Seed Research, Vol. 35(2): 151-154, 2007

Studies on Stigma Receptivity of Female Parent in Tomato Hybrid Seed Production

R.B. JOLLI, B.S. VYAKARANAHAL, M. SHEKARAGOUDA, P.R. DHARMATTI AND A.A. PATIL

Regional Agricultural Research Station, Bijapur College of Agriculture, University of Agricultural Sciences, Dharwad 586 101
jollirb@rediffmail.com

ABSTRACT A field experiment was conducted during *rabi* 2002 and 2003 at Agricultural Research Station, Hanumanamatti of Haveri District in Karnataka to ascertain the peak period of stigma receptivity of seed parent (Arka Alok) in DTH-1 hybrid seed production. The pooled data had indicated that the pollination on two days and three days after emasculation of flowers recorded higher fruit set (53.01 and 55.89%), crossed fruit yield (2124 and 2406 g/plant), seed recovery per cent on net weight basis (4.19 and 4.46) number of seeds (87.56 and 96.68) per fruit, seed yield (10.93 and 11.72 g) per plant and seed quality such as germination (93.73 and 94.93%), seedling vigour (1594 and 1709) and field emergence (89.35 and 90.13%) as compared to the pollination on same day, one day, four day and five days after emasculation.

Key words: Stigma receptivity, Fruit set, Seed yield, Quality, Hybrid Seed Production

Tomato (*Lycopersicon esculentum* Mill.) is the most valuable commercial fruit vegetable crop of India. In recent years rapid development of improved varieties and hybrids along with better technology for increasing the production has assumed the tomato cultivation on commercial status. The heterosis in tomato has been exploited for developing hybrids through hand emasculation and pollination technique [1]. Transfer of pollen from the pollen parent to the seed parent is the hardest obstacle in large scale production of hybrid tomato seed. The maximum stigma receptivity is on second day after emasculation of flower as exhibited by higher values of fruit set, whereas pollination just after emasculation leads to lower fruit set and also lesser number of seeds per fruit. This means at the time of emasculation the stigma is capable of receiving pollen but all the ovules are not ripe and as a result less number of seeds are produced [2]. Further, the stigma receptivity is also influenced by the environmental factors such as temperature, light and relative humidity. There are very limited and conflicting reports on stigma receptivity in order to obtain maximum fruit set, seed set, seed recovery per cent and good quality seeds. The information on hybrid seed production of newly developed tomato hybrid (DTH-1) from UAS, Dharwad is not available. Hence, a study on stigma receptivity of female parent (Arka Alok) in tomato hybrid seed production was initiated.

MATERIALS AND METHODS

The experiment was conducted at Agricultural Research Station, Hanumanamatti of Haveri district in Karnataka, during *rabi* season of 2002 and 2003. It is situated at 14° 39' 'N' latitude. 75° 33 'E' longitude and at an altitude of 594.36 m above mean sea level. The mean maximum temperature varied from 25 to 31°C and from 22 to 37°C whereas the minimum temperature varied from 17 to 27°C and from 19 to 26°C during the experimentation period of 2002 and 2003, respectively. The experimental site consisted of red sandy loam soil and neutral in reaction. The experiment was conducted during the first week of October in both the years. The male parent was staggered to get sufficient pollen throughout the crossing

Received July 2006 Revised November 2006 Accepted April 2007

programme. Fifty per cent of the male parent was planted ten days before the female planting and remaining 50 per cent of the male along with the entire female planting was done. The experiment was laid out in randomized block design with six treatments replicated four times. The spacing of 60 x 60 cm was followed with the net plot size of 3.0 x 2.4m ($7.2m^2$). The tomato hybrid DTH-1 parental seed was obtained from the Department of Horticulture, University of Agricultural Sciences, Dharwad.

The experiment consisted of six treatments of pollination after hand emasculation *viz.*, pollination on the day of emasculation (P_1), pollination for one day (P_2), two days (P_3), three days (P_4), four days (P_5) and pollination five days after emasculation (P_6) and laid out in randomised block design with four replications.

The observation on number of flowers pollinated, number of crossed fruits, fruit set percentage, fruit weight, fruit yield, seed recovery percentage, seed weight per fruit, seed yield per plant, germination percentage, field emergence and seedling vigour index were recorded as per the procedure suggested by Abdul Baki and Anderson [3]. Two years pooled data was subjected for statistical analysis [4].

Procedure of Emasculation: Flower buds, which were expected to open on next day, were selected, emasculation was done between 2.00 to 6.00 pm using pointed forceps. Previous day emasculated flowers in five tagged plants in each treatment were pollinated and labelled. The number of pollinated flower buds of five labelled plants were counted and the mean number of crossed flowers per plant were worked out.

