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Interspecific Hybridization between *Corchorus olitorius* Linn. (Strain C. G.) and *C. sidoides* F. Muell., and *C. capsularis* Linn. (Strain D 154) and *C. sidoides* Muell.

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Souhrn

Autoři sledovali možnost mezidruhového křížení mezi *Corchorus olitorius* Linn. a *C. sidoides* F. Muell a *C. capsularis* Linn s *C. sidoides* F. Muell.

1. U kombinace *C. olitorius* ♀ × *C. sidoides* ♂ se založilo 29,4 % plodů a sklizeno bylo jen 20 % plodů z celkového množství. Všechny sklizené plody byly sterilní.

2. U kombinace *C. sidoides* ♀ × *C. olitorius* ♂ se zakládalo 26,8 % plodů, z nichž dozrálo 9 %. Jeden sklizený plod obsahoval tato semena: 4 sterilní, 9 částečně plných a 4 zřetelně plná semena. Ani jedno z nich nebylo klíčivé.

3. Při křížení *C. capsularis* ♀ × *C. sidoides* ♂ a při reciprokém křížení se zakládalo 31 % a 20 % plodů, z nichž žádný plně nedozrál.

4. Fylogeneticky se tyto tři sledované druhy vzájemně značně liší.

Summary

1. In *C. olitorius* ♀ × *C. sidoides* ♂, the pod set was 29·4 per cent and the percentage of pod harvested (out of the set pods) was 20 per cent. All harvested pods were empty.

2. In *C. sidoides* ♀ × *C. olitorius* ♂, the pod set was 26·8 per cent and that 9·0 per of the cent pods were harvested. The single harvested pod yielded the following types of seeds — 4 empty seeds, 9 partially full seeds and 4 apparently full seeds. The apparently full seeds were underweighed. All seeds were non-viable.

3. The pod sets in *C. capsularis* ♀ × *C. sidoides* ♂ and in its reciprocal were 31 per cent and 20·0 per cent respectively. No pod remained till maturity.

4. These three species are phylogenetically wide apart.

Introduction

Corchorus olitorius LINN. and *C. capsularis* LINN. are the two cultivated jute species. Each species has a certain number of desirable characters of its own. Several workers have tried to combine these desirable characters (industrial as well as agricultural) by hybridization, but all of them have failed. FINLOW (1917, 1921, 1923) first tried hybridization between these two species but failed to get any hybrid. HOWARD (1924) confirmed this. PATEL, GHOSE and DASGUPTA (1944) after attempting seven different methods to hybridize these two species reported that "often pods were obtained but the seeds were not viable and well developed, being light in weight and pale coloured". Ultimately they also failed to get any hybrid and concluded that these two species have different centres of origin and phylogenetically they are wide apart. DATTA (unpublished, a) carried on interspecific hybridization between different types (both wild and cultivated) of these two species *(C. olitorius* and *C. capsularis)* and between different wild species of *Corchorus* on an extensive and intensive scale for three consecutive years (1953—1955) to find out whether there is any seasonal difference. He observed pod setting in practically all the crosses but the percentages of pod setting varied in different crosses including the reciprocal ones. Few seeds were obtained and they were of three types—empty, partially full, and apparently normal-looking full seeds. The percentages of these three types of seeds varied in different crosses, even in reciprocals. A few apparently normal-looking full seeds were underweighed, when compared with the same number of selfed seeds from their respective female parents. This suggested the underdevelopment of the seed tissues of embryo and/or endosperm. All the seeds did not germinate in next seasons.

As all the species of *Corchorus* (cf. Table 2 of DATTA, unpublished, a) were found to be cross-incompatible, the wild species from Australia (viz. *C. sidoides* F. MUELL.) was crossed with *C. capsularis* and *C. olitorius* with a view of getting any viable hybrid which can be used for bridge crossing to overcome the strong incompatibility barrier existing amongst the two cultivated jute species.

Material and Methods

Seeds of *Corchorus sidoides*, a wild species of jute, were obtained by Sri R. M. DATTA in 1957, prior to the jute season from Dr. W. HARTLEY, Principal Plant Introduction Officer, Commonwealth Scientific Research Organisation (Division of Plant Industry), Canberra, Australia. The seeds were sown in pots. The plants flowered from May to October. The flowers generally open at 9 to 9.30 A. M. and close at 1 to 1.30 P. M. The haploid chromosome number of this species has been reported to be seven (BASAK 1958), thus the same as in the cultivated species.

Table 1. Summary of the reciprocal crosses between *C. olitorius* (Strain C. G.), *C. capsularis* (Strain D 154), and *C. sidoides* F. Muell.

Sl. No.	Cross		No. of flowers pollinated	No. of pods set	% of pods set	No. of pods harvested	% of pods harvested	Seeds			Seeded or empty	Percentage of seeds		
	Parent ♀	Parent ♂						empty	par-tially full	full		empty	par-tially full	full
1.	*C. olitorius* (C. G.)	*C. sidoides*	34	10	29·4	2	20·0	0	0	0	empty	0	0	0
2.	*C. sidosides* *(2 mg.)	*C. olitorius* (C. G.)	41	11	26·8	1	9·0	4	9	4 (1·25 mg.)	Seeded	23·5	53·0	23·5
3.	*C. capsularis* (D 154)	*C. sidoides*	29	9	31·0	0	0·0	0	0	0	0	0	0	0
4.	*C. sidoides*	*C. capsularis* (D 154)	25	5	20·0	0	0·0	0	0	0	0	0	0	0

* Figures in brackets indicate the seed weights in milligrams.

