RELIABILITY OF YIELD CONTRIBUTING CHARACTERS FOR IMPROVING YIELD POTENTIAL IN CHILLI (*Capsicum annum*)

M. FARHAD, M. HASANUZZAMAN, B. K. BISWAS, A. K. AZAD AND M. ARIFUZZAMAN

Department of Genetics and Plant Breeding, Hajee Mohammad Danesh Science and Technology Universityt, Dinajpur, Bangladesh

Accepted for publication: March 30, 2008

ABSTRACT

Farhad M., Hasanuzzaman M., Biswas B. K., Azad A. K. and Arifuzzaman M. 2008. *Reliability of Yield Contributing Characters for Improving Yield Potential in Chilli (Capsicum annum).* **Int. J. Sustain. Crop Prod. 3(3):30-38**

The experiment was conducted with 45 chilli (*Capsicum annum*) genotypes in the Field Laboratory, Dept. of Genetics and Plant Breeding, Hajee Mohammad Danesh Science and Technology University, Dinajpur during March to July, 2006 to study variability, association and direct and indirect effects present among themselves. Fourteen quantitative characters viz. days to 50% flowering, time between fruit set and maturity, plant height, primary branches per plant, number of secondary branches per plant, fruit length, fruit girth, fruit weight, number of fruits per plant, seeds per fruit, 100 seed weight, fruit pedicel length, vitamin-C content and dry fruit yield per plant were taken into consideration. The analysis of variance revealed remarkable variation among the genotypes for the characters concerned. The magnitudes of phenotypic coefficient of variations were higher than corresponding genotypic coefficients of variations. Higher genotypic as well as phenotypic coefficient of variations were computed for vitamin-C content, number of secondary branches per plant, number of primary branches per plant and yield per plant. Heritability estimates were higher for all the characters except days to 50% flowering and pedicel length. High heritability coupled with high genetic advances were estimated for seeds per fruits and plant height. Dry fruit yield per plant showed significant and positive correlation with number of secondary branches per plant, fruit girth, fruit weight, fruits per plant, seeds per fruit and 100-seed weight. Fruits per plant and fruit weight exerted highest positive direct effect both at genotypic and phenotypic levels.

Key words: Variability, correlation, path coefficient, Chilli (*Capsicum annum*)

INTRODUCTION

Chilli is used as a major ingredient in curry for culinary preparations. In Bangladesh, chilli is essentially used in vegetables and meat preparations either fresh or dry. Chilli is also used for pickle preparation and the sweet varieties are used as vegetables. Though 20 wild species of chilli have been reported, only 5 species are cultivated viz *Capsicum annum, C. baccatum, C. frutescens, C. chinenses and C. pubescens* (Heiser, 1976). Almost all the varieties with low and medium pungency cultivated on a field scale in Bangladesh are belonged to *Capsicum annum*. A number of cultivars are grown in Bangladesh differing in habit, yield, and consumers' preference and in size, shape, color and pungency of the fruits. Chilli is grown all over Bangladesh but the yield is only 1.48 metric ton per hectare (BBS 2006). The lack of improved genotypes is the main constraint to high yield. On the other hand, wide range of variability is observed in respect of morphophysiological traits in chilli.
Selection of suitable genotypes depends on a number of characters along with the set of coefficients for weighing traits to gain economic return. An effective breeding program and particularly of selection depends upon the availability of in breeding materials. If the variability in the population is largely due to genetic cause with least environmental effect, the probability of isolating superior genotype is high. But it is often difficult to judge, what proportion of the observed variability is heritable (genotypic) and what proportion is non-heritable (environmental), particularly in case of characters under polygenic fashion. The progress of breeding in such a population is primarily conditioned by the magnitude, nature and interrelation of genotypic and environmental variations in the various plant characters. It then becomes necessary to make partition the observed variability into its heritable and non heritable components with the help of suitable genetic parameters such as genotypic coefficient of variation, heritability estimates, genetic advance under selection, etc.

Knowledge about the degree of interrelationship that exists among different component characters themselves and with fruit yield is important for devising on efficient selection criterion for fruit yield and a basis for planning and efficient breeding program for the future. Besides, path co-efficient analysis is used to measure the causes of association and qualify the direct and indirect influences of one character upon another (Dewey and Lu, 1958) and it provides successful partitioning of the correlation coefficients into direct and indirect effects. (Rahman *et al*., 1982).

