INHERITANCE OF PIGMENTATION PATTERNS IN *TALINUM TRIANGULARE* (JACQ.)WILLD

Oziegbe, M. [1]*, Faluyi, J. O.[1] and Idowu, J. A.[1]

[1]Department of Botany, Obafemi Awolowo University, Ile-Ife, Nigeria.
*Corresponding author, E-mail: oziegbem@oauife.edu.ng
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ABSTRACT

This study investigated the mode of inheritance of pigmentation in the floral and vegetative parts of two variants of *Talinum triangulare* with pink and white petals. Intraspecific hybridization involving these two variants, and their reciprocal crosses were carried out. Also backcrosses of the F_1 hybrid with white petal parent were made. The various F_1 hybrids were advanced to F_2 and F_3 generations. The F_1 plants from each reciprocal cross produced light pink petal and filament colours. In the F_2 and F_3 generations, petal and filament colours segregated into ratio of 1 deep pink: 2 light pink: 1 white. Stigma colour segregated into ratio of 3 deep pink: 1 light pink. The backcross segregated into ratio of 1 light pink: 1 white for petal and filament colours; and a ratio 1 deep pink: 1light pink for stigma colour. The segregation patterns for petal and filament colour in all the generations indicate incomplete dominance of deep pink colour over white colour showing that the same gene conditions their inheritance in a monohybrid form and this gene exhibits a pleiotropic effect on the filament colour. The segregation pattern for stigma colour indicates complete dominance of deep pink over light pink colour. The same gene which is in the homozygous state conditions deep pink pigmentations on the leaf base and panicle junction in the two variants of *T. triangulare* investigated.

Keywords: Intraspecific, Petal Colour, Inheritance, Incomplete Dominance, Monohybrid

INTRODUCTION

The genus *Talinum* Adans. belongs to the family Portulacaceae which consists of about 50 species with predominantly Austral distribution (Nyananyo and Olowokudejo, 1986). About 30-35 species occur in North America particularly in Mexico. There are 19 genera and 1580 species in this family (Gill, 1988). In West Africa, it is represented by two genera, namely *Talinum* and *Portulaca*. In the genus *Talinum*, only two species are identified in the west coast of Africa. *Talinum triangulare* (Jacq.) Willd; also known as *T. fruticosum* (L.) Juss. and *T. portulacifolium* (Rahl.) (Hutchinson and Dalziel, 1994). Plant pigments are often considered as minor agrobotanical characters by geneticists but they possess a lot of visual appeal in tracing gene through generations which is of great importance to plant breeders (Mustapha, 2007; Ayoola and Faluyi, 2007).

It is generally accepted that anthocyanin colouration plays an important role, not only for the elucidation of gene regulation and character expression in plant metabolism, but also provides side effects or the symptoms to biotic and abiotic stresses (Maekawa, 1996; Kumar and Shamar, 1999; Edreval *et al.,* 2002). Mustapha (2007) reported that colour production in plants is an integral part of the development of various parts which may adapt the plant for specific function. According to Fery (1985), the presence of pigments in the flower is dependent upon a general colour factor and the anthocyanin factor; the presence of anthocyanin in flower tissue is the result of an interaction of two dominant factors, one conditioning the pale colour while the other increases the intensity of the colour in the presence of the other. White colours result when either the general colour factor of the complementary genes is absent. Experiments have shown that anthocyanin pigmentation is developmentally regulated (Jaakola *et al.,* 2002; Honda *et al.*, 2002).

Talinum triangulare, commonly known as waterleaf, is cultivated as major leaf vegetable in view of its nutritional value (Denton, 1997). Different cultivars of the genus *Talinum* have been in cultivation over decades and the exact origins are still in doubt (Nya and Eka, 2008). The varietal differentiation in *T. triangulare* stem from the inherent genotypic variations attributed to their free natural hybridization within and between species (Nya and Eka, 2008). Generally, *T. triangulare* is a self-pollinated crop but there is the tendency of the population to be heterogenous due to their floral propensity for insect pollinations (Gill, 1988). Inflorescence of *T.*

triangulare is terminal, sepals are 2, petals are consistently 5, white or pink, stamens are 20-40 in number. Pink petal *T. triangulare* is commonly found growing and dominates the population of *T. triangulare* in Ile-Ife, while the white petal *T. triangulare* is rarely found. This study investigated the pattern of inheritance of pigmentation between white petal and pink petal *T. triangulare* in Ile-Ife.

