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INTRASPECIFIC HYBRIDIZATION IN "EGUSI" MELON, *COLOCYNTHIS CITRULLUS* L.

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ABSTRACT

Intraspecific hybridization in Melon, *Colocynthis citrullus* L. was carried out in the botanical garden of university of Calabar using three varieties namely "sewere" (S) "barablackedge" (BB) and "barawhite edge" (BW). They were crossed in all possible combinations including their reciprocals Average percentage fruit set of 18.1 was recorded. Colour of young fruits and colour of mature fruits were each found to be controlled by a single gene pair (monogenic inheritance). Chi-square analysis of the data on inheritance showed a good fit between observed and expected ratios in all the populations. Analysis of variance for some growth characters studied showed that most of the hybrids obtained did not differ significantly from their parents ($P > 0.05$) in leaf length, number of leaves per branch, stem width, vine length at maturity and height at branching. However, hybrid BW X BB was found to have produced significantly ($P < 0.05$) longer internode length than its parents. Hybrids BBXBW, BWXBB, SXBW and BW x S showed better parent heterosis for vine length at maturity. These findings may prove useful in future breeding work involving the crop.

KEYWORDS: *Colocynthis citrullus*, Intraspecific-Hybridization, Heterosis, Fruit colour inheritance

INTRODUCTION

Colocynthis citrullus L. (Synonyms *Citrullus vulgaris* shard, *Cucumeropsis edulis* L; *Cucumeropsis manii* L. and *Citrullus colocynthis* L. (Abu-Nasr and potts, 1953; Sen and Chakrabarty; 1964; Oyolu and Macfarlane, 1982; Susan and Anne, 1988; Joda et al; 1996) is an important source of oil and protein in the diet of most Nigerians (Joda et al; 1996). The seed Kernels which contain approximately 46% of oil and 36% protein (purseglove, 1991) when ground could be used as a thickener in local soups or fried in vegetable oil to obtain melon snack ("robo"). The oil extracted from the seeds is mostly used for cooking purposes and could be used for producing biscuit, margarines and soap (Ajibola, 1990). Also seeds could be popped and eaten as snacks.

In spite of these economic values, the species has been studied very little in Nigeria and hardly had any improvement work been done on this crop. Fundamental information on hybridization is scarce. Hence this research was undertaken to give an insight into the crossability relationships and inheritance pattern of fruit colour among three varieties of the species *Colocynthis citrullus* L.

MATERIALS AND METHODS

Seeds of two of the three varieties of *C. citrullus* studied namely "bara black edge" (BB) and "barawhite edge" (BW) were collected from National Horticultural Research Institute Ibadan while the third variety "Sewere" (S) was collected from National Horticultural Research Institute Okigwe. They were sown in the botanical garden of the University of Calabar, Calabar and crossed in all possible combinations including their reciprocals.

The procedure for hybridization was the same as that described by Bithi and Roy (1971). Since the male flowers were more numerous than the female flowers, the male flowers of one variety were plucked and the pollen dabbed on the stigma of an emasculated female flower of another variety. Pollination was done in the morning (between 6am and 10am).

Being an out-breeder, unwanted cross pollination was prevented by bagging the flowers with "Organza" bags (a material with fine holes which allows the passage of air and light thereby reducing the chances of the flowers collapsing before and after pollination), (Susan and Anne, 1988). The flower were bagged a day before they opened. During hybridization, the bags were removed, pollen quickly dabbed on the female flowers and the flowers rebagged for a day.

F_1 seeds resulting from the crosses together with the parent were planted using a randomized complete block design with four replications. The F1 plants were selfed to obtain F_2 seeds which were used to raise F_2 plants. The segregation pattern of fruit colour in F_2 population was studied by making segregation counts and subjecting them to standard chi-square tests to determine the goodness of fit for the observed genetic ratios as required by Bohn (1961); Bains and Kang (1963); Hoffman and Nugent (1973) and Nugent and Hoffman (1974).

Some growth characters were also measured and subjected to analysis of variance tests (Bemis, 1963). The means were separated using least significant difference tests. Heterosis was calculated using the method of Falconer (1994).

RESULTS

FRUITING AND SEED GERMINATION

Mean percentage fruit set obtained from the crosses made ranged from 11.11% SXBB to 27.59% in BBXBW with an average of 18.1% Mean days to germination ranged from 4 to 6 in the different parents and hybrids. Hybrids SXBW, BWXS, BBXBW and

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Table 1: Flowering, fruiting and seed germination characteristics in intraspecific crosses carried out in *C. citrullus*.

