

PERFORMANCE EVALUATION OF TOMATO CULTIVARS AT HIGH ALTITUDE

Fayaz Ahmad*, Obedullah Khan*, Sair Sarwar*, Akhtar Hussain* and Sher Ahmad**

ABSTRACT

This experiment was conducted to evaluate the comparative performance of 11 tomato cultivars in the Northern Areas of Pakistan during 2003. It was found that days to first picking, plant height, number of branches per plant, number and weight of fruits per plant, harvesting period, fresh and dry fruit yield showed significant differences among the various cultivars under the trial. Maximum days to first picking (96.40) were recorded in cultivar Local round followed by Shalkot (95.25 days) while Rio grande gave the earliest fruit maturity (82.40 days). Cultivar Local round also showed maximum plant height (110.50 cm), number of branches per plant (10.77) and fruits per plant (98.30) followed by Shalkot, Nagina and Peto-mech-II with 58.47, 51.33 and 46.15 fruits per plant, respectively. The lowest number of fruits per plant (29.47) was found in Nemadina. Cultivar Shalkot attained maximum fruit weight per plant (3.03 kg), fresh fruit yield (68.36 t ha⁻¹) and dry fruit yield (4.49 t ha⁻¹) while cultivar Local round gave the lowest fruit weight per plant (0.83 kg), fresh fruit yield (20.30 t ha⁻¹) and dry fruit yield (1.01 t ha⁻¹). Cultivars Peto-mech-II and Rio grande stood second and third in term of fresh and dry fruit yield, respectively. Longest harvesting period was recorded in Local round (137.67 days) while the cultivar Gala gave the shortest harvesting period (107.23 days). Considering the overall performance it was found that tomato cultivars Shalkot, Peto-mech-II, Rio grande, Red blast and Roma were promising with stable performance, for yield and other characters. However, potential of these cultivars is needed to be further tested under the climatic conditions of the Northern Areas of Pakistan to elicit substantial conclusions.

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill) is an important vegetable; grown in most home gardens and by market gardeners. It can be eaten either fresh or processed into different products. It is helpful in healing wounds because of antibiotic properties found in ripe fruits. It is good source of Vitamins A, B and C (Baloch, A.F, 1994). Four varieties of tomato were tested along with Roma as a check under hot/wet conditions at NARC Islamabad. Xina and AVRDC L-19 were high yielding with 342 and 225 fruits per plant (PARC, Annual Report, 1994). Haque *et al.* (1988) reported that highest yield (103.59 t ha⁻¹) in line TMO 076 on Nov. 15 planting while local check (Roma) took 85-91 days to maturity and produced yield of 47.04 t ha⁻¹. Line TMO 369 Produced the tallest plants (116.60 cm) and line TMO 260 gave the shortest plants (47.63 cm). Sharma and Rastogi (1993) screened six tomato cultivars and reported significant variations among the cultivars for plant height, branches per plant and fruits per plant. Kallo *et al.* (1998) evaluated twenty cultivars of tomato for yield and its components. Considering the overall performance DVRT-1, DVRT-2, Sel-1, H-36 and Sel-10 were promising with stable performance for yield and other characters like plant height, fruits per plant, fruit size and average fruit weight. Mishra and Lal (1998) studied the performance of 39 varieties of tomato and reported that variety Pusa Ruby was found to have maximum fruit yield per plant (2.7 Kg). Manoj and Raghav (1998) studied the performance of 11 cultivars/hybrids of tomato and one control (Plant. T-3). Hybrid Moti produced significantly higher yield over the control. Salon Gola produced the tallest plants whereas the hybrid

