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Full Length Research Paper

Somatic chromosome counts and yield performance of some accessions of 'egusi' melon (*Citrullus lanatus*)

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Investigation in 20 accessions of *Citrullus lanatus* ('egusi' melon) revealed somatic chromosome counts ranging from 18 to 24 with 2n = 22 being the most frequent. Polyploid counts of 2n = 40 and 2n = 44 were made for accessions DD98/4 and L6, respectively. Diploid chromosome counts varying from 2n = 22 suggest aneuploid changes in chromosome number or can be attributed to counting difficulties caused by the overlapping of the sticky small chromosomes. The polyploid counts were exact multiples of the diploid numbers, suggesting occurrence of polyploid forms/cultivars of the species. The high yield performance observed for L6 as reflected in the fruit size and weight is a reflection of gigas effect that is characteristic of polyploid genomes. The study reveals that knowledge of chromosome counts and character expression will be useful in the selection of genotypes for hybridization purposes.

Key words: Chromosome, 'egusi' melon, diploid, aneuploid, polyploidy.

INTRODUCTION

'Egusi' melon, *Citrullus lanatus* (Thunb.) Matsum. & Nakai is one of the most important vegetable crops in the tropical and subtropical region of the world (Schippers, 2000). It is a cross pollinated crop and germplasm often exists in the form of heterozygous genotypes which could be improved through intraspecific hybridization. Other close relatives of *C. lanatus are*. *C. colocynthis*, *C. ecirrhosus*, *C. nandianus* and *C. mucosospermus*, all having chromosome counts of 2n = 22 (n = 11) as reported by Wehner and Barrett (1996). Stickiness, poor stainibility and extremely small size of the chromosomes are factors militating against cytogenetic studies in *Citrullus* species. However, staining with acetocarmine or aceto-orcein has been shown to produce good results (Schimotsuma, 1961).

This paper reports chromosome counts in 20 accessions of *C. lanatus* collected from National Institute of Horticultural Research (NIHORT), Ibadan and different towns in Nigeria.

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MATERIALS AND METHODS

Field cultivation and evaluation

Twenty accessions of *C. lanatus* were used in this research. Fourteen of the accessions were obtained from the germplasm unit of National Institute of Horticultural Research (NIHORT) Ibadan, Nigeria and six accessions from different towns in Nigeria (Table 1).

The field evaluation of the accessions was carried out at the Teaching and Research Farms, University of Agriculture, Abeokuta (7.35°N, 3.88°E, 450 m asl) in August, 2005. Double row plot was adopted for the study in a Randomized Complete Block Design (RCBD) with three replications. A block consisted of 40 rows and planting was done in 6- m long rows. The rows were 1 m apart and the plant – to – plant distance was also 1 m. Two seeds of each accession was planted per hole and later thinned to 1 plant per hill. Each row therefore contained seven plants and five competitive plants within each row were observed. Manual weeding was carried out when necessary.

Data on quantitative characters were collected on ten competitive plants for each accession. The characters measured were number of branches/plant, vine length, number of fruits/plant, fruit size (i.e. fruit circumference), fruit weight, seed weight/fruit, number of seeds/fruit, 100-seed weight and seed yield. The quantitative data collected were statistically analyzed using SAS Microsoft Windows Release 8.0 (SAS Institute, 1999).

Table 1. Sources of the accessions used for the study.

Accession	Source
V2	NIHORT, Oyo State
131DA	NIHORT, Oyo State
DL99/46	NIHORT, Oyo State
DL99/71	NIHORT, Oyo State
DL99/75	NIHORT, Oyo State
DL99/76	NIHORT, Oyo State
DD95/549	NIHORT, Oyo State
DD98/3	NIHORT, Oyo State
DD98/4	NIHORT, Oyo State
DD98/7	NIHORT, Oyo State
DD98/506	NIHORT, Oyo State
DD98/511	NIHORT, Oyo State
DD98/533	NIHORT, Oyo State
DD98/550	NIHORT, Oyo State
L1	Okene, Kogi State
L2	Minna, Niger State
L3	Benin, Edo State
L4 (PAPA SAKI)	Saki, Oyo State
L5 (SOFIN 'BIG')	Abeokuta,Ogun State
L6 (SOFIN 2)	Saki, Oyo State

