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Association of characters and their direct and indirect contribution for yield in off- season bottle gourd [*Lagenaria siceraria* (Mol.) Standl]

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ABSTRACT : Correlation and path analysis were carried out in order to quantify the contribution of explanatory characters towards yield for off- season bottle gourd cultivation. The characters like number of fruits per plant, average number of seed per fruit, average fruit weight, vine length and days to first male flower anthesis, number of fruit per plant,average fruit weight and days to first male flower anthesis had the highest positive direct effect on fruit yield per plant.

KEY WORDS : Off- season, Bottle gourd, Association, Path co-efficient

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It is true that off- season cultivation of this crop (in plains and river beds)has opened a better marketing window to the growers for better return of their produce ,which ultimately result better livelihoods of forming community (Singh and Kumar, 2002). In eastern up the temperature and photo radiations are sub optimal which provide conductive environment for off season cultivation of the crop. The statistical quantification of the relationship among the component characters as well as relative share towards economic yield is useful for selection /improvement in off season cultivation (Sharma and Bhutani, 2001 and Nimbalker *et al*., 2002).

Bottle gourd (*Lagenaria siceraria*),2n=22 is an important cucurbitaceae crop grown throughout the country. It is a warm season vegetable, which thrives well in warm and humid climates but it can be grown throughout the year in northern Indian plane as off-season vegetable. The bottle gourd fruits in the green stage are used as vegetable which is available throughout the year and also for preparation of some delicious sweets. It is highly digestive and reduced cough. As medicinal properties, it has cooling cardiotonic and diuretic. Its also useful in controlling asthma, bronchitis and ulcers.

It is a monoecious and highly cross pollinated crop in which a large amount of variation is observed in many economically important traits. Variation found in shape, size and colour of fruits is most conspicuous.The variability of different characters is pre-requisite for crop improvement (Ramesh *et al*., 2000). Variability also exists with respect to other quantitative and qualitative morphological traits in local land races of bottle gourd availability of wide range of variability in India, very little attention has been paid for their rigorous collection, evaluation and documentation. Local varieties /land races are most commonly used by growers because very few improved varieties are available in this crop for cultivation. The great extent of natural variation present in various characters among the genotypes of bottle gourd suggests good scope for improvement in economic

traits through conventional selection techniques (Prasad and Prasad, 1978; Narayan *et al.*,1996 and Singh *et al.*,1996).Improvement through selection in any characters depend upon the genetic variability present in the germplasm. Greater the genotypic variability better are the chances for improvement through selection. Most of the agronomically important characters including yield are polygenically controlled and one highly influenced by environmental factors. Since yield is complex characters dependent on several components (Grafius, 1964).

RESEARCH METHODS

The experiment was carried out during the winter season(off- season) of 2013-2014 at Vegetable Research Farm, Department of Horticulture, P.G. College Ghazipur (U.P.).

The materials for the present study comprised of twenty five germplasm of bottle gourd which were planted in Randomized Block Design and replicated thrice. Correlation co-efficients were calculated for all quantitative characters combinations at phenotypic and genotypic level by the formula given by Al Jibouri *et al.* (1958). The direct and indirect contribution of various characters to yield was calculated through path co-efficiant analysis as suggested by Wright, 1921 and elaborated by Dewey and Lu (1959).

RESEARCH FINDINGS AND DISCUSSION

Correlation analysis provides a good measure of the linear association between characters and helps to identify the most important characters to be considered

Table 1 : Estimates genotypic and phenotypic correlation co-efficients for yield and its contributing characters in bottle gourd

Characters	Number of days to germination	Node no.to first male flower emergence	Node no.to first female flower emergence	Days to first male flower anthesis	Days to first female flower anthesis	Days to first harvest	Vine length(m)	Average fruit weight(kg)	Number of fruit per plant	Average no. of seed per fruits	Edible fruit yield (q/ha.)
1	rg	0.0655	-0.2464	0.6235	0.5515	0.4009	0.1490	-o.1650	0.1748	-0.0876	0.2818
	rp	-0.0569	-0.2438*	0.6107**	0.5461**	0.3837**	0.1341	-0.1412	0.1657	-0.0824	0.2656*
2	rg		0.7913	-0.0724	0.0100	0.0178	-0.0454	0.2846	0.0619	0.3785	0.1853
	rp		0.7627**	-0.0719	0.0130	0.0192	-0.0473	0.2607*	0.0564	0.3426**	0.1817
3	rg			-0.1204	-0.1166	-0.0786	0.0673	0.3138	-0.0308	0.4229	0.0318
	rp			-0.1173	-0.1124	-0.0812	0.0727	0.2581*	-0.0280	0.4002**	0.0341
4	rg				0.8969	0.8157	0.4069	0.2690	-0.0484	-0.0825	0.3387
	rp				0.8798**	0.7752**	0.3993**	0.2337*	-0.0829	-0.0755	0.3309**
5	rg					0.9188	0.4133	0.1863	-0.0715	-0.0899	0.1994
	rp					0.8796**	0.3970**	0.1461	-0.0677	-0.0914	0.1921
6	rg						0.3864	0.1461	-0.2487	-0.2064	0.0531
	rp						0.3635**	0.1038	-0.2060	-0.1832	0.0492
7	rg							0.3954	-0.2083	0.0699	0.2845
	rp							0.3366**	-0.1852	0.0731	0.2767*
8	rg								-0.4145	0.4700	0.3567
	rp								-0.3247**	0.3624**	0.2983**
9	rg									0.0870	0.5740
	rp									0.0825	0.5360**
10	rg										0.4047
	rp										0.3854**