	S	BB	BW	SXBB	BBXS	SXBW	BWXS	BBXBW	BWXBE
No. of crosses made	-	-	-	27	28	32	28	29	28
% fruit set	-	-	-	11.11	25	12.5	17.86	27.59	14.29
% seed germination	98	87.5	95.5	93.75	95	96.88	90.63	92.5	81.25
Mean germination period (in days)	4a ± 0.0538	6b ± 0.754	4a0 ± 0554	4a ± 0.727	6b± 0.0754	4a± 0.0539	4a± 0.0554	6b± 0.0330	4a± 0.0269
Mean days To flowering	35a ± 0.3354	42b ± 0.1983	36a ± 0.1983	35a ± 0.3354	42b± 0.1875	35a± 0.3354	35a± 0.2576	42b± 0.0854	35a± 0.1983
Petal length (cm):									
Female flower	1.5a ± 0.032	1.5a ± 0.030	1.4a ± 0.053	1.6a ± 0.043	1.5a± 0.027	1.5a± 0.027	1.4a± 0.026	1.5a± 0.031	1.6a± 0.065
Male flower	1.4a ± 0.025	1.4a ± 0.026	1.4a ± 0.034	1.4a ± 0.030	1.4a± 0.025	1.4a± 0.025	1.4a± 0.023	1.3a± 0.025	1.4a± 0.037
Petal width (cm):									
Female flower	1.3a ± 0.020	1.1a ± 0.034	1.1a ± 0.025	1.3a ± 0.052	1.1a± 0.021	1.3a± 0.033	1.1a± 0.037	1.2a± 0.036	1.2a± 0.039
Male flower	1.1a ± 0.023	1.1a ± 0.037	1.1a ± 0.045	1.1a ± 0.023	1.0a± 0.028	1.1a± 0.022	1.0a± 0.016	1.1a± 0.025	1.0a± 0.035
Mean days to fruit formation from flowering	12a ± 0.0854	16b± 0.1708	12a± 0.0854	12a ± 0.0854	18b± 0.0854	12a± 0.1708	12a± 0.0854	17b± 0.1008	12a± 0.1708
Mean No. of mature fruits per plant	10b ± 0.164	8a± 0.258	8.75a± 0.256	11.25cd ±0.093	11bc± 0.134	12cde± 0.167	12.5e± 0.134	12.25de± 0.111	12cde± 0.134

Mean followed with same case letters in a given horizontal array indicate no significant difference (P>0.05).

TABLE 2: F_1 hybrids and F_2 segregation pattern for colour of young fruits.

Crosses	F_1 Phenotype	F_2 Phenotype	TOTAL POPULATION Observed	Expected	Ratio	X^2	P(Range)
SXBB	Light green	Light green	35	38			
		Dark green	15	12	3:1	0.9868	0.30-0.50
BBXBW	Light green	Light green	36	38			
		White	14	12	3:1	0.4386	0.30-0.05
SXBW	Light green	White	12	15			
		Light green	22	24	1:2:1	0.9359	0.30-050
		Dark green	16	13			

BWXBB produced significantly more (P<0.05) mature fruits per plant than the parents (table 1). Hybrid BBXS had the highest mean days to fruit formation which was significantly higher (P <0.05) than those of its 2 parents.

INHERITANCE OF FRUIT COLOUR

(a) COLOUR OF YOUNG FRUITS.

The F1 hybrids and the F_2 segregation pattern for colour of young fruits is presented in table 2.

The cross SXBB and its reciprocal produced F1 progenies which closely resembled the BB parent in colour of young fruits. The F2 fruits segregated in a ratio of 3BB: 1 S indicating the dominance of the gene for the light green colour.

The hybrids of the cross BBX BW and its reciprocal had light green fruits with stripes (resembling BB parent). The F2 generation segregated in a ratio of 3 BB: IBW indicating that BB is dominant over BW and is controlled by a dominant gene.

In the cross SXBW and its reciprocal, all the F1 members were light green. The F2 progenies segregated in a ratio of 1 S :2BB:IBW indicating incomplete dominance. However, the light green colour totally faded out in the F1 and F2 generations as the fruits grew older giving rise to dark green fruits resembling the S parent (Sewere) completely. Chi-square analysis for the three crosses showed a good fit between observed and expected ratio in all the populations.

(b) COLOUR OF IMATURE FRUITS.

The F1 hybrids and the F2 segregation pattern for colour of mature fruits is presented in Table 3. The cross SXBW and its reciprocal produced F1 progenies which closely resembled the S parent(dark green) indicating that the white colour of BW is recessive to the dark green colour. A ratio of 3 dark green: I white was obtained in F2 generation (Table 3).

