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# Correlation and Path Coefficient Analysis in Groundnut Genotypes (*Arachis Hypogaea* L.)

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**ABSTRACT**

Simple correlation coefficients are used to find out the degree and direction of relationship between two or more variables are worked out for yield components and qualitative characters in fifty genotypes. The highly significant positive correlation were observed between kernel yield per plant and number of filled pods per plant, total pods per plant, pod yield per plant, harvest index per cent, 100 kernel weight, shelling per cent and SCMR at 60 DAS. Results of path analysis revealed haulm yield per plant, shelling per cent, harvest index per cent and 100 kernel weight were the major contributors of kernel yield by way of their positive and high direct effect. Hence there is much scope for selecting high yielding genotypes if selection pressure is exerted on above traits.

Key words: *Correlation, Groundnut, Path coefficient analysis.*

Groundnut (*Arachis hypogaea* L.) is an important oil and protein producing legume crop and belongs to family *Fabaceae*. India is the largest grower and second producer after China and occupies an area of 44.46 lakh ha with a production of 71.81 lakh tonnes and yield of 1615 kg/ha. Andhra Pradesh occupies third place in production in India. The productivity of Andhra Pradesh is very low against Indian productivity of 1615 kg/ha and world productivity of 1675.9 kg/ha (Annual report 2014-15, Directorate of Groundnut Research). The low productivity can be attributed to factors like erratic rainfall, incidence of pests and diseases in addition to cultivation of low yielding varieties. Many biotic stresses are limiting the productivity of groundnut. Peanut stem necrosis is an important biotic stress causing severe economic losses in groundnut since *kharif,* 2000.

Kernel yield in groundnut is a complex trait based on various yield component characters and hence, direct selection for yield is ineffective. Therefore, selection for various component traits responsible for conditioning of kernel yield in groundnut is advocated. In this context, the nature and magnitude of association among kernel yield and its component traits important for the breeder to make an effective selection strategy. Further, identification of important kernel yield components and information about their inter-relationship would be useful in developing high yielding varieties. Path co-efficient analysis provides an effective means of finding out the direct and indirect causes of association and presents a critical examination of the specific forces acting to produce a given correlation and also measures the relative importance of each causal factor.

## MATERIAL AND METHODS

The material for the present study comprised of 50 groundnut genotypes, grown in a randomised block design with two replications at Agricultural research station, Kadiri during *kharif*, 2015. Each treatment was sown in two rows of 5m length by adopting a spacing of 30 X 10 cm. Observations were recorded on randomly chosen five competitive plants for all characters *viz.*, days to 50 per cent flowering, plant height (cm), number of filled pods per plant, total pods per plant, number of seeds per pod, sound mature kernel per cent, haulm yield per plant (g), pod yield per plant (g), kernel yield per plant (g), shelling per cent, harvest index per cent, 100 kernel weight , SPAD Chlorophyll Meter Reading at 60 days after sowing, oil content and protein content. The character days to 50 per cent flowering was recorded on per plot basis. The simple correlation coefficients (r) for yield components and qualitative traits were calculated as per Panse and Sukhatme (1957). The direct and indirect effects of various characters on kernel yield were calculated through path coefficient analysis as suggested by Wright (1921) and applied to plants by Dewey and Lu (1959).

