

INHERITANCE OF PIGMENTATION IN LEAF AXIL, PETIOLE, MIDRIB AND VEINS IN COWPEA

R. Lokaprakash, Shanta R. Hiremath and G. Shivashankar
University of Agricultural Sciences, Hebbal, Bangalore

Pigmentation on various plant parts help to identify the varieties and hence it has drawn the attention of the geneticists. Several workers have classified the varieties of cowpea based on pigmentation in various plant parts (Krishnaswamy *et al.*, 1945; Sen and Bhowal, 1961). Although some preliminary information is available on patterns of pigmentation on vegetative parts as reported by various workers, the inheritance pattern of these characters is not well understood.

Materials and Methods

Two cowpea lines, Virginia and TVX 2112 were studied at the University of Agricultural Sciences, Hebbal, Bangalore in the year 1977. F_1 , F_2 and F_3 generations were evaluated in the subsequent years. The F_2 population consisted of 460 individual plants and 40 randomly selected families were raised in F_3 . Chi-square test was applied for testing the observed frequencies of the F_2 segregation on the basis of the ratios.

Results and Discussion

Virginia is devoid of pigment on axil, petiole, midrib and veins whereas the other parent TVX 2112 has pigmentation on them. Both pigmented and unpigmented conditions were observed in F_1 depending upon the type of genic interaction. Data on the occurrence of colouration in the parents, F_1 plants and nature of F_2 segregation are presented in Table 1.

Pigmentation on the axil is governed by three factors, one basic, one inhibitory and one anti-inhibitory as indicated by the ratio of 39 purple : 25 green. The basic gene Px does not have any expression in the presence of the inhibitory gene $I-Px$; in other words, inhibitory gene $I-Px$ suppresses the expression of the colour on the axil. The third gene $Ai-Px$ anti-inhibits the action of inhibitory gene and produces the colour. This is a new kind of genic interaction in this crop. Pigment on petiole, midrib and veins are conditioned by two genes, one basic and the other inhibitory, segregating in the ratio of 3 purple : 13 green. The combined segregation data given in Table 2 on these characters revealed the presence of a pleiotropic gene (Px) which is responsible for the expression of the colour on these parts. Pleiotropic nature of the gene Px is represented in a line diagram in Fig 1. In case of petiole, midrib and veins due to the presence of this gene the joint ratio of 9:39:39:169 was modified to 3:9:9:43. On the basis of the modified ratio, expected frequencies were in close agreement with the observed ones (Table 2). The F_2 ratios were confirmed by studying F_3 generation (Table 3).

Table 1

Character expression in parents, F₁ and F₂ segregation in cowpea cross Virginia xTVX 2112

Characters Pigment- ation in	Character expression in			F ₂ segregation			χ ²	P value
	Virginia	TVX 2112	F ₁	Ratio	Pigmented	Non- pigmented		
Axil		+	+	39:25	Obs 291.00 Exp 280.31	169.00 179.69	1.04	0.50-0.30
Petiole		+		3:13	Obs 90.00 Exp 86.25	370.00 373.75	0.20	0.70-0.50
Midrib		+		3:13	Obs 83.00 Exp 86.25	377.00 373.75	0.15	0.70-0.50
Veins		+		3:13	Obs 78.00 Exp 86.25	382.00 373.75	0.97	0.50-0.30

+ = Pigment present

- = Pigment absent

Obs = Observed

Exp = Expected

Table 2

Combined segregation of characters in F₂ of the cowpea cross Virginia x TVX 2112

Character combinations	Joint ratio	Remarks	F ₂ segregation				χ^2	P value
			PP	PG	GP	GG		
<i>Axil (39:25) with</i>								
Petiole (3:13)	117:507:75:325 39:117:9:91	Obs	76.00	215.00	14.00	155.00		
		Exp Ind	52.50	227.80	33.70	146.00	22.65	0.01
		Exp one gene common	70.10	210.20	16.20	163.50	1.35	0.80—0.70
Midrib (3:13)	117:507:75:325 39:117:9:391	Obs	70.00	221.00	13.00	156.00		
		Exp Ind	52.50	227.80	33.70	146.00	19.36	0.01
		Exp one gene common	70.10	210.20	16.20	163.50	1.53	0.70-0.50
Veins (3:13)	117:507:75:325 39:117:9:91	Obs	65.00	226.00	13.00	156.00		
		Exp Ind	52.50	227.80	33.70	146.00	16.34	0.01
		Exp one gene common	70.10	210.20	16.20	163.50	2.54	0.50—0.30
<i>Petiole (3:13) with</i>								
Midrib (3:13)	9:39:39:169 3:9:9:43	Obs	26.00	64.00	57.00	313.00		
		Exp Ind	16.20	70.10	70.10	303.60	9.20	0.05—0.01
		Exp one gene common	21.60	64.70	64.70	309.00	1.87	0.70-0.50
Veins (3:13)	9:39:39:169 3:9:9:43	Obs	24.00	66.00	54.00	316.00		
		Exp Ind	16.20	70.10	70.10	303.60	8.20	0.05—0.01
		Exp one gene common	21.60	64.70	64.70	309.00	2.22	0.70-0.50
<i>Midrib (3:13) with</i>								
Veins (3:13)	9:39:39:169	Obs	24.00	59.00	544.00	323.00		
		Exp Ind	16.20	70.10	70.10	303.60	10.45	0.05—0.01
		Exp one gene common	21.60	64.70	64.70	309.00	2.17	0.70-0.50

