# PATH COEFFICIENT ANALYSIS OF SOME CHARACTERS CONTRIBUTING TO YIELD OF GIZA 89 COTTON CULTIVAR

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## ABSTRACT

This investigation was carried out at Gemmeiza Agricultural Research Station to study the relationship between plant yield, yield components and the relative contribution of plant height, first sympodium, number of fruiting branches, number of open bolls/plant, boll weight, lint percentage, seed index, micronaire reading and pressley index to the total variation of yield plant for "Giza 89 cotton cultivar, during 2000 and 2001 seasons.

Simple correlation coefficient was used for assessing the relationships between yield and the studied characters. Plant yield was positively correlated with plant height, number of fruiting branches, number of open bolls/plant, boll weight, seed index and pressley index in both seasons, and with first sympodium and micronaire reading in 2001 and 2000 seasons, respectively. The other relationships between the various studied characters were also computed. Boll number had the highest direct effect, followed by boll weight, whereas the other traits influenced yield through boll number.

## INTRODUCTION

The study of the relationship between plant yield and its components, upon which the performance of cotton cultivars depends, is very important in breeding for high yield ability. Thus, knowledge concerning the association between characters is of prime importance to the breeder as it broadens the perspective with which he can manipulate indirect selection for yield and the possibility of selecting for two or more characters simultaneously. Path coefficient analysis can also be used to identify the relative contribution of each yield component in plant yield variation. This analysis is of major importance to plant breeder to formulate a suitable selection criteria for further improvement of plant yield. The relationships between yield components and plant yield have been discussed by several investigators, Bridge *et al.* (1971), Waldin *et al.* (1979), El-Marakby *et al.* (1980), Megahed *et al.* (1984), El-Shaer *et al.* (1984), Seyam *et al.* (1984a) and El-Beily *et al.* (1996).

The present investigation was undertaken to examine the nature and extent of association between morphological characters, yield components, yield and fiber properties of cotton. Moreover, path coefficient analysis was

followed to find out the yield characters having the greatest contribution to yield per plant.

## MATERIALS AND METHODS

Two experiments were carried out at Gemmeiza Agriculture Research Station, during 2000 and 2001 seasons in a randomized complete block design with six replications, to study the association among plant yield (g.) and plant height (cm), first sympodium, number of fruiting branches, number of open bolls/plant, boll weight (g), lint percentage, seed index, micronaire reading and pressley index. The relative importance of the yielding characters on plant yield for Giza 89 cotton cultivar was also studied. Each plot had five rows, with 4.5 m long spaced at 60 cm between rows and 30 cm between hills. Two plants were left per hip at thinning time. Sowing date was 27 and 29 march in 2000 and 2001, respectively. All cultural practices were done according to the standard recommendation. Data were recorded on 30 samples taken at random from six replications i.e., five samples per replication, each sample contained 10 plants. Path analysis was applied according to Dewey and Lu (1959) to elucidate the relative importance of certain characters as a percentage of the total variability of the seed-cotton yield per plant.

## RESULTS AND DISCUSSION

### 1. Correlation coefficients:

The estimates of correlation coefficients among yield/plant, plant height, first sympodium, number of fruiting branches, number of open bolls/plant, boll weight, lint percentage, seed index, micronaire reading and pressley index in 2000 and 2001 seasons are presented in Tables 1 and 2.

The relationship between yield/plant and the above mentioned characters, showed positive and significant associations between yield/plant and each of number of fruiting branches, number of open bolls/plant and boll weight in both seasons and with seed index in 2000 season, plant height and first sympodium in 2001 season only. These results are in agreement with those obtained by Gad (1973), Zaitoon (1973), Seyam *et al.* (1984b), El-Shaer *et al.* (1984) and El-Beily *et al.* (1996).

For number of open bolls/plant, the associations with each of plant height, number of fruiting branches and boll weight were positive and significant in both seasons, whereas, Seyam *et al.* (1984a) reported no relationship between open bolls and number of fruiting branches was found. Meanwhile, the number of fruiting branches was associated positively with plant height in both seasons. Also, the relationship between boll weight and seed index was positive and significant association in both seasons. These results obtained herein are in accordance with those obtained by Megahed *et al.* (1984), Seyam *et al.* (1984a), Ghaly *et al.* (1990) and El-Beily *et al.* (1996).