*and** indicate significance of values at P=0.05 and 0.01, respectively,
rp= Phenotypic correlation co-efficient, rg= Genotypic correlation co-efficients

for effective selection for increasing yield. In the present investigation correlations were worked out both at phenotypic and genotypic levels for all possible character combinations. In general genotypic correlations co-efficients were higher in magnitude than phenotypic correlations co-efficients (Chander *et al.*, 2000) in the same direction and magnitude indicated that there is a strong inherent association between each pair of characters which might be due to masking or modifying effect of the environment.

On the basis of analysis (Table 1) the edible fruit yield had highly significant and positive association with number of fruit per plant (rp=0.5360), average number of seed per fruit (rp=0.3854), days to first male flower anthesis (rp=0.3309) and average fruit weight (rp=0.2983), but was negatively correlated with average number of seed per fruits and number of fruit per plant whereas number of fruit per plant had negative and significant correlation with fruit yield per plant (rp=-0.3247). Number of days to germination exhibited a positive and significant association with days to first male flower anthesis (rp= 0.6107) followed by days to first female flower anthesis (rp=0.5461) and days to first harvest (rp=0.3837) whereas negative and significant correlation with node number to first female flower emergence (rp=-0.2438).

Node number to first male flower emergence exhibited a positive and significant association with node

Table 2 : Genotypic and phenotypic path analysis showing direct and indirect effect on fruit yield of bottle gourd

Characters		Number of days to germination	Node no. to first male flower emergence	Node no. to first female flower	Days to first male flower anthesis	Days to first female flower anthesis	Days to first harvest	Vine length(m)	Average fruit weight(kg)	Number of fruit per plant	Average no. of seed per fruits	Edible fruit yield (q/ha.)
Number of days to germination	G	0.1429	0.0094	-0.0352	0.0891	0.0788	0.0573	0.0213	-0.0236	0.0250	-0.0125	0.2818
	P	-0.0529	-0.0030	0.0129	-0.0323	-0.0289	-0.0203	-0.0071	0.0075	-0.0088	0.0044	0.2656
Node no.to first male flower emergence	G	-0.0196	0.2992	0.2368	-0.0217	0.0030	0.0053	-0.0136	0.0852	0.0185	0.1133	0.1853
	P	-0.0222	0.3893	0.2969	-0.0280	0.0051	0.0075	-0.0184	0.1015	0.0220	0.1334	0.1817
Node no to first female flower emergence	G	0.1103	-0.3542	-0.4477	0.0539	0.0522	0.0252	-0.0301	-0.1405	0.0138	-0.1893	0.0318
	P	0.1027	-0.3213	-0.4212	0.0494	0.0473	0.0342	-0.0306	-0.1087	0.0100	-0.1686	0.0341
Days to first male flower anthesis	G	0.3622	-0.0421	-0.0700	0.5809	0.5210	0.4738	0.2364	0.1562	-0.0493	-0.0479	0.3387
	P	0.4583	-0.0540	-0.0880	0.7505	0.6602	0.5817	0.2997	0.1754	-0.0622	-0.0566	0.3309
Days to first female flower anthesis	G	-0.6807	-0.0124	0.1439	-1.1071	-1.2343	-1.1341	-0.5107	-0.2300	0.0883	0.1109	0.1994
	P	-0.3128	-0.0074	0.0644	-0.5039	-0.5728	-0.5038	-0.2274	-0.0837	0.0388	0.0524	0.1921
Days to first harvest	G	0.2816	0.0125	-0.0552	0.5730	0.6455	0.7025	0.2714	0.1026	-0.1747	-0.1450	0.0531
	P	0.0018	0.0001	-0.0004	0.0036	0.0041	0.0046	0.0017	0.0005	-0.0009	-0.0008	0.0492
Vine length (m)	G	0.0376	-0.0115	0.0170	0.1027	0.1044	0.0975	0.2524	0.0998	-0.0526	0.0176	0.2845
	P	0.0380	-0.0134	0.0206	0.1132	0.1125	0.1030	0.2834	0.0952	-0.0525	0.0207	0.2767
Average fruit weight(kg)	G	-0.1001	0.1727	0.1905	0.1632	0.1131	0.0887	0.2400	0.6070	-0.2516	0.2853	0.3567
	P	-0.0312	0.0577	0.0571	0.0517	0.0323	0.0230	0.0743	0.2213	-0.0718	0.0802	0.2983
Number of fruit per plant	G	0.1643	0.0582	-0.0289	-0.0797	-0.0672	-0.3238	-0.1958	-0.3896	0.9400	0.0818	0.5740
	P	0.1059	0.0361	-0.0152	-0.0530	-0.4333	-0.1317	-0.1184	-0.2076	0.6393	0.0527	0.5360
Average no. of seed per fruits	G	-0.0167	0.0721	0.0806	-0.0157	-0.0171	-0.0393	0.0133	0.0896	0.0166	0.1906	0.4047
	P	-0.0220	0.0917	0.1071	-0.0202	-0.0245	-0.0490	0.0196	0.0970	0.9221	0.2677	0.3854