Cytological studies

Healthy seeds were selected from each accession and planted in Petri dishes lined with moistened filter paper with cotton wool at the base. Young roots from sprouted seeds were excised and treated with 0.04% colchicine solution for 3 h between the hours of 9.00 am and 12.00 noon before fixation as suggested by Ekanem and Osuji (2004). The pretreated roots were fixed in 1:3 acetic/ethanol (v/v) for 24 h before using for cytological studies. The roots were then hydrolysed in 1 N HCl for 5 min, rinsed in distilled water and the tips (one at a time) squashed on slides to form an homogenous solution as described by Olorode (1974). A drop of FLP-orcein was added after which a cover slip was placed on the squashed root tip. The prepared slides were left for 10 min for the cells to take up the stain before tapping out the excess stain by placing the slide between a fold of filter paper and tapping gently with the blunt end of a biro pen without allowing the cover slip to move. The slides were viewed under the microscope for dividing cells and photographs taken at x1000 magnification under oil immersion using a Leica 2000 phase contrast microscope.

RESULTS AND DISCUSSION

Data on morphological/yield performance and somatic chromosome counts are shown in Table 2. Majority of the accessions of *C. lanatus* considered in this study showed chromosome counts of 2n = 22. Lower chromosome counts of 2n = 18 was made for accession DL98/533 while accessions L3, L4, L5 and DD99/75 showed chromosome counts of 2n = 20. Chromosome counts of 2n = 24 were made for accession L2. Euploid counts of 2n = 40 and 2n = 44 were recorded for accessions DD98/4 and L6, respectively.

The observation of variable chromosome number within the species suggests the occurrence of intraspecific aneuploid and polyploid series. This observation suggests that the species is still undergoing some evolutionary process with respect to chromosome number. However, it was noted that the small size and sticky nature of the melon chromosomes always resulted in clumping together and overlapping of some chromosomes in the genome. This observation could be responsible for some of the chromosome counts showing aneuploid changes from 2n = 22.

The highest yield was recorded for accession L4 (514.67 kg/ha) and the least for DD98/3 (25.26 kg/ha). Accession L3 had the longest vine (327.20 cm) and the shortest was recorded for DD98/3 (151.97 cm). The number of branches per plant ranged from 1 to 3. The largest fruit size per plant was recorded for L6 (86 cm) and the smallest for DD98/3 (30 cm). The highest fruit weight was recorded for accession L5 (2600 g) and the least for accession DD98/3 (373 g). The high yield recorded for accessions L4, L2, L6 and L1 can be attributed to their high number of branches per plant and longer vine length which gave the accessions increased fruit bearing nodes and larger photosynthetic surfaces.

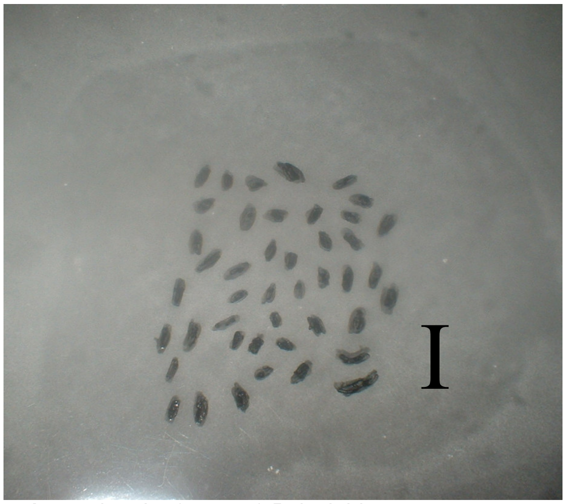
The number of fruits per plant observed ranged from 1 – 3, with seven of the accessions, having one fruit per plant, ten accessions having two fruits per plant and three accessions having three fruits per plant. This yield performance is low when compared with the vine length and number of flowers produced by the plants. The low yield performance can be attributed to two factors. It could either be due to low levels of fertilization of the ovules resulting from low level of cross pollination since the crop is an out crosser or abortion and dropping of pollinated flowers which can be caused by genetic and environmental factors. Genomic compatibility of the accessions, time of cultivation, availability of pollinating agents, insect pests, amount frequency and heaviness of rains are some of the genetic and environmental factors that could be responsible for the low seed yield per plant. Number of seeds/fruit ranged from 120 for accession DD98/3 to 334 for accession L2, while the seed weight / fruit ranged from 17.43 g (DD98/3) to 41.79 g (L2). The highest 100-seed weight was recorded for DD98/3 (14 g) and the least for L3 (11.28 g).