To generate information, the study was undertaken with the following objectives:

i) to study the variability and character association in the collected germplasm of chilli.
ii) to determine the direct and indirect effects among the attributes of yield.
iii) to identify the suitable genotypes for future hybridization programme.

MATERIALS AND METHODS

The experiment was conducted on an upland field at the southern field of the farm of Hajee Mohammad Danesh Science and Technology University (HSTU) Dinajpur during March to July, 2006. A total 45 genotypes of chilli (*Capsicum annum*) collected from Plant Genetic Resource Centre of BARI were included in this study. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The unit plots size was 2.5 m ×2.5 m consisting of 5 rows the spacing was 50 cm x 50 cm. Thirty days old seedlings were transplanted in the experimental plot.

Data on the characters viz. days to 50% flowering, time between fruit set and maturity, plant height, number of primary branches per plant, number of secondary branches per plant, fruit length (cm), fruit girth (cm), fruit weight (g), number of fruits per plant, seeds per fruit, 100 seed weight (g), fruit pedicel length (cm), Vitamin-C content (mg/100g) were recorded on individual plant basis from the 10 randomly selected plants.
Genotypic and phenotypic variances were estimated according to the formulae given by Johnson *et al*., (1955).Genotypic and phenotypic coefficients of variations were estimated following the formulae used by Burton (1952). Heritability in broad sense was calculated by using the formulae suggested by Singh and Chaudhury, 1985 (1998)**.** The expected genetic advances for different characters under investigation were estimated according to the formulae used by Johnson *et al*., (1955) and Allard (1960).Genetic advance expressed as percentage of mean were estimated by using the formulae as described by Comstock and Robinson (1952).

Genotypic and phenotypic correlations coefficients for different characters in all possible combinations were estimated according to the following formulae as used by Miller *et al*., (1958) and path coefficient analysis was done according to the procedure stated by Singh and Chaudhury (1985) and Dabholkar (1992) that were originally suggested by Dewey and Lu (1959).

RESULTS AND DISCUSSION

Significant differences were found among the genotypes for the character studied. The estimates of range, mean, genotypic variance(σ^2g), phenotypic variance(σ^2p), genotypic coefficient of variation(GCV), Phenotypic coefficient of variation(PCV), heritability (h^2%), genetic advance(GA) and genetic advance as % of mean (GA %) for the different characters are shown in Table 1. The phenotypic variance (σ^2p) and Phenotypic coefficient of variation (PCV) were slightly higher than corresponding genotypic variance (σ^2g) and genotypic coefficient of variation (GCV) for most of the characters indicated the presence of less environmental effect upon the characters. Relatively higher value of genotypic variance (σ^2g) and phenotypic variance (σ^2p) were found for plant height and seeds per fruit. The Genotypic coefficient of variation (GCV) was maximum for Vitamin-C content, number of secondary branches per plant and number of secondary branches per plant and the lowest for days to 50% flowering. Nandadevi and Hosamani (2003) also found similar results working on 26 genotypes of chilli.

Heritability estimates were relatively higher for most of the character studied. High values of heritability coupled with high genetic advance (GA) as percentage of mean were obtained for NP (number of primary branches per plant), VC (Vitamin-C content, mg/100g), YP (Yield per plant, g/plant), NF (Number of fruits per plant) and NS (Number of secondary branches per plant) suggested the selection for these characters would give better response from the genotypes. Similar results have also been found by Bendale *et al.* (2006), Bhagyalakshmi (1990), Sreelathakumary and Rajamony (2004a) and Das and Chaudhury (1999). But low heritability for this character was reported earlier by Anandanayaki and Natarajan (2000) in six homozygous chilli lines.

The values of the genotypic correlation coefficients in general were higher than those of the phenotypic correlation coefficients indicated the association in largely due to genetic reason. In some cases, phenotypic correlation coefficients were higher than genotypic correlation coefficient indicated the suppressing effect of the environment which modified the expression of the characters at phenotypic level. Yield per plant was significantly and positively associated with NS (Number of secondary branches per plant), FG (Fruit grith (cm)), NF (Number of fruits per plant), SF (Seeds per fruit) and SW (100 seed weight (g)) in both genotypic and phenotypic levels (Table 2). Karad *et al*.(2006), Raikar *et al*.(2005), Rani *et al*.(1996), Rangaiah *et al*(2001), Rathod *et al.* (2002) reported similar results.

