Journal of Tropical Agriculture 35 (1997) : 16-18

CAUSE-EFFECT RELATIONSHIP OF DROUGHT TOLERANT TRAITS AND GRAIN YIELD IN COWPEA

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Abstract : Sixteen grain cowpea varieties were evaluated in a replicated field experiment at the College of Agriculture, Vellayani, Trivandrum. Estimation of cause and effect relationship of seven drought tolerant traits and grain yield revealed that varieties with high harvest index, leaf area index at vegetative period and long grain filling period will produce high grain yield under conditions of drought.

Key words : Cause-effect relationship, cowpea, drought tolerant traits, harvest index, leaf area index.

INTRODUCTION

Different varieties of cowpea respond differently to drought because of the differences in the traits contributing to drought tolerance such as deep wide-spread root system, high leaf area index and harvest index and long grain filling period. Path analysis is an effective biometric tool throwing light on the contribution (direct effect) of a character to yield and also its influence (indirect effect) through other characters. Hence, in this study, the genotypic correlations between grain yield and seven characters contributing to drought tolerance were partitioned into direct and indirect effects through path analysis to identify the attributes which exerts maximum influence on grain yield under conditions of drought.

MATERIALS AND METHODS

Sixteen grain cowpea varieties were evaluated in a randomised block design with four replications in 4 m x 2.4 m plots with a spacing of 30 x 20 cm at the Instructional Farm, College of Agriculture, Vellayani under natural conditions of drought. Five plants selected at random from each plot were used for recording observations on 13 characters and grain yield. The data collected were subjected to analysis of variance and covariance and genotypic and phenotypic correlations of grain yield and 13 characters were estimated (Kempthorne, 1957). Path analysis at the genotypic level was carried out using characters contributing to drought tolerance such as leaf area index and root/shoot ratio at vegetative period, root length and spread at harvest period, grain filling period, duration up to maturity and harvest index as causes and grain yield as the effect, following Dewey and Lu (1959). Soil moisture percentage in each plot was also estimated at weekly intervals by gravimetric method (Table 2).

RESULTS AND DISCUSSION

Analysis of variance for soil moisture percentage do not show any significant difference indicating that uniform soil moisture level was present in the experimental area. The direct and indirect effects of seven traits and yield are presented in Table 1.

Harvest index exerted maximum direct effect (1.39) on yield followed by leaf area index at vegetative period (1.13) in conformity with the results of Sharma (1988) in maize. Harvest index had low positive indirect effect on grain yield through root spread at harvest period (0.06) and negative indirect effects through the other components. Leaf area index exerted through the positive indirect effects through grain filling period (0.32) and duration up to maturity (0.07) while the indirect effects of this component through the other components are negative. Grain filling period (0.62) and duration up to maturity (0.50) are the other components having positive direct effects on yield. Grain filling period exerted positive indirect effects through leaf area index at vegetative period and duration up to maturity while this component had negative indirect effects on yield through the remaining components. High direct effect of duration up to maturity on yield is in agreement with the

Table 1. Direct and indirect effects of drought tolerant parameters on grain yield in cowpea

Sl. No.	Characters	LAI at VP	RSR at VP	RL at HP	RS at HP	GFP	Duration up to maturity	HI	Total correlation
1	LAI at VP	*1.13*	-0.01	-0.02	-0.25	0.32	0.07	-0.46	0.78
2	RSR at VP	0.08	*-0.16*	-0.07	-0.14	0.02	-0.08	0.73	0.38
3	RL at HP	0.25	-0.114	*-0.09*	-0.27	0.19	-0.31	0.46	0.10
4	RS at HP	0.59	-0.05	-0.05	*-0.48*	0.64	0.06	-0.16	0.55
5	GFP	0.44	-0.004	-0.02	-0.38	*0.82*	0.24	-0.78	0.33
6	Duration up to maturity	0.16	0.03	0.06	-0.05	0.40	***0.50***	0.06	0.03
7	HI	-0.38	-0.08	-0.03	0.06	-0.46	-0.38	*1.39*	0.11

Residual effect = 0.149; Direct effects are in italics
LAI - Leaf area index; VP = Vegetative period; RSR = Root shoot ratio; RL = Root length
HP - Harvest period; RS = Root spread; HI - Harvest index; GFP - Grain filling period

Table 2. Mean values of soil moisture

Sl. No.	Varieties	Soil moisture, %						
		Days after sowing						
		18	25	32	39	46	53	60
1	C-88	11.1	10.2	5.6	5.0	5.0	3.9	3.9
2	V-240	12.1	10.5	8.5	6.5	4.7	3.6	3.4
3	C-190	11.8	11.1	7.4	7.9	4.7	3.1	3.1
4	CC 82-7	10.9	13.0	9.7	7.3	4.7	3.6	3.4
5	1-26	7.9	8.1	7.3	5.3	3.9	3.1	3.1
6	UPC 124	7.1	10.5	7.9	5.6	3.6	2.6	2.6
7	IC-38956	9.0	10.5	9.7	4.8	3.9	3.4	3.2
8	DPLC 224	9.4	10.5	11.2	5.3	4.2	2.8	2.7
9	DPLC 198	7.5	9.9	8.0	5.0	3.9	3.1	3.1
10	DPLC 216	8.1	11.4	10.2	5.6	4.4	3.4	3.4
11	VCM-8	9.0	9.9	9.2	7.8	4.7	3.6	3.3
12	DPLC 210	9.9	10.2	12.1	6.2	3.6	2.6	2.6
13	Kanakamony	10.9	11.1	11.4	8.7	4.7	3.6	3.4
14	Charodi	9.0	11.1	7.7	5.6	4.2	3.1	3.1
15	C-152	8.4	11.4	10.5	6.7	5.0	3.4	3.3
16	V-26	10.2	9.6	10.4	6.7	5.8	4.2	4.1
General mean		9.5	10.6	9.2	6.2	4.4	3.3	3.3
CD (0.05)		3.37	2.24	4.61	2.75	1.38	1.01	1.01

results of Narasinghani *et al.* (1978) in pea. Even though root / shoot ratio at vegetative period and root length at harvest period exerted negative direct effects on grain yield, both these components exerted high positive indirect effect on yield through harvest index

(0.73 and 0.46 respectively) indicating the importance of indirect causal factor viz., harvest index during selection programmes for increasing the grain yield as suggested by Singh and Choudhary (1979). It can be concluded that varieties with high harvest index, leaf area index at vegetative period and long grain filling period will produce high grain yield under conditions of drought. The residual effect represents the failure of the estimated genetic correlation among the variables to account for the total genetic variation in a traits (Sidwell *et al.*, 1976). In this study, the residual effect is low indicating that most of the genetic variability in respect of yield and drought tolerant traits were accounted by the model used for cause and effect relationship.

ACKNOWLEDGEMENT

This paper forms part of the M.Sc.(Ag) thesis submitted by the first author to the Kerala Agricultural University. The senior author is grateful to the ICAR for providing Junior Research Fellowship for the postgraduate programme.

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