# THE PATH COEFFICIENT ANALYSIS OF SOME CHARACTERS CONTRIBUTING TO LINT YIELD IN THREE EGYPTIAN COTTON CULTIVARS

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***Abstract***

This investigation was carried out at Sakha Agricultural Research Station, North Delta, Egypt, to study the relationship between yield components and lint yield and the contribution of boll weight, number of open bolls/plant, number of fruiting branches/plant, date to first flower appearance and plant height to lint yield in three Egyptian cotton cultivars , i.e. Giza 85, Giza 77 and Giza 76, during the two seasons 1994 and 1995.

Using path coefficient analysis, ranks of the five factors contributing to lint yield per plant and their interaction differed. Number of open bolls had the highest direct effect for the three cultivars during the two seasons of study. It amounted to 34.68, 60.23 and 46.86% for Giza 85, Giza 77 and Giza 76 respectively.

Moderate direct effect in both seasons were recorded for number of fruiting branches per plant for Giza 85 and boll weight for Giza 77 and Giza 76.

## INTRODUCTION

Knowledge concerning the association between characters is of prime importance to the breeder because it broadens the perspective with which he can manipulate indirect selection for lint yield and the possibility of selecting for two or more characters simultaneously. Path coefficient analysis could be used in that respect. It partitions correlation coefficients into direct effects and indirect effects through alternate path ways (Dewey and Lu 1959). The relationships between yield components and lint yield have been discussed by a number of authors; El-Bayoumi (1978), Waldin *et al.* (1979), El-Marakby *et al.* (1980), El-Shaer *et al.* (1984); Nsrallah (1987). Shafshak *et al.* (1987) and Ghaly *et al.* (1990).

Using stepwise analysis, Worley *et al.* (1974), Seyam *et al.*, (1984) Abou Zahra *et al.*, (1992) and Abou-Tour *et al.*, (1996) determined the order of the relative

importance of the basic yield components on lint yield.

The present investigation was undertaken to study the relationship between five yield components and their contribution to lint yield variation on three Egyptian cotton cultivars: Giza 85, Giza 77 and Giza 76, to determine how genotypes affect the relative importance of characters contributing to lint yield.

## MATERIALS AND METHODS

Three Egyptian cotton cultivars, namely: Giza 85, Giza 77 and Giza 76 were sown during the last week of March 1994 and 1995 seasons at Sakha Agricultural Reseach Statation, Kafr El-Sheikh, Egypt.

A randomized complete block design with six replications was used. Each plot had five rows (4 meters long) and 60 cm wide and 25 cm between hills. Two plants per hill at thinning time were left. All agricultural practices were done according to the standard recommendations. Data were recorded on 30 plants chosen at random from each plot to study the association among lint per plant (g), boll appearance and plant height (cm). The relative importance of five main components on lint yield per plant for each of the three cotton cultivars was also studied. Path analysis was employed on each cultivar according to Dewey and Lu. (1959) to estimate the relative contribution of certain characters as a percentage of the total variability of the lint yield per plant.

## RESULTS AND DISCUSSION

The path coefficient analysis proposed by Wright (1921) was used to analyze some components of lint yield per plant within the three Egyptian cotton cultivars Giza 85, Giza 77 and Giza 76. Simple correlation coefficients between lint yield/plant and the characters that might have contributed to it were partitioned into their components. Therefore, path coefficient method was followed to find the relative importance of these five characters contributing to lint yield.

Direct and indirect path coefficients are illustrated in Table 1. The relative importance of each trait to lint yield/plant is presented in Table 2. It includes the percentage of variation contributed by each trait and its interaction with other traits.

For Giza 85, path coefficient (Table 1) indicated that the number of open bolls/plant in season 1995 and number of fruiting branches in season 1994 had size-

able positive direct effect on lint yield. Also, date of the first flower appearance and plant height revealed moderate positive direct effect on the same trait in season 1994. However, the other three traits i.e. number of fruiting branches, date of the first flower and plant height exhibited negligible direct effect on lint yield per plant in 1995. The indirect effect of number of fruiting branches through number of open bolls in 1995, the indirect effect of date of first flower through number of fruiting branches in 1994, number of open bolls through boll weight and number of fruiting branches, boll weight through number of fruiting branches and number of open bolls in 1994 and 1995 seasons, respectively, and plant height through number of open bolls in 1995 and number of fruiting branches in 1995 seasons were considerable. Other indirect effects were small in magnitude.