Time between fruit set and maturity showed significant and negative correlation both at genotypic and phenotypic levels with dry fruit yield (Table 2). Dipendra Gogoi and Gautam found non significant negative association between days to maturity and yield per plant in 2003 working with 52 genotypes of chilli. Genotypic

and phenotypic correlations of plant height with number of secondary branches per plant and pedicel length were positive and significant which indicated that plant height has significant contribution to increase these two traits. Number of primary branches per plant found to show genotypically significant and positive correlations with number of secondary branches per plant, fruits per plant, and seeds per fruits (Table 2) which indicated that number of primary branches per plant have significant contribution to increase these three traits. Rangaiah *et al*. reported the same results in 2001.

Fruit length showed significant and positive correlation with fruit weight both genotypically and phenotypically. Ghai and Thakur (1987), Mohammed Ibrahim *et al*., (2001), Palsuledesal *et al*., (2006) and Raikar *et al*., (2005) found similar results. Fruit girth showed genotypically and phenotypically significant and positive correlations with fruit weight and it also showed weak and negative relationships with pedicel length and vitamin-C content. Similar results were also found by Mohammed Ibrahim *et al*., (2001) in 17 genotypes, Singh and Singh (2004) in 10 genotypes and Sreelathakumary and Rajamony (2004) in 15 accessions of chilli.

Genotypic and phenotypic correlations of fruit weight with fruit length, fruit girth seeds per fruit and 100 seed weight were positive and significant. Similar results were also observed by Pawade *et al*., (1995) in 36 local genotypes; Rani *et al*., (1996) in 79 genotypes.

Path coefficient analysis

Path co-efficient analysis was done with all the 14 characters studied. The estimates of direct and indirect effects of thirteen characters on seed yield based on genotypic and phenotypic correlation are presented in Table 3. Path coefficient analysis showed that NF had maximum direct effect on dry fruit yield followed by FW (Fruit weight (g)), FG (Fruit grith (cm)), PL (Fruit pedicel length (cm)), SW (100 seed weight (g)), DF (Daye of 50% flowering), VC (Vitamin-C content (mg/100g)) and NP (Number of primary branches per plant). Similar results were observed by Nandadevi and Hosamani (2003), Singh and Singh (2004), Palsuledeshal *et al.* (2006),Ranghaiah *et al*.(2001). PH (Plant height (cm)), NS (Number of primary branches per plant), FL (Fruit length (cm)) and SF (Seed per fruit) showed negative direct effect towards YP (Yield per plant (g/plant)) although their correlations with YP (Yield per plant (g/plant)) were positive. On the other hand, DM had negative direct effect towards YP (Yield per plant (g/plant)). The highly significant and positive correlation of NS (Number of primary branches per plant), FW (Fruit weight (g)), FG (Fruit grith (cm)) and SW (100 seed weight (g)) were due to their respective high positive direct effect on fruit yield. Raikar *et al*. (2005) also found similar results. Seeds per fruit showed positive correlation with yield though it showed negative direct effect at both genotypic and phenotypic level.

From the above study it was observed that NP (Number of primary branches per plant), VC (Vitamin-C content (mg/100g)), YP (Yield per plant 9g/plant)), NF (Fruit weight (g)) and NS (Number of secondary branches per plant) had high heritability together with high GA as percentage of mean. Therefore, selection including through the characters would be effective for improvement of chilli. Correlation and path analysis suggested that during selection more emphasis should be given on NS (Number of secondary branches per plant), FW (Fruit weight (g)), FG (Fruit grith (cm)) and SW (100 seed weight (g)) as these characters have high positive correlation and high direct effect on fruit yield.

