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Correlation and path analysis in turmeric (*Curcuma longa* L.)

B Panja, D K De[1], S Basak[1] & S B Chattapadhyay[2]

Bidhan Chandra Krishi Viswavidyalaya
Regional Research Station, Akshaynagar
Kakdwip-743347, West Bengal, India.

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Abstract

Studies on nineteen characters of eight turmeric (*Cuucuma longa* L.) genotypes revealed that plant height, leaf number, number of primary fingers, number and weight of secondary fingers had positive genotypic correlation while length of primary fingers, internode length and ratio of outer and inner core of primary fingers had significant negative association with rhizome yield. The number and weight of secondary rhizomes exhibited higher positive correlation with yield than other characters. Path analysis indicated higher direct positive effect of weight of primary and mother rhizomes but insignificant correlation with rhizome yield due to higher indirect negative effect of some of the component characters. On the contrary, the number of primary fingers had the highest direct negative effect on rhizome yield, but significantly positive correlation with it, apparently due to high positive indirect effect via weight of primary and mother rhizomes and number of secondary rhizomes. The importance of plant height, leaf number, number of primary fingers, number and weight of secondary fingers as criteria for selection of better turmeric genotypes has been indicated.

Key words: correlation, *Curcuma longa*, path analysis, turmeric genotypes.

Improving rhizome yield, a complex character, governed by or the result of interaction of many variables, is very difficult by selecting the genotypes for yield *per se*. Therefore, selection for desirable type should not be restricted to yield alone but other yield contributing characters should also be considered. Correlation and path co-efficient analysis are the two important biometrical techniques to measure the degree of association between two traits and the extent of contribution of each character to rhizome yield, respectively. While correlation co-efficient does not indicate the relative contribution of each variable, path analysis splits the correlation co-efficient into direct and indirect effects so as to measure the relative contribution of each variable towards rhizome yield. Hence, the present investigation was carried out to gather information on closely related characters and to identify the main yield contributing characters to be considered for selecting a better genotype.

Eight diverse genotypes of turmeric (*Curcuma longa* L.) viz. TCP-1, TCP-2, TCP-4, TCP-5, TCP-7, TCP-8, TCP-10 and BSR-1 were evaluated for yield in randomized block design with three replications during 1998-99 at Pundibari Research Farm of North Bengal Campus, Bidhan Chandra Krishi Viswavidyalaya, Coochbehar, West Bengal. The size of the experimental plot and spac-

[1] Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar 736165, West Bengal.
[2] Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal.

ing between plots, rows and plants were 3 m x 1 m, 70 cm, 30 cm and 20 cm, respectively. In each plot forty five pieces of seed rhizomes weighing 20 g each were sown in three rows during the first week of May. Plots were fertilized as per recommendations and mulched properly with wheat straw after sowing. Intercultural operations were done according to requirement. Data from nine randomly selected plants from each plot were recorded with respect to plant height, tillers plant^{-1}, leaf number, leaf length and leaf breadth at 180 days age of the crop i.e. just before the start of senescence. Data on weight, length and breadth of mother rhizome; number, weight, length and breadth of primaries and secondaries along with internodal length, ratio of outer and inner rhizome core of primary fingers and rhizome yield per plant were collected from the same nine plants. Statistical analyses with respect to correlation co-efficient were done using the method given by Singh & Chaudhary (1995) and path co-efficient by Dewey & Lu (1959).

