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CALCIUM INFLUENCE ON GROWTH AND YIELD OF TOMATO: A REVIEW

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ABSTRCT

Calcium which play an important role in the growth and yield of tomato plant and protect the tomato plant from some serious problems like curling of young leaves or shoots scorching or spotting on young leaves, poor growth, leaf tip burns, stunted roots, and damage to fruit, and hence increase the production of tomatoes, appears to be the very significant nutrient for the greater production of tomatoes. The present review is therefore generalized to evaluate the influence of calcium on the production of tomatoes and gather the abstracts of some researches recently published to highlight the importance and role of calcium in tomato plant.

KEY WORDS: Tomato, Calcium, Yield, Production and growth.

INTRODUCTION

Tomato (*Lycopersicon esculentum*) belongs to family Solanaceae. Tomatoes are generally classified as determinate or indeterminate. Determinate or bushy type tomato plant bears fruit within a short period of time and top off at a specific height. Such types of tomatoes are generally preferred by the commercial growers who wish to harvest whole field at once or in limited period of time. Indeterminate types develop into vines that never top off and continue producing until killed by frost. Such types are preferred by home growers and local-market farmers who want ripe fruit throughout the season (Rick *et al*. 2009).

It is an important condiment in most diets and a very cheap source of vitamins. It also contains a large quantity of water (%), calcium (%) and Niacin all of which are of great importance in the metabolic activities of man. Tomato is a good source of vitamins A, C and E and minerals that are very good for body and protect the body against diseases (Taylor, 1987).

There are four major elements among the 16 essential elements for the better growth and production of tomatoes. That are N, P, K and Ca.

Calcium which is readily available in sources like calcium nitrate, calcium chloride, lime, gypsum, calcium chelates and some other organic sources, play a very great role in growth and yield of production of plants, especially in tomato. In the absence of calcium tomato plant faces various problems like curling of young leaves or shoots scorching or spotting on young leaves, poor growth, leaf tip burns, stunted roots, and damage to fruit. Calcium stabilizes soil structure by adsorbing soil particles like sodium that might cause the soil to crack when dry and swell up when wet. Calcium also replaces the adsorbed sodium and prevents damages to soil structure. It also participates in metabolic processes of other nutrients uptake, Promotes proper plant cell elongation, Strengthen cell wall structure forming calcium pectate compounds which give stability to cell walls and bind cells together, Participates in enzymatic and hormonal processes, Helps in protecting the plant against heat stress, improves stomata function and participates in induction of heat shock proteins, helps in protecting the plant against diseases and also has a role in the regulation of the stomata (Guy Sela. 2016).

Keeping in view the importance of calcium in the production of tomatoes the present review article is summarized to report the main findings of some previously published research works in a single document.

MAIN RESULTS OF PREVIOUS RESEARCH WORKS

Haque*et al.* (2011) studied the effect of nitrogen on tomato by considering four levels (0, 60, 120 and 180 kg N ha^{-1}) at the research farm of Sher-e-Bangla Agricultural University, Dhaka, during November 2006 to March 2007 by using RCBD design. They observed that by increasing the level of nitrogen up to 120 kg ha^{-1} yield was increased. They found that all the parameters were increased with the increase in nitrogen up to 120 kg ha-^{1}. Highest plant height (122.46 cm), flower clusters $plant^{-1}$ (9.67), flowers cluster-1 (10.44), fruits cluster-^{1} (6.76), fruits $plant^{-1}$ (52.44), fruit weight $plant^{-1}$ (1.60 kg) fruit weight plot-^{1} (19.14 kg) and fruit yield (48.33 t ha^{-1}) was observed at 120 kg ha^{-1}.

Fandi*et al.* (2010) concluded that high concentration of N, P and K in the nutrient solution gave higher total yield and tomato fruit weight than the control nutrient solution in tuff culture grown tomato. High nitrogen concentration (100 ppm) in the nutrient solution gave the highest total and marketable yield, number of marketable fruits and yield per plant.

Park *et al.* (2009) conducted an experiment to test the development of two cherry tomato cultivars and their honeydew production at different nitrogen levels. They applied the two cherry tomato plant cultivars (*Lycopersiconesculentum Mill*), cultivars ‘Koko’ and ‘Pepe’) with high (395 ppm), medium (266 ppm) and low (199 ppm) concentration of nitrogen. They observed that by applying more nitrogen increase the nitrogen, protein, and chlorophyll contents of tomato leaves as compared to medium or low nitrogen supplied plants, but an inversely relationship was found in sugar content and nitrogen rate. They also observed that by lowering nitrogen concentrations honey dew production was increases. At low nitrogen concentration the highest honeydew production was found in the ‘Pepe’ cultivar.