Table 1: Different parameters of variability of 14 characters of chilli (*Capsicum annum*)

Characters	Range	Mean	Genotypic variance (σ^2g)	Phenotypic variance (σ^2p)	Genotypic coefficient of variation (GCV)	Phenotypic coefficient of variation (PCV)	Heritability (h_b^2%)	Genetic advance (GA)	Genetic advance as % of mean (GA %)
DF	61.17-84.93	75.65	23.625	44.911	6.42	8.86	52.60	7.262	9.599
TM	25.77-43.87	36.94	12.575	17.654	9.60	11.37	71.23	6.165	16.692
PH	20.06-67.95	41.99	126.538	143.508	26.78	28.52	88.17	21.759	51.813
NP	2.03-6.57	3.34	1.880	1.921	41.06	41.51	97.86	2.794	83.684
NS	3.13-15.4	6.89	8.536	9.475	42.40	44.67	90.09	5.713	82.911
FL	3.34-10.53	6.09	2.502	2.737	25.97	27.16	91.41	3.115	51.156
FG	1.61-0.49	0.86	0.087	0.096	34.42	36.15	90.62	0.578	67.494
FW	0.27-0.92	0.48	0.019	0.020	28.54	29.28	95.00	0.277	57.300
NF	5.76-24.2	11.86	17.820	19.467	35.58	37.19	91.53	8.320	70.134
SF	37.97-114.00	65.99	259.393	313.654	24.41	26.84	82.701	30.172	45.723
SW	0.258-0.558	0.423	0.0057	0.0067	17.79	19.30	85.00	0.143	33.798
PL	2.38-3.83	3.14	0.092	0.139	9.66	11.88	66.19	0.508	16.199
VC	0.43-3.44	1.61	0.537	0.5587	45.55	46.48	96.06	1.479	91.983
YP	1.97-11.78	5.82	5.599	6.0346	40.66	42.27	92.77	4.694	80.682

DF = Days to 50% flowering (days)
TM = Time between fruit set and maturity (days)
PH = Plant height (cm)
NP = Number of primary branches per plant
NS = Number of secondary branches per plant
FL = Fruit length (cm)
FG = Fruit girth (cm)
FW = Fruit weight (g)
NF = Number of fruits per plant
SF = Seeds per fruit
SW = 100 seed weight (g)
PL = Fruit pedicel length (cm)
VC = Vitamin-C content(mg/100g)
YP = Yield per Plant (g)

Table 2: Genotypic (r_g) correlation coefficients among 14 characters in chilli (*Capsicum annum*)

Characters		DF	TM	PH	NP	NS	FL	FG	FW	NF	SF	SW	PL	VC
TM	r_g	0.2504												
	r_p	0.0822												
PH	r_g	0.0181	0.0736											
	r_p	-0.0023	0.0578											
NP	r_g	-0.1184	0.1571	-0.0175										
	r_p	-0.0850	0.1232	-0.0145										
NS	r_g	-0.0816	-0.0395	0.3283	0.7390**									
	r_p	-0.0655	-0.0784	0.2877	0.6944*									
FL	r_g	-0.3819*	-0.1009	0.0450	0.0882	0.2475								
	r_p	-0.2778	-0.0946	0.0407	0.0904	0.2196								
FG	r_g	0.0045	-0.0651	0.1167	-0.1176	0.0276	0.2825							
	r_p	0.0411	-0.0539	0.1021	-0.1159	0.0281	0.2686							
FW	r_g	-0.1101	-0.2326	0.2251	-0.0429	0.2813	0.5944**	0.3735*						
	r_p	-0.0599	-0.2123	0.2004	-0.0414	0.2599	0.5501**	0.3409*						
NF	r_g	-0.1907	-0.2503	-0.0271	0.3023*	0.3503*	-0.1595	0.1213	-0.1809					
	r_p	-0.0986	-0.2168	-0.0239	0.2855	0.3249*	-0.1507	0.1199	-0.1677					
SF	r_g	-0.2798	0.1116	0.1873	0.3210*	0.4042**	0.1286	0.0695	0.3765*	0.2342				
	r_p	-0.1404	0.1131	0.1460	0.2955*	0.3348*	0.1245	0.0812	0.3333*	0.1905				
SW	r_g	-0.1215	-0.1361	0.2452	0.1095	0.2487	0.1641	0.1182	0.4261**	0.0492	0.2284			
	r_p	-0.0689	-0.0727	0.2066	0.1005	0.2141	0.1569	0.1200	0.3763*	0.0851	0.2306			
PL	r_g	0.0171	0.2354	0.3844**	0.1404	0.1465	0.1458	-0.2049	-0.0756	-0.2122	-0.2239	0.0138		
	r_p	-0.0088	0.1492	0.2627	0.1298	0.1125	0.1546	-0.1573	-0.0524	-0.1774	-0.1255	0.0039		
VC	r_g	0.0964	0.1302	-0.1845	-0.2078	-0.1318	0.1418	-0.2529	-0.0987	-0.3039*	-0.0107	-0.1333	0.2787	
	r_p	0.0863	0.0977	-0.1645	-0.2046	-0.1224	0.1249	-0.2447	-0.0896	-0.2892	-0.0093	-0.1400	0.2287	
YP	r_g	-0.1813	-0.4674**	0.1189	0.1900	0.4591**	0.2233	0.4360**	0.5087**	0.7474**	0.3530*	0.3620*	-0.1872	-0.3202*
	r_p	-0.1471	-0.3782*	0.1233	0.1761	0.4338**	0.1999	0.3889**	0.4698**	0.6679**	0.2954*	0.3026*	-0.1754	-0.2969*

