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Ananlysis of heterotic response for zinc and iron content in cowpea (*Vigna unguiculata* (L). Walp)

Pallavi, Alankar Singh and YV Singh

Abstract

The investigation involved was carried out during 2014-2015 at G.B. Pant University of agriculture and Technology, Pantnagar. Pant Lobia-1, Pant Lobia-2, Pant Lobia-3, Pant Lobia-5, PGCP-59, PGCP-63 and PVCP-20 along with their 21 F_1's were evaluated. Crossing between the parental inbred lines was made in half-diallel fashion (without reciprocals) during 2014/15 cropping season.Being a self-pollinated crop, the scope for exploitation of hybrid vigour looking to the biological feasibility and gene action need to be searched out. Pant Lobia-2 and Pant Lobia-5 for iron content and zinc content and Pant Lobia-3 for zinc content found to had best heterobeltiosis and economic heterosis.

Keywords: Cowpea, zinc, iron and heterosis

Introduction

Shull (1914) [4] coined the term 'heterosis' for developmental stimulus resulting from the union of different gametes, while 'hybrid vigour' was referred to the manifestation effect of heterosis (Whaley, 1952) [10]. "Heterosis can be defined as the increased vigour of the F_1 generation of a cross over the better parents" **(**Hayes *et al.*, 1955) [3]. Because of its high protein (23-25%) and carbohydrate (50-67%), fats (1.9%), fibre (6.35%) and small percentage of the B-vitamins such as folic acid, thiamine, riboflavin and niacin as well as some micronutrients such as iron and zinc, cowpea plays an important role in both human and animal nutrition (Li *et al.*, 2001; Nielsen *et al*., 1997; Singh *et al.*, 1997) [1, 2, 5]. The haulms are also very nutritious, containing about 15 to 17% protein, which is highly digestible and useful as a fodder for livestock (Singh, 2007; Tarawali *et al.*, 1997a and Tarawali *et al.*, 1997b) [8, 9]. It also has the useful ability to fix atmospheric nitrogen through its root nodules, and grows well in poor soils (Singh *et al.*, 2014) [7]. According to Yadav *et al.*, 1986, cowpea fix 563 kg of atmospheric nitrogen ha^{-1}. Cowpea protein is rich in the amino acids, lysine and tryptophan, compared to cereal grains; however, it is deficient in methionine and cystine when compared to animal protein.

Materials and Methods

The seven parental genotypes were crossed in diallel design to obtain 21 F1 hybrids. The emasculation and pollination were done as per method proposed by Krishnaswamy *et al.*, (1945). was laid out in a randomized block design with three replications during summer 2014/15. The recommended agronomic practices and plant protection measures were adopted for raising a good crop. The data were analysed to compute heterosis (%) over better parent (BP) and standard check (SH) values. Heterosis expressed as the per cent increase or decrease in value of F_1s over mid-parent (heterosis), over better parent (heterobeltiosis) and over the check variety (standard heterosis) was calculated as-

a. $\text{Heterosis}\ \% = \frac{\overline{F_1} - \overline{MP}}{\overline{MP}} \times 100$

b. $\text{Heterobeltiosis}\ \% = \frac{\overline{F_1} - \overline{BP}}{\overline{BP}} \times 100$

c. $\text{Standardheterosis}\ \% = \frac{\overline{F_1} - \overline{BP}}{\overline{BP}} \times 100$

where,
$\overline{F_1}$ = Mean of the F_1
$\overline{MP}$ = mean of two (mid parent) parents of a particular cross

$\overline{BP}$ = mean of the better parent of a particular cross
$\overline{CP}$ = mean of the check parent (variety)
Standard error were calculated as:

SE for relative heterosis = $\sqrt{\frac{3MSE}{2r}}$

SE for heterobeltiosis and standard check = $\sqrt{\frac{2MSE}{r}}$

CD= SE x t value at error degree of freedom
where,
MSE = error mean square of RBD analysis
r = number of replications
t = table value of't' at error degree of freedom corresponding to 5 and 1 per cent level of significance.

Results and Discussion

The heterosis for zinc and iron content in cowpea is shown in table.1.