Accession L6 (2n = 4x = 44) and DD98/4 (2n = 4x = 40) were observed to be polyploids which is reflected in the fruit size of accession L6. However, the yield performance recorded for accession DD98/4 was unexpectedly comparatively lower than that of accession L6. This could be due to chromosome segregation problems during gamete production process in accession DD98/4 consequent upon the in balance of its genome. Accession DD98/4 (2n = 4x = 40) probably evolved from 2n=20 diploid accession that have undergone an aneuploid decrease from 2n = 22 to 2n = 20 (Figure 1). The aneuploid decrease in the diploid accession could be

Table 2. Morphological/yield performance and somatic chromosome counts of twenty accessions of 'egusi' melon.

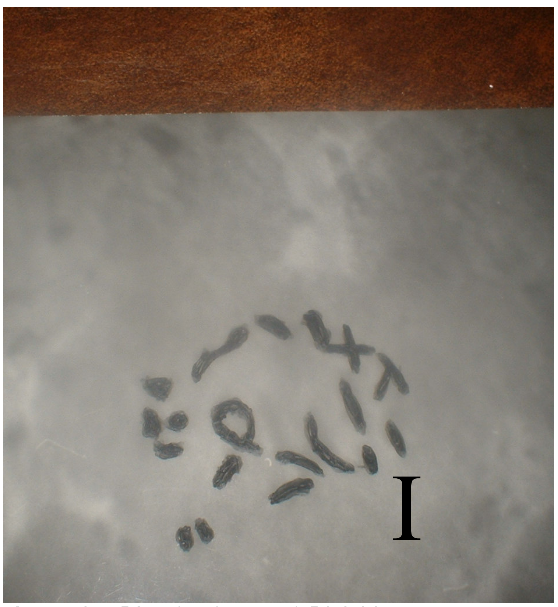
Accession	Seed yield (Kg/ha)	Number of branches/plant	Main vine length (cm)	Number of fruits/plant	Total fruit weight/plant (gm)	Fruit size/plant (cm)	Seed weight/ fruit (g)	Number of seeds/fruit	100-seed weight (m)	Chromosome No. (2n)
V2	188.2 ± 57.76	3 ± 0.15	255±45	1 ± 0.40	1113 ± 102	54 ± 26.38	20.23 ± 9.31	138 ± 54	13.02 ± 1.34	22
131DA	305.58 ± 42.10	3 ± 0.51	234±54	2 ± 0.44	1187 ± 98	60 ± 16.26	35.02 ± 7.60	210 ± 41	13.11± 1.45	22
DL99/46	194.01 ± 13.99	3 ±0.27	248±46	2 ± 0.25	1003 ± 59	53 ± 8.42	21.91± 3.66	151 ± 20	12.56 ± 1.39	22
DL99/71	165.63 ± 85.40	2 ± 0.51	249±40	1 ± 0.20	963 ± 74	49 ± 9.97	31.16 ± 5.07	251 ± 37	11.52 ± 0.41	22
DL99/75	202.11 ± 85.53	3 ± 0.06	263±38	2 ± 0.51	1177 ± 109	55 ± 19.04	22.48 ± 4.24	171 ± 23	11.65 ± 0.73	20
DL99/76	199.81 ± 55.54	3 ± 0.25	272±39	2 ± 0.11	1270 ± 124	64 ± 14.75	28.00 ± 5.15	201 ± 26	14.52 ± 0.61	22
DD95/549	268.33 ± 24.54	3 ± 0.25	256±20	2 ± 0.20	1480 ± 104	59 ± 5.36	22.08 ± 12.66	169 ± 25	12.20 ± 0.91	22
DD98/3	25.26 ± 15.02	2 ± 0.32	152±35	1 ± 0.06	373 ± 87	30 ± 2.75	17.43 ± 6.04	135 ± 25	14.00 ± 0.83	22
DD98/4	119.24 ± 73.85	3 ± 0.12	234±50	2 ± 0.82	1083 ± 97	58 ± 25.49	21.64± 5.52	154 ± 30	13.55 ± 1.27	40
DD98/7	225.36 ± 80.30	2 ± 0.35	271±46	1 ± 0.12	970 ± 60	53 ± 14.83	27.84± 13.59	207 ± 62	11.50 ± 0.52	22