Lerica gave the earliest days to 1st picking. Maximum dry matter was produced by the control. Sanjoy *et al.* (1999) studied the impact of seedling age (15 or 30 days old) and planting time (Early: 16 November or late: 16 December) on the fruit yield performance of tomato cultivars. They reported that among the tomato cultivars remarkably good fruit yield of 60.70 t ha⁻¹ and 41.9 t ha⁻¹ during 1994-95 and 1995-96, respectively. Sandhu *et al.* (1999) studied the effect of staking on the performance of tomato cultivars and reported that staking had no significant effect on yield. Differences among the cultivars, however, were significant. The highest fruit yield (537.75q ha⁻¹) was obtained by cultivar Rashmi. Hassan *et al.* (2000) evaluated twenty-one tomato cultivars and lines as potential parents' hybrids in 1995. Line VFNT produced the highest early and total yield. C.V Oxheart produced the heaviest fruits (215.5 g). In 1996 the highest significant marketable yield was produced by hybrids Moneymaker x Castlerock and by hybrids Moneymaker x Giza 80 in 1997. Muthuvel *et al.* (2000) studied the performance of different tomato genotypes and reported that the genotypes LE 1253, LE 1258, LE 1259 and LE 1265 were superior with respect to yield attributing characters at high temperature conditions. Moya *et al.* (2000) assessed the performance of 41 tomato genotypes. Amalia and Mariela were notable since they maintained high yield and produced large fruits as did B-2-1 and A-31 lines. Chaudhuri *et al.* (2000) evaluated tomato variety Pusa Ruby and 6 hybrids for yield and resistance to insect and pest and revealed that considering overall performance with regard to relative tolerance to insect pest and yield, Arjuna

* National Tea Research Institute Shinkiari, Mansehra - Pakistan

** Karakoram Agricultural Research Institute for Northern Areas, Juglote, Gilgit - Pakistan

(84.34 t ha⁻¹) is recommended. Jaha and Krishi (2001) conducted experiment to evaluate the performance of 4 hybrids cultivars of tomato (Abinash-2, Rashmi, Vaishali and Naveen) grown in polyethylene shades under two different planting methods (direct sowing and transplanting). Under direct sowing, Naveen gave the highest number of fruits per plant (61.77), the highest fresh fruit yield per plant (4.30 kg), the earliest fruit maturity (80.33 days after sowing or DAS) and the longest harvesting period (163.00 DAS). Vaishali recorded the earliest flowering (41 DAS) and the highest individual fruit weight (95.70 g). Under the transplanting method Naveen recorded the earliest flowering (49.33 DAS), the highest fresh fruit yield per plant (4.33 kg) and the highest harvesting period (165.33 DAS). Abinash recorded highest number of fruits per plant (69.07), Vaishali recorded the earliest fruit maturity (84.00 DAS) and Rashmi recorded the highest individual fruit weight (101.70 g). Rida *et al.* (2002) evaluated thirteen open pollinated cultivars and three hybrids of tomato and reported that marketable yield ranged from 76.07 t ha⁻¹ (Rio grande) to 37.07 t ha⁻¹ (Money maker).

The climatic conditions of the Northern Areas of Pakistan are highly conducive and congenial for the production of different vegetables. But this climatic suitability is not being exploited to the full extent due to many reasons. Among which the unavailability of improved and high yielding cultivars coupled with less awareness of crop management is most important. Due to low production of tomato crop most of the demand is met by transporting the produce from Mansehra and Swat districts of NWFP. As the area is always in danger to be cut off from the rest of the country for a longer period due to continuous land slides and consequently blockage of the Karakoram High Way (KKH), the only ground route to the Northern Areas, hence it is imperative to get self sufficiency at local level to meet any untoward situation. This study was conducted to select the high yielding tomato cultivars suitable for the climatic conditions of the Northern Areas of Pakistan to enhance the productivity of tomato crop at local level.

MATERIALS AND METHODS

This study was conducted at Karakoram Agricultural Research Institute for Northern Areas (KARINA) Juglot, some 50 km South East of Gilgit during 2003. The experiment was laid out in Randomized Complete Block Design with three replications. Plant to plant and row-to-row distances were kept 60 x 60 cm. The sub plots size was 10 m². The cultivars of tomato evaluated were Local round,

Red blast, Modi red, Nagina, Gala, Pesto-mech-II, Nemadina, Shalkot, Roma, Liger-87 and Rio grande. Nursery was raised under plastic tunnels by sowing seeds on January 05, 2003. Since temperature drops below 0C⁰ during winter, therefore plastic covers provide enough heat to make the germination successful. Young seedlings were transplanted to field on March 18, 2003. Each cultivar was given the same management treatments i.e. fertilization, irrigation, weeding and spray against insects, pest and diseases. Fruits were harvested at ripe stage throughout the harvesting period. Data were collected on various parameters as discussed below. Data were analyzed statistically by using analysis of variance techniques with the help of computer software MSTAT-C. Duncan's New Multiple Range Test was used to determine the differences among the means for different plant growth and yield parameters.

