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Inheritance of Stem Pigmentation in Two Local Varieties of *Hibiscus sabdariffa* in Nigeria

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ABSTRACT

Character difference was studied in intra-specific crosses involving two local varieties of *Hibiscus sabdariffa* L. One variety has green pigment on the stem and calyces while the other has red. Results showed that the inheritance of red pigmentation was controlled by one independently assorting gene with a dominant allele (R-) producing red pigment on the stem and calyces. Only the genotypes (rr) homozygous for the recessive allele produced a green stem and calyces. The implications of these findings on the species evolution are discussed.

Keywords: allele, character difference, gene, inter-specific crosses, roselle

INTRODUCTION

Hibiscus sabdariffa L., also known as roselle, is one of the most important species of *Hibiscus* in Nigeria (Falusi 2004). It belongs to the order Malvales, the family Malvaceae and the genus *Hibiscus* (Olubukola and Illoh 1996). The genus consists of about 300 species some of which are widely distributed as tropical herbs and shrubs (Heywood, 1978). Some of these species are *H. sabdariffa* L., *H. cannabinus L.*, *H. asper* Hook. F., *H. tilliaceus* L., *H. acetosella* Welw ex Hiern, *H. noldeae* Baker F., *H. surattensis* L., *H. physaloides* Guill & Perr and *H. scotelli* Bak. F. The most popular among these species in terms of food value is *H. sabdariffa* (Murdock 1995). Generally the utility of the crop varies among different people around the world. In Nigeria, it is cultivated for many different purposes, the most common of which are as a refreshing beverage and leafy vegetable (Schippers 2000).

Two common varieties of this species are grown in the country (Udom *et al.* 2001). One of them has red pigment on both stem and calyces while the other has green pigment. The green variety is more predominant in the southern parts of the country while the red variety is predominant in the Northern parts. The calyx of the red variety is usually boiled in hot water while the red extract is sweetened and flavoured as a beverage drink. It has a number of uses and promising prospects for industrial purposes (Alegbejo 2000). These two varieties exhibit different characteristics. Few of these differences have however, been genetically investigated. Wilson and Menzel (1967) studied the inheritance of resistance to root knot nematodes in *Hibiscus* species. They reported that the mode of inheritance of this character was monogenic. This paper is a further report on the mode of inheritance of character difference from intra-specific crosses. It also sheds some light on the role of gene mutation on the development of character difference between two local varieties of *H. sabdariffa*.

MATERIALS AND METHODS

The experimental materials were obtained from parts of central and Northwestern Nigeria (Falusi 2004). They were identified by the morphological description of Hutchinson and Dalziel (1963), Schippers (2000) and Mann *et al.* (2003). The varieties in relation to the character studied are as follows:

NRG-NG-R7: Red pigmented stem and calyces; NRG-NG-R8: Green pigmented stem and calyces.

Twenty seedlings of each variety were raised in plastic buckets containing sandy loam soil. At maturity, crosses were made repeatedly many times between the two varieties using flower buds emasculated just before anthesis (14 weeks after planting for the green variety and 16 weeks for the red variety) and pollinated the second day with pollen grains from freshly dehisced anthers of the male parent. Ten F1 seeds for each cross were planted and the resulting plants were naturally self-pollinated while five were backcrossed to both parents. One hundred F2 and backcross populations were grown while the segregating seedlings were counted to determine the inheritance of the character under investigation. Chi-square tests were used to compare the observed and theoretical ratio.

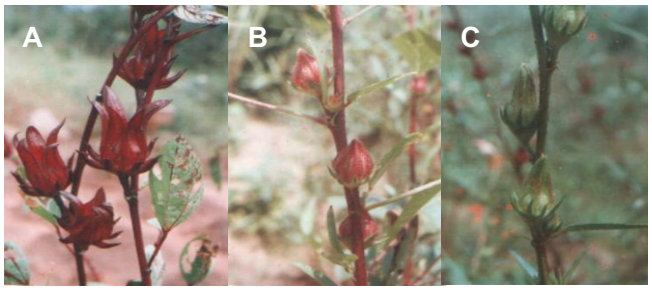

Fig. 1 Shoots of two local varieties of *Hibiscus sabdariffa* and their hybrid. (**A**) Shoot of the variety with red pigment on stem and calyces. (**B**) Shoot of the hybrid with Red pigment on stem and calyces. (**C**) Shoot of the variety with green pigment on stem and calyces.

RESULTS AND DISCUSSION

Despite the promising prospects that roselle enjoys, there has been no proportionate effort in research on the crop. All ten F1 plants from the cross between the two varieties of *H. sabdariffa* in this study had red pigmentation on the stem and calyces (**Fig. 1**). The F2 and backcross data from the crosses are presented in **Table 1**. When the F1 plants were

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Research Note

Table 1 Inheritance of pigmentation in a cross between two varieties of *Hibiscus sabdariffa* L.

Cross	Experimental		Theoretical		X2	P	Ratio
	R-	rr	R-	rr			
NRG-NG-R7 X NRG-NG-R8 (selfed)	72	28	75	25	0.48	0.90-0.8	3:1
NRG-NG-R7 X NRG-NG-R8 X NRG-NG-R7	44	0	44	0	0	0.00	All R
NRG-NG-R7 X NRG-NG-R8 X NRG-NG-R8	16	12	14	14	0.57	0.70-0.50	1:1

R- = red pigmentation; rr = green pigmentation

backcrossed to the red pigment parent, all the progeny had red pigment on the stem and calyces. The backcross progenies of the F1 to the green pigment parent however, produced a phenotypic ratio of one red pigment to one green pigment plants. The chi-square values obtained for the cross showed a good fit for a monogenic inheritance for an F2 phenotypic ratio of 3:1. This was confirmed in the phenotypes of the backcross progenies of either, 1:1 when the F1 was crossed to the recessive parent (green pigment variety), or red pigment when the F1 was crossed to the dominant parent (red pigment variety).

These results suggest that the expression of red pigment on stem and calyces was due to the presence of the dominant allele (R--) i.e., RR or Rr, while the presence of the recessive allele (rr) produced green pigment on the stem and calyces. This is an indication that character difference between the two local varieties of *H. sabdariffa* was inherited simply. Thus a gene with marked phenotypic effect controls the adaptive characteristic by which both varieties are distinguished. By representing the genotypes of the green variety plant by rr and the red variety plant by RR, the change from the red variety could have been caused by the mutation of R to r. This suggests that the green variety plants were derived through gene mutation. A similar monogenic trait, though with complementary action, was reported for the expression of stem hairiness in the cross between *Sesamum indicum* and *Ceratotheca sesamoides* (Falusi *et al*. 2002). The ease of gene exchange between these two local varieties of *H. sabdariffa* confirms that they are very closely related. Further evidence is borne by the fact that the F1 produced by crossing them was fertile and their F2 progenies were vigorous.

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