## RESULTS AND DISCUSSION

Kernel yield in groundnut is a complex trait based on various yield component characters and hence, direct selection for yield would be ineffective. Therefore, selection for various component traits responsible for conditioning of kernel yield in groundnut is advocated. In this context, the nature and magnitude of association among kernel yield and its component traits are important for the breeder to make an effective selection strategy. Further, identification of important kernel yield components and information about their inter-relationship would be useful in developing high yielding varieties. The genotypic and phenotypic correlations for yield and various yield components studied in the present investigation are presented in Table 1. A perusal of these results revealed phenotypic and genotypic correlations to be of similar direction and significance. However, genotypic correlations recorded a higher magnitude compared to phenotypic correlations indicating the masking effect of environment. Further, positive and significant association of kernel yield with number of filled pods per plant (0.5785 and 0.6102), total pods per plant (0.5548 and 0.6035), pod yield per plant (0.8374 and 0.9825), harvest index per cent (0.4804 and 0.5217), 100 kernel weight (0.4092 and 0.4418), both at phnotypic and genotypic used respectively. Further, pod yield per plant also manifestid significant and position association with harvest index per cent (0.4814 and 0.4254), 100 kernel weight (0.4789 and 0.4424) and SCMR at 60 DAS (0.3438 and 0.3880) was observed in the present investigation, indicating that an increase in kernel yield and pod yield could be realized with an increased performance of these characters. Therefore, priority should be given to these traits while making selections for improvement of kernel yield. These findings are in agreement with the reports of Shoba *et al.* (2012) for the traits *viz.*, number of filled pods per plant, total pods per plant, pod yield per plant, harvest index, 100 kernel weight, shelling per cent and SCMR at 60 DAS. Further, Reddy *et al.* (2004) for SCMR at 60 DAS, Reddy *et al.* (1986) and Jayalakshmi *et al.* (2000) for number of filled pods per plant, Ofori (1996) for total pods per plant, Babaria and Dobariya (2012), Toprope *et al.* (2013), Satish (2014) for pod yield per plant, Babaria and Dobariya (2012), Chandrasekhar and Kenchenagoudar (2012) and Alam *et al.* (2014) for 100 kernel weight, Dolma *et al.* (2010 b) and Shoba *et al.* (2012) for shelling per cent also reported similar findings.

Patil *et al.* (2006) and Makinde and Ariyo (2013) reported significant positive association of total pods per plant with pod yield per plant; Dhaliwal *et al.* (2010) and Satish (2014) for haulm yield per plant with pod yield per plant; Narasimhulu *et al.* (2012) and Babaria and Dobariya (2012) for pod yield per plant with 100 kernel weight and Toprope *et al.* (2013) for pod yield per plant with SCMR at 60 DAS.

A perusal of the results on inter-character associations revealed significant and positive association of days to 50 per cent flowering with protein content (0.2280 and 0.2660); number of filled pods per plant with total pods per plant (0.9120 and 0.9553), pod yield per plant (0.4261 and 0.5454), shelling per cent (0.2121 and 0.3596) and harvest index per cent (0.3019 and 0.4081); total pods per plant with pod yield per plant (0.4443 and 0.5575) and harvest index per cent (0.2440 and 0.3219); haulm yield per plant with pod yield per plant (0.2317 and 0.3014) and SCMR at 60 DAS (0.5244 and 0.5575); shelling per cent with harvest index per cent (0.4804 and 0.5217), 100 kernel weight (0.4092 and 0.4418) and SCMR at 60 DAS (0.2212 and 0.2512) in the present investigation, indicating a scope for simultaneous improvement of these traits through selection. These findings are in agreement with the reports of Sharma and Varshney (1990) for number of filled pods per plant with total pods per plant, Sonone *et al.* (2010) for number of filled pods per plant with pod yield per plant and Reddy *et al.* (1986) for number of filled pods per plant with shelling per cent.

In contrast, significant and negative association of days to 50 per cent flowering with SCMR at 60 DAS (-0.2105 and -0.2543); plant height with SCMR at 60 DAS (-0.2524 and -0.2713); haulm yield per plant with shelling per cent (-0.2396 and -0.4725) and harvest index (-0.6921 and -0.7386); harvest index with SCMR at 60 DAS (-0.2672 and -0.4958); and 100 kernel weight with SCMR at 60 DAS (-0.2453 and -0.2678) were

**Table 1. Genotypic and phenotypic correlations among yield, yield components and qualitative traits in PSND tolerant groundnut genotypes.**

