Pollination Studies in Hybrid Tomato Seed Production (*Lycopersicon esculentum* Mill)

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Abstract

Tomato (*Lycopersicon esculentum* Mill.), a solanaceous self pollinated vegetable crop. It occupies the largest area among the vegetable crops in the world after potato. This study was conducted on pollen viability, stigma receptivity and effect of fruit picking on seed yield and quality, using the parents of hybrid Maheshi, at the experiment field of Horticulture crops Research and Development Institute (HORDI), Gannoruwa, Peradeniya. Three experiments were conducted and Randomized Complete Block Design with 3 replicates was used for all experiments. To identify the effective period for pollen viability, pollen stored for seven days under room temperature(25-27 ^{0}C),refrigerated condition(9-10^{0} C), and deep freeze condition(4 - 5 ^{0}C) to obtain high fruit set and seed set. For all temperature conditions, the highest values for pollen viability, fruit set%, average fruit weight and seed number per fruit were observed for one day storage period. Emasculated female flowers remained fully receptive until fourth day of emasculation with higher fruit set. Except the second and third pickings there were no significant difference in total fruit yield, seed yield, seed weight and seed number per fruit until seventh picking. The viability of seeds extracted after sixth picking gave significantly lower viability percentage. Therefore, seeds from late pickings should not be recommended in tomato seed production.

Key words: Tomato, Emasculation, Picking Stages

Introduction

Tomato (*Lycopersicon esculentum* Mill) is an important vegetable crop,as it has high nutrient of vitamin A, B, C and minerals which consider as essential compounds in human diet. The lycopene which contains in red pigments prevents the growth of cancers (Antherton and Rudich,1984).People are more concerned on the economically beneficial characters such as high yield, quality, uniformity and resistance to pest and diseases. The exotic hybrids gained high demand for the quality and yield, though it does not contain more resistance to pest and diseases. The department of Agriculture has developed new promising hybrids of tomato and brinjal to improve local market, but it is necessary to maintain genetic purity of the parents for continuous production of local hybrids. Not like in seed production of open pollinated varieties, the hybrid seed production is a tedious one. Abundance of the pollen is very rare due to unfavorable environment conditions (Dampsey, 1970). This shortage of pollen creates inefficiency in hybrid seed production.

For the supplementary pollination, pollen grains have to be stored in viable conditions until use, to ensure the availability of pollen throughout the year to continue the hybridization process. And also this eliminates the need of growing pollen parents in breeding programs and save the considerable time and space involved in staggered sowing of male parent to synchronize flowering with female parent. Therefore this study was initiated with the objective of finding out the storage period of pollen for an effective seed production, to study the effective time period for efficient fruit set after emasculation and study the quantity of seed production at different picking stages.

Materials and Methods

The experiment was conducted at the experiment field of Horticulture crops Research and Development Institute (HORDI), Gannoruwa, Peradeniya. Three experiments were conducted and Randomized Complete Block Design with 3 replicates was used for all experiments.

1. Effect of pollen storage period in hybrid seed production.

Parents of Hybrid Maheshi (P1xP2) were selected as experimental materials.Emasculation was done by using sharp forceps for the flower buds which just opened and hand pollination was practiced after 2 days of emasculation.The number of days of pollen stored under different temperature conditions, (Room temperature (T1-25 0C-27 0C); Refrigerator (T2-9 0C-10 0C);Deep freezer(-4 - -5 0C) were considered as treatments and each treatment consist pollens of 15 male flowers. All the management practices including fertilizer application, pest and disease management etc. were performed according to the recommendations of the Department of Agriculture, Sri Lanka.At the maturity stage, fruit set percentage, fruit weight, seed number per fruit,seed weight per fruit and seed to fruit ratio were measured.Collected data were analyzed using ANOVA.

2. Study on effective time period for efficient fruit set after emasculation

Parents of Hybrid Maheshi (P1xP2) were selected as experimental materials. Emasculation was done for the flower buds which petals were just out by using sharp forceps,and hand pollination was practiced after 2 days of emasculation.The days after emasculation (One day after emasculation-T1, two days after emasculation-T2,three days after emasculation-T3, four days after emasculation- -T4, five days after emasculation-T5, six days after emasculation-T6, seven days after emasculation-T7) were selected as treatments. Each treatment consist pollens of 15 male flowers. At the maturity stage, fruit set percentage, fruit weight, seed number per fruit, seed to fruit ratio were measured.

3. Studies on quantity and quality of seed produced at different picking stages

Parents of Hybrid Maheshi (P1*P2) were selected as experimental materials. After maturity fruits were picked at regular intervals of three days lasting for twenty one days. Totally seven pickings were made and in each picking fifteen fruits (five fruits per replicate) were harvested separately and total fruit yield, total seed yield, fruit weight, number of seeds per fruit, seed to fruit ratio and seed viability were measured.

Data collected were analyzed using ANOVA.

Results and Discussions

Table 1. Changes of measured characteristics with pollen storage period.