The data in Table 2 indicates that the five traits and their interaction as sources of total lint yield/plant variations, were responsible for 97.21% and 88.09% in 1994 and 1995, respectively. The main determinants of lint yield/plant were ordered according to their relative importance in both seasons. In 1994 seaso n, the main sources of variation were boll weight x number of fruiting branches, direct effect of fruiting branches, boll weight and number of open bolls/plant x number of fruiting branches, boll weight x number of open bolls and direct effect of number of open bolls/plant. These main yield-related components were responsible for about 94.05%.

In the second season, the main components of lint yield per plant were arranged according to their importance i.e. nubmer of open bolls per plant followed in order by its joint effect with both plant height and number of fruiting branches. These main sources were responsible for about 84.39% of the variations. The residual effects of the other yield components not accounted for in this study in both season ranged from 2.81% to 11.91%.

As for Giza 77, (Table 1), the direct effect of number of open bolls per plant ranked first and exceeded all the other effects in both seasons. Direct effect of boll weight ranked second in both seasons. The indirect path effect of number of fruiting branches through number of open bolls was positive and moderate.

The contributions of five traits and their interaction to lint yield per plant (Table 2) represented 99.94% and 99.14% of the total variation in 1994 and 1995, respectively. The main sources of variation in 1994 season were the direct effect of number of open bolls followed in order by joint effect of it with boll weight and

Table 1. Partitioning of simple correlation coefficients between lint yield/plant and its components in three cultivars in 1994 and 1995 seasnons.

| Sources | Giza 85 | | Giza 77 | | Giza 76 | |
|---|---|---|---|---|---|---|
| | 1994 | 1995 | 1994 | 1995 | 1994 | 1995 |
| **1- Boll weight vs.lint yield/plant.** | | | | | | |
| Direct effect (Py1) | -4.0633 | 0.0046 | 0.4743 | 0.4076 | 0.3563 | 1.2037 |
| Indirect via no.of open bolls | 0.1796 | 0.1175 | -0.2517 | -0.3844 | -0.1405 | -0.3854 |
| Indirect via no. of fruiting branches | 4.0789 | 0.0061 | 0.0091 | -0.0001 | 0.0061 | -0.0154 |
| Indirect via date of first flower | 0.0335 | -0.0095 | -0.1175 | -0.0065 | 0.0016 | -0.0060 |
