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EVALUATION OF INTERSPECIFIC HYBRIDIZATION IN THE GENUS *Cucumis* L.*

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ABSTRACT

Wild species of African origin of the genus *Cucumis* were crossed to gherkin (*Cucumis anguria*) in order to evaluate the degree of interspecific relationship that could be used to increase the genetic variability of the cultivated species.

Interspecific crosses were also made for compatibility studies within the genus.

The degree of interspecific hybridization was evaluated through the percentage of fruit set, quantity and quality of seeds, and viability of the F_1 plants.

INTRODUCTION

The genus *Cucumis* comprises approximately 30 species, three of which are grown as foodstuffs: melons (*C. melo*), cucumbers (*C. sativus*) and gherkins (*C. anguria*).

Gherkins, a species originating from Africa, were introduced in Brazil approximately 300 years ago through the slave trade (Meeuse, 1958). It is the cultivated species showing the greatest compatibility with wild African species of *Cucumis* in studies of interspecific hybridization with African gherkin introductions (Deakin *et al.*, 1971; Nijs and Visser, 1985).

Wild *Cucumis* species produce bitter-tasting fruits varying widely in size, color, an spininess. The Brazilian populations of *C. anguria* are characterized by the production of large, smooth and non-bitter fruits. However, little genetic variability is observed

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among gherkin populations for plant and fruit traits, indicating that the genetic base is quite narrow.

The objective of the present investigation was to study the degree of compatibility and relatedness between wild African species of *Cucumis* and Brazilian *C. anguria* strains.

MATERIAL AND METHOD

The *Cucumis* species and strains came from the germplasm collection of the sector of Vegetable Breeding of the Department of Genetics, ESALQ-USP, and are listed in Table I.

Table I - Species, designation and origin of the *Cucumis* introductions used for interspecific hybridization.

No.	Species	Designation	Origin
01	*C. africanus* L.f.	-	South Africa
02	*C. dipsaceus* SPACH.	GBNR 1733	Ethiopia
03	*C. dipsaceus* SPACH.	GBNR 1774	Ethiopia
04	*C. longipes* HOOK. f.	PI 249896	Africa
05	*C. longipes* HOOK. f.	-	South Africa
06	*C. metuliferus* NAUD.	-	Japan
07	*C. myriocarpus* NAUD.	PI 282449	South Africa
08	*C. myriocarpus* NAUD.	PI 374153	USA
09	*C. anguria* L.	BGH 4146 (mx 23L)[a]	Sta. Tereza, ES
10	*C. anguria* L.	Mx 6-77[a]	Mtes. Claros, MG
11	*C. anguria* L.	Composto Carambola[a]	Piracicaba, SP
12	*C. anguria* L.	PI 91676	USA
13	*C. anguria* L.	Mx 41 L[a]	Dourados, MS
14	*C. anguria* L.	Mx 22[a]	South Africa

[a] Introduction code of the *Cucumis* germplasm collection of the Department of Genetics, ESALQ-USP.

Pollination was performed in greenhouses on the ESALQ-USP Campus, from march to December 1986.

Reciprocal crosses were performed among the wild species and between them and gherkins. In addition, all parental species were selfed. The crosses performed are listed in Table II.

Table II - Crosses performed.

	1	2	3	4	5	6
1 - *C. africanus*	X		X	X	X	X
2 - *C. dipsaceus*	X	X				
3 - *C. longipes*	X		X	X	X	X
4 - *C. metuliferus*				X		
5 - *C. myriocarpus*				X	X	X
6 - *C. anguria*	X	X	X	X	X	X

The species used as female parents in the rows, and the species used as male parents, in the columns.

The viable interspecific F_1 hybrids obtained were selfed and backcrossed to *C. anguria* to determine their fertility and the possibility of obtaining segregant generations.

Cross compatibility was expressed by the following parameters: a) fruit setting, i.e., percent of pollinated flowers converted into fruits in relation to the total number of pollinations made; b) seed quantity and quality. The quantity of seeds was observed and compared to that of *C. anguria*, and quality was determined by visual inspection. Malformed seeds or seeds containing pericarp only were considered rudimentary.