| Character | | DFF | PH | FP | TP | S/P | SMK | HY | PY | S% | HI% | 100KW | SCMR | OC | PC | KY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DFF** | $r_p$ | 1.000 | 0.0813 | 0.1693 | 0.1824 | 0.0214 | -0.0274 | -0.1255 | 0.1116 | 0.0378 | 0.1840 | 0.0447 | -0.2105* | 0.0031 | 0.2280* | 0.1266 |
| | $r_g$ | 1.000 | 0.0737 | 0.3067 | 0.2812 | -0.0883 | -0.1077 | -0.1419 | 0.1392 | 0.2365 | 0.2334 | 0.0291 | -0.2543* | -0.0704 | 0.2660* | 0.2067 |
| **PH** | $r_p$ | | 1.000 | 0.1570 | 0.1417 | 0.0914 | 0.0908 | 0.0454 | 0.1251 | 0.0574 | 0.0756 | -0.0355 | -0.2524* | -0.1358 | -0.1059 | 0.1471 |
| | $r_g$ | | 1.000 | 0.2064 | 0.1662 | 0.1155 | 0.1619 | 0.0585 | 0.1201 | 0.1757 | 0.0830 | -0.1369 | -0.2713* | -0.1759 | -0.1232 | 0.1601 |
| **FP** | $r_p$ | | | 1.000 | 0.9120** | 0.0449 | 0.0092 | 0.0264 | 0.4261** | 0.2121* | 0.3019** | -0.0162 | -0.0902 | 0.1479 | 0.0515 | 0.5785** |
| | $r_g$ | | | 1.000 | 0.9553** | 0.1525 | -0.0982 | -0.0289 | 0.5454** | 0.3596* | 0.4081** | -0.0361 | -0.0918 | 0.2568 | 0.0886 | 0.6102** |
| **TP** | $r_p$ | | | | 1.000 | 0.1604 | -0.0360 | 0.1186 | 0.4443** | 0.1279 | 0.2440* | 0.0956 | -0.0088 | 0.1664 | -0.0476 | 0.5548** |
| | $r_g$ | | | | 1.000 | 0.2486 | -0.1168 | 0.0742 | 0.5575** | 0.3098 | 0.3219* | 0.0661 | 0.0061 | 0.2734 | -0.0125 | 0.6035** |
| **S/P** | $r_p$ | | | | | 1.000 | -0.0123 | 0.1188 | -0.0390 | -0.0348 | -0.0865 | 0.1226 | 0.0093 | -0.1082 | -0.0548 | -0.0537 |
| | $r_g$ | | | | | 1.000 | -0.0382 | 0.1754 | -0.0365 | -0.3231 | -0.1523 | 0.1317 | -0.0014 | -0.0888 | -0.0806 | -0.1601 |
| **SMK** | $r_p$ | | | | | | 1.000 | -0.0393 | -0.0444 | 0.0900 | 0.0115 | 0.0386 | -0.1310 | -0.1223 | 0.0375 | -0.0052 |
| | $r_g$ | | | | | | 1.000 | -0.0424 | -0.0413 | -0.0591 | 0.0056 | 0.1026 | -0.2185 | -0.0833 | 0.0432 | -0.0372 |
| **HY** | $r_p$ | | | | | | | 1.000 | 0.2317* | -0.2396* | -0.6921** | 0.1229 | 0.5244** | 0.1785 | 0.0900 | 0.1301 |
| | $r_g$ | | | | | | | 1.000 | 0.3014* | -0.4725* | -0.7386** | 0.1748 | 0.5575** | 0.2436 | 0.1272 | 0.1504 |
| **PY** | $r_p$ | | | | | | | | 1.000 | -0.2702 | 0.4814** | 0.4789** | 0.3438** | 0.0997 | 0.0216 | 0.8374** |
| | $r_g$ | | | | | | | | 1.000 | -0.0913 | 0.4254** | 0.4424** | 0.3880** | 0.1652 | -0.0090 | 0.9825** |
| **S%** | $r_p$ | | | | | | | | | 1.000 | 0.4804** | 0.4092** | 0.2212* | 0.1593 | 0.0014 | 0.2226* |
| | $r_g$ | | | | | | | | | 1.000 | 0.5217** | 0.4418** | 0.2512* | 0.3074 | 0.0007 | 0.2496* |
| **HI%** | $r_p$ | | | | | | | | | | 1.000 | -0.1377 | -0.2672* | 0.1833 | -0.0457 | 0.4804** |
| | $r_g$ | | | | | | | | | | 1.000 | 0.0794 | -0.4958* | 0.4840 | 0.0154 | 0.5217** |
| **100KW** | $r_p$ | | | | | | | | | | | 1.000 | -0.2453* | -0.0808 | -0.0622 | 0.4092** |
| | $r_g$ | | | | | | | | | | | 1.000 | -0.2678* | -0.0814 | -0.1255 | 0.4418** |
| **SCMR** | $r_p$ | | | | | | | | | | | | 1.000 | -0.1388 | -0.0269 | 0.2212* |
| | $r_g$ | | | | | | | | | | | | 1.000 | -0.1383 | -0.0654 | 0.2512* |
| **OC** | $r_p$ | | | | | | | | | | | | | 1.000 | -0.0791 | 0.1593 |
| | $r_g$ | | | | | | | | | | | | | 1.000 | -0.0840 | 0.3074 |
| **PC** | $r_p$ | | | | | | | | | | | | | | 1.000 | 0.0014 |
| | $r_p$ | | | | | | | | | | | | | | 1.000 | 0.0007 |

