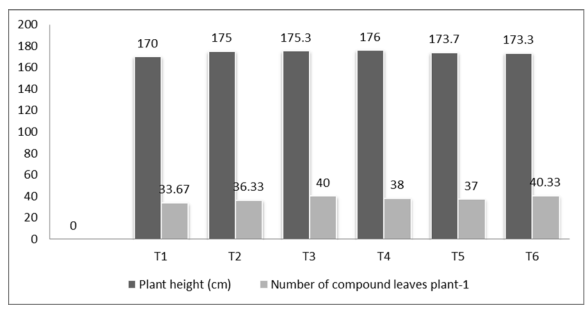

Fig. 1: Effect of $CaCl_2$ on growth components of tomato

Effect of $CaCl_2$ on yield components

Similar trends were observed regarding yield parameters (Table 1) like number of flower clusters plant^{-1}, fruit set %age, number of healthy and diseased fruits plant^{-1}, fruit weight, fruit length and width; where treatments gave optimistic and significantly higher response than the control.

Maximum number of flower clusters plant^{-1} (9.66) were recorded in case of T_3 and minimum number of flower clusters (7.33) were counted with control. Dey (2000) reported similar results and concluded that calcium stimulated the uptake of phosphorus by plant roots. This increased uptake might have promoted more cluster formation, as phosphorus directly promotes flowering.

The use of $CaCl_2$ significantly increased fruit set percentage. Highest fruit set (69.3 %) was noted in case

Table 1: Effect of $CaCl_2$ on yield components of tomato

Treatments	No. of flower clusters plant^{-1}	Fruit set (%)	No. of fruits plant^{-1}	No. of diseased fruits plant^{-1}	Fruit weight plant^{-1} (kg)	Fruit length (cm)	Fruit width (cm)
T_1	7.33c	60c	77.33c	3.67a	5.27c	5.66d	3.23c
T_2	7.66bc	63.3a	79.33c	2.67ab	5.67ab	6.03d	3.7b
T_3	9.66a	69a	94.33a	1.33c	6a	7.5ab	4.36a
T_4	8.33bc	65b	90ab	2.33bc	5.7ab	7c	3.8b
T_5	8.66ab	65.7b	86b	2.33bc	5.56bc	7.03bc	3.9b
T_6	9.66a	69.3a	95.33a	1.67bc	6a	7.7a	4.4a

of T_3 and lowest fruit set (60.0 %) were recorded with control. $CaCl_2$ spray also produced more number of healthy fruits. As the maximum number of fruits (95.33) was obtained in cases of T_6 and minimum (77.33) recorded with control. This effect can be positively correlated to the fact that calcium plays a vital role in metabolism and nutrient uptake (Kamal, 2000). All these factors might be responsible for an increased fruit set percentage and number of fruits plant^{-1}.

Data regarding diseased fruits plant^{-1} showed that maximum number of diseased fruits (3.6 7) was obtained in those plants which were not sprayed with $CaCl_2$. While a few numbers of diseased fruits (1.33) were found in plants sprayed with 0.2M $CaCl_2$. It significantly reduced mildew on tomato fruits. Wijerathne et al. (2009) observed similar results by preharvest application of $CaCl_2$ to control fungal diseases of tomato. This could largely be due to the increased firmness of fruit. Introduced Ca^{2+} has shown to entrap in the middle lamella thus increasing its stability and elevated Ca^{2+} in tissues is reported to hinder the action of polygalacturonase enzyme, making the tissues more firmer (Doesburg, 1975).

Observations regarding fruit weight plant^{-1} revealed a significant effect of $CaCl_2$. Maximum fruit weight was recorded with 0.2M $CaCl_2$ while minimum in case of control. As Ca is an important component of cell wall, it prevents the breakdown of cell walls and associated with the release of wall bound enzymes, hence acts as a cementing agent (Souza et al., 1999).

Calcium Chloride also increased fruit size s-ignificantly. Maximum fruit length and width were observed in plants sprayed with 0.5M $CaCl_2$ whereas, control produced fruits with minimum length and width. This might be due to role of Ca in maintenance of cell integrity. The addition of high levels of Ca inhibits the activity of pectic enzymes in tomato and increases its size, while the low calcium levels decrease fruit size, as they increase the activity of pectic enzymes (Rylski, 1994).