The F1 fruit colour of the cross "bara black edge" BB, (light green) X "bara white edge", BW, (white) revealed dominance of the light green colour over white colour as all the fruits in the F1 were light green. The F2 data fit in the ratio of 3 light green :1 white (Table 3).

Fruits of the cross between "Sewere" S, (dark

green colour) X "bara-black edge", BB, (light green colour) were dark green in the F1 generation. F2 fruits segregated in a ratio of 3 dark green: 1 light green indicating that the dark green colour is dominant over light green. Chi-square analysis showed a good fit for observed and expected ratios (Table 3).

EVALUATION OF SOME GROWTH CHARACTERS

Analysis of variance tests for some growth characters studied showed that the hybrids did not differ significantly (P>0.05) from their parents in leaf length, number of leaves per branch, stem width, height at branching and vine length at maturity (Table 4).

However, hybrid BBXS produced significantly fewer braches than both parents (P<0.05) while hybrid SXBW had significantly fewer branches than parent BW only (P<0.05). Hybrids BBXBW SXBB, BBXS all had significantly larger leaf breadth (P<0.05) than parent BB only

TABLE 3: F_1 Phenotypes and F_2 segregation of hybrid progenies of various crosses involving colour of mature fruits in *C. citrullus*

Crosses	F_1 Phenotype	F_2 segregation	Total Population Observed	Expected	Ratio	X^2 value	P(Range)
		Dark green	31	33			
SXBW	Dark green		44		3:1	0.4848	0.30-0.50
(Dark green) X (white)		white	13	11			
BBXBW	Light green	Light green	28	30			
(Light green)	X (white)		40		3:1	0.5333	0.30-050
		White	12	10			
SXBB	Dark green	Dark green	35	38			
(Dark green) X (Light green)			50		3:1	0.9868	0.30-0.50
		Light green	15	12			

TABLE 4: Mean * and standard error of parents & hybrids (at maturity) for the growth characters studied in *C. citrullus*

Character	Varieties S	BW	BB	SXBB	BBXS	BBXBW	BWXBB	SXBW	BWXS
Leaf length (cm)	17.45a± 0.3884	17.875a± 0.2394	16.55a± 0.3379	17.15a± 0.2629	17.475a± 0.5006	17.574a± 0.4973	15.65a± 0.5620	17.573a± 0.5977	17.00a± 0.3109
Leaf breadth (cm)	15.975cd± 0.4715	15.3bc± 0.2121	14.05a± 0.3708	15.875cd± 0.3881	15.575bcd± 0.1436	15.90c± 0.1779	14.50ab± 0.5049	16.50d± 0.4899	15.1abc± 0.2000
Internode length (cm)	10.6cd± 0.9496	9.475ab± 0.3966	8.475a± 0.3351	11.00cd± 0.2273	10.35bc± 0.150	10.4bc± 0.2708	11.175cd± 0.2869	11.75d± 0.3227	10.875cd± 0.3010
Number of Branches per plant	4.75bc± 0.4787	5.0cd± 0.5774	5.75d± 0.250	4.5abc± 0.2887	5.35a± 0.500	4.5ab± 0.2887	4.0abc± 0.0	3.75ab± 0.25	4.0abc±0.0
Number of leaves per branch	47.5a± 5.3307	46.25a± 4.0078	43.0a± 5.212	46.0a± 1.779	47.5a± 5.331	49.75a± 4.767	48.25a± 3.449	48.5a± 5.515	48.5a± 6.384
Stem width (cm)	1.00a± 0.0816	0.875a± 0.1377	0.90a± 0.0816	1.00a± 0.1291	0.90a± 0.1080	1.90a± 0.0913	0.925a± 0.025	0.925a± 0.075	0.90a± 0.0816
Height at branching(cm)	3.775a± 0.3424	4.0425a± 0.4661	3.8a± 0.2041	3.85a± 0.2062	3.75a± 0.4052	3.925a± 0.2016	4.20a± 0.4778	4.35a± 0.3476	3.70a± 0.0577
Vine length at maturity	399.5a± 55.231	378.75a± 23.081	399.25a± 35.352	422.75a± 20.986	399.5a± 54.463	440.5a± 43.724	429.75a± 24.642	410.5a± 40.858	449.5a± 38.126

Key
S = Sewere
BB = Barablack edge
BW = Barawhite edge

* Means followed with same case letters in a given horizontal array indicate no significant difference (P>0.05)

Hybrids BBXBW, BWXBB, SXBW and BWXS showed better parent heterosis for internode length, number of leaves per branch and vine length at maturity while all the hybrids recorded negative heterotic values for number of branches per plant (see Table 5).