**Table (1):** Simple correlation coefficients between any two of ten characters including seed-cotton yield.

| Characters | Season | Plant height | First symp. | No. of Fruiting branches | No. of open bolls/plant | Boll weight | Lint percentage | Seed index | Micronaire reading. | Pressley Index |
|---|---|---|---|---|---|---|---|---|---|---|
| Seed cotton yield | 2000 | 0.2209 | -0.0736 | 0.2913* | 0.9286** | 0.4939** | -0.0087 | 0.2802* | 0.2660 | 0.0312 |
| | 2001 | 0.6630** | 0.3842** | 0.5420** | 0.9608** | 0.5864** | -0.2874* | 0.2371 | -0.0885 | 0.2329 |
| Plant height | 2000 | | -0.1480 | 0.5878** | 0.3566** | -0.0738 | -0.0290 | -0.1476 | -0.0603 | 0.1695 |
| | 2001 | | 0.2890* | 0.6677** | 0.6367** | 0.4176** | -0.3278* | 0.2789* | 0.1014 | 0.1629 |
| First sympodium | 2000 | | | 0.1573 | -0.1996 | -0.0095 | -0.1268 | 0.0959 | -0.0429 | -0.0730 |
| | 2001 | | | 0.0627 | 0.3847** | 0.1837 | 0.0313 | 0.0762 | 0.0107 | 0.0329 |
| No. of fruiting branches | 2000 | | | | 0.3582** | 0.0861 | 0.1072 | -0.0832 | -0.0272 | -0.1592 |
| | 2001 | | | | 0.5857** | 0.1420 | -0.2196 | -0.0373 | -0.0100 | 0.1530 |
| No. of open bolls/plant | 2000 | | | | | 0.2739* | -0.0220 | 0.2479 | 0.1839 | 0.1333 |
| | 2001 | | | | | 0.3424* | -0.2092 | 0.0821 | -0.1753 | 0.2491 |
| Boll weight | 2000 | | | | | | -0.1549 | 0.3733** | 0.3739** | -0.3305* |
| | 2001 | | | | | | -0.3500* | 0.6055** | 0.2689 | 0.0466 |
| Lint percentage | 2000 | | | | | | | -0.4704** | -0.1816 | -0.0252 |
| | 2001 | | | | | | | -0.1547 | 0.2195 | -0.3146 |
| Seed index | 2000 | | | | | | | | 0.5505** | -0.1702 |
| | 2001 | | | | | | | | 0.6206** | -0.0726 |
| Micronaire reading | 2000 | | | | | | | | | -0.2945* |
| | 2001 | | | | | | | | | -0.2801* |

*, ** denotes significant at 5% and 1%, respectively

**Table (2):** Partitioning of simple correlation coefficients between seed-cotton yield/plant and its components in 2000 and 2001 seasons.

| Sources | Season | |
|---|---|---|
| | 2000 | 2001 |
| **1. Plant height vs. seed-cotton yield/plant** | | |
| Direct effect (py1) | -0.0801 | -0.0094 |
| Indirect via first sympodium | -0.0172 | 0.0003 |
| Indirect via no. of fruiting branches | 0.0006 | 0.0006 |
| Indirect via no. of open bolls | 0.3264 | 0.5475 |
| Indirect via boll weight | -0.0191 | 0.1260 |
| Indirect via lint percentage | -0.0011 | 0.0007 |
| Indirect via seed index | 0.0110 | -0.0015 |
| Indirect via micronaire reading | -0.0034 | -0.0014 |
| Indirect via pressley index | 0.0037 | 0.0002 |
| Total correlation (ry1) | 0.2209 | 0.6630** |
| **2. First sympodium vs. seed cotton yield/plant** | | |
| Direct effect (py2) | 0.1160 | 0.0011 |
| Indirect via plant height | 0.0118 | -0.0027 |
| Indirect via no. of fruiting branches | -0.0002 | 0.0001 |
| Indirect via no. of open bolls | -0.1828 | 0.3308 |
| Indirect via boll weight | -0.0025 | 0.0554 |
| Indirect via lint percentage | -0.0050 | 0.0001 |
| Indirect via seed index | -0.0072 | -0.0004 |
| Indirect via micronaire reading | -0.0024 | -0.0001 |
| Indirect via pressley index | -0.0016 | 0.0000 |
| Total correlation (ry2) | -0.0736 | 0.3842** |
| **3. No. of fruiting branches vs. seed cotton yield/plant** | | |
| Direct effect (py3) | 0.0010 | 0.0008 |
| Indirect via plant height | -0.0471 | -0.0063 |
| Indirect via first sympodium | -0.0182 | 0.0001 |
| Indirect via no. of open bolls | 0.3279 | 0.5036 |
| Indirect via boll weight | 0.0223 | 0.0428 |
| Indirect via lint percentage | 0.0042 | 0.0005 |
| Indirect via seed index | 0.0062 | 0.002 |
| Indirect via micronaire reading | -0.0015 | 0.0001 |
| Indirect via pressley index | -0.0034 | 0.0002 |
| Total correlation (ry3) | 0.2913* | 0.5420** |

