Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(6): 1648-1651
Received: 19-09-2017
Accepted: 20-10-2017

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Studies on Path Coefficient Analysis in guar [*Cyamopsis tetragonoloba* (L.) Taub.] Genotypes

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Abstract
Fifty genotypes of cluster bean were evaluated to ascertain path analysis. The study was carried out in the Department of Horticulture, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal. Analysis of variance showed significant variation for all the characters, indicating presence of sufficient variability in the material studied. Path coefficient analysis revealed that number of branches per plant, number of clusters per plant, number of pods per cluster, fresh pod yield, seed yield per plant, hundred seed weight, days to maturity, harvest index, crude fibre and gum content registered positive direct effect on dry pod yield per plant.

Keywords: Cluster bean, genotypes, Path coefficient analysis, positive effects, yield

Introduction
Yield is a complex character and is known to be associated with a number of component characters and is highly affected by environmental variations. Thus, specification of causes and measuring the relative importance of each of the yield components can be achieved by using the method of path analysis, as a mean of separating the direct effects from the indirect ones through other characters. Several path coefficient analysis have been conducted in guar, using grain-type cultivars by Chaudhary and Singh (1976) [3], Bhardwaj *et al*. (1981) [1], Henry *et al*. (1986) [6] and Shah *et al*. (2000) [16]. Breeding and selection programmes often encompass several characters simultaneously.
Path coefficient analysis provides better index for selection than mere correlation coefficient by separating correlation coefficients of yield and its components into direct and indirect effects. Therefore the present study was carried out to find out all possible component characters for improvement of guar through path coefficient analysis.

Materials and methods
A total number of 50 cluster bean accessions collected from NBPGR, New Delhi, were raised during *Kharif* at college orchard, Department of Horticulture, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, in a Randomized Block Design with three replications at a spacing of 45cm x 15cm. Uniformly grown five plants under each replication were selected and tagged for recording observations for the following characters *viz*., plant height, number of branches per plant, days taken to first flowering, number of clusters per plant, number of pods per cluster, pod length, pod girth, individual pod weight, pod yield per plant, seed yield per plant, number of seeds per pod, 100 seed weight, days taken to maturity and harvest index. Qualitative characters like crude protein content, crude fibre and gum content were also recorded. The path coefficient analysis was calculated, following the procedure suggested by Dewey and Lu (1959) [4]. It was used for partitioning the genotypic correlation between seed yield and five of its components into direct and indirect effects.

Results and discussion
A simple measure of correlation of characters with yield does not quantify the relative contribution of the causal factor to the ultimate entity yield, since the component traits are themselves inter-dependent, they often affect their direct relationship with yield and consequently restrict the reliability of selection indices arrived based upon the correlation study. Upon the assessment of apparent relationship between yield and yield components, it was felt necessary to partition the direct and indirect effects of each character on yield to understand the nature of association at the genotypic level.
In order to fulfill the requirement, path coefficient analysis was computed and the genotypic correlations of direct and indirect effects of different characters on dry pod yield per plant.

Path coefficient analysis is a standardized partial regression coefficient and as such measures the direct influence of one variable upon another and permits the separation of correlation coefficient into components of direct and indirect effects (Dewey and Lu, 1959 [4] and Brindha *et al*., 1995 [2]).

In the present investigation, the characters *viz*., number of branches per plant, number of clusters per plant, number of pods per cluster, fresh pod yield, seed yield per plant, hundred seed weight, days to maturity, harvest index, crude fibre and gum content registered positive direct effect on dry pod yield. The direct selections for these characters are likely to bring about an overall improvement in dry pod yield per plant. Similar results were observed by Natarajan and Arumugam (1980) [11], Henry *et al*. (1986) [6], Brindha *et al*. (1995) [2], Kumaran *et al*. (1995) [10] in peas, Farid and Savithramma (2004) [5] in cluster bean, Shridhar (2005) [17] and Kaur *et al*. (2007) [9] in peas, Ramaprasad *et al*. (2007) [13] in french bean, Patel *et al*. (2008) [12] in moth bean. Plant height, days taken to flowering, pod length, number of seeds per pod, crude protein had registered negative direct effect on dry pod yield per plant. This result is in line with the findings of Kalaiselvan and Irulappan (1985) [8] in winged bean, Kumaran *et al*. (1995) [10], Ramesh and Tewatia (2002) [14] and Shridhar (2005) [17] in peas, Ramaprasad *et al*. (2007) [13] in french bean, Ibrahim *et al*. (2012) [7] in cluster bean for the above characters.

Path analysis for dry pod yield was carried out at genotypic level and it is presented in Table 1. The direct effect of fresh pod yield was positive and highest on dry pod yield. The direct contribution of plant height, days taken to first flowering, pod length, number of seeds per plant and crude protein were negative whereas plant height, days taken to first flowering and pod length had positive correlation with dry pod yield. The direct effect of days taken to maturity was positive and highest on dry pod yield per plant and also characters like number of branches per plant, number of clusters per plant, number of pods per cluster, fresh pod yield, seed yield per plant, hundred seed weight, harvest index, crude fibre and gum content registered positive direct effect. Similar results were observed by Henry *et al*. (1986) [6], Brindha *et al*. (1995) [2] and Shabarishrai and Dharmatti (2014) [15] in cluster bean.