REFERENCES

Adam P, LC Ho, M Femandez, J Cuartro and GML Gomez, 1999. Calcium deficiency affects blossom-end rot in tomato. Acta Horticulturae, 412: 374-387.

Anjum F, Khan BA, Noreen N, Masood T and Faisal S, 2008. Effect of boiling and storage on Beta-Carotene content of different vegetables. Pakistan Journal of Life and Social Sciences, 6: 63-67.

Chohan TZ and Ahmad S, 2008. An assessment of tomato production practices in Danna Katchely, Azad Jammu Kashmir. Pakistan Journal of Life and Social Sciences, 6: 96-102.

Dey SC, 2000. Tomato Crop. In: Vegetable Growing. Pub. Co., Agrobios., New Delhi, India, pp. 59-61.

Doesburg JJ, 1975. Relation between the solubilization of pectin and the fate of organic acids during maturation of apples. Journal of Science of Food and Agriculture, 8: 206-216.

FAOSTAT, 2009. Available at: www.faostat.fao.org/ site/ 340/ default.aspx (accessed on Aug 19, 2011).

Fenn LB, RM Taylor, MI Binzel and CM Burks, 1991. Calcium stimulation of ammonium absorption in onion. Agronomy Journal, 83: 840-843.

Ferguson IB, 1984. Calcium in plant senescence and fruit ripening. Plant Cell and Environment, 7: 477–489.

Hao X and AP Papadopoulos, 2003. Effects of calcium and magnesium on growth, fruit yield and quality in a fall greenhouse tomato crop grown on rockwool. Canadian Journal of Plant Science, 83: 903-912.

Hussain N, A Ali, G Sarwar, F Mujeeb and M Tahir, 2003. Mechanism of salt tolerance in rice. Pedosphere, 13: 233-238.

Iqbal S, MI Chaudhary and MA Anjum, 1999. Effect of various root stock and leaf mineral composition and productivity of Kinnow mandarin. International Journal of Agriculture and Biology, 1: 91–93.

Kamal BA, 2000. Physiological studies on nutrition status and productivity of olive tree under new land conditions. Ph.D. Thesis, Zagazig University, Egypt.

Minami K and J Bovi, 2000. Mechanical conditioning of tomato seedlings (*Lycopersicon esculentum*). Acta Horticulturae, 533:141-144.

Naggar AHE, MEH Osman, MME Sheekh and MF Makled, 2005. Ameliorative effect of Ca^{2+} on the Nitrogen metabolism changes induced by salinity in *Anabaena subcylindrica*. International Journal of Agriculture and Biology, 7: 247–252.

Olaniyi JO, WB Akanbi, TA Adejumo and OG Akande, 2010. Growth, fruit yield and nutritional quality of tomato varieties. African Journal of Food Science, 4: 398-402.

Rashid M, 2000. Secondary and Micronutrients. In: Soil Science. National Book Foundation, Islamabad, pp: 342-343.

Rylski I, B Aloni, L Karni and Z Zaidman, 1994. Flowering, fruit set, fruit development and fruit quality under different environmental conditions in tomato and pepper crops. Acta Horticulturae, 366: 45-55.

Salunkhe DK, SJ Jadhav and MH Yu, 1974. Quality and nutritional composition of tomato fruit as influenced by certain biochemical and physiological changes. Plant Foods for Human Nutrition, 24: 85–113.

Souza BS, TJ O'Hare, JF Durigan and PS Souza, 2006. Impact of atmosphere, organic acids and calcium on quality of fresh-cut 'Kensington' mango. Postharvest Biology and Technology, 42: 161–167.

Wijerathne RY, WAM Daundasekera and R Peiris, 2009. Effect of preharvest calcium chloride application on postharvest diseases and some physico-chemical parameters of tomato cv. Rajitha. Proceedings of the Peradeniya University Research Sessions, Sri Lanka, pp. 11–17.

Wojcik P, 2001. Prune fruit quality as influenced by Calcium spraying. Journal of Plant Nutrition, 24: 1229–1241.