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Methods of Hybrid Seed Production in Vegetable Crops

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Methods of hybrid seed production in vegetables:

The manual pollination method of seed production on commercial scale is only feasible in the development of hybrids of vegetables like tomato, eggplant and cucurbits (bottle gourd, watermelon, pumpkin etc.) where large number of F_1 seeds can be obtained per pollination. The advance hybrid seed production techniques like, use of functional male sterility in tomato, use of stable genic and sporogenous male sterility with marker character in watermelon and muskmelon can be utilized in these vegetables. The functional male sterility has been exploited for hybrid seed production of tomato cv. Pusa Divya under poly house condition by Manjunath (2009). Hybrid seed in tomato, brinjal, capsicum and chilli are produced through hand emasculation and pollination (Table 1). The hybrid seeds of bottle gourd, bitter gourd and pumpkin through protection of female flower and hand pollination (Flemine, 2010; Jat, 2011; Behera et. al, 2015); cucumber through natural pollination in case of gynoceious seed parent (Munshi et al., 2015); onion, cabbage and cauliflower by utilizing the CMS and SI system respectively. The hybrid seeds of summer squash are produced by use of ethephon for inducing the staminate flower and natural pollination. Cryopreservation of pollen in liquid nitrogen at -196°C offers many advantages to the hybrid seed production of vegetables. This method can provide a constant supply of viable and fertile pollen and can also allow supplementary pollinations for improving seed set.

Table 1: Method of hybrid seed production used in vegetable crops

S.No.	Hybrid seed production mechanism	Commercially exploited crops
1	Hand emasculation and manual pollination	Tomato, Brinjal, Sweet pepper, Okra, Chilli

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2	Pinching of staminate flowers and hand pollination	Bitter gourd, Bottle gourd, pumpkin
3	Removal of staminate flower + emasculation + hand pollination	Watermelon and muskmelon
4	Functional male sterility and hand pollination	Tomato, Brinjal
5	GMS + bee pollination	Chilli
6	CMS + natural pollination	Capsicum, onion, cabbage, carrot, radish
7	Self Incompatibility and natural pollination	Cauliflower, broccoli
8	Gynocecism and natural pollination	Cucumber , bitter gourd
9	PGR and natural pollination	Squash's
10	Detasseling + wind pollination	Sweet corn, baby corn

Source: Tomar et al., (2016)

Mechanisms for hybrid seed production in vegetable crops:

1. **Gynoecious sex form:** The hybrids of cucumber are produced mainly by crossing gynoecious lines with monoecious lines. The other systems of producing gynoecious hybrid seed are gynoecious × gynoecious but gynoecious × monoecious hybrids are still widely grown hybrids because this offers advantages like earliness (Jat et al., 2015), high degree of female sex expression (Jat et al., 2016; Jat et al., 2017), with uniform and concentrated fruit formation, which was especially advantageous for mechanical harvest (Kumar et al., 2003).
2. **Male sterility system**: Genetic male sterlity systems have been utilized for commercial hybrid production in muskmelon (Punjab Hybrid-1). The female and male are grown in 4:1 ratio. However, to maintain the good plant population in female rows it is suggested that seed parent should be sown with double seed rate. It is also advised that female line seedling should be raised in polythene bags and transplanted at flower appearance in order to avoid the fertile plants in female rows. The pollination is done by honey bees. The male sterile line is maintained in heterozygous

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form by crossing with maintainer line under adequate isolation distance or under cover.

Among the genetic emasculation tools, both genetic male sterility (GMS) and cytoplasmic genetic male sterility (CGMS) have been employed in hybrid seed production of chillies.

Procedure for hybrid seed production of Chilli

1. Selection of parents: The parents are selected according to breeder desire in which A (female parent) male sterile and B (male parent) male fertile and according to characters that they want in 4: 1 ratio.
2. No need of emasculation in chilli because only gynoecious active in female parent (A).
3. Pollination: Pollens are inactive in A parent and pollen from B parent only use in pollination and honey bee boxes are put near the crop and allow for pollination. This pollination done by honey bees.
4. Development of F1 hybrid seeds: Thus, after the pollination F1 hybrid seeds are harvested from A parent which is male sterile.