Table 1: Path coefficient analysis showing direct and indirect effect of yield components on dry pod yield

Traits	PH	NBPP	DTFF	NCPP	NPPC	PL	FPY	NSPP	SYPP	HSW	DTM	HI	CF	CP	GC	DPY
PH	-0.02476	-0.01905	0.22657	-0.00563	0.12423	-0.01078	0.09995	-0.00095	0.07835	0.00131	-0.10482	-0.00010	-0.00103	0.00188	0.00091	0.366
NBPP	0.00684	0.06891	-0.10856	0.01893	-0.13845	0.01018	-0.05494	0.00307	-0.04722	-0.00015	0.04887	-0.00025	0.00268	0.00227	-0.00007	-0.180
DTFF	0.00794	0.01059	-0.70665	0.01074	-0.21806	0.01387	-0.24237	0.00226	-0.17449	-0.00240	0.33919	0.00057	0.00103	0.00144	-0.00070	-0.957
NCPP	0.00372	0.03480	-0.20254	0.03748	-0.17078	0.00117	-0.05269	0.00121	-0.05137	-0.00091	0.10070	0.00121	0.00336	-0.00507	0.00005	-0.299
NPPC	-0.01079	-0.03347	0.54053	-0.02245	0.28507	-0.01391	0.20356	-0.00172	0.14763	0.00243	-0.26029	-0.00039	-0.00166	-0.00235	0.00147	0.833
PL	-0.00580	-0.01523	0.21285	-0.00095	0.08611	-0.04605	0.09498	-0.00039	0.06443	0.00232	-0.09750	-0.00061	-0.00142	-0.00873	0.00066	0.285
FPY	-0.00942	-0.01442	0.65218	-0.00752	0.22097	-0.01666	0.26261	-0.00227	0.17375	0.00220	-0.31099	0.00001	-0.00141	-0.00232	0.00077	0.947
NSPP	-0.00221	-0.01972	0.14928	-0.00423	0.04586	-0.00167	0.05574	-0.01071	0.01345	-0.00042	-0.06218	-0.00005	-0.00093	0.00352	0.00120	0.167
SYPP	-0.01019	-0.01710	0.64792	-0.01012	0.22115	-0.01559	0.23976	-0.00076	0.19031	0.00236	-0.30993	-0.00049	-0.00074	0.00210	0.00030	0.939
HSW	-0.00565	-0.00183	0.29594	-0.00598	0.12092	-0.01872	0.10094	0.00078	0.07847	0.00572	-0.13878	0.00015	-0.00107	-0.01125	0.00062	0.420
DTM	0.00765	0.00993	-0.70646	0.01112	-0.21870	0.01322	-0.24072	0.00196	-0.17385	-0.00234	0.33928	0.00069	0.00105	0.00131	-0.00074	-0.956
HI	0.00040	-0.00282	-0.06571	0.00738	-0.01797	0.00458	0.00023	0.00008	-0.01509	0.00014	0.03832	0.00614	-0.00063	-0.00692	0.00019	-0.051
CF	0.00228	0.01646	-0.06457	0.01123	-0.04209	0.00581	-0.03306	0.00089	-0.01258	-0.00054	0.03187	-0.00035	0.01122	0.00708	-0.00128	-0.068
CP	0.00111	-0.00375	0.02430	0.00455	0.01600	-0.00961	0.01460	0.00090	-0.00958	0.00154	-0.01064	0.00102	-0.00190	-0.04181	-0.00029	-0.013
GC	-0.00274	-0.00055	0.05974	0.00021	0.05084	-0.00371	0.02468	-0.00157	0.00696	0.00043	-0.03060	0.00014	-0.00175	0.00145	0.00822	0.112

Diagonal bold numbers - direct effect

Residual effect = 0.268

* Significant at 5 per cent level ** Significant at 1 per cent level.

PH - Plant height, **NBPP -** Number of branches per plant, **DTFF -** Days taken to first flowering, **NCPP -** Number of clusters per plant, **NPPC -** Number of pods per cluster, **PL -** Pod length, **FPY -** Fresh pod yield, **DPY -** Dry pod yield, **NSPP -** Number of seeds per pod, **SYPP -** Seed yield per plant, **HSW -** Hundred seed weight, **DTM -** Days to maturity, **HI -** Harvest index, **CF -** Crude fibre content, **CP -** Crude protein content, **GC -** Gum content.

Conclusion

It could be concluded from this study that days to maturity, number of pods per cluster, fresh pod yield and seed yield per plant were the most important yield components as pointed out by path analysis. These components were positively associated with each other and with yield, suggesting that simultaneous improvement in these characters might be easy.

Acknowledgement

The authors are thankful to Pandit Jawaharlal Nehru College of Agriculture and Research Institute for providing necessary facilities in carrying out the present investigation.

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