$r_p$ = Phenotypic correlation; $r_g$ = genotypic correlation; *, ** Significant at 5% and 1% levels, respectively

DFF=Days to 50% flowering., PH=Plant height., FP=Number of filled pods per plant., TP=Total pods per plant.,S/P=Seeds per pod., SMK=Sound mature kernel per cent., HY=Haulm yield per plant., PY=Pod yield per plant.,S%=Shelling per cent.,HI%=Harvest index per cent., 100 KW=100 Kernel weight., SCMR=SPAD Chlorophyll Meter Reading.,OC=Oil content., PC=Protein content

**Table 2. Genotypic and phenotypic path coefficients of yield components and qualitative characters on kernel yield per plant in PSND tolerant groundnut .**

| Character | | DFF | PH | FP | TP | S/P | SMK% | HY | PY | S% | HI% | 100KW | SCMR | OC | PC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DFF | Pp | **0.0256** | 0.0021 | 0.0043 | 0.0047 | 0.0005 | -0.0007 | -0.0032 | 0.0018 | 0.0010 | 0.0047 | 0.0011 | -0.0054 | 0.0001 | 0.0058 |
| | Pg | **-0.0013** | -0.0001 | -0.0004 | -0.0004 | 0.0001 | 0.0001 | 0.0002 | -0.0032 | -0.0003 | -0.0003 | 0.0000 | 0.0003 | 0.0001 | -0.0003 |
| PH | Pp | 0.0018 | **0.0226** | 0.0035 | 0.0032 | 0.0021 | 0.0021 | 0.0010 | 0.0033 | 0.0013 | 0.0017 | -0.0008 | -0.0057 | -0.0031 | -0.0024 |
| | Pg | 0.0118 | **0.1601** | 0.0331 | 0.0266 | 0.0185 | 0.0259 | 0.0094 | -0.0284 | 0.0281 | 0.0133 | -0.0219 | -0.0434 | -0.0282 | -0.0197 |
| FP | Pp | 0.0422 | 0.0391 | **0.2492** | 0.2273 | 0.0112 | 0.0023 | 0.0066 | 0.0164 | 0.0528 | 0.0752 | -0.0040 | -0.0225 | 0.0369 | 0.0128 |
| | Pg | 0.0622 | 0.0419 | **0.2029** | 0.1938 | 0.0309 | -0.0199 | -0.0059 | -0.0803 | 0.0730 | 0.0828 | -0.0073 | -0.0186 | 0.0521 | 0.0180 |
| TP | Pp | -0.0136 | -0.0105 | -0.0678 | **-0.0744** | -0.0119 | 0.0027 | -0.0088 | -0.0253 | -0.0095 | -0.0181 | -0.0071 | 0.0007 | -0.0124 | 0.0035 |
| | Pg | 0.0201 | 0.0119 | 0.0681 | **0.0713** | 0.0177 | -0.0083 | 0.0053 | -0.0495 | 0.0221 | 0.0230 | 0.0047 | 0.0004 | 0.0195 | -0.0009 |
| S/P | Pp | -0.0016 | -0.0070 | -0.0034 | -0.0122 | **-0.0761** | 0.0009 | -0.0090 | 0.0005 | 0.0026 | 0.0066 | -0.0093 | -0.0007 | 0.0082 | 0.0042 |
| | Pg | 0.0240 | -0.0314 | -0.0414 | -0.0675 | **-0.2716** | 0.0104 | -0.0476 | -0.0095 | 0.0878 | 0.0414 | -0.0358 | 0.0004 | 0.0241 | 0.0219 |
| SMK | Pp | 0.0005 | -0.0016 | -0.0002 | 0.0006 | 0.0002 | **-0.0177** | 0.0007 | -0.0001 | -0.0016 | -0.0002 | -0.0007 | 0.0023 | 0.0022 | -0.0007 |
| | Pg | 0.0053 | -0.0079 | 0.0048 | 0.0057 | 0.0019 | **-0.0489** | 0.0021 | -0.0015 | 0.0029 | -0.0003 | -0.0050 | 0.0107 | 0.0041 | -0.0021 |
| HY | Pp | -0.1059 | 0.0383 | 0.0223 | 0.1000 | 0.1002 | -0.0332 | **0.8434** | 0.0642 | -0.2021 | -0.5837 | 0.1037 | 0.4423 | 0.1506 | 0.0759 |