Flowers of *C. capsularis* open at about 9 A. M. and remain open for about 6 hours. Flowers of *C. olitorius* open at 7 A. M. or a little earlier and remain so for about 7 hours.

Flowers were carefully emasculated in the previous afternoon with finely pointed loose sterilised forceps and bagged with cellophane paper bags. Much care and vigilance are needed while emasculating smaller flowers of *C. sidoides* and *C. capsularis*. The next morning the bags were removed and after carefully pollinating the emasculated flowers with pollen from the desired parents, they were immediately bagged and labelled.

One week after pollination the bags were removed and records were taken as to whether the flowers had set pods or fallen into the bag. Every set pod was labelled. Each week the set pods were checked individually whether they were continuing to grow or had fallen off. In these crosses the number of flowers pollinated, pods set and harvested were recorded. The cross pods were harvested after they matured fully. The seeds were extracted pod-wise; they were then classified as to full, partially full and empty (shrivelled) seeds and their percentages were calculated. The full seeds when obtained were weighed and compared with the weight of the same number of seeds of their female parents, taken at random from the bulk of selfed seeds.

Results

After crossing *C. olitorius* with *C. sidoides* it was observed that pod set was only 29·4 per cent and only 20 per cent of the set pods remained till maturity and were harvested. In case of *C. sidoides* × *C. olitorius* pod set was 26·8 per cent and 9·0 per cent of these pods were harvested. In the former case, 2 pods matured in 25 days after crossing. They were very small in size and had no seed of any kind. In the latter cross one pod matured in 41 days and contained all the three kinds of seeds.

In case of *C. capsularis* ♀ × *C. sidoides* ♂ and *C. sidoides* ♀ × *C. capsularis* ♂ the pod set were 31 per cent and 20·0 per cent respectively, but no pod was finally harvested (cf. Table 1).

It is evident from Table 1 that the majority of the set pods failed to reach maturity and shed during different stages of growth. Only in one case a seeded pod was obtained.

The quality and quantity of seeds produced in that single pod varied greatly. Full seeds from the cross pod were found to be less in weight than the corresponding number of randomly selected selfed seeds of the maternal parent. All the seeds were separately sown in pots this year (April, 1958), but they did not germinate.

The average number of ovules per pod and number of seeds per gramme of these species (when selfed) are given below for comparison.

Species	Average number of ovules in a pod	Number of seeds per gramme
C. capsularis	50	300
C. olitorius	200	500
C. sidoides	55	1893

Discussion

It has been observed by DATTA (unpublished, a) and BANERJI and DATTA (in press) that in cross pollinated ovaries of both the species *(C. olitorius* and *C. capsularis)*, the rate of pollen tube growth down the styles is slower than that in case of self-pollination. In both the cases of cross-pollinations, only the few uppermost ovules are found to be fertilized, while the lower ones are seen to be collapsed. DATTA (unpublished, a) first records that fertilization is in process in *capsularis* ♀ × *olitorius* ♂, at 2 days, and in *olitorius* ♀ × *capsularis* ♂ at 3—4 days after pollination. In normal self-pollinations of both the species, fertilization is first noticed in embryo-sacs 6 hours after pollination and triple fusion after 10 hours (BANERJI, 1932). In the crosses between *olitorius* and *capsularis* BANERJI and DATTA (in press) have observed that the fertilized egg maintains two distinct nucleoli of different sizes till 20 days and the zygote does not divide till this time. Even the gametic fusion is sometimes withheld and unburst pollen tubes can be seen in the micropyles of the crossed ovules till this period. Finally the production of underweighed, non-viable full seeds, partially full and empty seeds clearly point out that there are some sorts of difficulties in normal growth of embryo and/or endosperm. Apparently there is some disharmony between endosperm and embryo or any one or both of them with the maternal tissues, which ultimately leads to the production of non-viable seeds.

The main barriers to success in this interspecific hybridization are: (1) the inability of most of the pollen tubes to grow rapidly and fertilize a majority of the ovules, (2) the long delay in actual fertilization processes, and (3) the failure of the zygote to divi de early to form an embryo, if any, and (4) the failure of a few seeds thus produced to germinate. The last one is termed as "hybrid inviability" by STEBBINS (1950) and this strongest barrier is considered to be one of the most widespread factors in isolation of plant species.

From these results it thus appears that these species of the genus *Corchorus*, though having the same chromosome numbers, are phylogenetically so wide apart that successful hybridization is well nigh impossible. Hybrid embryo-culture or crossed ovary culture with or without hormones should be tried to overcome this insurmountable genic incompatibility.

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Межвидовое скрещивание растений *Corchorchus olitorius* L. (линия *C. G.*) с *C. sidoides* F. MUELL. и *C. capsularis* L. (линия D 154) с *C. sidoides* F. MUELL

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Резюме

1. При скрещивании *C. olitorius* ♀ × *C. sidoides* ♂ завязывалось 29,4% плодов и собрано было лишь 20% плодов от количества завязанных. Все собранные плоды оказались пустыми.

2. При скрещивании *C. sidoides* ♀ × *C. olitorius* ♂ завязывалось 26,8% плодов и 9,0% от количества последних созрело. Один собранный плод содержал следующие типы семян: 4 пустых семени, 9 частично полных и 4 явно полные семена. Вес последних был ниже нормы. Ни одно из полученных семян не было жизнеспособным.

3. При скрещивании *C. capsularis* ♀ × *C. sidoides* ♂ и при реципрокном скрещивании завязывалось соответственно 31 и 20 процентов плодов. Ни один из них не достиг полной зрелости.

4. В филогенетическом отношении три исследованных вида стоят далеко друг от друга.