*and ** indicate the significant at 5% ad 1% level of probability, respectively

Table 3: Path analysis of yield contributing characters on yield in chilli

Characters		DF	DM	PH	NP	NS	FL	FG	FW	NF	SF	SW	PL	VC
DF	r_g	**0.0413**	0.0103	0.0007	-0.0049	-0.0034	-0.0157	0.0001	-0.0045	-0.0079	-0.0115	-0.0050	0.0007	0.0039
	r_p	**-0.06946**	-0.0057	0.00016	0.0059	0.0045	0.0193	-0.0028	0.0042	0.0068	0.0097	0.0048	0.0006	-0.006
DM	r_g	-0.00766	**-0.09313**	-0.0053	-0.0114	0.0073	0.0088	0.0050	0.0197	0.0201	-0.0105	0.0068	-0.014	-0.0091
	r_p	-0.0326	**-0.1303**	-0.0096	-0.0205	0.0051	0.0132	0.0085	0.0303	0.0326	-0.0145	0.0177	-0.0306	-0.0169
PH	r_g	-0.0007	-0.0032	**-0.0440**	0.0008	-0.0144	-0.0019	-0.0051	-0.0099	0.0012	-0.0082	-0.0107	-0.0169	0.0081
	r_p	-0.000004	0.0001	**0.00173**	-0.00003	0.0004	0.00007	0.0002	0.0003	-0.00004	0.0003	0.0004	0.0004	-0.0003
NP	r_g	-0.0028	0.0038	-0.0004	**0.0241**	0.0177	0.0021	-0.0028	-0.0011	0.0073	0.0077	0.0026	0.0033	-0.0050
	r_p	0.00193	-0.00281	0.00033	**-0.0228**	-0.016	-0.0021	0.0026	0.0009	-0.0065	-0.0067	-0.0023	-0.0029	0.0047
NS	r_g	0.0014	0.0007	-0.0056	-0.0127	**-0.0171**	-0.0042	-0.0005	-0.0048	-0.0060	-0.0069	-0.0042	-0.0025	0.0023
	r_p	-0.00655	-0.00784	0.02876	0.0694	**0.0999**	0.0219	0.0028	0.0259	0.0324	0.0334	0.0214	0.0112	-0.0122
FL	r_g	0.0347	0.0091	-0.0041	-0.0080	-0.0225	**-0.0909**	-0.0257	-0.0541	0.0145	-0.0117	-0.0149	-0.0132	-0.0129
	r_p	0.02223	0.00756	-0.00326	-0.0072	-0.0175	**-0.0800**	-0.0214	-0.0440	0.0121	-0.0099	-0.0125	-0.0123	-0.0099
FG	r_g	0.0006	-0.0091	0.0163	-0.0164	0.0038	0.0394	**0.1395**	0.0521	0.0169	0.0097	0.0165	-0.0285	-0.0353
	r_p	0.00586	-0.0077	0.01456	-0.0165	0.0040	0.0383	**0.1425**	0.0486	0.0171	0.0115	0.0171	-0.0224	-0.0349
FW	r_g	-0.0729	-0.1542	0.1493	-0.0285	0.1865	0.3941	0.2476	**0.6630**	-0.1200	0.2496	0.2825	-0.0501	-0.0654
	r_p	-0.03242	-0.11483	0.10841	-0.0224	0.1406	0.2975	0.1844	**0.5409**	-0.0907	0.1803	0.2035	-0.0284	-0.0484
NF	r_g	-0.1623	-0.2131	-0.0231	0.2574	0.2982	-0.1358	0.1033	-0.1540	**0.8513**	0.1994	0.0419	-0.1806	-0.2587
	r_p	-0.06815	-0.14973	-0.01657	0.1972	0.2244	-0.1041	0.0828	-0.1158	**0.6907**	0.1315	0.0587	-0.1225	-0.1997
SF	r_g	0.0130	-0.0052	-0.0087	-0.0149	-0.0188	-0.0059	-0.0032	-0.0175	-0.011	**-0.0465**	-0.0106	0.0104	0.0005
	r_p	0.00671	-0.00541	-0.00699	-0.0141	-0.0160	-0.0059	-0.0038	-0.0159	-0.0091	**-0.0478**	-0.0111	0.0060	0.0004
SW	r_g	-0.0060	-0.0067	0.0121	0.0054	0.0123	0.0081	0.0058	0.0211	0.0024	0.0113	**0.0495**	0.0007	-0.0066
	r_p	-0.00128	-0.00135	0.00384	0.0018	0.0039	0.0029	0.0022	0.0070	0.0016	0.0042	**0.0186**	0.00007	-0.0026
PL	r_g	0.0019	0.0261	0.0425	0.0155	0.0162	0.0161	-0.0227	-0.0083	-0.0235	-0.0247	0.0015	**0.1106**	0.0308
	r_p	-0.00004	0.00062	0.0011	0.0005	0.0005	0.0006	-0.0006	-0.0002	-0.0007	-0.0005	0.00002	**0.0041**	0.0009
VC	r_g	0.0034	0.0045	-0.0065	-0.0073	-0.0046	0.0049	-0.0088	-0.0035	-0.0106	-0.0003	-0.0047	0.0097	**0.0350**
	r_p	0.00176	0.00198	-0.0033	-0.0041	-0.0024	0.0025	-0.0049	-0.0018	-0.0059	-0.0002	-0.0028	0.0046	**0.0203**
Total correlation with yield	r_g	-0.1813	-0.4674*	0.1189	0.1900	0.4592**	0.2233	0.4360**	0.5087**	0.7474**	0.3531*	0.3620*	-0.1872	-0.3203*
	r_p	-0.14706	-0.3782*	0.1233	0.1761	0.4339**	0.1999	0.3889**	0.4698**	0.6679**	0.2953*	0.3026*	-0.1754	-0.2969*