RESULTS AND DISCUSSION

Table III presents the indices of fruit setting after selfing of the parental species used for interspecific hybridization. High values were obtained for all species. The results of interspecific hybridization are reported as fruit set and are presented in Table IV.

All interspecific F_1 hybrids were identified on the basis of fruit traits, which were phenotypically intermediate betweeen those of the parents in terms of color, spininess and size.

Crossing of C. anguria with wild Cucumis species

C. anguria crossed easily with *C. africanus, C. longipes* and *C. myriocarpus* (Table IV), confirming the results obtained by Deakin *et al.* (1971), Kho *et al.* (1980a), and Nijs and Visser (1981, 1985). Fruit set was high in these crosses, showing that the species are closely related.

Table III - Selfing of the parental *Cucumis* species used for interspecific hybridization, reported as fruit setting.

No.	Species	No. of selfings	No. of fruit	Fruit set (%)
01	*C. africanus*	5	5	100
02	*C. dipsaceus*	-	-	-
03	*C. dipsaceus*	1	1	100
04	*C. longipes*	2	2	100
05	*C. longipes*	4	4	100
06	*C. metuliferus*	2	1	50
07	*C. myriocarpus*	2	1	50
08	*C. myriocarpus*	2	1	50
09	*C. anguria*	5	5	100
10	*C. anguria*	5	4	80
11	*C. anguria*	2	1	50
12	*C. anguria*	6	5	83.3
13	*C. anguria*	5	5	100
14	*C. anguria*	3	2	66.6
General		46		84.8

The *C. africanus* x *C. anguria* and *C. myriocarpus* x *C. anguria* crosses, however, were less successful, with low fruit set and little seed production (Table IV). This phenomenon, called unidirectional compatibility, is attributed to the inhibition of the pollen tube in the style of *C. myriocarpus* (Nijs and Visser, 1985). Thus, *C. africanus* and *C. myriocarpus* should be used as male parents in crosses with gherkins.

Hybridization of *C. anguria* with *C. longipes* was successful, with a high percentage of fruit setting and abundant production of normal seeds in both crossing directions (Table IV). Meeuse (1958) considers *C. longipes* to be the ancestor of the gherkin and suggests that these species should be recognized as varieties of a single species, i.e., *C. anguria* var. *anguria* and *C. anguria* var. *longipes*.

The *C. anguria* x *C. africanus, C. anguria* x *C. longipes* and *C. anguria* x *C. myriocarpus* hybrids proved to be fertile and prolific, with viable F_2 generations and backcrosses to *C. anguria* (Table V). Thus, these interspecific crosses have great potential for use in gherkin breeding for increased genetic variability of the populations of cultivated species. In addition, *C. africanus* and *C. myriocarpus* carry resistance to cucumber green mottle virus (CGMV) and to watermelon mosaic virus (WMV) (Kroon *et al.*, 1979; Nijs, 1982).

Table IV - Crosses between African species of *Cucumis*, with the number of combinations of different introductions, reported as fruit set.

Parental combination	No. of combinations	No. of pollinations	Fruit set (%)	Seed properties
C. anguria x *C. africanus*	6	25	64	MS, RS
C. africanus x *C. anguria*	3	11	18.1	FS, RS, NS
C. anguria x *C. dipsaceus*	4	7	43.0	SF
C. anguria x *C. longipes*	8	26	84.6	MS, NS
C. longipes x *C. anguria*	3	7	85.7	MS, NS
C. anguria x *C. myriocarpus*	7	30	70.0	FS
C. myriocarpus x *C. anguria*	5	11	18.2	FS, RS, NS
C. africanus x *C. myriocarpus*	1	3	66.7	NS, RS
C. myriocarpus x *C. africanus*	1	3	33.3	NS, RS
C. africanus x *C. longipes*	2	5	60.0	FS
C. longipes x *C. africanus*	2	6	50.0	RS
C. dipsaceus x *C. africanus*	1	4	0	-
C. longipes x *C. myriocarpus*	3	8	62.5	NS
C. myriocarpus x *C. longipes*	2	9	0	-
C. metuliferus x *C. africanus*	1	1	0	-
C. africanus x *C. metuliferus*	1	1	0	-
C. longipes x *C. metuliferus*	1	2	0	-
C. myriocarpus x *C. metuliferus*	1	1	0	-
C. anguria x *C. metuliferus*	4	11	0	-

MS, Many seeds; RS, rudimentary seeds; FS, few seeds; NS, normal seeds; SF, seedless fruits.