Among the nineteen characters studied, the genotypic correlation of five characters viz. plant height (0.47), number of leaves (0.45), number of primary fingers (0.48), number (0.96) and weight (0.60) of secondary fingers showed significant positive association with rhizome yield. The significant correlation of number of primary fingers with their weight (0.78) and rhizome yield (0.48) also seems obvious. But insignificant correlation between weight of primary fingers and yield might be due to negative correlation between weight and length of primary fingers and also between length of primary fingers and yield. Number of secondary fingers also showed significant positive correlation with weight of secondary fingers (0.45), number of primary fingers (0.63), leaf number (0.65) and plant height (0.57). Weight of secondary fingers on the other hand exhibited positive correlation with number (0.45), length (0.63) and breadth (0.51) of secondary fingers. Number of secondary fingers had significant negative correlation with length and breadth of primary fingers. The results indicated that the number of secondary fingers that exhibited highest positive correlation with yield was highly dependent upon number of primary fingers on which secondary fingers are borne rather than length and breadth of primary fingers. Weight of secondary fingers had very high and significant correlation with yield and it has significant positive correlation with its length and breadth. Length of secondary fingers was in turn dependent upon length of primary fingers. As secondary fingers are borne on the primary fingers, dependence of the weight of secondary fingers on the length of primary fingers seems quite predictable. Thus consistently strong correlation of some of the above mentioned characters with number of secondary rhizomes could be a good predictor of rhizome yield. Unlike the weight of secondary fingers, the number of primary and secondary rhizomes, plant height and leaf number, being easily observable characters at the field level, could be relied upon for indirect selection of genotypes for rhizome yield. Significant positive correlations of rhizome yield with leaf number (Hazra *et al.* 2000), plant height and number of fingers (Nambiar 1979) have earlier been observed in turmeric.

Rhizome yield per plant exhibited significantly higher negative correlation with ratio of outer and inner rhizome core followed by length of primary fingers and internodal length. These parameters could be ignored while selecting the turmeric genotypes for yield.

Path analysis of yield and its component characters (Table 1) revealed that the weight of primary fingers had the highest direct positive effect on rhizome yield followed by weight of mother rhizome. Similar results have been reported by Singh & Tiwari (1995). But the two characters showed insignificant correlation with rhizome yield possibly due to negative indirect effects of number of primary finger, length of mother rhizome and weight of secondary rhizomes. On the contrary, the number of primary fingers had the highest direct negative effect followed by the length of mother rhizome and tillers per plant; yet the former character exhibited significant positive correlation with yield, possibly due to high positive indirect effect of the number of primary finger via weight of primary finger,

Table 1. Direct and indirect genotypic effects of different yield contributing characters on rhizome yield of turmeric