RESULTS AND DISCUSSION

Days to First Picking

The data presented in Table I regarding days to first picking indicate significant differences among 11 tomato cultivars. It was found that cultivar Rio grande gave the earliest days to first picking (82.40) after transplantation followed by Liger-87 and Roma with 83.07 and 85.33 days respectively, while cultivar Local round recorded maximum days to first picking (96.04) followed by Shalkot (95.25 days). The early or late maturity is attributed as genotypic character and somewhat influenced by the environmental factors of any particular growing area. Jaha and Krishi (2001) reported that under direct sowing method cultivar Naveen gave the earliest fruit maturity (80.33 DAS) while under transplanting method cultivar Vaishali recorded the earliest fruit maturity (84.00 DAS).

Plant Height

It is evident from Table I that significant differences were recorded in plant height by tomato cultivars. Local round with a plant height of 110.50 cm was recorded as the tallest followed by Shalkot (102.30 cm), Nemadina (67.47 cm), Nagina (67.00 cm) and Red blast (64.25 cm). Minimum plant height (47.60 cm) was noted in Liger-87. Thus a wide range of plant height (47.60-110.50 cm) was observed in the test cultivars. The tallness, shortness and other morphological differences are varietal characteristics, which are controlled and expressed by certain genes. These results coincide with the findings of Haque *et al.* (1988) who reported that line TMO 369 produced the tallest plant (116.60 cm) and line TMO 260 gave the shortest plants of 47.63 cm height during evaluation of tomato lines. Kallo *et al.* (1998) and Manoj and Ragav (1998) also reported differences in

plant height among cultivars/hybrids of tomato put under evaluation and screening trials.

Number of Branches Plant¹

Cultivar Local round produced significantly higher number of braches per plant (10.77) over other cultivars. Cultivars Shalkot, Nagina, Rio grande and Red blast with 10.30, 9.10, 8.83 and 8.25 branches per plant followed it respectively. The lowest number of branches per plant was recorded by Liger-87 (5.25) and Nemadina (5.80). The data show an increasing tendency in the number of branches per plant with an increase in the plant height. These results are in close conformity with the findings of Sharma and Rastogi (1993) who reported significant variation among the cultivars of tomato for the number of branches per plant.

Number of Fruits Plant¹

Like other yield and growth parameters significant variations were observed in the number of fruits per plant among the tomato cultivars (Table I). Local round, Shalkot, Nagina, Peto-mech-II and Roma excelled other cultivars with 98.30, 58.47, 51.33, 46.15 and 45.47 fruits per plant respectively. Nemadina gave the minimum number of fruits per plant (29.47) followed by Liger-87 (30.55) and Gala (36.37). These results resemble with those of Jaha and Krishni (2001) who reported that among 4 hybrid cultivars of tomato Abinash recorded the highest number of fruits per plant (69.07).

Fruit Weight Plant¹

Data in Table II revealed that cultivar Shalkot with 3.03 kg fresh fruit weight per plant was significantly higher yielder than other cultivars. Other cultivars i.e. Peto-mech-II, Rio grande, Red blast and Roma also gave remarkably good fruit weight per plant of 2.84, 2.73, 2.63 and 2.57 kg respectively. Local round recorded the minimum fruit weight per plant (0.83 kg) followed by Liger-87 (1.82 kg) and Gala (2.2 kg). Jaha and Krishni (2001) reported 4.03 kg fresh fruit yield per plant in cultivar Naveen while Mishra and Lal (1998) reported that variety Pusa Ruby gave the maximum fruit yield per plant (2.7 kg) among the 39 tomato cultivars.