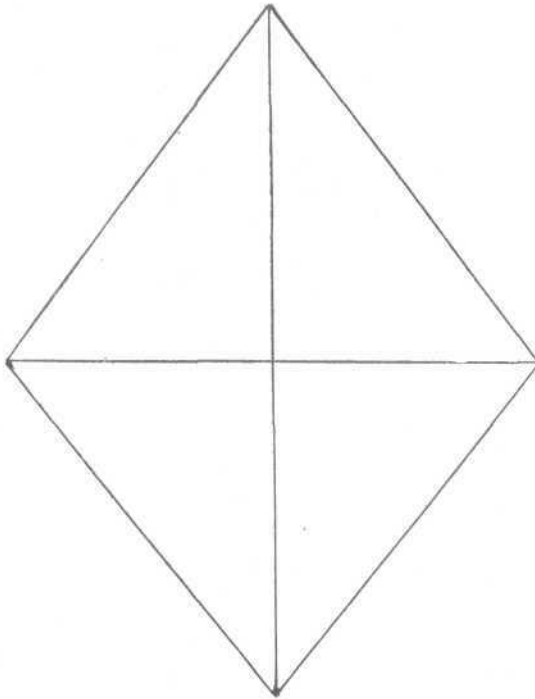
Ind = Independent
Exp = Expected

PP = Both characters purple
PG = Purple and green

GP = Green and purple
GG = Both characters green

Axil (39:25)
Px, l—Px, Ai—Px

Petiole (3:13)
Px, l—Pt/l



Veins (3:13)
Px, l—Pvn

Midrib (3:13)
Px. l—Pmd

Fig. 1 Pleiotropic nature of the genes for anthocyanin pigmented characters

Table 3

F₃ breeding behaviour of characters showing 39:25 ratio for axil colour and 3:13 ratio for petiole, midrib and veins in the cross Virginia x TVX 2112

Characters	Breeds true for presence of pigment	Segregating into						Breeds true for absence of pigment	χ^2	P value
		3:1	9:7	13:3	39:25	1:3	3:13			
Expected										
(7:16:4:4:8:2:4:19)	4.38	10.0	2.5	2.5	5.0	1.25	2.5	11.87		
Observed axil	5.0	8.0	3.0	2.0	6.0	1.0	3.0	12.0	1.04	0.95
Expected										
(1:2:4:4:5)	2.5	15.0	—	—	—	10.0	10.0	12.5		
Observed petiole	2.0	6.0	—	—	—	12.0	8.0	12.0	1.12	0.90-0.80
Midrib	2.0	6.0	—	—	—	12.0	8.0	12.0	1.12	0.90-0.80
Veins	2.0	6.0	—	—	—	12.0	8.0	12.0	1.12	0.90-0.80

A monogenic segregation of 3 purple : 1 green was reported by Sree-kantaradhy *et al.* (1980) for colour on the axil. The present study revealed the operation of 3 genes for pigmentation on the axil. The study on inheritance of pigmentation in petiole, midrib and veins has not been attempted previously (Krishnaswamy *et al.*, 1945; Saunders, 1960; Sen and Bhowal, 1961; Koine, 1970; Lokaprakash *et al.*, 1983). This is the first report on the inheritance pattern of these characters. The gene symbols designated are *Px* for axil, *Ptl* for petiole, *Pmd* for midrib and *Pvn* for veins, respectively.

Summary

Inheritance of four characters namely pigmentation in axil, petiole, midrib and veins in cowpea was studied in a cross Virginia x TVX 2112. An unusual ratio of 39:25 was obtained for axil and 3:13 for petiole, midrib and veins. A basic pleiotropic gene (*Px*) was detected in these characters. The inheritance pattern on these characters was studied for the first time and the gene symbols were given.

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