TABLE I

The performance of dwarf sunflowers during Zaid 1977

	Control	Treatment 1	Treatment 2	Treatment 3
		Seed yield (kg)/block (6 × 6 m)		
Filled seeds				
(*a*) Average	3·32±0·064	3·78±0·317	4·27±0·335	4·41±0·339
(*b*) Range	3·17–3·44	3·27–4·55	3·47–4·84	3·63–4·98
C.D. (5%): 0·670				
Unfilled seeds				
(*a*) Average	0·144±1·38	0·157±1·57	0·178±0·97	0·165±0·56
(*b*) Range	0·125–0·178	0·133–0·195	0·160–0·195	0·151–0·173
C.D. (5%): 0·044				
Total seed yield				
(*a*) Average	3·46±0·050	3·94±0·312	4·44±0·343	4·57±0·319.
(*b*) Range	33·5–3·56	3·41–4·68	3·63–5·03	3·80–5·03
C.D. (5%) : 0·677				
		Seed number/10 g		
Filled				
(*a*) Average	336±1·54	337±24·06	339±53:06	310±39·58
(*b*) Range	334–340	286–388	218–440	220–386
C.D. (5%) : 96·19				
Unfilled				
(*a*) Average	732±16·10	691±32·92	702±23·63	722±5·93
(*b*) Range	693–750	612–745	650–750	710–735
C.D. (5%): 87·36				
		Oil percentage		
(*a*) Average	39·68±0·285	40·35±0·629	40·35±0·487	41·12±0·462
(*b*) Range	39·00–40·15	39·10–41·75	39·50–41·50	40·00–41·85
C.D. (5%) : 2·114				
		Filled seed yield qt/ha (estimated)		
	8·45±0·16	9·62±0·80	10·85±0·85	11·30±0·86

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ONE NEW INTERSPECIFIC HYBRID IN THE GENUS *PASSIFLORA*

Introduction

Of the 400 known species of the genus *Passiflora* about 50 to 60 bear edible fruits. Probably all these are indigenous to American tropics. Although a few species have been introduced into tropical and subtropical regions and have become the basis for local industries, the majority of the edible passion fruits are unknown outside these limited areas where they grow wild or are sometimes cultivated.

Nakasone *et al.*[1] have obtained a hybrid between *P. edulis* f. *flavicarpa* and *P. edulis*. This cross has opened the door for the development of new and useful varieties combining desirable traits from both

TABLE I

Size of hybrid Passiflora *fruit, seed, production of normal and aborted seeds in relation to hormone treatment*

Crossing combination	No. of crosses	Hormone Treatment GA (0.1%)	IAA (100 ppm)	No. of fruits GA	No. of fruits IAA	Size of fruit (mean in mm) Length	Size of fruit (mean in mm) Breadth	No. of seeds Normal	No. of seeds Aborted	Size of seed (mean in mm) Length	Size of seed (mean in mm) Breadth
P. incarnata × *P. quadrangularis*	10	5	5	Nil	3	46	32	7	54	6	4

parents. A list of hybrids among *Passiflora* species has been presented in a review by Martin and Nakasone[2]. Beal[3] has produced hybrids by crossing *P. edulis* with *P. caerulea* and *P. incarnata*. Recently, new hybrid combinations have been produced by Ruberté and Martin[4] and by Payan and Martin[5].

In the present study an attempt has been made to overcome a barrier leading to a successful hybridization between ♀ *P. incarnata* and ♂ *P. quadrangularis*. Both these species belong to the subgenus *Granadilla* (Killip[6]). *Passiflora incarnata*, one of the most important species which flowers almost throughout the year is disease and wilt resistant. It does not set fruit owing to pollen abnormalities and hence was used as a female parent.

Materials and Methods

A cross between ♀ *P. incarnata* and ♂ *P. quadrangularis* was made in the Botanical Garden of Chowgule College, Margao, Goa. In both these species the chromosome number is $2n = 18$. Complete incompatibility has been observed in *P. incarnata*. It is due to pollen abnormalities and stylar inhibition of pollen tube growth. Several crosses were made between ♀ *P. quadrangularis* and ♂ *P. incarnata* but yielded no fruits.

Pollen grains of *P. quadrangularis* were dusted on previously emasculated flowers of *P. incarnata*. Pollination was effected at the normal time of anthesis of the flower or somewhat later when pollen from *P. quadrangularis* was available. Pollinated flowers were bagged and labelled. The sign of successful fertilization was noticed three days after cross pollination. To prevent abscission, indoleacetic acid (100 ppm) and 0·1% gibberellic acid were sprayed on the developing fruits. Fruits abscised after 7 days when 0·1% gibberellic acid was applied. Length and breadth of fruit obtained from spraying of indoleacetic acid were measured.

Results and Discussion

Hybrid fruits were ovoid, oblong, pubescent with ridges and soft in texture. They were much smaller as compared to those of *P. quadrangularis* while *P. incarnata* does not set fruit. The hybrid fruits, when opened, had a sweet smell and contained large quantities of aborted seeds. Very few normal sized seeds were obtained.

Physiological barriers to crossing exist between *P. quadrangularis* and *P. incarnata* although the time of anthesis and time of receptiveness of stigma of both these species are more or less the same. For *P. incarnata* the time of anthesis is 9 a.m. and receptive time of stigma is 11–30 a.m. and for *P. quadrangularis* the respective timing are 8–30 a.m. and 11 a.m. to 4 p.m.