Harvesting Period

A wide range of 30.44 days was recorded in the harvesting period among the cultivars. Highest

harvesting period of 137.67 days was observed in Local round followed by Shlakot (133.10 days), Roma (128.53 days), Nagina (128.35 days) and Rio grande (125.50 days). The shortest harvesting period of 107.23 days was given by Gala. The remaining cultivars were in the range of 110.30-121.50 days. Jaha and Krishni (2001) recorded the highest harvesting period of 165.33 day in cultivar Naveen under the transplanting method.

Fresh Fruit Yield

Fresh fruit yield data in the Table II indicate significant variations among the cultivars. Cultivar Shalkot ranked 1st in term of fresh fruit yield (68.36 t ha⁻¹) followed by Peto-mech-II (66.44 t ha⁻¹), Rio grande (63.35 t ha⁻¹), Red blast (61.53 t ha⁻¹) and Roma (60.44 t ha⁻¹). Minimum fresh fruit yield (20.30 t ha⁻¹) was produced by Local round. The highest fresh fruit yield of these cultivars may be attributed to the highest fruit weight per plant (Table II). These results agree with those of Sanjoy *et al.* (1999) who recorded fruit yield of 60.70 t ha⁻¹ and 47.00 t ha⁻¹ from cultivar BT 18 during 1994-95 and 1995-96 respectively. While Rida *et al.* (2002) reported that marketable yield ranged from 76.18 t ha⁻¹ (Rio grande) to 37.07 t ha⁻¹ (Money maker) in thirteen open pollinated cultivars and three hybrids of tomato screened for yield and growth characters.

Dry Fruit Yield

Cultivar Shalkot, Peto-mech-II, Rio grande, Nagina and Red blast gave significantly higher dry fruit yield of 4.49, 4.27, 4.06, 3.91 and 3.53 t ha⁻¹ respectively than other cultivars. The differences among Red blast, Modi red, Gala and Nemadina were not significant. Lowest dry fruit yield (1.01 t ha⁻¹) was recorded by Local round. Differences in dry fruit yield might be due to differences in fresh fruit yield and nature of fruits in term of their succulence and dry matter content. Manoj and Ragav (1998) reported maximum dry matter by Pant T-3 used as control among 11 tomato cultivars studied for their performance.

CONCLUSION

On the basis of these findings tomato cultivars i.e. Shalkot, Peto-mech-II, Rio grande, Red blast and Roma are recommended as commercial cultivars for the Northern Areas of Pakistan.

Table I Performance evaluation of tomato cultivars at high altitude

Cultivar	Days to 1 st picking	Plant height (cm)	Number of Branches plant ⁻¹	Number of Fruits plant ⁻¹
Local round	96.40 a	110.50 a	10.77 a	98.30 a
Red blast	86.33 cde	64.25 cd	8.25 abc	40.28 de
Modi red	88.67 bcd	57.13 de	6.75 abc	38.50 de
Nagina	93.50 ab	67.00 c	9.10 abc	51.33 bc
Gala	89.25 bc	53.30 ef	6.25 c	36.37 de
Peto-mech-II	90.78 abc	54.63 ef	6.50 bc	46.15 cd
Nemadina	92.23 ab	67.47 c	5.80 c	29.47 e
Shalkot	95.25 a	102.30 b	10.30 ab	59.47 b
Roma	85.33 cde	58.20 de	7.17 abc	45.47 cd
Liger-87	83.07 de	47.60 f	5.25 c	30.55 e
Rio grande	82.40 e	60.87 cde	8.83 abc	42.70 cd
LSD (0.01)	5.73	7.86	4.03	10.88

Means followed by same letter (s) do not differ significantly at 1% level of probability