Table (2): Continued.

| Sources | Season | |
|---|---|---|
| | 2000 | 2001 |
| **4. No. of open bolls vs. seed cotton yield/plant** | | |
| Direct effect (py4) | 0.9154 | 0.8598 |
| Indirect via plant height | -0.0286 | -0.0060 |
| Indirect via first sympodium | -0.0232 | 0.0004 |
| Indirect via no. of fruiting branches | 0.0004 | 0.0005 |
| Indirect via boll weight | 0.0708 | 0.1033 |
| Indirect via lint percentage | -0.0009 | 0.0005 |
| Indirect via seed index | -0.0185 | -0.0004 |
| Indirect via micronaire reading | 0.0103 | 0.0024 |
| Indirect via pressley index | 0.0029 | 0.0003 |
| Total correlation (ry4) | 0.9286** | 0.9608** |
| **5. Boll weight vs. seed-cotton yield/plant** | | |
| Direct effect (py5) | 0.2585 | 0.3017 |
| Indirect via plant height | 0.0059 | -0.0039 |
| Indirect via first sympodium | -0.0011 | 0.0002 |
| Indirect via no. of fruiting branches | 0.0001 | 0.0000 |
| Indirect via no. of open bolls | 0.2507 | 0.2944 |
| Indirect via lint percentage | -0.0061 | 0.0008 |
| Indirect via seed index | -0.0279 | -0.0032 |
| Indirect via micronaire reading | 0.0209 | -0.0037 |
| Indirect via pressley index | -0.0071 | 0.0001 |
| Total correlation (ry5) | 0.4939** | 0.5864** |
| **6. Lint percentage vs. seed cotton yield/plant** | | |
| Direct effect (py6) | 0.0393 | -0.0022 |
| Indirect via plant height | 0.0023 | 0.0031 |
| Indirect via first sympodium | -0.0147 | -0.0000 |
| Indirect via no. of fruiting branches | 0.0001 | -0.0002 |
| Indirect via no. of open bolls | -0.0202 | -0.1799 |
| Indirect via boll weight | -0.0401 | -0.1056 |
| Indirect via seed index | 0.0351 | 0.0008 |
| Indirect via micronaire reading | -0.0101 | -0.0030 |
| Indirect via pressley index | -0.0005 | -0.0004 |
| Total correlation (ry6) | -0.0087 | -0.2874* |

**Table (2):** Continued.

| Sources | Season | |
|---|---|---|
| | 2000 | 2001 |
| **7. Seed index vs. seed cotton yield/plant** | | |
| Direct effect (py7) | -0.0747 | -0.0053 |
| Indirect via plant height | 0.0118 | -0.0026 |
| Indirect via first sympodium | 0.0111 | 0.0001 |
| Indirect via no. of fruiting branches | -0.0001 | -0.0000 |
| Indirect via no. of open bolls | 0.2269 | 0.0706 |
| Indirect via boll weight | 0.0965 | 0.1827 |
| Indirect via lint percentage | -0.0185 | 0.0003 |
| Indirect via micronaire reading | 0.0307 | -0.0086 |
| Indirect via pressley index | -0.0037 | -0.0001 |
| Total correlation (ry7) | 0.2802* | 0.2371 |
| **8. Micronaire reading vs. seed cotton yield/plant** | | |
| Direct effect (py8) | 0.0558 | -0.0139 |
| Indirect via plant height | 0.0048 | -0.0010 |
| Indirect via first sympodium | -0.0050 | 0.0000 |
| Indirect via no. of fruiting branches | -0.0000 | -0.0000 |
| Indirect via no. of open bolls | 0.1683 | -0.1507 |
| Indirect via boll weight | 0.0967 | 0.0811 |
| Indirect via lint percentage | -0.0071 | -0.0005 |
| Indirect via seed index | -0.0411 | -0.0033 |
| Indirect via pressley index | -0.0064 | -0.0003 |
| Total correlation (ry8) | 0.2660 | -0.0885 |
| **9. Pressley index vs. seed cotton yield/plant** | | |
| Direct effect (py9) | 0.0216 | 0.0012 |
| Indirect via plant height | -0.0136 | -0.0015 |
| Indirect via first sympodium | -0.0085 | 0.0000 |
| Indirect via no. of fruiting branches | -0.0002 | 0.0001 |
| Indirect via no. of open bolls | 0.1220 | 0.2141 |
| Indirect via boll weight | -0.0854 | 0.0141 |
| Indirect via lint percentage | -0.0010 | 0.0007 |
| Indirect via seed index | 0.0127 | 0.0004 |
| Indirect via micronaire reading | -0.0164 | 0.0039 |
| Total correlation (ry9) | 0.0312 | 0.2329 |

Consequently, these findings suggested that selection practiced for the improvement of any one of a set of correlated characters would automatically improve the other, even though direct selection for its improvement has not been made.

