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INFLUENCE OF PLANT CHARACTERS ON YIELD IN BLACK PEPPER *(PIPER NIGRUM* L.)

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Abstract: Data on 580 genotypes of black pepper were utilised to estimate the correlations among yield and 20 quantitative characters. The results revealed that the reproductive characters viz., green spike yield per vine, green berry yield per vine, number of spikes per vine and number of under-developed berries per spike as well as the vegetative characters, thickness of node and internode of orthotrope and angle of insertion of plageotrope are positively and significantly correlated with yield. The inter-correlations among these characters were also positive and significant. Path analysis revealed positive direct effect on yield by the characters green berry yield, spike number, spike length and angle of insertion of plageotrope. The effect of the remaining characters on yield were due to their indirect influence through other component characters.

Key words: Black pepper, path coefficient analysis, *Piper nigrum* L., reproductive characters, vegetative characters.

INTRODUCTION

Yield is a complex quantitative character which is influenced by a number of other plant characters. These component characters of yield are correlated with yield and they are inter-correlated among themselves. Due to this intercorrelation, selection exercised in favour of any particular component character, with the aim of increasing the yield, will affect the other component characters. Therefore estimations of correlation between yield and these component characters are, essential for effective selection programme.

When more than two component characters are simultaneously considered in such a selection programme, the partitioning of the cause and effect relationship among these characters also gain importance. This is done by path coefficient analysis.

MATERIALS AND METHODS

The data utilised for this study were generated from 492 open pollinated progenies of 35 cultivars/cultures and 45 hybrids belonging to eight different itervarietal combinations of crosses along with their parents planted during 1982-83 at the Pepper Research Station, Panniyur, all receiving uniform management practices. Observations were recorded on yield and 11 vegetative and 9 reproductive characters influencing yield.

Simple correlation between yield and the various vegetative and reproductive characters were calculated as per Falconer (1981). Path coefficient analysis as suggested by Wright (1921) and elaborated by Dewey and Lu (1959) was utilised to partition the cause and effect relationship among the characters. Fourteen characters showing maximum correlation with dry berry yield per vine were subjected to path coefficient analysis.

RESULTS AND DISCUSSION

The investigations revealed that six out of nine reproductive characters and three out of eleven vegetative characters showed positive and highly significant correlation with yield

Reproductive characters

Out of these, the highest correlation was exhibited by green berry yield per vine (Table 1) closely followed by green spike yield per vine and spike number. Green spike yield per vine is also highly correlated with green berry yield per vine, spike number, spike length, number of developed berries per spike, number

Table 1. Intercorrelation matrix of dry berry yield per vine and important plant characters

Character	GB yield/ vine	Spike number	Spike length	DB per spike	UDB per spike	Thickness, internode orthotrope	Thickness, node orthotrope	Angle of insertion of plageotrope	Dry berry yield
GS yield	0.998 **	0.938 **	0.317 **	0.330 **	0.234 *	0.377 **	0.332 **	0.220 *	0.990 **
GB yield		0.931 **	0.309 **	0.331 **	0.239 *	0.386 **	0.331 **	0.226 *	0.991 **
Spike number			0.227 *	0.213 *	0.183	0.326 **	0.290 **	0.192	0.937 **
Spike length				0.493 **	0.278 **	0.301 **	0.273 **	0.030	0.305 **
Number of developed berries per spike					0.254 *	0.137	0.162	0.101	0.335 **
Number of UDB per spike						0.115	0.107	0.084	0.218 *
Thickness of inter-node orthotrope							0.749 *	0.205 it	0.366 **
Thickness of node orthotrope								0.146	0.310 **
Angle of insertion of plageotrope									0.226 *

* Significant at 5% level; ** Significant at 1% level; GS - Green spike; GB - Green berry; DB = Developed berry; UDB - Under-developed berry

of under-developed berries per spike, thickness of node and internode of orthotrope and angle of insertion of plageotrope. Green berry yield per vine also showed highly significant correlation with the above characters. Positive and highly significant correlation was found between the pairs of characters viz., spike length and number of developed berries per spike, spike length and number of under-developed berries per spike. This is because, as the length of spike increases, the total number of berries also increases. Ibrahim, *et al.* (1985a) also reported positive and significant relationship between yield and spike number, spike length and number of developed berries per spike.

Path coefficient analysis revealed that the maximum contribution to yield is through green berry yield per vine since it has a high and positive direct effect (Table 3). Green spike yield per vine had a negative direct effect but its high correlation with yield is due to the high indirect effect through green berry yield per vine. Spike yield refers to the total weight of berries and stalk After the separation of the berries, the stalks are discarded. Hence its weight does not contribute to the actual yield. This is the reason for the negative direct effect and high positive indirect effect through berry yield. A similar result was observed between dry weight of haulm and pod yield in groundnut by Kuriakose and Joseph (1986).