Pollen collection

Fully opened flowers were plucked and filled in a polythene bag during early hours of the day. Anther cones separated and spread on a cloth and exposed to sun for three hours. Dried anthers were kept in a steel cup covered with muslin cloth and another steel cup in an inverted position was placed over it. This was agitated rigorously. The pollens were separated out from the anthers and filtered through muslin cloth in an empty cup. Separated pollens from the anthers in this way were transferred to plastic container with the help of a camel hair brush. The plastic cup was kept in a cool place over night under ambient condition. These stored pollens were used for pollination of the emasculated flower buds.

Pollination

The pollen stored under ambient conditions were subjected in plastic pollen ring specially designed to carry out hand pollination. The stigma of the emasculated flower buds were dipped in the pollen ring to effect pollination, the fresh and fully opened male flowers were directly used for pollination. Two calyx of the pollinated flower buds were given half cut after pollination for crossed fruits for identification. The pollination was carried out between 8.00 am to 12.00 noon.

RESULTS AND DISCUSSION

The data presented in Table 1 revealed that there was significant differences among the pollination treatments. Whereas, the number of flowers pollinated per plant was non-significant. Number of crossed fruits per plant was found to be significant in both the years (2002 and 2003) due to different days of pollination. The number of crossed fruits per plant were significantly higher in P_4 (42.91) as compared to other treatments (Table 1) followed by pollination after two days (P_3) of emasculation (41.49). The maximum stigma receptivity was observed with three days after emasculation then onwards it declined up to fifth day after emasculation.

The degree of stigma receptivity (based on per cent fruit set) was recorded significantly higher in P_4 as indicated by the fruit set (55.89) over rest of the treatments followed by P_3 (53.01), P_2 (50.62), P_4 (45.38) and same day P_1 (37.87) (Table 1). This had indicated that the peak stigma receptivity was on third day after emasculation under Hanumanamatti condition since the delayed pollination, particularly on fourth and fifth day had resulted in reduced fruit set. This may be due to the drying of stigmatic surface that led to the reduction in fruit set percentage.

The pollination, three days after emasculation

(P_4) recorded significantly highest fruit yield of 2405.86 g per plant over the rest of the pollinations *viz.*, pollination at two (P_3, 2123.70 g), one (P_2, 1832.96 g), four (P_5, 1766.35 g), same day (P_1, 1324.05 g) and five days (P_6, 1118.03 g/plant) after emasculation (Table 1). An increase in the crossed fruit yield per plant in pollination of three days after emasculation compared to other treatments may be due to significant increase in the number of crossed fruits per plant (42.91), higher fruit set percentage (59.89) and higher fruit weight (83.69g) (Table 1). The similar results were also reported in tomato hybrid seed production (5, 6, 7). The lowest fruit yield per plant was recorded in the treatment of pollination on the day of emasculation as well as in the treatment of pollination five days after emasculation (1324.05 g and 1118.03 g respectively), this may be due to all immature ovules when pollinated on the day of emasculation and failure of fertilization due to less receptive stigmatic surface because of dry weather conditions prevailing during this period when pollinated on 5th day after emasculation.

Significantly highest seed recovery percentage (4.46%) was recorded in the treatment of pollination at three days after emasculation (Table 1). This was on par with the pollination at two days after emasculation (4.19%) and there was no significant difference among the rest of the treatments.

A significant increase in the seed yield per plant in (11.72 g/plant) P_4 (three days after emasculation) may be attributed to higher seed weight (0.764g) and higher seed number (96.68) per fruit (Table 1). Similar results were also reported in the Pusa hybrid-1 and Pusa hybrid-2 tomato seed production [7]. The above findings corroborate the reports of [5], who have obtained maximum hybrid seed yield when buds were pollinated two days after emasculation. The lower seed yield per plant was observed when the pollination was done on the same day after emasculation (7.26 g) as well as in the pollination five days after emasculation (5.97 g) (Table 1). This may be due to the lower number of seeds per fruit and seed recovery pen cent. Lower seed yield per plant in early pollination may be due to higher number of immature pollens pollinated at early stage but at later stage high viable pollens pollinated on less receptive stigma. Hence, this led to lower seed formation in the fruit of these treatments. These results are in agreement with the findings of Yogeesha *et al.* [7].

