IJBPAS, May, 2019, 8(5): 1078-1083

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

EVALUATION OF UNILATERAL INCOMPATIBILITY AND CROSSING INDEX FOR INTERSPECIFIC HYBRIDIZATION IN TOMATO

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Received 16th Dec. 2018; Revised 5th Jan. 2019; Accepted 30th Jan. 2019; Available online 1st May 2019

https://doi.org/10.31032/IJBPAS/2019/8.5.4720

ABSTRACT

Tomato interspecific crossing programme was studied with two Indian tomato (*L. esculentum*) cultivars and six accessions of *L. peruvianum.* In reciprocal crosses an unilateral incompatibility was observed especially when *L. peruvianum* used as a maternal parent. While unilateral compatibility was noticed in crosses involved *L. esculentum* as a maternal parent with more than 50% crossing index coupled with normal fruit development. However, abnormal seed development was resulted with immature seeds due to post zygotic sterility. Between two tomato cultivars, cv. Dhanashree recorded higher crossing index (53.52%) than the cv. 85-1 (50.15%). While among the six accessions of *L. peruvianum*, the highest crossing index (55 –57.28 %) was recorded by EC 106294 while the lowest (46-46.67 %) by EC 486.

Keywords: Interspecific hybridization, unilateral incompatibility, biotic stresses, prezygotic sterility, unilateral compatibility

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is a commercially important vegetable crop throughout the world for fresh fruit market and the processed food industry. It is grown under a wide range of climates (temperate to tropical) in the open field or

under protection (e.g. in ventilated polyhouse / heated glasshouse).

Normally the cultivated tomato is exclusively self-pollinated crop but natural cross pollination (NCP) has been reported from 1.9 to 47.0% in various locations of California (Rick, 1949). However, wild tomato species are self incompatible and exclusively cross pollinated due to exerted stigma over anthercone (Rick, 1978).

Cultivated tomato is highly susceptible to several pathogens, insects and pests. An extensive survey of resistance made to identify source of resistance, which are mainly found in wild *Lycopersicon* species.

The most urgent need for tomato improvement is incorporation of horizontal resistance against viral diseases as viruses are not under chemical control and have poly races and therefore, resistance is a polygenic character. At present the major threat for tomato cultivation under tropical climates is incidence of viral diseases i.e. Tomato Spotted Wilt Virus (TSWV) and Tomato Leaf Curl Virus (TLCV). To date no commercial tomato cultivar is developed to offer horizontal resistance against both viral diseases. In this context, tomato interspecific hybridization can play a vital role; as sources of resistance for both these viral diseases are reported in distantly related wild species like *L. peruvianum* and *L. chilense* (Kalloo, 1991).

MATERIALS AND METHODS

The present study was undertaken to assess the crossing compatibility in tomato interspecific hybridization programme involving *L. Peruvianum* accessions.

Two cultivated tomato cvs. viz. Dhanashree and 85-1 which are developed by Tomato Improvement Scheme, MPKV, Rahuri were reciprocally crossed with six accessions of *L. peruvianum* viz., EC 127774, EC 106294, EC 252, EC 486, EC 34479 and EC 492, where seeds of *L. Peruvianum* were obtained from Tomato Genetic Centre, University of California, USA.

One hundred crosses for each cross combination were obtained while using cultivated tomato as a maternal parent. Whereas fifty crosses for each cross combination were attempted when tomato cultivar used as a pollen parent. All sexual crosses were made during *kharif* and *rabi* season. Receptive stigma and viable pollen were identified at the time of anthesis. Per cent crossing index was measured as per cent fruit set from crossed flowers. The fruit set in tomato interspecific hybridization programme was observed only in one way

crossing (i.e. in 12 cross combinations) when tomato cvs. used as a maternal parent thus, unilateral incompatibility was observed during interspecific crossing in tomato.

RESULTS AND DISCUSSIONS

For assessing unilateral incompatibility in tomato interspecific hybridization the two Indian tomato (*L. esculentum*) cultivars were used as a pollen as well as maternal parent, with six accessions of wild Lycopersicon species *L. peruvianum.*

Using cultivated tomato cv. as a pollen parent: Total 600 crosses were made in twelve cross combinations. However, not a single cross showed any fruit set and every cross resulted into flower drop (Table 1). Thus, unilateral incompatibility was observed in tomato interspecific hybridization when wild tomato was used as a maternal parent and cultivated tomato as a pollen parent. These results were in agreement of Tigchelaar (1986) and Patil (1993) who also reported prezygotic sterility (i.e. flower drop) in tomato interspecific hybridization while using cultivated tomato as a pollen parent.

Using tomato cvs. As a maternal parent: Overall 1209 crosses were made from twelve cross combinations out of which 627 crosses recorded fruit set (51.86%, Table 2). Thus, unilateral compatibility was observed in tomato interspecific hybridization programme. When cv. Dhanashree used as a maternal parent, 53.52 % crossing index was noticed while 50.15% crossing index recorded with cv. 85-1 (Table 3).

While among six pollen parents of *L. Peruvianum,* the fruit set ranged from 46.34 to 56.14 per cent (Table 4). The highest crossing index was registered by the *L. peruvianum* accession, EC 106294 (57.28 and 55.06 with cv Dhanshree and 85-1 respectively (Table 3) while, the lowest by EC 486 (46.00 and 46.67% with cv. Dhanashree and 85-5 respectively Table 3).