Balemi (2008) tested the performance of tomato cultivars behaving differently towards growth patterns to nitrogen and phosphorus application and spacing. He gives different levels of nitrogen and phosphorous with different spacing. He evaluated that tomato cultivars gives higher total as well as marketable yield by applying 110 kg N + 120 kg P_2O_5/ha or 80 kg N + 90 kg P_2O_5/ha respectively.

Rahman *et al*. (2007) used four levels of nitrogen (0, 80, 160 and 240 kg ha-1) and different irrigation treatments to investigate its effect on tomato yield and fruit quality. They found that the fruit yield and quality was responded significantly to different application of nitrogen and irrigation treated together and alone. They also concluded that the optimum yield (50.43 t ha^{-1}) of tomato was obtained under 163.3 kg ha^{-1} of nitrogen.

Badr and Yazied (2007) conducted a field experiment on tomato by using different levels of nitrogen with different-fertigation frequencies on a sandy soil. Yield of tomato yield and other growth parameter was decreased with the decrease in nitrogen rate and fertigation frequencies.

These estimates should assist breeders to determine a sufficient level of characterization, determine a minimum distance considered to be unique, and defend pedigree relationships.

Warner *et al.* (2004) performed an experiment to study influence of application of nitrogen on yield and quality of tomatoes. They applied Nitrogen at different levels of 0, 50, 100, 150 and 200 kg N ha^{-1}. They observed that by applying nitrogen fertilizer up to the levels of 150 to200 kg N ha^{-1} was enough for enhancing marketable yield. He found that the soluble solids, firmness, size and color of the marketable fruit were not influenced by nitrogen application and higher nitrogen application was required for more marketable fruit yield.

Wahle and Masiunas (2003) carried out an experiment on evaluation of growth and yield of tomato in response to different levels of nitrogen applications. They concluded that fruit yield of tomato was increased with the addition of 168 kg ha^{-1} N but showed small changes for additional application of nitrogen. They found that in reduction of nitrogen application for environmental protection was also decreased the tomato yield.

Kooner and Randhawa (2003) performed an experiment to study the influence of nitrogen levels and sources on various verities of tomato yield and quality. He observed that yield becoming more when nitrogen levels from 0 to 200 kg $ha^{-1}$was applied. They observed that in winter season, Ostankinskij and Cold Set varieties show maximum yield when 150 kg ha^{-1} N was use.

Bhutto (2003) used six treatments of urea (0, 0.50, 1.00, 1.50, 2.00 and 2.50 %) to investigating the effect of nitrogen on different parameters of tomato. Application of 2.5 % urea delayed flowering to 59.05 days while 58.45 and 57.71 days was observed when the urea sprayed at 2.00 and 1.50 %, respectively. Maximum 6.49 numbers of branches was observed under 2.5 % application of urea, while 6.47, 6.47 and 6.44 branches per plant under 1.50, 2.50 and 2.00% urea, respectively. Application of 2.00 % foliar application of urea gave highest (20.22) number of fruit as compared to 1.50 and 2.50 % which gave 20.09 and 19.89 fruits per plant, respectively. Plots sprayed with foliar application of 2.0 % urea showed maximum weight of fruits (1217.33 g), while 1.50% and 2.50% gave 1191.67 g and 1170.33 g mean fruit weight per plant, respectively. Foliar application containing 2.0% urea gave highest tomato yield (15.65kg) while 14.81kg and 14.77kg mean fruit yield per plot was observed under 2.50% and 1.50% urea, respectively. Application of 2 % foliar urea gave maximum yield of 14908kg per hectare, while 2.50 and 1.50 % urea gave 14105 and 14070 kg mean fruit yield per hectare, respectively. Positive effect was observed when plot was sprayed with urea on growth and yield parameters of tomato. The significant increase in tomato yield was observed in the plots treated with urea in the foliar solution.

Khattak *et al.* (2001) examined the response of eggplant cultivar to levels of nitrogen. (0, 50, 75,100,125, 150 kg ha) nitrogen levels were applied. They observed that nitrogen application at the rate of 125 kg/ha considerably change branches, leaves and fruit/plant, stem thickness, height of plant and yield. They examine that by applying 125 kg/ha gave more branches (7.84). leaves (285.380 and fruit/plant (13.67), stem thickness (1.19 cm) and yield (17674.91 kg/ha), while less number of branches (6.37), leaves (280.77) and fruit/plot different ant (11.08) were observed in control treatment and small stem thickness (1.01 cm) and yield (14062.41 kg ha^{-1}) were found when 50 kg nitrogen/ha was applied. They found that all the parameters (Number of branches, leaves, fruit thickness, stem thickness, plant height and yield kg/ha) were significantly influenced by cultivars. Greater number of branches (7.47), number of leaves (342.91), fruit thickness (3.64 cm), plant height (63.46 cm) and yield (17287.96 kg/ha) were observed in cultivars Long Purple, while smaller number of branches (6.63), leaves (127.41), plant height (58.81 cm) and fruit thickness (3.32 cm) were counted in cultivars Black Bahar, whereas stem thickness (1.06 cm) need (14365.74 kg/ha) were noted for tong purple Neelam Long respectively. The overall response of cultivars Long Purple supplied with 125 kg nitrogen/ha is recommended for the growers of Peshawar.

