

CROSSABILITY STUDIES AND ANALYSIS OF INCOMPATIBILITY IN THREE SPECIES OF *CAPSICUM**

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An earlier study conducted in the Division of Agricultural Botany, indicated that hybridization attempts among three species of *Capsicum* viz. *C. annuum*, *C. frutescens* and *C. pendulum* failed (Pillai, Unpublished). The present investigation was carried out to study the crossability barrier operating among these three species of *Capsicum*, and to find out the exact reason for the failure by embryological analysis. Different breeding techniques were used to find out an effective method to overcome this crossability barrier thereby suggesting the possibility of getting a good bearing type having large sized fruits in *Capsicum*.

Materials and Methods

The diploid plants of all the three species of *C. annuum*, *C. frutescens* and *C. pendulum* were used in the present study. Breeding techniques such as hand emasculation and pollination, bud pollination and pollination after amputation of upper part of style along with the stigma with and without the use of sucrose were tried. Three concentrations of sucrose viz. 5%, 10% and 15% were tried in the present investigation. Embryological analysis of the pollinated ovaries was also done. For this, pollinated ovaries obtained by normal hand pollination and pollination after amputation of style, collected at intervals of 4, 8, 20, 24, hours and upto 8 days of pollination were analysed. The material was fixed in FAA (5 ml formaldehyde + 5 ml acetic acid + 90 ml of 70% alcohol) for a minimum period of 48 hours and then transferred to 70% alcohol. The washing, dehydration, infiltration with paraffin and preparation of blocks were done as per standard procedures. Sections were cut at a thickness of 8–12 μ and slides were double stained with 2% safranin and 1% fast green.

Results and Discussion

The results of the crosses among 3 species of *Capsicum* made by normal hybridization technique are given in Table 1.

Though crosses were made in all possible combinations, two crosses viz, *C. frutescens* x *C. pendulum* and its reciprocal, were successful. Crosses attempted in all combinations failed when the method of bud pollination was employed.

Table 1

Percentage of fruitset by normal hand pollination among 3 species of *Capsicum*

No.	Female parent	Male parent	of flowers crossed	Fruit set	Percentage of fruit set
1.	<i>C. annuum</i>	<i>C. frutescens</i>	206	0	0
2.	<i>C. annuum</i>	<i>C. pendulum</i>	210	0	0
3.	<i>C. frutescens</i>	<i>C. annuum</i>	176	0	0
4.	<i>C. frutescens</i>	<i>C. pendulum</i>	200	21	10.5
5.	<i>C. pendulum</i>	<i>C. annuum</i>	188	0	0
6.	<i>C. pendulum</i>	<i>C. frutescens</i>	210	18	9.4

When amputation of upper stylar region along with the stigma was done before pollination, 3 crosses were successful viz. *C. frutescens* x *C. pendulum*; *C. pendulum* x *C. frutescens* and *C. pendulum* x *C. annuum*. However successful intercrossing involving all the six cross combinations among the three *Capsicum* species could be achieved by adopting the technique of pollination after amputation of upper 2 mm length of the style along with the stigma and applying 5% sucrose on the cut surface. Results are given in Table 2.

Table 2

Percentage of fruitset among 3 species of *Capsicum* in crosses where 5% sucrose solution was applied after amputation of style

SI. No.	Female parent	Male parent	No. of flowers crossed	No. of Fruitset	Percentage of fruitset
1.	<i>C. annuum</i>	<i>C. frutescens</i>	45	2	4.4
2	<i>C. annuum</i>	<i>C. pendulum</i>	48	1	2.1
3	<i>C. frutescens</i>	<i>C. annuum</i>	50	5	10.0
4.	<i>C. frutescens</i>	<i>C. pendulum</i>	47	6	12.8
5	<i>C. pendulum</i>	<i>C. annuum</i>	98	7	13.1
6.	<i>C. pendulum</i>	<i>C. frutescens</i>	52	6	11.5

Maximum percentage of fruitset was observed in the cross *C. pendulum* x *C. annuum* (13.1%) followed by *C. frutescens* x *C. pendulum* (12.8%). The application of 10% sucrose solution prevented the fruit setting in 4 combinations and only two crosses viz. *C. frutescens* x *C. pendulum* and *C. pendulum* x *C. annuum* were successful. All the crosses except *C. pendulum* x *C. annuum*

were unsuccessful when 15% sucrose was used. It was observed that there was increase in the percentage of fruitset when pollination was done immediately after emasculation.

