# Genetic variability, character association and path analysis for yield components in ginger (*Zingiber officinale* Rosc.)

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ABSTRACT

Twentynine collections of ginger *(Zingiber officinale)* were studied for variability, character association and path analysis for yield and its 10 component characters. Wide range of variability was observed for most of the characters studied. Rhizome yield per plant was positively associated with plant height, number of fingers per plant ,weight of fingers and weight of primary rhizome. Plant analysis revealed that weight of fingers, width of fingers and leaf width were the strongest forces influencing yield.

Key words: character association, genetic variability, ginger, path analysis, *Zingiber officinale*.

## Introduction

Knowledge of various character associations provided the basis of selection for yield and its components in crop improvement programmes. Since yield is a complex quantitative trait, simple character associations do not furnish precise estimate of cause effect relationship of various traits determining yield. Path coefficient analysis is a useful tool to understand direct and indirect effects of various characters influencing yield. Although several reports are available on phenotypic variability in ginger (Muralidharan & Sakunthala 1974; Nybe & Nair 1981), very little work has been done on correlation and path analysis in this crop. The present investigation is an attempt to find our the associations among characters and to identify the strongest characters afecting yield in ginger.

## Materials and methods

Twentynine collections of ginger collected from Assam, Meghalaya, Tripura and Nagaland were grown during *kharif* of 1991 following a Randomised Block Design with two replications. The plot size was 1.35 m x 1.5 m consisting of three rows of five plants each spaced 45 cm x 30 cm apart. Recommended package of

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practices were followed to raise the crop. Observations on five randomly selected plants were recorded for the characters as listed in Table 1. The mean values of five plants were used for statistical analysis. Correlations were worked out following the method of Panse & Sukhatme (1978) and path analysis was calculated as suggested by Dewey & Lu (1959).

## Results and discussion

The analysis of variance revealed highly significant differences among collections studied for all the characters except for finger length and width. The collection H-85 (203.2 g) followed by NH 6/4 (175.6 g) and MNCH/56 (174.3 g) were the high yielders and also exhibited higher mean values for weight of fingers and primary rhizome. The genotypes BD-16 (34.7 cm) and DKH-34 (33.1 cm) were taller while the genotypes DKH-28 (7.10) and TURA (7.95) exhibited higher number of suckers/plant.

The genetic variability parameters for the characters (Table1) revealed that phenotypic coefficient of variability (PCV) was in higher magnitude than the corresponding genotypic coefficient of variability (GCV) for all the characters. Higher magnitude of PCV and GCV was observed for plant height, number of suckers and fingers, weight of primary rhizome and yield per plant indicating presence of wide range of variability for these traits. Lowest values for leaf length, leaf width, number of leaves and length of fingers suggested rather limited variability and need to generate more variability for wider spectrum of selection. Medium heritability (broad sense) was observed for number of suckers and leaves, weight of fingers and primary rhizome and yield per plant suggesting that selection would be more effective for these traits. This selection would be more meaningful if genetic advance (G A) is also taken into consideration simultaneously. High heritability coupled with high GA was

**Table 1. Estimates of genetic constants for 11 characters in 29 lines of ginger**

| Character | Range | | Mean | PCV (%) | GCV (%) | $h^2$ | GA (% of $\bar{x}$) |
|---|---|---|---|---|---|---|---|
| | Min. | Max. | | | | | |
| Plant height (cm) | 14.25 | 34.70 | 25.09 | 22.85 | 11.94 | 27.28 | 12.85 |
| Suckers / plant | 2.25 | 7.95 | 3.99 | 41.16 | 26.76 | 42.26 | 35.84 |
| Leaves / plant | 9.25 | 16.60 | 12.59 | 16.31 | 10.18 | 39.15 | 13.15 |
| Leaf length (cm) | 13.60 | 22.65 | 18.15 | 15.67 | 8.11 | 26.80 | 8.65 |
| Leaf width (cm) | 2.02 | 3.25 | 2.54 | 15.95 | 7.37 | 21.30 | 6.97 |
| Fingers / plant | 1.10 | 4.40 | 2.58 | 40.52 | 22.08 | 29.70 | 24.75 |
| Finger length (cm) | 3.70 | 5.80 | 4.52 | 14.54 | 5.64 | 15.05 | 4.49 |
| Finger width (cm) | 1.76 | 3.33 | 2.23 | 27.04 | 8.26 | 9.34 | 5.20 |
| Finger weight (g) | 59.00 | 186.00 | 122.65 | 31.25 | 18.32 | 34.37 | 22.08 |
| Wt. of primary rhizome (g) | 5.95 | 17.20 | 11.04 | 33.23 | 20.44 | 37.83 | 25.87 |
| Yield / plant (g) | 67.60 | 203.20 | 130.23 | 29.68 | 18.74 | 39.89 | 24.33 |

PCV : Phenotypic coefficient of variability
GCV : Genotypic coefficient of variability
GA : Genetic advance