DISCUSSION

The low percentage fruit set obtained in all the crosses made is comparable to that of purseglove (1991) who reported that when melon is artificially pollinated percentage fruit set ranges from 10-50. Mann (1953) also had about 10% fruit set when he hand – pollinated some flowers of *Cucumis melo* L. The low values may be due to flower injury during the process, since these flowers are quite small in size.

The mean days to germination reported in this study agrees with reports from Tindall (1986) and Nihort (1999) who both reported a range of 4 to 6 days as period of germination in melon. Parent BB as well as hybrids BBXBW and BBXS all took much conger days to germinate (compared with others) Table 1 and also longer days to flower. This indicates that parent BB is a late maturing variety. The two hybrids (BBXBW and BBXS) therefore seem to have inherited this feature from BB parent.

The 3.1 ratio reported in table 2 suggests that light green colour of immature fruits is dominant to dark green and white colour and may probably be controlled by a dominant gene. This result agrees with that of Kubicki (1962) who equally reported a 3:1 ratio in colour of immature fruits in musk melon, confirming that colour of young fruit is monogenically inherited. However, the 1:2:1 ratio obtained in cross SXBW would tend to suggest that colour of young fruit is controlled by partially dominant genes. Since this was the only case out of the several crosses made in which the ratio occurred it may need further work to either debunk or confirm this ratio.

According to the results obtained in this work, colour of mature fruit appear to be controlled by dominant genes. The 3:1 ratio obtained in the crosses SXBW, BBXBW and SXBB suggests that dark green and light green colour are dominant over white colour. This result was also reached by Hughes (1948) who reported that white colour of mature fruits is recessive to dark green and Ganesan (1992) who reported that fruit colour in Musk melon is controlled by a single gene pair.

Most of the hybrids obtained from this study did not differ significantly ($P>0.05$) from their parents in some of the growth characters studied namely leaf length, number of leaves per branch, stem width, height at branching and vine length at maturity. This may be an indication that the combining abilities of these varieties are quite low with little or no hybrid vigour.

Adeniran and Dosunmu (1986) also reported no significant differences in yield performance of five (5) selected lines of melon. Our report however differs from that of Kalloo and Sidhy (1980) who had high significant difference among the genotypes for all the characters they studied in Musk melon. These differences may be as a result of the environment or the nomenclature problem still surrounding the species.

Hybrids BBXBW and BWXBB, showed better parent heterosis in leaf breadth and internode length respectively and this could prove useful for incorporation into future breeding programmes (if and only if these characters are positively correlated with yield).

The high heterotic values recorded in all the

TABLE 5: Heterotic Values for some growth characters in *C. citrullus*

S/n	Character	Crosses	∑ Mean		Heterotic value (in %)
			∑ hybrids	∑ parents	
1	Leaf length	SXBB/BBXS	17.31	17	+15.5
		BBXBW/BWXBB	16.61	17.21	-30
		SXBW/BWXS	17.285	17.665	-19
2.	Leaf breadth	SXBB/BBXS	15.72	14.95	+40
		BBXBW/BWXBB	16.20	14.675	+76.25
		SXBW/BWXS	15.80	15.635	+8.25
3.	Internode length	SXBB/BBXS	10.675	9.535	+57
		BBXBW/BWXBB	10.79	8.97	+91
		SXBW/BWXS	11.31	10.17	+57
4.	Number of branches per plant	SXBB/BBXS	4	5.25	-62.5
		BBXBW/BWXBB	4.25	5.75	-75
		SXBW/BWXS	3.875	4.875	-50
5.	Number of leaves per branch	SXBB/BBXS	46.75	45.25	+75
		BBXBW/BWXBB	49.0	46.625	+118.75
		SXBW/BWXS	48.50	46.875	+93.75
6.	Stem width	SXBB/BBXS	0.95	0.95	0
		BBXBW/BWXBB	0.9125	0.8875	+1.25
		SXBW/BWXS	0.9125	0.9375	-1.25
7.	Height at branching	SXBB/BBXS	3.8	3.79	+0.5
		BBXBW/BWXBB	4.06	3.92	+7.0
		SXBW/BWXS	4.025	3.91	+5.75
8.	Vine length at maturity	SXBB/BBXS	411.35	399.375	+598
		BBXBW/BWXBB	435.125	389.0	+2300
		SXBW/BWXS	430	389.125	+2043

crosses made for vine length (Table 3) strongly suggest a high combining ability of the parents for this character. And since increase in vine length means an increase in the number of male and female flowers produced and consequently increased chances of fruit set, it follows that these hybrids would be very usefull in yield improvement programmes for this crop.

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