Beal[3] has obtained a hybrid from ♀ *P. edulis* (F_1) × *P. incarnata*. Payan and Martin[5] have obtained a large number of hybrids among *Passiflora* species but *P. incarnata* was not used in any of the crosses.

Payan and Martin[5] have used three plant growth substances, *viz.*, gibberellic acid, α-napthalene acetamide and indoleacetic acid. These were mixed at concentrations of 1% and 0·1% in lanolin. They have noticed that 1% gibberellic acid is the most efficacious, followed by α-napthalene acetamide. To prevent abscission or to stimulate fruit set we used indoleacetic acid (100 ppm) and 0·1% gibberellic acid but obtained positive results after spraying indoleacetic acid of 100 ppm concentration.

We have obtained a very few normal sized seeds (7 in number) from 3 hybrid fruits while the majority of seeds were abortive. Beal[3] has obtained 45 seeds out of which 10 were aborted from hybrid fruits resulted from a cross between *P. edulis* (F_1) and and *P. incarnata*. Payan and Martin[5] obtained all aborted seeds from such crossing combinations such as the following: *P. edulis* × *P. maliformis*; *P. laurifolia* × *P. edulis*; *P. quadrangularis* × *P. edulis*. They have also obtained mainly abotted seeds with

a few apparently normal seeds from the following crosses : *P. alata* × *P. edulis* *P. alata* × *P. laurifolia; P. edulis* × *P. caerulea.*

In the present study *P. incarnata* could not be used as a male parent because of pollen abnormalities and hence it was used as a female parent. Payan and Martin[5] have observed differences in reaction of species *P. edulis* f. *flavicarpa* which proved to be quite fertile when used as a female, but was completely unsatisfactory as a male parent. They have also observed that *P. laurifolia*, a highly self-incompatible species that seldom sets seed in self-pollination, proved to be an efficient male parent.

This study shows very clearly that the self-incompatibility found in many passion fruit species, and believed to result in very poor pollen tube growth, was not a barrier to interspecific crosses. Pollen germination and tube growth appeared perfectly normal in *P. quadrangularis* but not in case of *P. incarnata*. The only obstacle to hybridization was a failure of hormonal stimulation. When growth-promoting substance (indoleacetic acid) was applied to the ovary, fruit set was promoted, and fruiting could be normal. None of the seeds germinated but it does not mean that the seeds from hybrid fruits contained aborted embryos as their abortiveness could have been confirme only after trying to germinate them in embryo culture chamber.

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INVESTIGATIONS ON VASCULAR BROWNING IN THE ROOTS OF ROOT (WILT) DISEASED COCONUT (*COCOS NUCIFERA* LINN.)

Vascular browning/discolouration in plant parts has been reported as a characteristic symptom of certain plant diseases[1,2]. Root (wilt) disease of conconut is of uncertain etiology but suspected to be pathogenic in nature[3]. Earlier investigations have shown that in apparently healthy roots of diseased, and, apparently healthy palms of root (wilt) affected area, vascular browning occurs in the order of 20 to 88% and 20 to 35% respectively, which did not exist in the roots of palms from a healthy area[3-6]. These observations merit consideration since emphasis was given by coconut research workers in the past to isolate patnogens from vascular tissues showing browning. The browning or discolouration of tissues when they are cut and exposed, can be attributed to auto-oxidation and increased activity of oxidising enzymes too[7-9]. Detailed studies were, therefore, undertaken to ascertain the occurrence of vascular browning, its nature and extent in the roots of coconut palms.

Apparently healthy (AH) root tips from different depths of the soil and distances were collected during rainy and summer seasons from 25 palms of healthy area and 47 apparently healthy (AH) and 65 diseased palms of diseased area, belonging to West Coast Tall (WCT) variety of coconut. The condition of palms was judged on the basis of symptoms described by Radha and Lal[10]. In total, 476 root tips consisting of 100, 146 and 230 roots from healthy, apparently healthy and diseased palms respectively were examined. Root tips (about 10 cm length) were cut and kept in water and antioxidant solution (2%, ascorbic acid/mercaptoethanol) separately in the field itself. They were soon brought to the laboratory and split longitudinally into two equal halves, cleaned and transferred into water and anti-oxidant. About one cm length including root cap was discarded from root tip. Free hand sections, from 2·5 cm of root tip were cut in respective solutions and examined immediately under microscope. Apparently healthy root tips kept in water/antioxidant for about half an hour on critical examination when showed any external lesions, were not considered as AH and discarded.

Microscopic examination of root-sections, immediately after sectioning in water or antioxidant did not reveal vascular browning in any of the roots collected from healthy, AH and diseased palms (Table 1). In water, after the lapse of about 2 minutes, most of the sections showed general very pale browning. The root sectioned in water when kept for about 5 minutes and more, showed browning of all the tissues including vascular ones. But sections in antioxidants did not produce any such discolouration. Thus browning of root tissues, sectioned in water is not original but only an after effect caused by oxidation.

Antioxidant prevented further browning of tissues but did not remove stationary discolouration. Experiments revealed that the superficial browning of tissues developed in water due to oxidation is removed by repeated washing in water followed by antioxidants