Number of spikes per vine had positive direct effect as well as high indirect effect through

Table 2. Direct and indirect effects of component characters on yield

Characters	X1	X2	X3	X4	X5	X6	X7	X8
X1	*-0.078*	0.079	-0.007	0.054	-0.002	0.001	-0.001	0.005
X2	-0.076	*0.081*	-0.007	0.053	-0.001	0.001	-0.001	0.004
X3	-0.004	0.004	*-0.158*	1.028	0.120	0.002	0.008	-0.005
X4	-0.004	0.004	-0.157	*1.029*	0.119	0.002	0.008	-0.005
X5	0.001	-0.001	-0.148	0.958	*0.128*	0.002	0.005	-0.004
X6	-0.006	0.006	-0.050	0.318	0.029	*0.008*	0.012	-0.006
X7	0.004	-0.005	-0.052	0.341	0.027	0.004	0.025	-0.005
X8	0.017	-0.017	-0.037	0.246	0.023	0.002	0.006	*-0.021*
X9	-0.019	0.018	-0.007	0.047	-0.002	0.003	0.003	-0.001
X10	-0.008	0.010	-0.008	0.051	0.005	0.001	0.000	0.000
X11	-0.005	0.005	-0.059	0.397	0.042	0.002	0.003	-0.002
X12	-0.002	0.003	-0.052	0.341	0.037	0.002	0.004	-0.002
X13	-0.017	0.017	-0.026	0.170	0.016	0.002	0.002	-0.001
X14	0.005	-0.005	-0.035	0.233	0.025	0.000	0.002	-0.002

Table 2 continued

Characters	X9	X10	X11	X12	X13	X14	r (with yield)
X1	-0.002	-0.000	-0.000	-0.000	0.001	-0.000	0.048
X2	-0.001	-0.000	-0.000	-0.001	0.001	-0.000	0.051
X3	-0.000	-0.000	-0.002	-0.005	0.001	0.001	0.990
X4	-0.000	-0.000	-0.002	-0.005	0.001	0.001	0.991
X5	0.000	-0.000	-0.002	-0.004	0.001	0.001	0.937
X6	-0.002	-0.000	-0.002	-0.004	0.001	0.000	0.305
X7	-0.001	0.000	-0.001	-0.002	0.000	0.001	0,335
X8	-0.000	-0.000	-0.001	-0.002	0.000	0.001	0.218
X9	-0.007	-0.000	-0.001	-0.003	0.002	-0.000	0.033
X10	-0.001	*-0.001*	-0.000	-0.001	0.000	-0.000	0.050
X11	-0.001	-0.000	*-0.006*	-0.001	0.000	0.001	0.366
X12	-0.001	-0.000	-0.004	-0.005	0.000	0.001	0.310
X13	-0.002	-0.000	-0.000	-0.001	0.005	0.000	0.165
X14	0.000	-0.000	-0.001	-0.002	0.000	0.007	0.226

Residual effect - 0.119

X1 Volume of 100 green berries; X2 Weight of 100 green berries; X3 Green spike yield; X4 Green berry yield per vine; X5 No of spike per vine; X6 Spike length; X7 No of developed berries; X8 No of under-developed berries per spike; X9 Length of leaf; X10 Length of internode, orthotrope; X11 Thickness of internode, orthotrope; X12 Thickness of node, orthotrope; X13 Length of internode, plageotrope; X14 Angle of plageotrope with oithotrope

green berry yield per vine. Spike length had a small direct effect but its significant correlation with yield was due to its high indirect effect through green berry yield. This is due to

the fact that it is the number of hermaphrodite flowers per spike and not the length of the spike itself that determines the production of berries. Ibrahim *el al.* (1985b) also reported a high direct effect of spike number and low direct effect of spike length on yield.

The significant positive correlation of number of under-developed berries per spike with yield was due to its highly significant inter-correlation with spike length (Table 1). It is also significantly correlated with green spike yield, green berry yield and number of developed berries per spike. This result suggests that a portion of the yield is contributed by under-developed berries also. But path analysis reveals a negative and small direct effect. Thus the significant positive correlation of under-developed berries with yield is due to its high indirect effect through green berry yield per vine (Table 2).

Vegetative characters

Among the vegetative characters, positive and significant correlation with yield was observed for the characters thickness of node of orthotrope, thickness 6f internode of orthotrope and angle of insertion of plageotrope. The inter correlation between thickness of node and green spike yield per vine, green berry yield per vine, spike number and spike length were also positive and highly significant. The thickness of internode also showed high inter-correlations with these reproductive characters. The inter-correlation between these two vegetative characters was also significant. Path analysis revealed that, the direct effects of these two stem characters are negative and small but the high and positive indirect effects through their influence on green berry yield per vine is the reason for high correlation with yield. This result suggests that the thickness of main stem of pepper vine influences the yield. The thickness of orthotrope increases as the vine matures (Chandy and Pillai' 1979). The anatomical studies of Pal (1981) showed the presence of cambium in the stem and this thickening was due to the cambial activity which occurred as the vine aged. A pepper vine starts yielding around fifth year of planting (George and Mercy, 1978) and yield increases and stabilises as the vine matures.

The inter-correlation of angle of insertion of plageotrope with green spike yield per vine, green berry yield per vine and thickness of internode of orthotrope was found significant. In path analysis also the direct effect was found positive though small and it had a positive significant indirect effect through green berry yield per vine (Table 2). The significant positive correlations of angle of insertion of plageotrope with yield is due to the fact that as the angle increases, the plageotropes will be more or less horizontal and this will enable the vine to hold most of the leaves on these fruiting branches directly against sun light thus increasing photosynthetic efficiency and yield. Chandy and Pillai (1979) observed that the drooping, horizontal or erect nature of the plageotropes determined the photosynthetic efficiency of the plant. Chandy *el al.* (1984) also reported the indirect influence on productivity by certain leaf and stem characters which determined the effectiveness of light interception.

Out of the remaining three reproductive characters, two, viz., volume of 100 green berries and weight of 100 green berries showed non-significant but positive correlation with yield and the weight of 100 dry berries showed a negative and non-significant correlation with yield. Among the rest of the vegetative characters studied, length of leaf, length of internode of orthotrope, length of internode of plageotrope and thickness of node of plageotrope showed nonsignificant and positive correlation with yield while the length of petiole, breadth of leaf, area of leaf and thickness of internode of plageotrope showed nonsignificant and negative correlation with yield.

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