Moreover, no relationship was observed between boll weight and number of fruiting branches in both seasons (Ghaly *et al.*, 1990 and El-Beily *et al.*, 1996). This independent relationship indicated that selection could be practiced for both characters at the same time without any reduction for the other. However, Megahed *et al.* (1984) reported a positive and remarkable association between boll weight and number of bolls/plant which was contradictory to the results obtained in this investigation.

**2. Path coefficient analysis:**

The direct and joint effects of yield-attributes on plant yield in 2000 and 2001 seasons are presented in Table 3. Number of open bolls and boll weight revealed the most prominent direct effects on plant yield with the highest relative importance values of 63.07% and 5.03% in 2000 season and 71.40% and 8.79% in 2001 season, respectively, as estimates of their relative contribution to the total variation of yield. Minor effects were revealed by the other studied characters in both seasons. The analysis also demonstrated that number of open bolls had the highest joint effect through boll weight (9.76% and 17.16%) contributing to plant yield in 2000 and 2001 seasons, respectively. The other direct and joint effects for the rest of the studied characters were negligible and showed very slight contributions to plant yield. These results indicated that the percentage contributed due to yield components accounted for more than 95% and 99% in both seasons of the total variability and that the characters under investigation included the actual yield components. The residual value 4.0% and 0.14% in both seasons, accounted for the rest of the studied characters which had negligible effects and/or very slight contributions to plant yield and also to the other characters which were probably not included in this model.

In general, the results obtained in this investigation indicated that number of open bolls and boll weight were the major and the most consistent sources accounting for variation as total contribution in plant yield variation. Therefore, it is inevitable for the breeder to consider these characters in formulating his breeding programmes to obtain gain in selection for plant yield. Similar results were obtained by El-Marakby *et al.* (1980), El-Shaer *et al.* (1984), Seyam *et al.* (1984a & 1984b), Ghaly *et al.* (1990) and El-Beily *et al.* (1996).

**Table (3):** Components (direct and joint effects) in percentage of seed cotton yield variation in 2000 and 2001 seasons.