DD98/506	180.16 ± 20.60	2 ± 0.62	218±61	2 ± 0.61	1013 ± 58	51± 27.17	34.32 ± 20.56	242 ± 62	12.09 ± 0.64	22
DD98/511	205.73 ± 36.44	3 ± 0.49	259±14	1 ± 0.06	1043 ± 55	49 ± 3.53	32.00 ± 10.17	253 ± 77	11.98 ± 0.39	22
DD98/533	135.71± 39.03	2 ± 0.40	233±52	1 ± 0.12	1007 ± 107	49 ± 7.19	15.52 ± 10.42	120 ± 55	11.85 ± 1.81	18
DD98/550	86.67 ± 9.98	2 ± 0.31	178±27	1 ± 0.42	643 ± 59	30 ± 3.56	21.45 ± 15.56	158 ± 52	12.59 ± 3.03	22
L1	356.33 ± 24.09	3 ± 0.10	323±43	2 ± 0.32	1323 ± 95	77 ± 6.84	26.10 ± 8.07	212 ± 36	12.14 ± 1.18	22
L2	448.33 ± 87.74	3 ± 0.46	306±13	3 ± 0.65	1310 ± 112	74 ± 19.18	41.79 ± 12.86	334 ± 82	12.46 ± 1.20	24
L3	223.89 ± 78.02	2 ± 0.29	327±60	2 ± 0.57	1157 ± 84	63 ± 26.68	25.61± 12.79	206 ± 77	11.28 ± 1.90	20
L4	514.67 ± 72.15	3 ± 0.15	289±70	3 ± 0.46	1370 ± 95	84 ± 17.49	27.06 ± 6.99	239 ± 57	12.01± 0.88	20
L5	50.45 ± 29.33	1 ± 0.23	321±38	2 ± 0.36	2600 ± 88	73 ± 6.37	28.78 ± 4.77	170 ± 27	13.45 ± 2.37	20
L6	335.41± 48.78	3 ± 0.38	276±57	3 ± 0.87	1377 ± 82	86 ± 38.28	17.99 ± 5.43	168 ± 45	11.99 ± 1.04	44
x ± SD	221.5 ± 20.23	2.42 ± 0.066	258.16±7.7	1.76 ± 0.07	1173.17 ± 76.92	55.58 ± 2.7 0	25.92 ± 1.46	194.38 ± 9.75	12.47± 0.18	

A



Accession L6 (2n = 44) Polyploid

B



Accession DL99/71 (2n = 22) Diploid

Figure 1. Metaphase chromosomes of *C. lanatus* **A.** Metaphase in Accession L6 with 2n = 44 chromosomes. **B.** Late prophase in Accession DL99/71 with 2n = 22 chromosomes Scale line represents 1.0 µm.

due to loss of two different chromosomes (double monosomy) or loss of a bivalent (nullisomy). The reduction in the chromosome number which created genomic imbalance problem coupled with multivalent association of chromosomes in polyploidy genomes, which are major factors in the determination of the qualities of the gametes and fruits produced, could be responsible for the low yield performance in accession DD98/4. This ascertion however needs to be confirmed by proper meiotic studies on the accessions.

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