| Indirect via plant height | -0.0179 | 0.0144 | -0.0108 | -0.0036 | -0.0044 | 0035 |
| Total correlation (ry1) | 0.2108 | 0.13313 | 0.1033 | 0.0130 | 0.2191 | 0.8004 |
| **2- No.of open bolls vs.lint yield/plant** | | | | | | |
| Direct effect (Py2) | -0.9806 | 0.8255 | 0.9608 | 1.0866 | 0.9065 | 1.2579 |
| Indirect via boll weight | 0.7441 | 0.0007 | -0.1243 | -0.1442 | -0.0552 | -0.3688 |
| Indirect via no. of fruiting branches | 1.2538 | 0.0192 | 0.0224 | -0.0021 | 0.0351 | 0.1141 |
| Indirect via date of first flower | -0.0886 | 0.0024 | 0.0580 | 0.0008 | 0.0043 | -0.0011 |
| Indirect via plant height | 0.0299 | 0.0794 | -0.0080 | -0.0189 | 0.003 | -0.0933 |
| Total correlation (ry2) | 0.9586 | 0.9272 | 0.9090 | 0.9227 | 0.8910 | 0.9087 |
| **3- No.of fruiting branches vs.Lint yield** | | | | | | |
| Direct effect (Py3) | 4.3807 | 0.0454 | 0.0688 | -0.0037 | 0.1349 | 0.1859 |
| Indirect via boll weight | -3.7834 | 0.0006 | 0.0630 | 0.0091 | 0.0161 | -0.0999 |
| Indirect via no. of open bolls | -0.2806 | 0.3483 | 0.3133 | 0.6031 | 0.2362 | 0.7720 |
| Indirect via date of first flower | -0.0445 | 0.0019 | 0.0297 | -0.0043 | 0.0055 | 0.0135 |
| Indirect via plant height | -0.0860 | 0.0668 | -0.0411 | -0.0269 | -0.0452 | -0.1770 |
| Total correlation (ry3) | 0.1862 | 0.4631 | 0.4336 | 0.5773 | 0.3475 | 0.6945 |
| **4- Plant height vs.lint yield/plant** | | | | | | |
| Direct effect (Py4) | 0.4915 | -0.0392 | -0.2313 | 0.0321 | -0.0180 | 0.0785 |
| Indirect via boll weight | -0.2769 | 0.0011 | 0.2410 | -0.0822 | -0.0316 | -0.0912 |
| Indirect via no. of open bolls | 0.1767 | -0.0511 | -0.2409 | 0.0281 | -0.2166 | -0.0181 |
| Indirect via no. of Fruiting branches | -0.3965 | -0.0022 | -0.0088 | 0.0005 | -0.0415 | 0.0320 |
| Indirect via plant height | -0.1673 | -0.0224 | -0.0061 | 0.0030 | 0.0317 | -0.0510 |
| Total correlation (ry4) | -0.1725 | -0.1138 | -02461 | -0.0186 | -0.2760 | -0.0499 |
| **5-Plant height vs. lint yield/plant** | | | | | | |
| Direct effect (Py5) | 0.5249 | 0.1412 | -0.0777 | -0.0395 | -0.0918 | -0.2243 |
| Indirect via boll weight | 0.1383 | 0.0005 | 0.0662 | 0.0373 | 0.0169 | 0.0185 |
| Indirect via no. of open bolls | -0.0558 | 0.4640 | 0.0987 | 0.5073 | -0.0026 | 0.5233 |
| Indirect via no. of Fruiting branches | -0.7180 | 0.0215 | 0.0364 | -0.0025 | 0.0664 | 0.1467 |
| Indirect via date of first flower | -0.1567 | 0.0062 | -0.0181 | -0.0025 | 0.0062 | 0.0179 |
| Total correlation (ry4) | -0.2673 | 0.6334 | 0.1054 | 0.5002 | -0.0048 | 0.4450 |

