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Comparison of Quality and Yield of Tomato under Polyhouse, Shade Net and Open Condition

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ABSTRACT: A field trial was conducted to determine the effect of three green shade nets (35,50 and 75%) along with three height (2, 2.5 and 3.5 metre) bamboo framed structures on yield and quality of tomato. There was no significant difference found in average monthly temperature and humidity inside shade net house and open field (control). Significant difference was recorded in yield. Highest average plant yield of (3.49 kg/plant) was found in 35 % shading net followed by open field (2.27). Lowest yield observed (1.07 kg / plant) in 75 % shading net. The tomatoes grown under shade net structures were glossy in appearance with good colour development as compared to open field (control). Further tomatoes produced in open field were attacked by the pest (*Helicoverpa armigera*) attack. No significant difference was observed in quality attributes viz. TSS, Acidity and ascorbic acid by shade net structures. However the higher TSS (6.1 o Brix), Acidity (0.69) and ascorbic acid (40.86 mg/100gm) was recorded in 35% shade net compare to control, (5.7, 0.61 and 36.42) respectively. Thus, use of 35 % shade net brought improvement in quality and yield of tomato grown in semi-arid region.

KEYWORDS: tomato, polyhouse, shade, net, open, condition, plant, improvement, quality, field

I. INTRODUCTION

Protected cultivation is a unique and specialized form of agriculture in which the microclimate surrounding the plant is controlled partially or fully, as per the requirement of the plant species grown during their growth period . The intent is to grow crops where otherwise they could not survive by modifying the natural environment to prolong the harvest period often with earlier maturity, to increase yield, improve quality, enhance the stability of production and make commodities available when there is no outdoor production. The principal vegetable crops, produced under protected conditions in India are tomato, cucumber, muskmelon, capsicum, lettuce and cauliflower. Many greenhouses in are specialized in the production of vegetable transplants, particularly tomato, lettuce, sweet pepper, eggplant, cabbage, broccoli and cauliflower. Tomato (*Solanum lycopersicum* L.) is a warm season crop and requires a relatively long growing season and moderately high temperature (20-28°C). The optimum fruit setting is at night temperature and the optimum range is 15°-20°C. Tomato, the globally leading popular vegetable belonging to Solanaceae family is being extensively cultivated under protected conditions and gives higher returns. Protected cultivation of tomato offers distinct advantages of earliness, higher productivity and quality particularly pesticide residue free produce, besides higher returns to growers. Being an important vegetable crop, research on every aspect of tomato cultivation to improve the productivity becomes essential. India has entered into the area of greenhouse vegetable cultivation more recently only. India being a vast country with diverse and extreme agro-climatic conditions, the protected vegetable cultivation technology can be utilized for year round and off-season production of high value, low volume vegetables, production of virus free quality seedlings, quality hybrid seed production and as a tool for disease resistance breeding programs . In

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the present scenario of perpetual demand of vegetables and drastically shrinking land holdings in the country, it is the best alternative and drudgery less approach for using land and other resources more efficiently. [1,2]

Analysis of variance revealed significant differences among the 12 hybrids of tomato under polyhouse condition for all the characters studied viz., plant height (cm), height at flowering (cm), node to first inflorescence, internodal length(cm), leaf length (cm), leaf width (cm), days to first flowering, days to fruit set, flowers per cluster, inflorescence per plant, fruit set (%), pollen viability (%), fruits per plant, truss per plant, fruits per truss, fruit length (cm), fruit girth (cm), fruit weight (g), yield /plant (g), TSS, beta carotene, lycopene and ascorbic acid. Mean sum of squares were found significant for all treatment because all genotypes are genetically different from each other and showed significant variation among each other. Mean sum of squares of replication was not significant because among replication there is no significant difference within genotypes. In the present study remarkable variation in the mean performance of hybrids was observed for vegetative characters like plant height, leaf length, leaf width etc. The observations recorded on plant height in different tomato hybrids grown under polyhouse ranged from 1.17 m to 2.80 m. The results indicated that under the polyhouse conditions tomato hybrid Naveen was the tallest with a height of 2.80 m which was on par with Rakshitha (2.79m). [3,4]

The accession INDAM 9802 recorded the minimum height (1.17m) among the hybrids. The plants received comparatively lower light intensity than the open condition there by facilitating cell elongation and increased internodal length leading to an increase in plant height. Ganesan (2001) revealed that Pusa Ruby attained maximum plant height (2.11m) under greenhouse conditions. However, as per the studies tomato hybrids grown in open field conditions show ranges in between the 81 to 181cm. Rakshitha had maximum height at flowering (87.74 cm) while grown under protected conditions. INDAM 9802 had minimum height at flowering (59.09 cm) and was on par with Indam Ruchi (59.26 cm). Polyhouse tomato plants had better plant height and leaf size as compared to open cultivation. Optimum temperature, increased carbon dioxide concentration, better light distribution etc might have contributed to the better crop growth. The hybrid Rakshitha had maximum leaf length (36.72 cm) which was on par with Naveen (36.47 cm). Leaf width was also high in Rakshitha (26.51 cm) and Naveen (26.16 cm). The shaded plants had large leaves with long petioles resulting in more area for better light interception thereby increased the light harvesting efficiency of the plants. This is how plants under shade tend to adjust the specific environment without compromising the yield potential. A higher concentration of carbon dioxide results in greater leaf expansion and larger canopy .[5,6]