| | Pg | -0.0890 | 0.0367 | -0.0181 | 0.0465 | 0.1100 | -0.0272 | **0.6272** | -0.0231 | -0.2963 | -0.4632 | 0.1096 | 0.3496 | 0.1528 | 0.0798 |
| PY | Pp | 0.0845 | 0.0947 | 0.3225 | -0.0253 | -0.0295 | -0.0336 | 0.0642 | **0.7569** | 0.6338 | -0.2045 | 0.3643 | 0.3625 | 0.2602 | 0.0163 |
| | Pg | -0.0662 | -0.0571 | -0.2593 | -0.0495 | 0.0174 | 0.0196 | -0.0231 | **-0.4755** | -0.4671 | 0.0434 | -0.2023 | -0.2103 | -0.1845 | 0.0043 |
| S% | Pp | 0.0154 | 0.0235 | 0.0867 | 0.0523 | -0.0142 | 0.0368 | -0.0979 | 0.0966 | **0.9365** | 0.0085 | -0.0563 | -0.1092 | 0.0749 | -0.0187 |
| | Pg | -0.0338 | -0.0251 | -0.0514 | -0.0442 | 0.0461 | 0.0084 | 0.0675 | 0.0032 | **1.0877** | -0.0515 | -0.0113 | 0.0708 | -0.0691 | -0.0022 |
| HI% | Pp | 0.1810 | 0.0744 | 0.2970 | 0.2401 | -0.0851 | 0.0113 | -0.6809 | 0.1707 | 0.0204 | **0.9838** | 0.2005 | -0.2413 | -0.0795 | -0.0612 |
| | Pg | 0.1997 | 0.0710 | 0.3493 | 0.2755 | -0.1303 | 0.0048 | -0.6322 | -0.1526 | 0.3088 | **0.8560** | 0.1143 | -0.2292 | -0.0697 | -0.1074 |
| 100KW | Pp | 0.0066 | -0.0052 | -0.0024 | 0.0140 | 0.0180 | 0.0057 | 0.0180 | 0.0237 | -0.0202 | 0.0299 | **0.1468** | 0.0445 | -0.0204 | -0.0039 |
| | Pg | 0.0099 | -0.0466 | -0.0123 | 0.0225 | 0.0448 | 0.0349 | 0.0595 | -0.1534 | 0.0270 | 0.0455 | 0.3404 | 0.1195 | -0.0471 | -0.0223 |
| SCMR | Pp | -0.0244 | -0.0292 | -0.0104 | -0.0010 | 0.0011 | -0.0152 | 0.0607 | 0.0131 | -0.0309 | -0.0284 | 0.0351 | **0.1158** | 0.0022 | -0.0092 |
| | Pg | 0.0035 | 0.0037 | 0.0013 | -0.0001 | 0.0000 | 0.0030 | -0.0077 | -0.0222 | 0.0068 | 0.0037 | -0.0048 | **-0.0138** | -0.0004 | 0.0012 |
| OC | Pp | 0.0000 | 0.0001 | -0.0001 | -0.0001 | 0.0001 | 0.0001 | -0.0001 | 0.0049 | -0.0001 | 0.0001 | 0.0001‘ | 0.0000 | **-0.0006** | 0.0000 |
| | Pg | -0.0192 | -0.0479 | 0.0699 | 0.0744 | -0.0242 | -0.0227 | 0.0663 | -0.0587 | 0.1317 | -0.0222 | -0.0376 | 0.0087 | **0.2721** | -0.0158 |
| PC | Pp | -0.0011 | 0.0005 | -0.0003 | 0.0002 | 0.0003 | -0.0002 | -0.0004 | 0.0000 | 0.0002 | 0.0003 | 0.0001 | 0.0004 | 0.0002 | **-0.0049** |
| | Pg | 0.0135 | -0.0062 | 0.0045 | -0.0006 | -0.0041 | 0.0022 | 0.0064 | 0.0008 | 0.0008 | -0.0064 | -0.0033 | -0.0043 | -0.0029 | **0.0507** |
| Correlation | Pp | **0.1266** | **0.1471** | **0.5785**** | **0.5548**** | **-0.0537** | **-0.0052** | **0.1301** | **0.8374**** | **0.2226*** | **0.4804**** | **0.4092**** | **0.2212*** | **0.1593** | **0.0014** |
| Kernel yield | Pg | **0.2067** | **0.1601** | **0.6102**** | **0.6035**** | **-0.1601** | **-0.0372** | **0.1504** | **0.9825**** | **0.2496*** | **0.5217**** | **0.4418**** | **0.2512*** | **0.3074** | **0.0007** |

