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INHERITANCE OF QUANTITATIVE CHARACTERS IN CHICKPEA

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ABSTRACT

In five crosses, viz., JG-315 x JG-74, JG-315 x Vishwas, JG-315 x Vikas, JG-315 x JG-62 and JG-315 x Sel. 436 of chickpea (*Cicer arietinum* L.), scaling test with five generation means showed the involvement of epistatic gene action in the expression of fruiting branches/plant, pods/plant, 100-grain weight, yield/plant, and days to maturity, except for fruiting branches and pods/plant in the crosses JG-315 x Vishwas and JG-315 x JG-62, and for days to maturity in JG-315 x Sel. 436. In all the five crosses, dominance gene action was involved for all the characters except for 100-grain weight. In 4 out of 5 crosses, additive gene action was involved in the inheritance of 100-grain weight. But additive and dominance gene effects, dominance x dominance, and additive x additive interactions were important for all the components. Dominance effects, followed by interactions and additive component played a significant role in the inheritance of grain yield. Duplicate epistasis was more predominant.

Key words: Chickpea, generation means, yield components, inheritance.

The inheritance studies were conducted in chickpea using diallel analysis [1–4], which does not provide the estimates of different nonallelic gene actions operating in the inheritance. The nonallelic interactions could inflate the measure of additive and dominance components. It is therefore, important to identify and estimate the components of epistasis along with the additive and dominance components so that the fixable components could be exploited by using suitable breeding techniques. Hence an experiment was undertaken to study the genetic behaviour of yield and its component characters with generation means in chickpea (*Cicer arietinum* L.).

MATERIALS AND METHODS

A diallel set of 15 crosses (excluding reciprocals) was made by using six diverse genotypes. The parents used were JG-315, JG-74, Vishwas, Vikas, JG-62 and Selection-436. These six parents along with their 15 F_1s, 15 F_2s and 15 F_3s were grown in randomized block design with three replications. Each parent, F_1, F_2 and F_3 were represented by two, single, six and six rows, respectively of 4.0 m length in each replication. The row and plant spacings were 30 and 15 cm, respectively. Observations on number of fruiting branches/plant, pods/plant, 100-seed weight, days to maturity, and grain yield/plant were recorded. On five randomly selected competitive plants in each parent and F_1, and 30 plants in each F_2 and F_3 generation.

Individual scaling tests proposed by Mather [5] were used to determine the presence of nonallelic gene interactions. The Hayman's [6] model was used to calculate ($\hat{m}$), ($\hat{d}$), ($\hat{h}$), ($\hat{i}$) and ($\hat{l}$) components in the interacting crosses.

RESULTS AND DISCUSSION

The F_1 means varied from character to character and from cross to cross (Table 1). The F_2 means for majority of the yield contributing characters were less than the F_1 means, indicating the role of dominance gene action in the inheritance.

As the F_3 populations were included in the experiment, the "C" and "D" scaling tests were carried out. The "C" and "D" scaling tests [5] were nonsignificant for No. of fruiting branches and pods/plant in the crosses JG-315 x Vishwas and JG-315 x JG-62, and for days to maturity in JG-315 x Sel. 436. The genetic architecture of individual character is discussed below:

Fruiting branches per plant. Both additive (d) and dominance (h) effects were significant in all the crosses except JG-315 x Vishwas and JG-315 x JG-62, in which additive (D) effects were significant, with a greater magnitude of dominance than additive, indicating predominance of dominance for fruiting branches. Additive x additive (i) interaction was significant in two of the five cross combinations, however dominance x dominance effect (l) was significant in three crosses with high magnitude, which indicated the importance of dominance x dominance interaction.

Pods per plant. Both additive (d) and dominance (h) effects were significant in all the crosses except JG-315 x Vishwas and JG-315 x JG-62, in which additive (d) effects were significant with a greater magnitude of dominance than additive, indicating predominance of dominance for this trait. Additive x additive (i) and dominance x dominance (l) interactions were significant for three out of five cross combinations. Higher magnitude of dominance x dominance interaction than additive x additive interaction indicated that dominance x dominance interactions were important.

100-grain weight. Additive gene effects were significant in all the crosses except JG-315 x Sel. 436. Additive x additive (i) interaction was significant for four cross combinations, of which three crosses also showed significant and greater magnitude of dominance x dominance (l) interaction.

Table 1. Mean values for different characters in five generations of five crosses in chickpea

