Chapter IV

POLLEN INCOMPATIBILITY IN *Passiflora incarnata* L.

POLLEN INCOMPATIBILITY IN PASSIFLORA INCARNATA

INTRODUCTION

Pollen grain possesses a unique form and performs a special and vital function ~~(vital functio~~ (Erdtman,1952). The common characters which are found on the pollen grains of numerous species are very distinct. Pollen abnormalities have been reported from time to time by various workers in angiosperms (Joshi,1933; Venkata Rao,1949; Mukherji,1951; Sharma,1962 and Nair,1978) and attributed to environmental, physiological, cytogenetical, evolutionary and phytogeographical reasons.

Ornamentals are essentially cross-pollinated plants with considerable heterozygosity (Khoshoo,1968), much of the heterozygosity is locked in, and is not ordinarily expressed under rigours of natural selection. *P. incarnata* is highly self and cross-incompatible plant under normal conditions. Self-incompatibility systems are considered to be ancient systems in angiosperms (Lewis and Crowe,1958). Investigations by Heslop-Harrison (1975), Howlett *et al.* (1975), have resulted in better understanding of sporophytic self-incompatibility in angiosperms. Coupled with this, there are some well known cases of self incompatibility reported in the genus Passiflora (Khight and Winter,1963). The occurrence of self-incompatibility system in passifloraceae is also recorded by Lewis (1966).

The aim of the present investigation is to study pollen germination *in vitro* and causes leading to incompatibility in *P. incarnata*.

MATERIALS AND METHODS

Three different types of flowers were detected (Dixit,1979) on the basis of position of styles in *P. incarnata*.

These types are :

Type - 1 : Flower with strongly curved styles, in which the stigmas are below the anthers (fig.1).

Type - 2 : Flower with slightly curved styles in which the stigmas form an angle of about 45^{o} with the anthers (fig.2.).

Type - 3 : Flower with styles remaining vertical with straight stigmas (fig.3.).

The pollination classes were : (a) Selfing within type 1, type 2, and type 3. (b) Crossing between each type. After selfing and crossing these flowers were baged.

Fig. 4.1 1-type flower —(I)

2-type flower —(II)

3-type flower —(III)

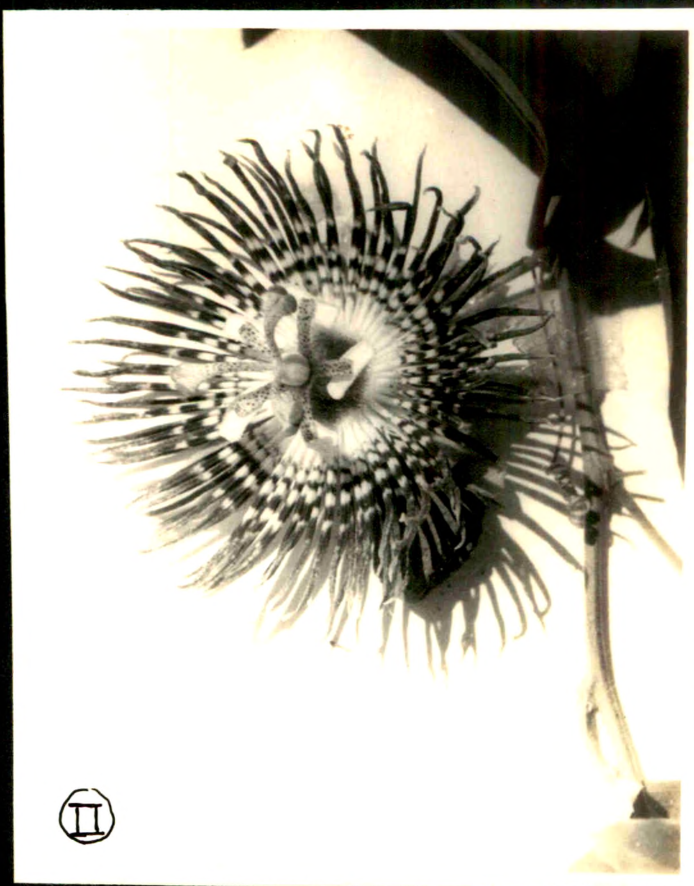
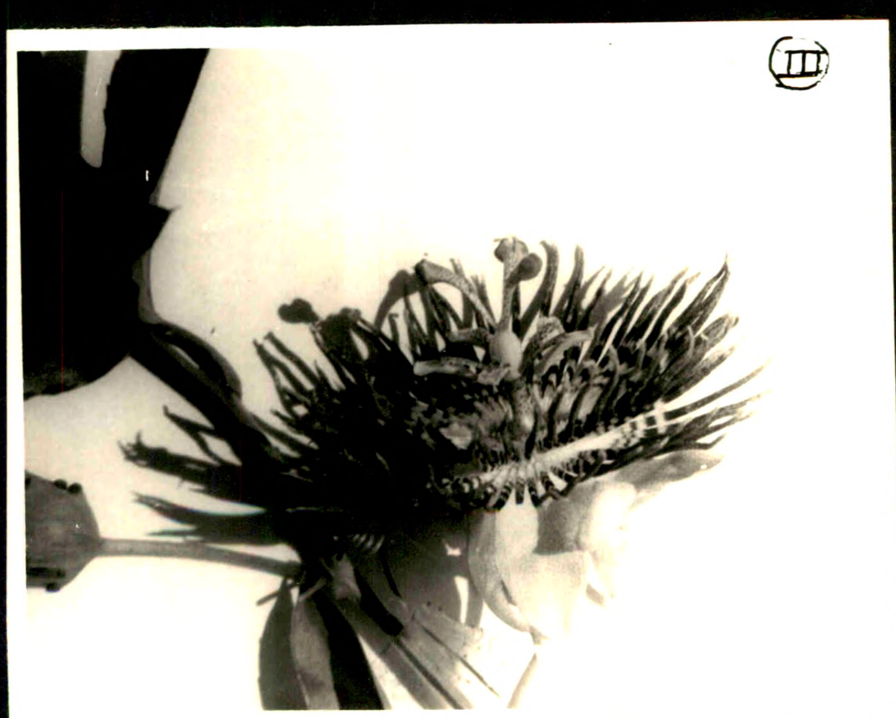