There was seedset in all successful crosses, though there was considerable reduction of number of seeds per fruit

Embryological studies revealed perfect pollen germination on stigmatic surface of the styles in all crossed and selfed flowers. After the emergence of pollen tube on the stigmatic surface the extent of its development was seen only upto the upper stylar region after which the pollen tubes failed to grow. In selfs and crosses of *C. frutescens* x *C. pendulum* and *C. pendulum* x *C. frutescens* normal development of embryo was observed after the second day onwards, indicating that fertilisation was over within one day after pollination. But in all the crosses involving *C. annuum* the embryosac showed degeneration indicating the failure of pollen tubes to reach the ovules and effect fertilisation. Again normal development of embryo was observed in all combinations when pollination was done after amputating the upper stylar region and applying 5% sucrose solution on the cut surface.

The failure to set fruits when *C. annuum* was used as the female parent may perhaps be due to a certain degree of female sterility in *C. annuum* at the diploid level (Malhova, 1966 and Pillai, Unpublished). Such an inhibitory reaction was reported by Georgieva and Malhova (1974) in *Capsicum*.

The failure of fertilization in the above mentioned crosses indicated that the pollen grains were not germinating properly on the cut surface of the style. This may be due to a lack of sufficient nutrients for pollen germination and tube growth available in the style as compared to their availability in the stigma. Therefore the logical step to be taken next was to provide additional nutrients to promote the germination and tube growth of pollen. Previous reports suggested that sucrose is the best nutrient for such a situation. Goud *et al.* (1970) observed that sucrose induces pollen germination. *C. annuum* varieties 'erect long' and 'erect round' when pollinated by *C. frutescens* (lavangi) after amputation of style and application of sucrose on cut surface gave increased fruitset. Kiss (1970) also revealed the fact that in *Capsicum*, pollen germination and pollen tube growth were promoted in sucrose medium. The solution was applied on the cut surface of the style after amputation of style and upper part of stigma just before pollination.

Summary

In the present study interspecific hybridization could be successfully done among 3 species of *Capsicum* viz., *C. annuum*, *C. frutescens* and *C. pendulum*

by the technique of cross pollination after amputation of the upper part of style along with the stigma followed by application of 5% sucrose solution on cut surface of the style.

Embryological analysis of the fertilized ovaries of self and cross combinations showed that in the incompatible combinations the embryosacs degenerated indicating failure of fertilisation. Further when pollination was done on the cut surface of the amputated styles after the application of 5% sucrose solution normal embryo development could be observed as in the case of selfed ovaries.

സംഗ്രഹം

ഈ പഠനത്തിൽ കാപ്സിക്കം ആനം, കാ. ഗ്രൂട്ടെസൻസ്, കാ. പെൻഡുലം എന്നീ മൂന്നു സ്പീഷീസുകളും തമ്മിൽ വിജയകരമായി സങ്കരണം നടത്തുന്നതിനു് സ്റ്റൈലിന്റെ മുക്തഭാഗം മുറിച്ചശേഷം മുറിപാടിൽ 5% സൂക്രോസ് ലായനി പുരട്ടിയശേഷം പരാഗണം നടത്തിയാൽ മതിയെന്നു് കണ്ടു.

സങ്കരണവും സങ്കരണവും നടത്തിയ ബീജസംയോജിത അണ്ഡാശയങ്ങളിൽ ഭ്രൂണ വിദ്വേഷണം നടത്തിയതിൽ പൊതുതമില്ലാത്ത സങ്കലനങ്ങളിലെ ഭ്രൂണസഞ്ചികൾ നശിച്ചു പോയതായി കണ്ടു. അതായതു് അത്തരം സങ്കലനങ്ങളിൽ ബീജസംയോഗം നടന്നില്ലെന്നു് സാരം. എന്നാൽ സ്റ്റൈൽ മുറിച്ചു് മുറിപ്പാടിൽ 5% സൂക്രോസ് ലായനി പുരട്ടിയശേഷം പരാഗണം നടത്തിയപ്പോൾ ഭ്രൂണം സാധാരണഗതിയിൽ വികാസം പ്രാപിച്ചതായി കണ്ടു.

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(M. S. received: 16-2-1977)