**Table 2. Estimates of simple correlation coefficients among 11 characters in 29 lines of ginger**

| Character | Plant height (cm) | Suckers/ plant | Leaves/ plant | Leaf length (cm) | Leaf width (cm) | Fingers/ plant (cm) | Finger length (cm) | Finger width (cm) | Finger weight (g) | Wt. of primary rhizome (g) |
|---|---|---|---|---|---|---|---|---|---|---|
| Plant height (cm) | 1.000 | | | | | | | | | |
| Suckers/plant | -0.029 | 1.000 | | | | | | | | |
| Leaves/plant | 0.643** | 0.103 | 1.000 | | | | | | | |
| Leaf length (cm) | 0.817** | 0.148 | 0.378* | 1.000 | | | | | | |
| Leaf width (cm) | 0.448** | 0.051 | 0.622** | 0.274 | 1.000 | | | | | |
| Fingers/plant | 0.580** | 0.450** | 0.533** | 0.321 | 0.342 | 1.000 | | | | |
| Finger length (cm) | 0.276 | 0.306 | 0.252 | 0.083 | 0.231 | 0.494** | 1.000 | | | |
| Finger width (cm) | 0.296 | 0.223 | 0.167 | 0.315 | -0.111 | 0.308 | 0.242 | 1.000 | | |
| Finger weight (g) | 0.379** | 0.341 | 0.112 | 0.155 | 0.049 | 0.354 | 0.230 | 0.380* | 1.000 | |
| Wt. of primary rhizome (g) | 0.610** | 0.025 | 0.396* | 0.388* | 0.352 | 0.241 | 0.353 | 0.313 | 0.479** | 1.000 |
| Yield/plant (g) | 0.460** | 0.191 | 0.196 | 0.255 | 0.130 | 0.410** | 0.250 | 0.428** | 0.920** | 0.499** |

*, ** : P = 0.05, P = 0.01, respectively

**Table 3. Path analysis for yield components showing direct and indirect effects in ginger**

| Character | Plant height (cm) | Suckers/ plant | Leaves/ plant | Leaf length (cm) | Leaf width (cm) | Fingers/ plant | Finger length (cm) | Finger width (cm) | Finger weight (g) | Wt.of primary rhizome(g) | TC with yield/ plant(g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Plant height(cm) | *-0.120* | 0.006 | 0.014 | 0.058 | 0.034 | 0.087 | 0.004 | 0.028 | 0.356 | -0.011 | 0.460** |
| Suckers/plant | 0.007 | *-0.224* | 0.002 | -0.011 | 0.004 | 0.068 | 0.004 | 0.021 | 0.320 | 0.000 | 0.191 |
| Leaves/plant | -0.154 | -0.023 | *0.021* | 0.027 | 0.047 | 0.080 | 0.003 | 0.016 | 0.105 | -0.007 | 0.196 |
| Leaf length(cm) | -0.196 | 0.033 | 0.008 | *0.071* | 0.021 | 0.048 | 0.001 | 0.029 | 0.146 | -0.007 | 0.255 |
| Leaf width(cm) | -0.108 | 0.011 | 0.030 | 0.019 | *0.076* | 0.051 | 0.003 | -0.010 | 0.046 | -0.006 | 0.130 |
| Fingers/plant | -0.139 | -0.101 | 0.011 | 0.023 | 0.026 | *0.150* | 0.006 | 0.029 | 0.332 | 0.004 | 0.410* |
| Finger length (cm) | -0.066 | -0.069 | 0.005 | 0.006 | 0.018 | 0.074 | *0.013* | 0.023 | 0.216 | -0.006 | 0.250 |
| Finger width (cm) | -0.071 | -0.050 | 0.004 | 0.022 | 0.008 | 0.046 | 0.003 | *0.093* | 0.357 | -0.006 | 0.428* |
| Finger weight (g) | -0.091 | -0.076 | 0.002 | 0.011 | 0.004 | 0.053 | 0.003 | 0.035 | *0.989* | -0.009 | 0.920** |
| Wt. of primary rhizome (g) | -0.146 | 0.006 | 0.008 | 0.028 | 0.027 | 0.036 | 0.005 | 0.029 | 0.450 | *-0.018* | 0.499** |

Residual effect = 0.246
TC : Total correlation
*Figures in italics denote direct effect*

observed for suckers per plant, weight of fingers and primary rhizome and yield per plant indicating that desirable improvement in these traits can be brought about through straight selection. High heritability coupled with high genetic advance for yield per plant was also reported by Maity, Sengupta & Som (1989).

The estimates of simple correlation coefficients (Table 2) revealed that plant height, number of fingers and yield per plant were signigicantly and positively associated with each other as also with most of the remaining traits. Highest significant and positive correlation was observed between yield per plant and finger weight followed by plant height and leaf length. To understand the cause and effect relationship, the correlations were further partitioned into indirect and indirect effects towards yield per plant.

Path coefficient analysis (Table 3) for yield per plant as dependent variable revealed that weight of fingers had the largest direct effect (0.989) on yield followed by number of fingers (0.150), width of fingers (0.093) and leaf width (0.076). These characters could thus be utilised by breeders as selection criteria to isolate higher yielding lines. In general, the indirect effect via weight of fingers was also high and positive suggesting that this character is most important influencing yield. Significant correlation with yield was recorded in case of weight of fingers because the characters plant height, number of suckers and weight of primary rhizome were hindering indirectly towards contributing more yield. However, caution must be exercised during selection against maximum plant height, number of suckers and weight of primary rhizome as these may offset the gain. Thus there is need to determine optimum number in these cases beyond which adverse effect would occur. Plant height, number of suckers and weight of primary rhizome exhibited negative direct effects on yield although the correlations were positive and significant. On the basis of these observations, it can be concluded that characters like weight of fingers, width of fingers and leaf width are the strongest forces influencing yield per plant in ginger.

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