II. DISCUSSION

The present study revealed that hybrids showed early flowering under poly house conditions. INDAM 9802 was the earliest to flower (26.27 days) and Rakshitha was the latest to flower (29 days) under polyhouse conditions. Commencement of flowering with minimum number of days is a desirable character since it denotes earliness. The hybrids showed a variation of 9.93 (INDAM 3004) to 14.33 (Rakshitha) for node to first flower. There was a significant difference in the number of flowers per cluster in different tomato hybrids grown under polyhouse (5.65-7.16). The tomato hybrid Malyshock produced 6-7 flowers per inflorescence under plastic green house and a range of 5.00 to 10.00 for flowers per cluster under net house conditions. The inflorescence per plant is an important character which influence the total yield of the plant. Maximum number of inflorescence per plant was recorded in Tomato F1 T 30 (29.80). Though the plants may produce a lot of inflorescence all of them may not bear fruits. Truss per plant ranged from 10.87 in INDAM Ruchi to 24.20 in Tomato F1 T 30 with a mean of 15.39. The number of fruits per truss is a genetic character and is also governed by the micro climatic condition surrounding the tomato plant under the polyhouse conditions. Tomato F1 Queen recorded maximum number of fruits per truss (3.49) among the 12 hybrids. Tomato crop grown under polyhouse conditions produced higher number of fruits per cluster than in the open field conditions because, better environmental conditions under polyhouse helped in better pollination which leads to more fruit setting . INDAM 3004 registered minimum number of fruits per truss (2.01). Reduced number of fruits per truss in tomato hybrids might be due to excessive style elongation and exertion of the stigma through the mouth of the antheridial cone. Pollen viability is one of the essential requirements for good fruitset. Pollen viability was maximum in

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INDAM 3001 (50.16) and minimum in Tomato F1 Queen (40.16). Maximum fruit set percentage was recorded in Arka Rakshak (53.0) whereas INDAM 3004 recorded the minimum fruitset (33.78). [7,8]

There were variations in fruits setting percentage due to variation in pollen release under fluctuating heat stress environment. Fruit length was maximum in Rakshitha (6.74 cm) and minimum in INDAM Ruchi (5.49 cm). Fruits of INDAM 3001 recorded maximum girth of 6.61 cm and fruits of INDAM 3004 recorded minimum girth of 4.68 cm. The observations recorded on average fruit weight in different tomato hybrids grown under polyhouse conditions indicated that tomato hybrid, INDAM 3001 had maximum average fruit weight (102.19 g) whereas, INDAM Ruchi had the minimum average fruit weight (41.81g). There were similar variations for fruit characters under protected cultivation. As far as number of fruits per plant are concerned, the result indicated that under polyhouse Tomato F1 T 30 had the potential of setting maximum fruits per plant (35.66) which was on par with Tomato F1 Queen (35.55). Tomato varieties varied in their reaction under polyhouse conditions than in open field conditions. The genetic make up of the plant decides its yield potential. But the expression of the yield is influenced by the environmental factors in which plant grows. In the present study yield per plant (g) showed a wide variation from 841.77 in INDAM 3004 to 1444.44 in INDAM 9802 which was on par with Tomato F1 T 30 (1412.22) with a mean of 1128.28. Maximum fruit yield per plant of tomato hybrids was due to higher fruit set and higher retention of matured fruits/plant. High yield recorded by INDAM 9802 might be due to the genetic potential of plant to produce fruits in less number but larger in size. Genotypic combination plays an important role in the development of fruit size and weight. A genotype exhibiting a compensation point at low light intensity and temperature may have a high photosynthetic efficiency and such genotypes perform better under shade. Quality characters are very important in any crop especially in vegetables like tomato because they impart nutritional quality of the produce as well as processing quality. In the present study, different hybrids showed variation in quality characters like ascorbic acid, lycopene, TSS and vitamin A. Fruits of INDAM 3003 recorded the highest TSS of 5.36 degree Brix which was on par with Rakshitha (5.35). A low TSS of 5.15 was recorded by NS 2535. The results indicated that under the net house conditions tomato hybrid Naveen recorded maximum ascorbic acid content (25.46mg) whereas, minimum ascorbic acid content (20.64 mg) was recorded in INDAM Ruchi. Increased ascorbic acid content of tomato under shading was also reported by Smitha (2002). Tomato is a rich source of Bbeta carotene. In the present study beta carotene exhibited a range of 145.75 in Arka Rakshak Tomato to 171.30 in F1 T 30. Polyhouse tomato fruits exhibited a higher content of lycopene. Fruits of INDAM 9802 recorded the maximum lycopene content of 11.94 which was on par with INDAM 3003 (11.34) and Arka Samrat exhibited a minimum lycopene content of 5.97. Fruits under shade were uniformly red coloured with very good appearance.[9,10]

III. RESULTS AND CONCLUSIONS

In this study, crop inside poly house was comparatively free from pest and disease incidence. Increased fruit yield per plant under polyhouse condition compared to open field condition due to minimum incidence of pest and insects under polyhouse in tomato . Influence of shade on disease incidence on tomato was good. [11,12]

Under polyhouse conditions, tomato hybrids performed well for yield and quality characters because of favourable conditions which positively influenced the morpho-phenological and physiological events of tomato plants. The differential shade responses of different hybrids is due to the inherent variability that exists among them. It is concluded that INDAM 9802 and Tomato F1 T 30 were found to be the high yielding hybrids under polyhouse conditions for the area under consideration. The higher yields in these hybrids might be due to cumulative effects of early flowering, higher fruit set and higher retention of matured fruits per plant. The optimum temperature accompanied by low relative humidity inside polyhouse hasten crop development and early maturity, so growers are benefited by being able to produce higher and off-season tomato which fetched premium prices in the market.[13,14]

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