Residual effect (Phenotypic) = 0.3570; Residual effect (Genotypic) = 0.1631; Diagonal values = Direct effects; Off-Diagonal values = Indirect effects; *, ** Significant at 0.05 and 0.01 levels, respectively

DFF=Days to 50% flowering., PH=Plant height., FP=Number of filled pods per plant., TP=Total pods per plant.,S/P=Seeds per pod., SMK=Sound mature kernel per cent., HY=Haulm yield per plant., PY=Pod yield per plant.,S%=Shelling per cent.,HI%=Harvest index per cent., 100 KW=100 Kernel weight., SCMR=SPAD Chlorophyll Meter Reading.,OC=Oil content., PC=Protein content observed in the present study, probably due to competition for a common possibility such as nutrient supply, indicating the need for balanced selection while effecting simultaneous improvement of these traits. These findings are in agreement with the reports of Nirmala (2012) for plant height with SCMR at 60 DAS; Parameshwarappa *et al.* 2008 for haulm yield per plant with shelling per cent.

Partitioning the genotypic correlation coefficients into direct and indirect effects through path analysis revealed that the shelling percent (0.93654 & 1.087) followed by harvest index percent (0.9838 & 0.8560) and halum yield percent (0.8434 & 0.6272) manigested position direct effects at phenotypic and genotypic levels respectvily on kernel yield per plants. (Table 2). The results are in line with the findings of John *et al* (2011), Mukhtar *et al*. (2013), Vange and Maga (2014) for haulm yield per plant, Mane *et al*. (2008) and Dolma *et al*.(2010 b) for shelling per cent and Rao *et al*. (2014), Kwaga (2013) and satish *et al*. (2014) for 100 kernel weight. The character number of filled pods per plant recorded moderate positive direct effect (0.2492 and 0.2029) on kernel yield per plant. These findings are in accordance to the earlier reports of Zaman *et al. (*2011) and Shanthala and Siddraju (2012). The traits *viz.*, number of filled pods per plant (0.5785 and 0.6102), shelling per cent (0.2226 and 0.2496), harvest index (0.4804 and 0.5217) and 100 kernel weight (0.4092 and 0.4418) recorded significant and positive association with kernel yield per plant. High direct effects of these traits therefore appear to be the main factor for their strong association with kernel yield. Hence, these traits could be considered as an important selection criteria in all groundnut improvement programmes and direct selection for these traits is recommended for improvement of kernel yield. Further, plant height and haulm yield per plant also recorded direct positive effects in addition to non-significant associations in general with kernel yield per plant, indicating the role of indirect effects and the need for consideration of indirect effects of these traits in PSND tolerant groundnut kernel yield improvement programme.

## CONCLUSION:

In the current study highly significant positive correlation were observed between kernel yield per plant and number of filled pods per plant, total pods per plant, pod yield per plant, harvest index per cent, 100 kernel weight, shelling per cent and SCMR at 60 DAS. Further, haulm yield per plant, shelling per cent, harvest index per cent and 100 kernel weight were identified to be the major contributors of kernel yield by way of their positive and high direct effect. Hence, there is much scope identify high yielding genotypes by focusing on these traits.

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