Genotypic residual effect=0.4784 , Phenotypic residual effect=0.1600

number to first female flower emergence (rp=0.7627), average fruit weight (rp=0.2607) and average number of seed per fruits (rp=0.3426). While node number to first female flower emergence showed positive and significant correlation with average fruit weight (rp =0.2581) and average number of seed per fruit (rp=0.4002) whereas negatively and non-significant correlated with days to first male flower anthesis (rp =-0.1173), days to first female flower anthesis (rp =-0.1124), days to first harvest (0.0812) and number of fruit per plant (rp=-0.028). Similar finding given by Singh *et al.* (2011) and Islam *et al.* (2009). Days to first male flower anthesis showed significant and positive correlation with days to first female flower anthesis (rp=0.8798), days to first harvest (rp=0.7752), vine length (rp= 0.3993) and average fruit weight (rp=0.2337), while days to first female flower anthesis exhibited a positive and significant association with days to first harvest (rp=0.8796) and vine length (rp=0.3970). Similar observations were also reported by Rahman *et al.* (2010).

Vine length showed positive and significant correlation with average fruit weight (rp=0.3360) and negatively associated with number of fruit per plant (rp= -0.1852), While average fruit weight showed positive and significant correlation with average number of seed per fruit(rp=0.2624) and yield per plant (rp=0.2983) where as negatively and significant correlation with number of plant (rp=-0.3247). Number of fruit per plant exhibited positive and significant association with fruit yield per plant (rp=0.5360) whereas average number of seed per fruits showed positive and significant association with edible fruit yield (rp=0.3854). Similar finding was given by Narayan *et al*. (1996); Singh *et al*. (1996); Kumar *et al.* (2011) and Bahve *et al*.(2003).

Path co-efficient analysis is simply a standardized partial regression co-efficient which split the correlation co-efficient into the measures of direct and indirect effect. In other words it measures the direct and indirect contribution of various independent character on a dependent character. The results of path co-efficient studies on the phenotypic data basis showing direct and indirect effects on yield and its component using fruit yield as dependent variable have been given in Table 2.

Path co-efficient analysis of different traits contributing towards edible fruit yield showed that days to first male flower anthesis (0.7505) had the highest positive direct effect followed by number of fruit per plant (0.6393), node number to first male flower emergence (0.3893), vine length (0.2834)and average number of seed per fruit (0.2677). Similar observation were also reported by Prasad (1985) and Narayan *et al.* (1996).

Number of fruit per plant (0.9221), days to first female flower anthesis (0.6602), days to first harvest (0.5817), days to germination (0.4583) and vine length (0.2997) showed considerable positive indirect effect on fruit yield per plant *viz.*, number of fruit per plant residual effect was (0.1600). Similar observations were also reported by Tikka *et al.*(1974); Grebensickov (1979); Dora *et al*. (2002) and Sharma and Bhutani (2001).

The path co-efficient anthesis estiruated at genotypic level is presented in Table 2 number of fruit per plant (0.9400), days to first harvest (0.7025), average fruit weight (0.6070), days to first male flower anthesis (0.5809) and node number to first male flower emergence (0.2992) exerted high order positive direct effect on edible fruit yield per plant .

Days to first female flower anthesis (0.6455), days to first male flower anthesis (0.5730), days to first harvest (0.4738), days to germination (0.3622), average number of seed per fruits (0.2853), vine length (0.2714) and node number to first female flower emergence (0.2368) indicated substantial indirect positive contribution on fruit yield *viz.*, number of fruit per plant where as days to first female flower anthesis (-1.234) and node number to first female flower emergence (-0.4477) had made considerable direct negative contribution on fruit yields while days to germination (-0.6807), node number to first male flower emergence (-0.3542), vine length (-0.5107), average fruits weight (0.3896) had made considerable indirect negative contribution on fruit yield per plant *viz.*, number of fruit per plant. The contribution residual factors towards variation in fruit per plant was (0.4784). Similar observation were also reported by Kumar *et al.* (2011) and Rajput *et al*. (1995).

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