Days of pollen storage	Pollen viability			Fruit set%			Average fruit weight			Seed number/fruit		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
1	95.2 ^{a}	97.1^{a}	91^{a}	93.3^{a}	86.7^{a}	80^{a}	74.3^{a}	80.2^{a}	75.3a	76.9a	44.7a	69.3a
2	78.3^{b}	92.2^{a}	20^{bc}	60^{a}	60^{a}	13.3^{c}	34.6^{ab}	60.6^{a}	27bc	20.2bc	49.3a	7.3b
3	22^{c}	88^{a}	21.1^{bc}	6.7^{c}	86.7^{a}	13.3^{c}	32.1^{ab}	88.1^{a}	29.4bc	22.7bc	56.9a	27b
4	17.4^{cd}	80^{b}	18.4^{cd}	13.3^{c}	60^{a}	13.3^{c}	30.2^{ab}	93.1^{a}	25.1bc	57.6ab	48.1a	20b
5	9.4^{d}	61.2^{c}	32.35^{d}	6.7^{c}	86.7^{a}	40^{b}	45.5^{ab}	89.7^{a}	41.5b	27abc	47.12a	22.4b
6	4.1^{d}	5.23^{d}	0^{d}	0^{c}	6.7^{b}	0^{c}	0^{b}	14.5^{b}	0c	0c	8b	0b
7	1.2^{d}	0.7^{d}	0^{d}	0^{c}	6.7^{b}	0^{c}	0^{b}	11.3^{b}	0c	0c	2b	0b

(T1-room temperature(25 0C-27 0C),T2-refrigerated condition (9 0C-10 0C),T3-defreeze condition((-4 0C)-(-5 0C)
Mean with the same letters are not significantly different. (P>0.05).

1. Effect of pollen storage period in hybrid seed production.

For all temperature conditions, the highest values for pollen viability, fruit set.%, average fruit weight and seed number per fruit were observed for one day storage period. There was no significant difference for fruit set, average fruit weight and seed number per fruit up to five days in refrigerated condition.

The highest fruit set % (91.1%) was observed in flowers pollinated in four days after emasculation.The receptivity of the stigma was maximized in fourth day of emasculation and thereafter declined confirming the findings of Yogeesaha (1999). Also weight per fruit, total seed yield, number of seeds per fruit and s/f ratio were maximized in fourth day of emasculation. Leopold and Kriedemenn (1975), Shivanna *et al.* (1997) also revealed that maximum seed set may be obtained by pollinating receptive stigmas at the optimal time.

There was no significant difference in seed viability until fifth picking. Thereafter viability of seeds decreased gradually.The highest fruit yield,seed yield,fruit weight,seed weight per fruit,seed number per fruit and s/f ratio were observed in second and third pickings.

Table 2. Changes of measured characteristics with days after emasculation

Daysof emasculation	Fruit set%	Weight per fruit	Total weight	No of seeds/fruit	Seed/fruit ratio
1	51.3^{c}	73.5^{b}	219.7^{d}	26.6^{b}	0.3^{bc}
2	70.1^{b}	92.4^{ab}	694.3^{c}	65a	0.7 ^{ab}
3	80^{ab}	117a	718.3^{b}	63.2^{a}	0.5 ^{bc}
4	91.1^{a}	117.3^{a}	919.3a	67.4^{a}	0.6 ^{abc}
5	88 ^{a}	95.06^{ab}	766 ^{b}	57.7^{a}	0.8 ^{a}
6	55.56 ^{c}	93.6^{ab}	255.3^{c}	29.5^{b}	0.3^{ac}
7	3.84^{d}	30.43^{c}	100.7^{d}	21.7^{b}	0.5^{abc}

Mean with the same letters are not significantly different. (P>0.05).

Table 3. Changes of measured characteristics with picking number

Picking no	Viability	Total fruit yield	Total seed yield	Weight of fruit	Seed weight/fruit	Seed no/fruit	Seed/fruit ratio
1	88.75^{a}	282.58^{b}	0.973^{c}	56.52^{b}	0.194^{c}	26.4^{d}	0.47^{bc}
2	95.6^{a}	458.76^{a}	2.203 ^{a}	91.75^{a}	0.44 ^{a}	67.46^{a}	0.75^{a}
3	98.92^{a}	464.79^{a}	1.55b^{c}	92.99^{a}	0.31 ^{b}	67.06^{a}	0.74^{a}
4	93^{a}	330.16^{b}	1.025^{c}	66.01^{b}	0.21c	31.86^{cd}	0.48^{bc}
5	90.1^{a}	345.50^{b}	1.23^{bc}	69.09^{b}	0.25 ^{bc}	49.4^{b}	0.71^{ab}
6	78.78^{b}	366.99^{b}	1.27^{bc}	73.39^{b}	0.25 ^{bc}	43.93^{bc}	0.60^{abc}
7	74.2^{b}	337.82^{b}	1.13^{c}	67.56^{b}	0.23^{c}	25.8^{d}	0.39^{c}

Mean with the same letters are not significantly different. (P>0.05).

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