Zinc content (mg/kg)

Heterobeltiosis ranged from -6.89 to 17.05%, sixteen crosses showed significant heterobeltiosis, out of which eleven crosses expressed heterobeltiosis in positive direction. The cross Pant Lobia-3 x Pant Lobia-2 (17.05%) followed by Pant Lobia-5 x Pant Lobia-3 (16.70%), Pant Lobia-3 x Pant Lobia-1 (12.48%), Pant Lobia-5 x Pant Lobia-1(11.82%) and Pant Lobia-5 x Pant Lobia-2 (10.85%). Twenty combinations showed significant economic heterosis which ranged from -18.26% to 12.00%. Out of which seven crosses combination showed economic heterosis in desired direction. Among which Pant Lobia-3 x Pant Lobia-2 (12.00%) had highest value followed by Pant Lobia-5 x Pant Lobia-3 (11.67%), Pant Lobia-3 x Pant Lobia-1 (11.24%) and Pant Lobia-5 x Pant Lobia-1 (8.54%). Cross Pant Lobia-3 x Pant Lobia-2 for heterobeltiosis (17.05%) and economic heterosis (12.00%) in desired direction. Similar results were observed by Varan *et al*., (2017).

Iron content (mg/kg)

Heterobeltiosis ranged from -18.73% to 13.48%. All twenty one crosses showed significant heterobeltiosis, out of which seven crosses expressed heterobeltiosis in positive direction. The cross Pant Lobia-5 x Pant Lobia-1 (13.48%) followed by PVCP-20 x Pant Lobia-1 (9.76%), PGCP-63 x Pant Lobia-1(7.66%) and PGCP-59 x Pant Lobia-1 (6.39%). Twenty one combinations showed significant which ranged from -19.19% to 13.85%, seven crosses combination showed economic heterosis in desired direction. Among which Pant Lobia-2 x Pant Lobia-1 (13.85%) had highest value followed by Pant Lobia-5 x Pant Lobia-2 (12.45%), Pant Lobia-5 x Pant Lobia-1 (10.64%) and PVCP-20 x Pant Lobia-2 (7.93%). Cross Pant Lobia-5 x Pant Lobia-1 emerged as best combination for heterobeltiosis (13.48%) and Cross Pant Lobia-2 x Pant Lobia-1for economic heterosis (13.85%) in desired direction. These crosses are likely to give recombinants with high iron content in advance generations.

Table 1: Heterobeltosis & economic heterosis for zinc znd iron content in cowpea

S.N.	Name of crosses	Zinc content (mg/kg)		Iron content (mg/kg)	
		Heterosis over		Heterosis over	
		BP	Check	BP	Check
1	Pant Lobia-2 X Pant Lobia-1	6.65**	5.66**	-4.22**	13.85**
2	Pant Lobia-3 X Pant Lobia-1	12.48**	11.24**	-5.46**	-9.86**
3	Pant Lobia-5X Pant Lobia-1	11.82**	8.54**	13.48**	10.64**
4	PGCP-59 X Pant Lobia-1	3.41*	1.94*	6.39**	1.40**
5	PGCP-63 X Pant Lobia-1	2.48**	0.68	9.76**	5.92**
6	PVCP-20 X Pant Lobia-1	-4.38**	-4.56*	-2.42	-2.92**
7	Pant Lobia-3 X Pant Lobia-2	17.05**	12.00**	-16.35**	-0.58
8	Pant Lobia-5 X Pant Lobia-2	10.85**	2.76**	-5.39**	12.45**
9	PGCP-59 X Pant Lobia-2	3.46**	-4.06**	-12.03**	4.56**
10	PGCP-63 X Pant Lobia-2	5.38**	-2.28*	-9.19**	7.93**
11	PVCP-20 X Pant Lobia-2	0.18	7.44**	-18.73**	-3.41**
12	Pant Lobia-5 X Pant Lobia-3	16.70**	11.67**	5.69**	-5.30
13	PGCP-59 x Pant Lobia-3	-3.09**	7.27**	2.24**	-13.85
14	PGCP-63 X Pant Lobia-3	2.03*	2.37**	7.66**	-2.47**
15	PVCP-20 x Pant Lobia-3	-6.89**	-10.90**	-1.30*	-18.90
16	PGCP-59 X Pant Lobia-5	1.11	7.78**	-2.61**	-12.74**
17	PGCP-63 X Pant Lobia-5	7.23**	2.20*	3.81**	-5.96**
18	PVCP-20 X Pant Lobia-5	-1.11	9.81**	-4.95**	-14.83**
19	PGCP-63 X PGCP-59	9.94**	3.72**	-3.31**	-12.41**
20	PVCP-20 X PGCP-59	-0.44	-16.23**	-4.10**	-19.19**
21	PVCP-20 X PGCP-63	-6.66**	-18.26**	-6.26**	-15.08**

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