| Source of variation | Season | | | |
|---|---|---|---|---|
| | 2000 | | 2001 | |
| | C.D. | % | C.D. | % |
| Plant height ($X_1$) | 0.01 | 0.48 | 0.00 | 0.01 |
| First sympodium ($X_2$) | 0.01 | 1.01 | 0.00 | 0.00 |
| No. of fruiting branches ($X_3$) | 0.00 | 0.00 | 0.00 | 0.00 |
| No. of open bolls ($X_4$) | 0.84 | 63.07 | 0.74 | 71.40 |
| Boll weight ($X_5$) | 0.07 | 5.03 | 0.09 | 8.79 |
| Lint percentage ($X_6$) | 0.00 | 0.12 | 0.00 | 0.00 |
| Seed index ($X_7$) | 0.01 | 0.42 | 0.00 | 0.00 |
| Micronaire reading ($X_8$) | 0.00 | 0.23 | 0.00 | 0.02 |
| Pressley index ($X_9$) | 0.00 | 0.04 | 0.00 | 0.00 |
| $X_1 \times X_2$ | 0.0027 | 0.21 | -0.0000 | 0.00 |
| $X_1 \times X_3$ | -0.0001 | 0.01 | -0.0000 | 0.00 |
| $X_1 \times X_4$ | -0.0523 | 3.93 | -0.0103 | 1.00 |
| $X_1 \times X_5$ | 0.0031 | 0.23 | -0.0024 | 0.23 |
| $X_1 \times X_6$ | 0.0002 | 0.01 | -0.0000 | 0.00 |
| $X_1 \times X_7$ | -0.0018 | 0.13 | 0.0000 | 0.00 |
| $X_1 \times X_8$ | 0.0005 | 0.04 | 0.0000 | 0.00 |
| $X_1 \times X_9$ | -0.0006 | 0.04 | -0.0000 | 0.00 |
| $X_2 \times X_3$ | -0.0000 | 0.00 | 0.0000 | 0.00 |
| $X_2 \times X_4$ | -0.0424 | 3.19 | 0.0008 | 0.07 |
| $X_2 \times X_5$ | -0.0006 | 0.04 | 0.0001 | 0.01 |
| $X_2 \times X_6$ | -0.002 | 0.09 | 0.0000 | 0.00 |
| $X_2 \times X_7$ | -0.0017 | 0.13 | -0.0000 | 0.00 |
| $X_2 \times X_8$ | -0.0006 | 0.04 | -0.0000 | 0.00 |
| $X_2 \times X_9$ | -0.0004 | 0.03 | 0.0000 | 0.00 |
| $X_3 \times X_4$ | 0.0007 | 0.05 | 0.0008 | 0.08 |
| $X_3 \times X_5$ | 0.0000 | 0.00 | 0.0001 | 0.01 |
| $X_3 \times X_6$ | 0.0000 | 0.00 | 0.0000 | 0.00 |
| $X_3 \times X_7$ | 0.0000 | 0.00 | 0.0000 | 0.00 |
| $X_3 \times X_8$ | -0.0000 | 0.00 | 0.0000 | 0.00 |
| $X_3 \times X_9$ | -0.0000 | 0.00 | 0.0000 | 0.00 |
| $X_4 \times X_5$ | 0.1296 | 9.76 | 0.1777 | 17.16 |
| $X_4 \times X_6$ | -0.0016 | 0.12 | 0.0008 | 0.08 |
| $X_4 \times X_7$ | -0.0339 | 2.55 | -0.0007 | 0.07 |
| $X_4 \times X_8$ | 0.0188 | 1.41 | 0.0042 | 0.40 |
| $X_4 \times X_9$ | 0.0053 | 0.40 | 0.0005 | 0.05 |
| $X_5 \times X_6$ | -0.0032 | 0.24 | 0.0005 | 0.04 |
| $X_5 \times X_7$ | -0.0144 | 1.08 | -0.0019 | 0.19 |
| $X_5 \times X_8$ | 0.0108 | 0.81 | -0.0023 | 0.22 |
| $X_5 \times X_9$ | -0.0037 | 0.28 | 0.0000 | 0.00 |
| $X_6 \times X_7$ | 0.0028 | 0.21 | -0.0000 | 0.00 |
| $X_6 \times X_8$ | -0.0008 | 0.06 | 0.0000 | 0.00 |
| $X_6 \times X_9$ | -0.0000 | 0.00 | 0.0000 | 0.00 |
| $X_7 \times X_8$ | -0.0046 | 0.35 | 0.0001 | 0.01 |
| $X_7 \times X_9$ | 0.0005 | 0.04 | 0.0000 | 0.00 |
| $X_8 \times X_9$ | -0.0007 | 0.05 | 0.0000 | 0.00 |
| Residual | 0.0539 | 4.06 | 0.0015 | 0.14 |

C.D. =Coefficient of determination.

% = Percentage contributed

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## الملخص العربى

# تحليل معامل المرور لبعض الصفات المساهمة فى المحصول لصنف القطن جيزة ٨٩

أنور فوزى لاشين ــ جمال حسنين عبد الظاهر ــ محمد عبد الجواد عباس
معهد بحوث القطن ــ مركز البحوث الزراعية

أجريت هذه الدراسة بمحطة البحوث الزراعية بالجميزة لمعرفة العلاقة بين محصول نبات القطن (جيزة ٨٩) وبعض الصفات المحصولية وكذا دراسة المساهمة النسبيه لصفات طول النبات ، ارتفاع أول فرع ثمرى ، عدد الافرع الثمريه ، عدد اللوز المتفتح / نبات ، وزن اللوزه ، معدل الحليج ، معامل البذره ، قراءة الميكرونير ومعامل بريسلى فى الاختلافات الكلية لمحصول النبات الفردى لصنف القطن جيزة ٨٩ موسمى ٢٠٠٠ ، ٢٠٠١.

تم استخدام معامل الارتباط فى دراسة العلاقة بين محصول النبات الفردى والصفات المدروسة.

وتشير النتائج المتحصل عليها الى إرتباط محصول البنات الفردى ارتباطا موجبا مع كلا من طول النبات ، عدد الافرع الثمرية ، عدد اللوز المتفتح/نبات ، وزن اللوزه ، معامل البذره ومعامل بريسلى فى كلا الموسمين ومع قراءة الميكرونير فى موسم ٢٠٠٠ وارتفاع اول فرع ثمرى فى موسم ٢٠٠١ وتم حساب معاملات الارتباط الاخرى بين الصفات المدروسة.

أوضحت نتائج تحليل معامل المرور أن عدد اللوز المتفتح ووزن اللوزه وتفاعلهما كان لهما النصيب الاكبر فى محصول النبات الفردى.