*and ** indicate the significant at 5% ad 1% level of probability, respectively

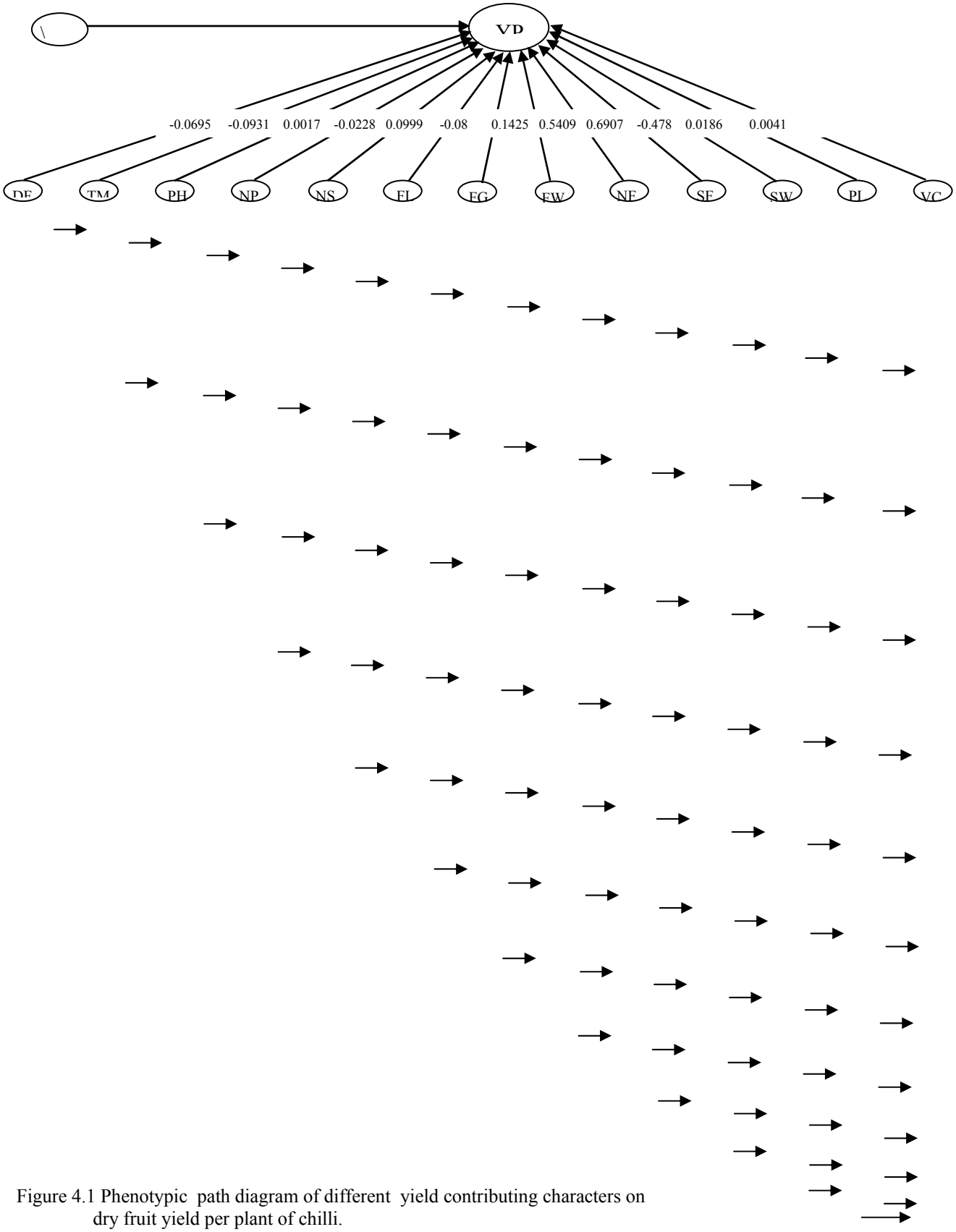

Figure 4.1 Phenotypic path diagram of different yield contributing characters on dry fruit yield per plant of chilli.

REFERENCES

Allard, R.W. 1960. Principles of plant Breeding. John willey and sons. Inc. New York. p. 36

Anandanayaki, D.and Natarajan, S. 2006. Genetics of certain growth and yield parameters in chilli (*Capsicum annum* L.). South Indian Hort. 48: 1-6, 123-125; 6 ref

Burton, G.M. 1952. Quantitative inheritance in grasses. Proc. 6 Tnt. Grassland cong. 1: 277-283

BBS. 2006. Statistical Yearbook of Bangladesh. Statistic Division. Ministry of planning, Government of the People's Republic of Bangladesh, Dhaka. pp 208

Bendale, V. W., Palsuledesai, M. R., Bhave, S. G., Sawant, S. S. and Desai, S. S. 2006. Genetic evaluation of some economic traits in chilli (*Capsicum annum* L.) in Konkan region of Maharashtra. Crop Res. Hisar. 31(3): 401—403