Table II Performance evaluation of tomato cultivars at high altitude

Cultivar	Fruit weight Per plant (kg)	Harvesting Period (days)	Fresh yield (t ha ⁻¹)	Dry yield (t ha ⁻¹)
Local round	0.83 c	137.67 a	20.30 h	1.01 c
Red blast	2.363 ab	110.30 hi	61.53 b	3.53 ab
Modi red	2.44 ab	112.40 gh	57.56 cd	3.70 ab
Nagina	2.34 ab	128.35 bc	55.16 de	3.91 a
Gala	2.24 ab	107.23 i	52.04 f	3.35 ab
Peto-mech-II	2.84 a	115.67 fg	66.44 a	4.27 a
Nemadina	2.28 ab	121.50 de	53.72 ef	3.45 ab
Shalkot	3.03 a	133.10 ab	68.36 a	4.49 a
Roma	2.57 ab	128.53 bc	60.44 bc	4.06 a
Liger-87	1.82 b	117.90 ef	42.32 g	2.37 bc
Rio grande	2.73 a	125.50 cd	63.35 b	4.11 a
LSD (0.01)	0.88	4.99	2.93	1.38

Means followed by same letter (s) do not differ significantly at 1% level of probability

REFERENCES

- Baloch, F.A. 1994. Vegetable crops. In: Horticulture. National Book Foundation, Islamabad. 508p.
- Chaudhuri, N., D.C. Deeb and S.K. Senapati. 2002. Evaluation of commonly grown tomato variety and hybrids in Terai region of West Bengal. Deptt. Zool. Univ. of North Bengal, Envir. and Ecol. 18(4): 933-939.
- Hassan, A.A., S.E. Mustafa, K.E.A. Ati and A.A. Muhammad. 2002. Development and release of some new tomato hybrids. Egypt. J. Hort. 27(2): 201-218.
- Haque, M.M., A.K.M. Rehman and S.M.M. Hossain. 1998. Physiological and yield potential of some promising tomato lines at different planting times. Pak. J. Agric. Res. 9(3): 359-362.
- Jaha, J.C. and B. Krishi. 2001. Studies on performance of different tomato hybrids in off-season under different planting methods in Terai agro-climatic zones of West Bengal. Uttar Banga Krishi Viswavidyalaya, W. Bengal, India, J. Interacademia 5(2): 186-189.
- Kallo, G., S.N.G. Chaurasia, S. Major and M. Singh. 1998. Stability analysis in tomato. Vegetable Research, Ghandi Nagar, India. Vegetable Sci. 25(1): 81-84.
- Manoj, R. and M. Raghav. 1998. Performance of F1 hybrids and high yielding varieties of tomato under mid-west plains of Uttar Pardesh. Progressive Hort. 30(3): 194-197.
- Mishra, Y.K. and S.D. Lal. 1998. Studies on varietal performance of tomato under the agro climatic conditions of U.P. hills. Progressive Hort. 30(3): 153-157.
- Moya, C., M. Alvarez and A. Caballero. 2000. Evaluation of new tomato lines based on producer's criteria of the methodology used. Departamento de

- Genetica, La Habana, Cuba, Cultivos-Tropicales. 21(3): 75-79.
- Muthuvel, I.S.T., D. Veeraragavathatham and V. Kanthaswamy. 2000. Performance of tomato under normal season and high temperature simulated glass house condition. South Indian Hort. 48(1): 96-99.
- PARC Annual Report. 1994. Directorate of Publication. Pak. Agric. Res. Council, Islamabad. 48p.
- Rida, A.S., A.A. Muhammad, I.E. Ereifij and A. Hussain. 2002. Evaluation of thirteen open pollinated cultivars and three hybrids of tomato (*Lycopersicon esculentum* Mill.) for yield, physiological disorders, seed production and vegetative growth. Pak. J. Agric. Res. 17(3): 290-296.
- Sandhu, M.S., Jaspreet, S. Daljit, J. Singhand and D. Singh. 1999. Effect of training system on fruit yield and quality attributes of different tomato (*Lycopersicon esculentum* Mill.) cultivars. Deptt. Veg. Crops, Punjab Agric. Univ. Ludhiana. Vegetable Sci. 26(2): 201-202.
- Sanjoy, S., P.Jahaand and S. Saha. 1999. Impact of seedling age and planting time on yield performance of tomato in upland rice based cropping system. Indian J. Agron. 44(4): 669-672.
- Sharma, S.K. and K.B. Rastogi. 1993. Evaluation of some tomato cultivars for seed production under mid hill conditions of Himachal Pardesh. Annals of Agric. Res. India. 14(4): 494-496.