Cross	P_1	P_2	F_1	F_2	F_3
		Fruiting branches/plant			
JG-315 x JG-74	9.6	13.1	14.5	14.4	9.3
JG-315 x Vishwas	9.6	15.9	14.1	14.1	11.8
JG-315 x Vikas	9.6	14.5	18.1	18.3	13.1
JG-315 x JG-62	9.6	16.3	17.5	13.7	12.8
JG-315 x Sel-436	9.6	15.4	19.3	18.9	12.0
		Pods/plant			
JG-315 x JG-74	44.4	59.2	66.5	69.5	27.5
JG-315 x Vishwas	44.4	55.9	67.1	59.9	41.6
JG-315 x Vikas	44.4	56.9	80.9	84.2	47.5
JG-315 x JG-62	44.4	84.5	76.1	62.2	51.6
JG-315 x Sel-436	44.4	84.6	102.7	94.0	46.1
		100-grain weight, g			
JG-315 x JG-74	13.5	16.1	16.2	14.3	14.9
JG-315 x Vishwas	13.5	25.4	19.6	18.0	17.0
JG-315 x Vikas	13.5	19.4	15.4	14.5	47.5
JG-315 x JG-62	13.5	15.7	15.4	13.2	15.2
JG-315 x Sel-436	13.5	14.6	16.9	13.7	15.1
		Yield/plant, g			
JG-315 x JG-74	7.1	10.0	11.3	12.4	4.1
JG-315 x Vishwas	7.1	14.6	14.3	13.0	7.9
JG-315 x Vikas	7.1	11.4	14.5	15.2	8.6
JG-315 x JG-62	7.1	13.7	16.0	10.1	8.5
JG-315 x Sel-436	7.1	13.4	20.6	16.4	8.3
		Days to maturity			
JG-315 x JG-74	100.3	101.3	105.0	97.0	107.3
JG-315 x Vishwas	100.3	103.7	105.7	100.0	107.0
JG-315 x Vikas	100.3	98.3	106.7	104.0	109.3
JG-315 x JG-62	100.3	100.3	104.7	97.7	109.7
JG-315 x Sel-436	100.3	97.7	104.3	100.3	106.7

Yield per plant. Both additive (d) and dominance (h) effects were significant in all the combinations, in which dominance (h) effects were greater in magnitude than additive, indicating predominance of dominance for this trait. Additive x additive (i) interaction was significant for three combinations, however, dominance x dominance interaction (l) was

Table 2. Estimates of gene effects for different characters in five crosses of chickpea

Cross	Genetic components					Type of epistasis
	m	d	h	i	l	
			Fruiting branches/plant			
JG-315 x JG-74	14.4**	–3.47*	13.6**	7.0**	–26.7**	Duplicate
JG-315 x Vishwas	14.1**	–3.13**				
JG-315 x Vikas	13.1**	–2.43**	13.7**	8.4**	–51.1**	Duplicate
JG-315 x JG-62	13.7**	–3.35**				
JG-315 x Sel-436	18.9**	–2.90**	18.7**	6.1	–36.1**	Duplicate
			Pods/plants			
JG-315 x JG-74	69.5**	–7.39**	110.0**	80.6**	–232.4**	Duplicate
JG-315 x Vishwas	59.9**	–5.75*				
JG-315 x Vikas	84.2**	–6.25**	95.8**	155.5**	–614.5**	Duplicate
JG-315 x JG-62	62.2**	–20.05**				
JG-315 x Sel-436	94.0	–20.09	133.4	55.0	–231.7	Duplicate
			100-grain weight			
JG-315 x JG-74	14.3**	1.31**	–0.1	–4.2	7.9	Duplicate
JG-315 x Vishwas	18.0**	–5.96**	3.6	–8.2*	–1.2	Duplicate
JG-315 x Vikas	14.5**	–2.94**	–2.9	–16.9**	28.3**	Duplicate
JG-315 x JG-62	13.2**	–1.11**	–4.0	–6.9**	16.6*	Duplicate
JG-315 x Sel-436	13.7**	–0.54	–1.5	–5.5*	16.0**	Duplicate
			Yield/plant			
JG-315 x JG-74	12.4**	–1.44**	21.3**	15.7**	47.1**	Duplicate
JG-315 x Vishwas	13.0**	–3.75**	14.4**	3.5	–23.7**	Duplicate
JG-315 x Vikas	15.2**	2.11**	17.2**	14.1**	–36.8**	Duplicate
JG-315 x JG-62	10.1**	–3.26**	8.1*	–4.1	7.7	Complementary
JG-315 x Sel-436	16.4**	–3.14**	24.4**	7.8**	–31.9**	Duplicate
			Days to maturity			
JG-315 x JG-74	97.0**	–0.50	–22.2*	–27.4**	76.4**	Duplicate
JG-315 x Vishwas	100.0**	–1.67	–14.9**	–21.9**	52.4**	Duplicate
JG-315 x Vikas	104.0**	1.00	–12.4**	–17.2	35.5**	Duplicate
JG-315 x JG-62	97.7**	—	227.3**	–31.7	82.7**	Duplicate
JG-315 x Sel-436	100.3**	1.34				

*, **Significant at 5 and 1% levels, respectively.

significant in four crosses. Higher magnitude of dominance x dominance interactions in all the crosses indicates importance of dominance x dominance interactions.

Days to maturity. Only dominance effect (h) was significant in all the crosses, except JG-315 x Sel. 436, with greater magnitude than the additive effect, indicating the importance of dominance effect for this trait. Additive x additive interaction was significant in three crosses, whereas dominance x dominance interaction was significant in four crosses with a greater magnitude than additive x additive interaction.

Duplicate epistasis was observed in all the crosses for all the yield contributing characters, except in JG-315 x JG- 62 for grain yield/plant. In this cross complementary epistasis was observed for grain yield.

In all the crosses, nonallelic interactions were predominant for yield per plant, days to maturity, pods/plant, 100-grain weight, and fruiting branches. Patil et al. [7] noticed the predominance of nonallelic interactions for fruiting branches and yield/plant. The relative magnitude of additive and dominance effects for the characters in each cross varied, leading to the variation in inheritance. As compared to additive gene effect, dominance gene effect had a greater contribution. Earlier workers [7-10] also reported the importance of both additive and dominance gene effects for improvement of yield contributing characters. The positive and significant dominance gene effect for yield per plant in all the crosses indicates the complex nature of inheritance. Additive x additive and dominance x dominance types of epistatic gene effects are important in chickpea improvement.

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