Bhagyalakshmi, P.V., Ravishankar, C., Subrahmanyam, D. and Babu, V.G. 1990. Study on heritability, genetic advance and character association in chilli (*Capsicum annum* L.). South Indian Hort. 38: 1, 15-17; 3 ref

Comstock, R.E. and H.F. Robinson. 1952. Genetic parameters, their estimation and significance. Proc. 6 Tnt. Congr. 1: 284-29 1

Dabholkar, A.R. 1992. Elements of Biometrical Genetics. Concept publishing company, New Delhi, India. p. 431

Das, S. and Choudhary, D. N. 1999(a). Genetic variability in summer chilli (*Capsicum annum* L.). J. Appl. Biol. 9: 1, 8-10; 9 ref

Dewey, D.R. and K.H. Lu. 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. Agron. J. 56:515-518

Dipendra Gogol and Gautam, B. P. 2003. Correlation and path coefficient analysis in chilli (*Capsicum* spp.). Agril. Sci. Digest. 23(3): 162—166

Ghai, T.R. and Thakur, M.R. 1987. Variability and correlation studies in an intervarietal cross of chilli. Punjab Horticultural Journal. 27: 1-2, 80-83; 9 ref

Heiser, (Jr) C. B. 1976. Evolution of crops Plants. Ed. N. W. Simionds, Longman, London, pp.256-258.