FIG. 4.1



Flowers of the above types were collected from Botanical Gardens of Shivaji University, Kolhapur. Pollen germination study was made by using the different concentrations of sucrose in Kwack and Kim (1967) nutrient medium. Pollen grains at the time of anthesis were collected and observations were taken in each concentration of sucrose. The number of germinated and nongerminated pollen grains was counted and the final value was expressed as percentage of germination.

RESULTS

Time of anthesis and receptivity of stigma in P.incarnata determined in the present investigation were 9.00 a.m. and 11.30 a.m. respectively.

Very poor percentage of pollen grain germination has been observed in all the three types of P.incarnata. Rather slight high percentage in pollen grain germination has been observed in type 1, than type 2 and type 3 of P.incarnata. For the maximum pollen grain germination in P.incarnata 18 % sucrose was required (Table 41).

The present investigation shows that P.incarnata never yielded fruits either in selfing or in inter type crossing experiments.

Table 1 : Percentage of pollen grain germination in different sucrose concentrations in Kwack and Kim nutrient medium as observed in three different types of *P. incarnata* after 9.00 hours.

% Sucrose concentration in Kwack and Kim nutrient medium :

Sugar % :	5	10	15	16	17	18	19	20	25	30
					Germination %					
1 - type :	1	7	11	12	13	14	12	10	5	1
2 - type :	0	6	10	11	12	13	11	9	4	0
3 - type :	0	3	7	8	9	10	8	6	1	0

DISCUSSION

Very poor percentage of pollen grain germination in all the three types of P.incarnata is correlated with meiotic abnormalities and thus result into abnormal pollen grain formation.

Sucrose is one of the basic requirements for pollen grain germination *in vitro*, because the carbon of it incorporates much more intensively into lipids and polysaccharides than the carbon of the other sugars (Harbetova and Tupy,1964). Previous research has shown that sugar requirements of pollen vary with different plant species (Stanley and Linskens,1974). Likewise in the present investigation for the maximum pollen grain germination in P.incarnata 18 % sucrose was required.

In *Petunia* the incompatible pollen tubes which reach the ovary usually fail to achieve fertilization (Brewbaker, 1969). Incompatibility system is linked with floral heteromorphism (Vuilleumier,1967). *Jepsonia parryi* has heterostylous flowers and is strongly self-incompatible, although the insect pollinators transfer ample compatible pollens on stigmas to account for seed production, much of the pollen deposited on stigma was incompatible (Ornduff,1961). The floral characters associated with heterostyly in P.incarnata are similar to those with other heterostylous species of Passifloraceae. Heterostyly is always accompanied by incompatibility with some exceptions (Mather and De Winton,1941). They stated that - "The real significance of the morphological differences shown by the pistils and stamens lies in the physiological differences which follows from them", and the heterostyly is of polyphyletic origin in the angiosperms. Under these circumstances the breakdown of heteromorphic incompatibility and its replacement by another breeding system should be selectively advantageous in P.incarnata. According to Linskens and Heinen (1962), self-incompatibility among angiosperms is the situation where occurrence of the same 'S' allele in both male and female floral organs prevent formation of seeds.

The sterility of the pollens, its abnormal germination in vivo and in vitro, presence of cutinase in pollens, inactivity of enzyme situated within the pollen due to early dehydration of pollen on the stigma, chromosomal abberation, type of cytomixis during meiosis, and heterostyly rule out the possibility of fertility and strongly confirm the incompatibility condition in P.incarnata. Studies on the nature of this incompatibility system, its inheritance and probable origin are under investigation.

Pollen grains in P.incarnata are smaller in size and shape. Small pollen grains will be more likely to be starchless (Baker and Baker,1979). Martin (1970 a,b,c) and Martin and Telak (1971) have found that the principal components of the stigmatic exudate are phenolic compounds of lipids. Martin (1969) tested 10 species from different families and suggested that these phenolic compounds and lipids in the stigma "may interact with growth substances to control pollen germination and growth, and account for the specificity of stigmas which permit only a few types of pollens to germinate on their surfaces".

The pollen wall proteins probably discharge several functions in the pollen-stigma interaction and there is now evidence that some are involved as recognition factors in inter and intra specific incompatibility reactions (Heslop-Harrison <u>et</u> <u>al</u>.1975). The self-incompatible pollen tube may grow to a limited extent because of a low growth rate metabolism depending primarily on pollen reserves (Ascher,1967).

However, what seems to be needed now are detailed analysis of individualreproductive systems and their origins, isolation of the inhibiting substances and confirmation of relationship between pollen/style incompatibilities and floral types.