MATERIALS AND METHODS

The study was carried out at the Department of Botany Obafemi Awolowo University Ile-Ife. The seeds of deep pink *T. triangulare* variant used for this study ware collected from the wild. The seeds of white petal *T. triangulare* variant were collected by Professor J.I. Awopetu. White petal *T. triangulare* was crossed with pink petal *T. triangulare* involving reciprocal crosses. Physical emasculation of the ovulate parents were carried out between 0600 h-0700 h before anthesis and anther dehiscence. Crosses were carried out between 1000 h-1100 h when the stigma was receptive. Flowers in each of the crosses were bagged to prevent extraneous pollen. The F_1 seeds from the reciprocal crosses were planted separately along with their parents in the screen house and characterized for morphological differences and similarities in their floral and vegetative parts. The F_1 progenies were raised to obtain F_2 seeds by selfing. The F_2 seeds from 3 fruits were randomly selected and bulked to study the segregation pattern in the floral and vegetative parts. Seeds from fruits of light pink petal F_2 plants were also selected randomly and bulked to obtain F_3 progenies. The F_3 progenies were also characterized for the segregation pattern in their floral and vegetative parts. The F_1 plant was backcrossed to the white petal parent. Seeds from 3 randomly selected fruits of the backcrosses (BC_1F_1) were also bulked, and planted for segregation pattern in the BC_1F_2 generation.

The observed ratios in F_2, F_3 and backcross progenies were subjected separately to chi-square analysis to determine the mode of inheritance of white and pink pigmentation in the floral and vegetative parts of *T. triangulare.*

RESULTS

The F_1 hybrid and parents are characterized as shown in Table 1. The reciprocal crosses between white petal *T. triangulare* and pink petal *T. triangulare* produced an F_1 hybrid with light pink petal and filament colours (Plate 1A-F); deep pink stigma colour; deep pink pigmentation on panicle junction and the abaxial surface of the leaf (Plate 2A-B). In the F_2 and F_3 progenies petal and filament colours segregated into deep pink, light pink and white colours. Chi-square analysis classified this segregation pattern into ratio 1 deep pink: 2 light pink: 1 white colour (Table 2). Stigma colour segregated into deep pink and light pink colours. There was no plant with white stigma colour in the F_1, F_2 and F_3 generations. It is important to note that the cross between a deep pink stigma and light pink stigma produced a deep pink F_1 stigma. This suggests that the dominant gene for petal colour exercised pleiotropic effect on the F_1 stigma. Proof for this differentiation is that the white petal parent had a light pink stigma. Chi-square analysis classified this segregation pattern into 3 deep pink: 1 light pink colour (Table 3). There was no segregation for yellow anther colour, white style, pink colour on adaxial surface of the leaf base and junction of the panicle in all the generations.

Table 1. Pigmentation of Floral and Vegetative parts of Parents and F_1 Hybrid of *T. Triangulare.*

Character	Pink Petal Parent	F_1 Hybrid	White Petal Parent
Petal Colour	Deep pink	Light pink	White
Filament Colour	Deep pink	Light pink	White
Stigma colour	Deep pink	Deep pink	Light pink
Style colour	White	White	White
Sepal colour	Green	Green	Green
Anther colour	Yellow	Yellow	Yellow
Adaxial surface leaf petiole	Deep pink	Deep pink	Deep pink
Panicle juncture	Deep pink	Deep pink	Deep pink

In the backcross of the F_1 hybrid with the white petal parent, petal and filament colours segregated into light pink and white colours. Chi-square analysis classified this segregation pattern into ratio 1 light pink: 1 white colour (Table 2). Stigma colour segregated into deep pink and light pink colours. Chi-square analysis classified this segregation pattern into ratio 1 deep pink: 1 light pink colour (Table 3).

Table 2. Chi-Square Analysis of Segregation Patterns for Petal and Filament Colours in F_2, F_3 and Backcross Generations of Crosses Involving Deep Pink and White Petal Variants of *T. triangulare*.

Crosses	Generation	Petal and Filament Colours: Deep Pink	Light Pink	White	Expected Ratio	^{2}	Probability
Deep Pink Petal x White Petal	F_1	-	45	-			
	F_2	21	42	22	1:2:1	0.035	0.97 P 0.9
	F_3	28	53	30	:2:1	0.298	0.9 P 0.5
White Petal x Deep Pink Petal	F_1	-	34	-			
	F_2	31	48	22	1:2:1	1.852	0.5 P 0.1
	F_3	25	52	26	1:2:1	0.029	0.97 P 0.9
Backcross (F_1 Light Pink Petal x White Petal)	-	54	47		1:1	0.485	0.9 P 0.5

Table 3. Chi-Square Analysis of Segregation Pattern for Stigma colour in F_2, F_3 and ackcross Generations of Crosses Involving Deep Pink and White Petal Variants of *T. triangulare*.