Table 1. Effect of stigma receptivity on seed yield and its components of seed parent (Arka Alok) of DTH-1 tomato hybrid (pooled data of two years, 2002 and 2003)

Pollination on different days	No. of flowers pollinated/ plant	No. of crossed fruits/ plant	Fruit set (%)	Crossed fruit wt. (g)	Crossed fruit yield/ plant (g)	No. of seeds/ fruit	Hybrid seed wt./ fruit (g)	Hybrid seed yield/ plant (g)	Seed recovery/ fruit(%)
P_1	74.58	27.27	37.87	64.64	1324.05	35.88	0.463	7.26	3.53
P_2	77.04	39.16	50.62	74.01	1832.96	80.38	0.623	10.32	4.06
P_3	78.27	41.49	53.01	80.27	2123.70	87.56	0.689	10.93	4.19
P_4	76.74	42.91	55.89	83.69	2405.86	96.68	0.764	11.72	4.46
P_5	76.02	34.48	45.38	71.63	1766.35	70.18	0.569	6.79	3.67
P_6	77.12	22.12	27.53	64.52	1118.03	36.82	0.457	5.97	3.50
Mean	76.63	34.57	45.05	73.18	1761.83	67.92	0.594	8.83	3.90
S.Em +	1.56	1.04	1.50	1.52	49.01	2.86	0.03	0.26	0.12
CD(P=0.05)	NS	3.10	4.49	4.55	146.93	8.59	0.08	0.76	0.37

P_1 : Pollination on the day of emasculation; P_2 Pollination one day after emasculation; P_3 : Pollination two days after emasculation; P_4 : Pollination three days after emasculation; P_5 : Pollination four days after emasculation; P_6 : Pollination five days after emasculation; NS : Non significant

Seed quality parameters

Pollination on three days after emasculation (P4) recorded significantly higher germination (94.93%) and field emergence (90.13%) over pollination on the same day and five days after emasculation (Table 2). But it was on par with the pollination on two days and four days after emasculation. Significantly higher germination and field emergence per cent recorded in the treatment of pollination at three days after emasculation may be due to higher seed weight and also bolder seeds.

Significantly higher seedling vigour index (1709) was recorded in the treatment of pollination at three days after emasculation followed by pollination on two days after emasculation (1594) over the rest of the pollination treatments (Table 2). The increase in seedling vigour in the treatment of pollination at three days and two days after emasculation can also be attributed to the higher per cent of germination, root length and shoot length, as the seedling vigour index calculated by the multiplication of germination percentage with the sum total of root and shoot length. These results are also in agreement with the reports [1, 5] in different tomato hybrid seeds production [5, 6, 7].

Table 2. Influence of pollination days after emasculation on seed quality of DTH-1 hybrid tomato seed (pooled data of two years, 2002 and 2003)

Pollination on different days	Germination (%)	Field emergence	Root length (cm)	Shoot length (cm)	Seedling vigour index
P_1	74.41 (93.49)*	69.34 (87.32)*	6.70	6.03	1229
P_2	75.50 (93.27)	70.51 (88.48)	8.53	7.83	1537
P_3	75.72 (93.58)	71.14 (89.35)	8.86	8.15	1594
P_4	77.70 (94.91)	71.85 (90.13)	9.46	8.77	1709
P_5	75.67 (93.33)	70.10 (88.17)	7.86	7.35	1415
P_6	74.43 (91.98)	69.53 (87.53)	7.49	6.82	1328
Mean	75.51 (93.86)	70.41 (88.55)	8.16	7.47	1469
S.Em +	0.68	0.82	0.09	0.07	13
CD(P=0.05)	1.95	2.44	0.28	0.20	40

From the above results, it can be concluded that the pollination on two days or three days after emasculation recorded higher fruit set, fruit yield, seed yield, seed recovery, number of seeds per fruit and superior seed quality parameters such as germination, field emergence, vigour index, over the present practice of pollinating one day after emasculation.

REFERENCE

1. KALLOO, G. (1995). Heterosis Breeding in vegetable crops. Present Status and Future Prospects. In: *Hybrid Research and Development*, (Ed.) Rai M. and Mauria S. *Indian Society of Seed Technology*. Department of Seed Science and Technology, IARI, New Delhi.
2. SIDHU, A.S., G. KALLOO, & M.C. PANDITA. (1980). Studies on some important aspects of floral biology in vegetable crops- A review. *Haryana J. Horti. Sci.*, **9**: 207-217.
3. ABDUL-BAKI, A.A. & I.D. ANDERSON (1973). Vigour determination in soybean by multiple criteria. *Crop Sci.*, **13**: 630-633.
4. PANSE, V.G. & P.V. SUKHATME (1978). *Statistical Methods for Agricultural Workers*, Indian Council of Agricultural Research, New Delhi, pp. 162-174.
5. CHITHRA DEVI, L. (2000). Determination of optimal conditions for the production of tomato hybrid seeds. *Ph.D. Thesis*, Indian Agricultural Research Institute, New Delhi.
6. DEV, H. (1997). The modification of flower structure by environment in varieties of *Lycopersicon esculentum*. *J. Agr. Res.*, **58**: 79-117.
7. YOGEESHA, H.S., A. NAGARAJA & S.P. SHARMA (1999). Pollination studies in hybrid tomato seed production. *Seed Sci. & Technol.*, **27**: 115-122.