Ghazi *et al.* (2000) conducted an experiment on three cultivars of tomato i.e. Sera, 898, Rohaba), which were grown under different levels of NaCl in nutrient solution. The objective of the experiment was to determine effects of salt stress on shoot and root dry matter (DM), plant height, water use efficiency (WUE, g DM kg^{-1} water evapo transpired), shoot sodium (Na) and potassium (K) concentrations, and K versus Na selectivity ($S_{K,Na}$). Increasing NaCl concentration in nutrient solution adversely affected shoot and root DM, plant height, WUE, K concentration, and K/Na ratio of all cultivars. Shoot Na concentrations increased with increasing NaCl concentration in the nutrient solution. Although increasing salt concentration in the solution adversely affected growth of all cultivars, the cultivar Sera had the highest shoot and root DM than the other two cultivars (898 and Rohaba). Shoot and root DM of cultivar 898 was most affected by salt, while cultivar Rohaba had an intermediate salt sensitivity. The cultivar Sera generally had higher WUE values, shoot K concentrations, and S, K and Na but had lower shoot Na concentrations than the other two cultivars when plants were grown under different salt levels. Greater Na exclusion, higher K uptake and shoot S, K and Na are suggested as being plant strategies for salt tolerance.

Villand*et al.* (1995) reported that precise cultivar descriptions are necessary to support Plant Variety Protection and utility applications for patent protection. However, accurate discrimination among cultivars is contingent upon the dependability of the method used to delineate lines. The efficiency and reliability of Amplified Fragment Length Polymorphisms (AFLPs), Random Amplified Polymorphic DNAs (RAPDs), microsatellite polymorphisms, and phenotypic traits were studied in order to determine a method's ability to accurately predict pedigree relationships among a set of 20 California processing tomato cultivars. All molecular marker and phenotypic trait data sets were independently produced using identical cultivar seed sources. Data was reduced to a genetic distance measure and presented as a multidimensional scaling (MDS) plot. Principal component analysis using the scored quantitative phenotypic traits was computed and is compared to molecular marker data results. Experimental error, sampling variance, and independence of scored bands for each molecular marker technique are presented.

Alsadon and Khalil (1993) carried out an experiment in plastic house conditions using two cultivars of tomato for studying nitrogen influence. They apply three levels of nitrogen (10, 20, and 30 gm N/m^2) on Manmade and Pearson tomato varieties to study their effect. They concluded that plants of Pearson gave maximum height of plant, fresh weight. Both the cultivars give good result for fresh weight and dry matter content increasing nitrogen fertilizer. Marmande cultivar gives the highest fruits/plant and total yield. Marmande give no variation of total yield to N, referring that 10 gm N/m^2 was enough for the cultivar. Nitrogen level up to 20 gm N/rn^2 gives satisfactory results for the number of fruits and total yield of Pearson plants, but the weight of the fruit was decreased, referring that 20 gm N/m^2 better Pearson production.

Byari*et al.* (1992) conducted a field study on tomato by using different nitrogen fertilizer levels and planting dates. Greater number of flowers, fruit set, and yield was observed under greater application of nitrogen. Among the cultivars Strain-B showed the best results for all the parameters of tomato.

Singh and Srivastava (1988) also reported tallest (58.70 cm) plants with highest level of nitrogen (120 kg ha^{-1}) in Pant C-1 cultivar of chilli. Among the four levels of nitrogen tried, maximum plant height (51.95 cm) was recorded at 80 kg N ha^{-1}.

Shukla *et al.* (1987) conducted a field experiment on bell pepper in sandy clay loam soil at Bangalore and reported that, highest plant height (28.19 cm) are produced by applying 180 kg

N ha^{1} which was notably higher over control (20.55 cm) but on similarity with 120 kg N ha^{-1} (27.98 cm).

Shrinivas (1983) performed an experiment to study the effect of nitrogen levels on plant height of chilli cv. G-3. They found that 90 kg ha^{-1}nitrogen give the plant with maximum height of 53.45 cm.

CONCLUSION

After studying the previously reposted research papers and keenly observing the main findings of their research works gathered in this article, it is concluded that calcium is really important necessity for the better production of tomatoes. It should be applied to the field of tomatoes to improve plant growth and attain high yield.

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