Johnson, H.E.; H.F. Robinson and R.E. Comstock. 1955. Estimates of genetic and Environmental variability in soybean. Agron. J. 47: 314-318

Karad, S. R. Navate, P. A.and Kadam, D. E. 2006. Variability and path coefficient analysis in chilli (*Capsicum annum* L.). Int. J. Agril. Sci. 2(1): 90-92

Miller, P.A.; J.C. Williams; H.F. Robinson and R.E. Comstock, 1958. Estimates of genetic and environmental variance and covariance and their implication in selection. Agron. J. 50: 126-13 1

Mohammed Ibrahim, Ganiger, V.M. and Yenjerappa, S.T. 2001.Genetic variability, heritability, genetic advance and correlation studies in chilli. Karnataka J. Agril. Sci.14: 3, 784-787; 5 ref

Nandadevi and Hosamani, R. M. 2003. Variability, correlation and path analysis in kharif-grown chilli (*Capsicum annum* L.) genotypes for different characters. Capsicum and Eggplant Newsletter. 2003 (22): 43—46

Palsuledesal, M. R., Bendale, V. W., Bhave, S. G., Sawant, S. S. and Desai, S. S. 2006. Association analysis for fruit yield and its components in chilli. Crop Res. Hisar. 31(2): 291—294

Pawade, S.B., Sontake, M.B., Shinde, N.N. and Borikar, S.T. 1995. Studies on correlation and path analysis for some characters in local chilli (*Capsicum annum* L.) types from Nagpur District. PKV Res. J.19: 1, 93-94; 1 ref.

Rahman, A. R. M. S., Islam, M. A. and Shaheed, M. A. 1982. Selection through combined effect of ANOVA, genetic parameters and score index and their relative efficiency in mungbean (*Phaseolus aureus*). Bangladesh J. Agric. 7(34): 89-97

Raikar, G. N., Karad, S. R. and Navale,P. A. 2005. Variability and path-coefficient analysis in chilli .J. Maharashtra Agril Univ. 30(1): 90-91

Rangaiah, S., Manjunath, A., Kulkarni, R. S. and Nehru, S. D. 2001. Character association following mutagenesis in chilli (*Capsicum annum* L.). Mysore 35(1): 58

Rani, K., Natarajan, S. and Thamburaj, S. 1996. Correlation and path analysis in chilli (*Capsicum annum* L.). South Indian Hort. 44: 1-2, 8-11; 6 refs.

Rathod, R. P., Deshmukh, D. T., Ghode, P. B. and Gonge, V. S. 2002. Correlation and path analysis studies in chilli (*Capsicum annum* L.). Haryana J. Hort. Sci. 31(1/2): 141-143

Singh, P.K. and B.D. Chaudhary. 1985. Biometrical Methods in Quantitative Genetic Analysis. Kalyani publishers. New Delhi, India. p. 318

Singh,-M. D. and Singh, N. G. 2004. Correlation and path analysis studies in selected local chillies (*Capsicum annum* L). Environment and Ecology. 2: 672 - 675

Sreelathakumary, I. and Rajamony, L. 2004a. Variability, heritability and genetic advance in chilli (*Capsicum annum* L.). J. Trop. Agric. 42(1/2): 35-37

Sreelathakumary, I. and Rajamony, L. 2004b. Correlation and path coefficient analysis for yield in hot chilli (*Capsicum chinense* Jacq.). Capsicum and Eggplant Newsletter.2004 (23): 53—56

Sreelathakumary, I. and Rajamony, L. 2002. Variability, heritability and correlation studies in chilli (*Capsicum* spp.) under shade. Indian J. Hort.59: 1, 77-83; 13 ref