   Example: CGMS hybrid: Arka Sweta, Arka Harita, Arka Meghana

   GMS hybrid: CH-1, CH-2 (PAU)

3. **Hand emasculation and pollination procedure:** Eg.: Tomato, Brinjal, Okra, Sweet pepper
   a. **Selection of parents:** Select the two parents A and B having the characters present in A should not present in B and Character of B not present in A.
   b. **Emasculation:** Flowers are usually emasculated one day prior to anhesis. Anthers are removed as a group, with or without the surrounding corolla, by griping the base of the anthers and petals with forceps, which are then removed by a firm but steady pull. Emasculated flower should be covered immediately with butter paper to protect against contamination from foreign pollen and also for easy identification of emaculation bud during dusting.
   c. **Pollen collection:** Collection of the pollen and pollen collected from one male flower can be used for dusting 5-7 emasculated flower.

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d. **Pollination:** Stigma become fully receptive at this stage of pollinatio. In experimental crosses, pollen is collected by slitting mature anthers cone with the forceps and applied safely to stgmatic surfaces that should be visible as a white covering.

e. **Bagging**: Protection of pollinated flower by wrapping with cotton or small pollination bag is essential.

f. **Tagging:** Tagging of emaculated flower with date of emasculation and pollination and and their parents name.

g. **Fruit harvesting and seed collection:** Fruits are harvested after full maturity of fruit when turn into red colour fruits and fruit from in between 6-7 harvest should be used for seed extraction.

References

Behera, T.K., Jat, G.S. and Dev, B. (2015). Improved seed production technology of bitter gourd and bottle gourd. In: MTC on Entrepreneurship development to ensure quality vegetable seed production for making the country nutritionally secure from 10-17th December, 2015in the Division of vegetable Science pp. 46-50.

Flemine, X., (2010) Studies on hybrid seed production in pumpkin under insect proof net house and open field conditions. M Sc. Thesis, Indian Agriculture Research Institute, New Delhi 110012.

Jat, G.S., Munshi A.D., Behera T.K., Choudhary H., Dev B., 2015, Exploitation of heterosis in cucumber for earliness, yield and yield components utilizing gynoecious lines. Indian Journal of Horticulture 72 (4): 494-499.

Jat, G.S., Munshi A.D., Behera T.K., Tomar B.S. (2016). Combining ability estimation of gynoecious and monoecious hybrids for yield and earliness in cucumber (*Cucumis sativus*) Indian Journal of Agricultural Sciences86 (3): 399–403.

Jat, G.S., Munshi, A.D., Behera T.K., Singh A.K. and Kumari S., (2017). Genetic analysis for earliness and yield components using gynoecious and monoecious lines in cucumber (*Cucumis sativus* L.). Chemical Science Review Letter 6(22), 1075-1079.

Kumar, Sanjeet & Singh, PK. (2013). Mechansim of hybrid development in vegetable. Environment Technology and Innovation journal. 6. 2004

JUST AGRICULTURE
multidisciplinary e-Newsletter

Manjunath (2009). Studies on functional male steility in tomato (*Lycopersicon esculentum*mill.) and its application in hybrid seed production. Ph. D. Thesis, Indian Agriculture ResearchInstitute, New Delhi-110012.

Munshi, A.D., Behera, T.K., Sureja, A.K., Jat, G.S. and Singh, J. (2015). Improved seed production technology of cucumber and sponge gourd. In: MTC on Entrepreneurship development to ensure quality vegetable seed production for making the country nutritionally secure from 10-17th December, 2015 in the Division of vegetable Science pp. 20-23.

Tomar, B.S., Jat, G.S. and Singh, J. (2016). Quality seed production of root crops in saline environment. In: MTC on Quality seed production, processing and certification of selected field vegetable crops in salt affected areas from 15-22 Dec. 2016. pp 44-47.