Crosses	Generation	Stigma Colour: Deep Pink	Light Pink	White	Expected Ratio	^{2}	Probability
Deep Pink Petal x White Petal	F_1	45	-	-			
	F_2	63	22	-	3:1	0.035	0.9 P 0.5
	F_3	81	30	-	3:1	0.243	0.9 P 0.5
White Petal x Deep Pink Petal	F_1	34	-	-			
	F_2	79	22	-	3:1	0.558	0.5 P 0.1
	F_3	77	26	-	3:1	0.003	P 0.9
Backcross (F_1 Light Pink Petal x White Petal)		54	47	-	1:1	0.485	0.9 P 0.5

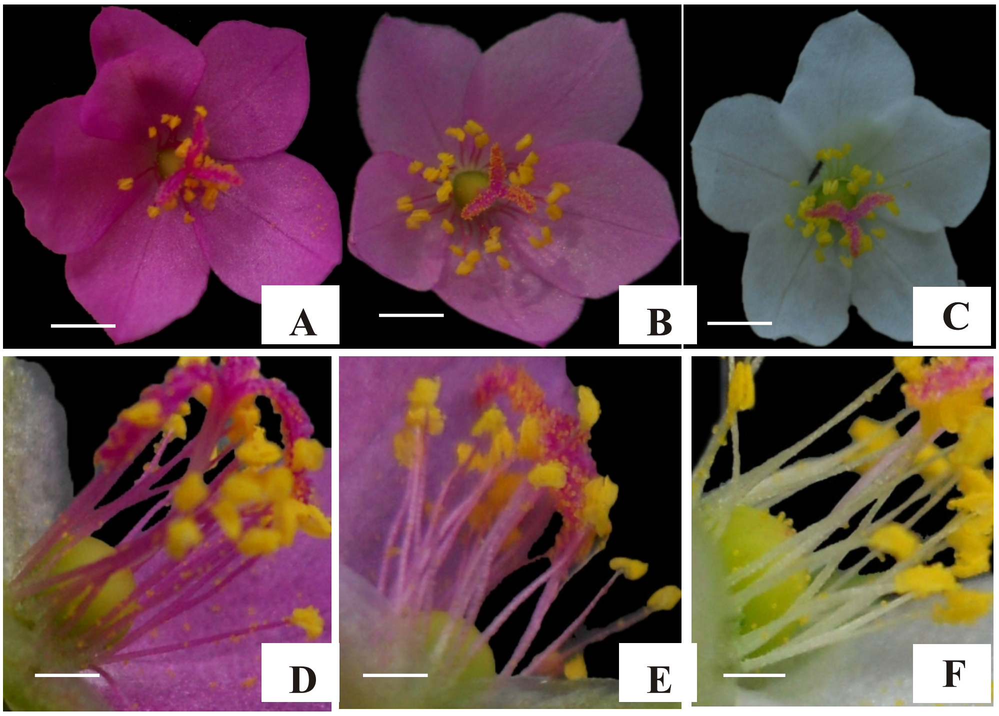

Plate 1. Petal and Filament Colours in Parents and F_1 Hybrid. A.and D. Deep Pink Petal and Filament Parent. B and E. Light Pink Petal and Filament of F_1 Hybrid. C and F. White Petal and Filament Parent. Scale bars = 2 mm

Plate 2: Pigmentation of Leaf Base and Panicle. A. Pink Pigmentation on Adaxial Surface of the Leaf Base. B. Pink Pigmentation on Panicle Junction. Scale bars = 4 mm.

DISCUSSION

Results showed that the inheritance of petal and filament pigmentation follows the same pattern. This indicates that the same gene determines the petal and filament colours in *T. triangulare*, and that this gene exhibits a pleiotropic effect on the filament.

Inheritance pattern for pigmentation of the petal and filament revealed that white pigmentation is recessive to pink, due to its absence in F_1 generation and segregation pattern observed in the F_2 and F_3 progenies. The segregation pattern of 1 deep pink: 2 light pink: 1 white colours in the F_2 and F_3 progenies indicates an incomplete dominance of the deep pink petal colour over white colour. Single gene of allelic pairs determines petal and filament colours as a result of discrete colour expressions observed in the progenies of the generation as opposed to shades of colours in multiple alleles. Mustapha (2007) had various reports on the inheritance of pigmentation in cowpea. He reported that two genes controls winged petal colour in cowpea in which pigmented gene was epistatic over none pigmented. He also reported complete dominance of purple standard petal colour over white colour in a monogenic inheritance of cross (TVx-2 x 1101-5) and complementary interaction of two genes in another cross (TVx-3236-1 x IT97K-1101-5) in cowpea. The segregation pattern observed for stigma colour in *T. triangulare* indicates a complete dominance of deep pink colour over light pink colour. The F_1 hybrids of the reciprocal crosses show exactly the same form of character pigmentation indicating no maternal effects.

There was no alternate pair of alleles controlling style colour, anther colour, pink pigmentation at the base of leaf and panicle junction in the two variants of *T. triangulare* investigated because no segregation was observed for the colours. Othman *et al.* (2006) reported no segregation for purple pigmentation in colour of joints between stem and peduncle, stem and branches as well as stem and leaflets in the F_1, F_2 and F_3 of cross in cowpea.

It can be concluded that three genes are responsible for pigmentation in *T. triangulare;* the first one controls pigmentation on the petal and filament, the second controls pigmentation on the stigma while the third gene controls pigmentation on the vegetative parts. The deep pink pigmentation on petal and filament showed an incomplete dominance over the white petal and filament colours but the deep pink pigmentation on the stigma showed complete dominance over the light pink stigma colour.

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