Parameter	Tillers plant^{-1}	Plant height	Leaf No.	Leaf length	Leaf breadth	Wt. of mother rhizome	Length of mother rhizome	Breadth of mother rhizome	No. of primary fingers	Wt. of primary fingers	Length of primary fingers	Breadth of primary fingers	No. of secondary fingers	Wt. of secondary fingers	Length of secondary fingers	Breadth of secondary fingers	Inter-nodal length	Ratio of outer & inner core of primary finger	Rhizome yield plant^{-1}
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Tiller plant^{-1} (1)	-.42	-.01	.22	-.24	-.06	-.17	.11	.02	-.21	.27	.14	-.01	.38	.09	-.02	-.07	.09	.06	.20
Plant height (2)	.02	.09	.11	.24	-.30	-.03	.06	-.05	-.74	.56	.01	-.01	.57	.02	-.03	-.12	-.04	.10	.47*
Leaf No. (3)	-.37	.04	.26	-.22	-.19	-.06	.04	-.01	-.43	.48	.17	-.01	.65	.12	-.06	-.12	.05	.13	.45*
Leaf length (4)	.21	.04	-.12	.48	-.13	.19	-.04	-.07	-.23	-.03	-.12	.00	-.03	-.08	.01	-.02	-.04	.00	.04
Leaf breadth (5)	-.06	.07	.13	.17	-.36	.62	-.36	-.11	-.77	1.21	.04	-.01	.30	-.23	-.14	-.12	-.01	-.05	.31
Wt. of mother rhizome (6)	.05	.00	-.01	.07	-.17	1.29	-.74	-.15	-.61	1.25	.09	.01	-.11	-.51	-.23	-.08	.01	-.09	.08
Length of mother rhizome (7)	.07	-.01	-.01	.02	-.18	1.31	-.73	-.14	-.60	1.37	.09	.01	-.08	-.44	-.26	-.06	.03	-.12	.28
Breadth of mother rhizome (8)	.05	.03	.02	.20	-.24	1.16	-.62	-.17	-.79	1.05	.07	.00	.18	-.36	-.19	-.11	.03	-.04	.28
No. of primary fingers (9)	-.07	.05	.09	.09	-.23	.63	-.35	-.11	-1.25	1.37	.14	-.01	.63	-.28	-.13	-.18	.01	.07	.48*
Wt. of primary fingers (10)	-.07	.03	.07	-.01	-.25	.91	-.56	-.10	-.97	1.76	.13	.00	.16	-.50	-.21	-.14	-.01	-.08	.18
Length of primary fingers (11)	.29	-.01	-.21	.27	.07	-.56	.32	.06	.85	-1.11	-.21	.01	-.58	.19	.15	.14	-.06	-.14	-.52*
Breadth of primary fingers (12)	.20	-.05	-.15	-.05	.11	.43	-.36	-.02	.66	-.28	-.09	.02	-.55	.04	-.05	.15	.01	-.15	-.11
No. of secondary fingers (13)	-.16	.05	.17	-.01	-.11	-.14	.06	-.03	-.79	.29	.12	-.01	1.00	.35	-.01	-.10	.07	.23	.96**
Wt. of secondary fingers (14)	-.05	.00	.04	-.05	.11	-.86	.42	.08	.46	-1.16	-.05	.00	.45	.76	.16	.10	.07	.14	.60**
Length of secondary fingers (15)	.03	-.01	-.07	.03	.20	-1.21	.75	.12	.66	-1.51	-.12	.00	-.02	.48	.25	.10	.00	.03	-.30
Breadth of secondary fingers (16)	.15	-.05	-.16	-.06	.23	-.54	.23	.09	1.14	-1.24	-.15	.02	-.53	.39	.12	.19	.01	-.11	-.28
Internodal length (17)	.27	.02	-.09	.14	-.03	-.13	.14	.04	.11	.14	-.09	.00	-.46	-.36	.01	-.01	-.14	-.06	-.51*
Ratio of outer & inner core of primary finger (18)	.08	-.03	-.11	-.01	-.06	.39	-.28	-.02	.27	.46	-.09	.01	-.74	-.34	-.03	.07	-.03	-.30	-.75**

* & ** Significant at P=0.05 and P= 0.01 level, respectively. Diagonal and off diagonal indicate direct and indirect effects, respectively. Residual effect = 0.001

weight of mother rhizome and number of secondary rhizomes. In turmeric, the primary fingers are borne on the mother rhizome which if increases in length and breadth would provide space for more number of primaries resulting in significant correlation as observed between these two constellation of characters.

Substantially high and significant correlation as well as high direct positive effect of number and weight of secondary rhizomes indicated that they could be good indicators for selecting high yielding turmeric lines. The importance of the weight of secondary rhizomes as daughter rhizome in selecting high yielding turmeric genotypes had been emphasized by Nandi *et al.* (1994) and Singh & Tiwari (1995). Though the direct effects of plant height and leaf number were poor and positive, they exhibited significant positive correlation with rhizome yield and it could be attributed to higher indirect positive contribution of the weight of primary fingers and number of secondary fingers. Plant height and leaf number had also significant positive correlation with number of primary and secondary fingers. Importance of the leaves per clump as direct contributor to rhizome yield has been reported by Hazra *et al.* (2000) and indirect positive effects of the number and weight of secondary rhizomes on rhizome yield per plant indicated as the principal yield contributing characters. Since plant height, leaf number and number of primary fingers can be easily measured at field level, the significance of their indirect effects on rhizome yield need to be given emphasis. The contribution of plant height and number of fingers on rhizome yield, either as direct or indirect effect, has earlier been indicated by Nambiar (1979). The effect of residual factor (0.001) on yield was almost nil, thereby suggesting that no other yield component was left over in the present study to be considered. It has been pointed out that whenever significant positive correlations between yield and morphological characters were established, it was mainly due to substantial positive contribution by plant height and number of fingers either directly or indirectly. The present study clearly indicated the importance of plant height, leaf number, number of primary fingers, number and weight of secondary fingers as criteria for selection of better turmeric genotypes.

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