Table 2. Coefficient of determination (direct and joint effect) in percentage of lint yield/plant varition for three cultivars in 1994 and 1995 seasons.

| Source of variation | Giza 85 | | | | Giza 77 | | | | Giza 76 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1994 | | 1995 | | 1994 | | 1995 | | 1994 | | 1995 | |
| | C.D. | % | C.D. | % | C.D. | % | C.D. | % | C.D. | % | C.D. | % |
| Boll weight (g) (x1) | 16.51 | 21.06 | 0.00 | 0.00 | 0.22 | 12.74 | 0.17 | 9.59 | 0.13 | 10.29 | 1.45 | 24.79 |
| No.of open bolls/plant (x2) | 0.96 | 1.23 | 0.68 | 68.13 | 0.92 | 52.31 | 1.18 | 68.15 | 0.82 | 66.64 | 1.58 | 27.07 |
| No. of fruiting branches (x3) | 19.19 | 24.48 | 0.00 | 0.21 | 0.00 | 0.27 | 0.00 | 0.00 | 0.02 | 1.47 | 0.03 | 0.59 |
| Date of first flower (x4) | 0.24 | 0.31 | 0.00 | 0.15 | 0.05 | 3.03 | 0.00 | 0.06 | 0.00 | 0.03 | 0.01 | 0.11 |
| Plant height (cm) (x5) | 0.28 | 0.35 | 0.02 | 1.99 | 0.01 | 0.34 | 0.00 | 0.09 | 0.01 | 0.68 | 0.05 | 0.86 |
| x1 X x2 | -1.4592 | 1.86 | 0.0011 | 0.11 | -0.2388 | 13.53 | -0.3134 | 18.09 | -0.1004 | 8.12 | -09279 | 15.87 |
| x1 X x3 | -33.1478 | 42.28 | 0.0001 | 0.01 | 0.0087 | 0.49 | -0.0001 | 0.00 | 0.004 | 0.35 | -0.0371 | 0.64 |
| x1 X x4 | -0.2722 | 0.35 | 0.0001 | 0.01 | -0.1115 | 6.32 | -0.0053 | 0.30 | 0.0011 | 0.09 | -0.0143 | 0.25 |
| x1 X x5 | 0.1452 | 0.19 | 0.0001 | 0.01 | -0.0103 | 0.58 | -0.0029 | 0.17 | -0.0031 | 0.25 | 0.0083 | 0.14 |
| x2 X x3 | -2.4588 | 3.14 | 0.0316 | 3.16 | 0.0431 | 2.44 | -0.0045 | 0.26 | 0.063 | 5.17 | 0.2870 | 4.91 |
| x2 X x4 | 0.1737 | 0.22 | 0.0040 | 0.40 | 0.1114 | 6.31 | 0.0918 | 0.10 | 0.007 | 0.63 | -0.0028 | 0.05 |
| x2 X x5 | -0.0586 | 0.07 | 0.1311 | 13.10 | -0.0153 | 0.87 | -0.0400 | 2.31 | 0.0005 | 0.04 | -0.2347 | 4.02 |
| x3 X x4 | -0.3897 | 0.50 | 0.0002 | 0.02 | 0.0041 | 0.23 | -0.0000 | 0.00 | 0.001 | 0.12 | 0.0050 | 0.09 |
| x4 X x5 | -0.7538 | 0.96 | 0.0061 | 0.61 | -0.0057 | 0.32 | 0.0002 | 0.01 | -0.0122 | 0.99 | -0.0658 | 1.13 |
| x4 X x5 | -0.1645 | 0.21 | 0.0018 | 0.18 | 0.0028 | 0.16 | 0.0002 | 0.01 | -0.0011 | 0.09 | -0.008 | 0.14 |
| Residual | 2.2057 | 2.81 | 0.1191 | 11.91 | -0.0009 | 0.06 | 0.014 | 0.86 | 0.0620 | 5.02 | -1.1319 | 19.36 |

C.D. = Coefficient of determination.

% = Percentage contributed.

direct effect of boll weight followed in order by joint effect of it with date of the first flower and number of open bolls x date of first flower. The main sources are responsible for about 91.21% of the variation. In 1995, the direct effect of number of open bolls was followed in order by the joint effect of boll weight, direct effect of boll weight and number of open bolls x plant height. These main sources are responsible for about 98.14%. The other component generally, showed slight contribution to lint yield per plant.

As for Giza 76, data in Table 1, indicated that direct effect of number of open bolls per plant was high in magnitude and exceeded the other traits during the two seasons and boll weight exhibited positive direct effect in 1994 and a high direct effect in 1995 season. The indirect effect of number of fruiting branches through number of open bolls/plant was positive in two seasons. This means that, with other variables held constant, increasing the average boll weight will increase lint yield/ plant. On the other hand, the path analysis showed that most of the combined effects of date of first flower and plant height effect on lint yield per plant were indirectly affected through number of open bolls per plant in 1994 and 1995, respectively. From Table 2, it is shown that the five traits and interactions were responsible for 94.96% and 80.66% of total variation in 1994 and 1995, respectively. The main sources of variation in both seasons were the direct effect of number of open bolls, boll weight the joint effects of number of open bolls with boll weight, number of fruiting branches and the plant height in 1995 season. These main sources were responsible for about 90.22% and 76.66% of variations in 1994 and 1995 seasons, respectively.

Generally, it could be concluded that the nubmer of open bolls per plant is an essential factor in determining plant yield since it is expected to have the greatest direct influence upon lint yield per plant for the three cultivars during both seasons. It amounted to 34.68%, 60.23% and 46.86% for Giza 85, Giza 77 and Giza 76.

The results of this study were in partial agreement with those of Worley *et al.* (1974). El-Bayoumi (1978), El-Marakaby *et al.* (1980), El-Shaer *et al.* (1990), Abou Zahra *et al.* (1992), Abou-Tour *et al.* (1996) and El-Beily *et al.* (1996) who reported that boll number made the greatest contribution to cotton yield, but they mentioned different orders with regard to other contributing characters.