Table V - Selfing of hybrids between *C. anguria* and wild *Cucumis* species and backcrosses to *C. anguria*, reported as fruit set. Piracicaba, SP, 1986.

Hybrids	Selfed		Backcross to *C. anguria*	
	N.P.	F.S. (%)	N.P.	F.s. (%)
C. anguria x *C. africanus*	64	37.5	14	21.4
C. africanus x *C. anguria*	8	12.5	-	-
C. anguria x *C. longipes*	15	53.3	13	69.2
C. longipes x *C. anguria*	4	75.0	-	-
C. anguria x *C. myriocarpus*	68	25.0	26	30.8

N.P., Number of pollinations; F.S., fruit setting.

The *C. anguria* x *C. dipsaceus* cross did not yield fruits in two combinations and produced seedless fruits in the other two, suggesting that these species are not related. Deakin *et al.* (1971) obtained partially fertile fruits from hybrids between *C. anguria* and *C. dipsaceus*, whereas Nijs and Visser (1985) did not identify hybrids between these two species.

Crosses between wild Cucumis species

Table IV shows that *C. africanus* and *C. myriocarpus* are compatible in reciprocal crosses. The interspecific F_1 hybrid showed great vegetative growth, as well as considerable vigor, rusticity and prolificacy. *C. africanus* crossed with *C. longipes* in both directions but with low seed production. *C. longipes* x *C. africanus* gave origin to fruits with rudimentary seeds which did not germinate (Table IV).

Interestingly, *C. africanus* presents greater crossing compatibility with *C. anguria* than with *C. longipes*, as shown by the greater fruit setting and by the larger amounts and better quality of seeds from the *C. anguria* x *C. africanus* hybrid.

The *C. dipsaceus* x *C. africanus* hybrid showed no fruit setting although the two species are considered compatible (Kho *et al.*, 1980b). It was concluded that the compatibility of these species depends on the combination utilized.

Table IV shows once again the phenomenon of unidirectional compatibility in *C. longipes* x *C. myriocarpus* hybrids. When *C. myriocarpus* was used as male parent, a good fruit set index was obtained, as well as production of normal seeds, whereas the reciprocal cross did not produce fruit.

C. metuliferus did not produce female flowers and was used only as a male parent. No fruit setting was observed when *C. metuliferus* was crossed with *C. africanus, C. longipes, C. myriocarpus* and *C. anguria* (Table IV). *C. metuliferus* is considered to be genetically isolated from other African species of *Cucumis* (Nijs and Vesser, 1985; Kho *et al.*, 1989a).

However, with the use of special pollination techniques and embryo culture, Oost and Nijs (1979) and Custers *et al.* (1981) performed a successful cross between *C. metuliferus* and *C. africanus*. The objective of this hybridization was to incorporate resistance to nematodes and to CGMV of *C. metuliferus* into cultivated *Cucumis* species, especially cucumbers.

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RESUMO

No presente trabalho foram realizados cruzamentos entre espécies selvagens de origem africana do gênero *Cucumis* e o maxixe (*C. anguria*), com o objetivo de avaliar o grau de relacionamento interespecífico, visando ao aumento da variabilidade genética em populações da espécie cultivada.

Os cruzamentos interespecíficos foram úteis para estudos de compatibilidade dentro do gênero.

O grau de hibridação interespecífica foi avaliado através da porcentagem de pegamento de frutos, quantidade e qualidade de sementes produzidas e viabilidade da planta F_1 obtida.

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