However, even though, an unilateral compatibility was noticed while using cultivated tomato cvs. as a female parent with more than 50% fruit set associated with normal fruit development in tomato interspecific hybridization, the abnormal seed development was noticed as no matured seeds were observed in crossed fruits at physiological maturity (50 days after pollination). While few seeds (33-48) were partially developed with various immature stages. It clearly showed post zygotic sterility during tomato interspecific hybridization programme even after attempting unilateral compatible cross combination. These results

confirmed the finding of Rick (1979) as post zygotic sterility was reported during tomato interspecific hybridization. Nevertheless Kosova and Kiku (1979) reported that failure of hybridization between *L. esculentum* x *L. Peruvianum* was due to death of embryo through lack of nutrition caused by disturbances in development of endosperm and it's subsequent degeneration.

Thus, for development of tomato interspecific hybrids, it is prerequisite to use tissue culture techniques like embryo culture or immature seed culture to overcome the post-zygotic sterility. In this context, the various fruit developmental stages upon pollination will be crucial factor for culture of embryos or immature seeds.

Table 1: Evaluation of crossing index for interspecific hybridization of *Lycopersicon esculentum* x *L. peruvianaum*: Using wild tomato (*L. peruvianum*) as a maternal parent

Maternal parent	Pollen parent	No. of crosses made	No. of fruit set	Per cent fruit set (Crossing index)
EC 127774	Dhanashree	50	0	0
EC 106294		50	0	0
EC 252		50	0	0
EC 486		50	0	0
EC 34479		50	0	0
EC 492		50	0	0
	Total	300	0	0
EC 127774	85-1	50	0	0
EC 106294		50	0	0
EC 252		50	0	0
EC 486		50	0	0
EC 34479		50	0	0
EC 492		50	0	0
	Total	300	0	0
	Grand total	600	0	0

Table 2: Evaluation of crossing index for interspecific hybridization of *Lycopersicon esculentum* x *L. peruvianaum*: Using wild tomato (*L. peruvianum*) as a pollen parent

Maternal parent	Pollen parent	No. of crosses made	No. of fruits set	Per cent fruit set (Crossing index)	No. of mature seed per fruit at harvest	No. of immature seed per fruit at harvest
Dhanashree	EC 127774	105	59	56.20	-	46
	EC 106294	103	59	57.28	-	48
	EC 252	112	60	53.57	-	41
	EC 486	100	46	46.00	-	38
	EC 34479	89	49	55.06	-	48
	EC 492	100	53	53.00	-	45
	Total	609	326	321.10	-	266
	Mean	101.5	54.33	53.52	-	44.33
85-1	EC 127774	115	58	50.43	-	40
	EC 106294	100	55	55.00	-	45
	EC 252	104	51	49.04	-	39
	EC 486	90	42	46.67	-	33
	EC 34479	100	50	50.00	-	42
	EC 492	91	45	49.45	-	43
	Total	600	301.00	300.59	-	242
	Mean	100	50.17	50.15	-	40.33
	Grand total	1209	627	621.59	-	508
	Grand mean	100.75	52.25	51.86	-	42.33

Table 3: Performance of maternal parent during interspecific hybridization

Sr. No.	Maternal parent	Per cent fruit set (Crossing index)	Per cent seed germination during in vitro culture
1	Dhanashree	53.52	0.23
2	85-1	50.15	0.12
	S.E.±	1.06	-
	C.D.	3.11	-

Table 4: Performance of pollen parent during interspecific hybridization

Sr. No.	Pollen parent	Per cent fruit set (Crossing index)	Per cent seed germination during in vitro culture
1	EC 127774	53.31	0.19
2	EC 106294	56.14	0.36
3	EC 252	51.31	0.29
4	EC 486	46.34	0.19
5	EC 34479	52.53	0.02
6	EC 492	51.23	0.00
	S.E.±	1.84	-
	C.D.	5.39	-

CONCLUSIONS

On the basis of results obtained in present investigations following conclusions were drawn.

a. In tomato interspecific hybridization programme, due to involvement of unilateral incompatibility, the tomato (*L. esculentum*) cultivars should be used as a maternal parent and wild taxa such as *L. peruvianum* should be used as a pollen parent.

b. As post-zygotic sterility observed during tomato interspecific hybridization, aid of tissue culture techniques (e.g. culture of immature seeds) was pre-requisite in development of *in vitro* F_1 plants.

c. The parents with low crossing barriers should be used in tomato interspecific hybridization programme e.g. Tomato cv. Dhanashree and *L. peruvianum* accessions EC 106294 and EC 252.

d. Through culture of immature seed, about 0.18% recovery of *in vitro* tomato interspecific F_1 hybrid was obtained.

e. Through culture of immature seed, about 0.18% recovery of *in vitro* tomato interspecific F_1 hybrid was obtained. Interspecific F_1 hybrids can be used as a source of resistance for biotic stresses e.g. pest and disease incidence. In particular, these F_1 hybrids will be exploited effectively to incorporate resistance against viral diseases like

f. TSWV and TLCV from *L. peruvianum* to tomato (*L. esculentum*) germplasm. The protocol

developed for efficient plant regeneration in genus *Lycopersicon* can be utilized for genetic manipulation of these tomato genotypes.

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