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# تحليل معامل المرور لبعض الصفات التى تساهم فى كمية محصول الشعر لثلاثة أصناف من القطن المصرى

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أجريت هذه الدراسة بمحطة البحوث الزراعية بسخا لتحديد الأهمية النسبية لمساهمة بعض الصفات فى كمية محصول القطن الشعر خلال موسمى ١٩٩٤ ، ١٩٩٥ وزرعت الأصناف التجارية الثلاثة جيزه ٨٥، جيزه ٧٧، جيزه ٧٦ فى تجربة تصميم قطاعات كاملة عشوائية ذات ستة مكررات والصفات التى درست هى محصول النبات الفردى من القطن الشعر – وزن اللوزه – عدد اللوز على النبات – عدد الأفرع الثمرية على النبات – موعد ظهور أول زهرة – طول النبات.

وقدرت المساهمة النسبية لكل صفة بإستخدام طريقة معامل المرور لتقدير ما تساهم به كل صفة فى المحصول كنسبة مئوية حيث يمكن ترتيب الصفات حسب أهميتها النسبية فى محصول القطن الشعر فى الصنف جيزه ٨٥ فى الموسم الأول كما يلى : التأثير المشترك لوزن اللوزه مع عدد الأفرع الثمرية (٤٢,٢٨٪)، عدد الأفرع الثمرية (٢٤,٤٨ ٪)، وزن اللوزه (٢١,٠٦٪) والتأثير المشترك لعدد اللوز المتفتح مع عدد الأفرع الثمرية (٣,١٤٪) والتأثير المشترك لوزن اللوزه مع عدد اللوز المتفتح (١,٨٦ ٪) والتأثير المباشر لعدد اللوز المتفتح (١,٢٣٪) وتساهم هذه العوامل بحوالى (٩٤,٠٥٪) من التباين الكلى لمحصول الشعر. وأمكن ترتيب الصفات فى الموسم الثانى كما يلى عدد اللوز المتفتح على النبات (٦٨,١٣٪) والتأثير المشترك لعدد اللوز المتفتح على النبات وطول النبات (١٣,١٠٪) والتاثير المشترك لعدد اللوز المتفتح على النبات وعدد الافرع الثمرية (٣,١٦٪) وتساهم هذه العوامل بحوالى ٨٤,٣٩٪ من التباين الكلى لمحصول القطن الشعر.

ويمكن ترتيب الصفات فى الصنف جيزه ٧٧ فى الموسم الأول كما يلى : عدد اللوز المتفتح ٥٢,٣١٪ التأثير المشترك لعدد اللوز المتفتح مع وزن اللوزه ١٣,٥٣٪، والتأثير المباشر لكل من وزن اللوزه ١٢,٧٤٪ تاريخ ظهور أول زهره ٦,٣٢٪، التأثير المشترك لعدد اللوز المتفتح مع تاريخ ظهور أول زهره ٦,٣١٪ وتساهم هذه العوامل بحوالى ٩١,٢١٪ من التباين الكلى لمحصول القطن الشعر ويمكن ترتيب الصفات فى الموسم الثانى كما يلى : عدد اللوز المتفتح ٦٨,١٥٪، التأثير المشترك لوزن اللوزه المتفتح ١٨,٠٩٪، والتأثير المباشر لوزن اللوزه ٩,٥٩٪، والتأثير المشترك لعدد اللوز المتفتح مع طول النبات ٢,٣١٪ ومجموع مساهمة هذه العوامل يبلغ حوالى ٩٨,١٤٪ مع التباين الكلى لمحصول القطن الشعر.

ويمكن ترتيب الصفات فى الصنف جيزه ٧٦ فى الموسم الأول كما يلى : عدد اللوز المتفتح ٦٦,٦٤٪، وزن اللوزه ١٠,٢٩٪، والتأثير المشترك لعدد اللوز المتفتح مع وزن اللوزه ٨,١٢٪، التأثير المشترك لعدد اللوز المتفتح مع عدد الأفرع الثمرية ٥,١٧٪ ومجموع مساهمة هذه العوامل يبلغ حوالى ٩٠,٢٢٪ من التباين الكلى لمحصول القطن الشعر. وفى الموسم الثانى كان ترتيب الصفات كما يلى: عدد اللوزن المتفتح ٢٧,٠٧٪، وزن اللوزه ٢٤,٧٩٪، والتاثير المشترك لعدد اللوز المتفتح مع وزن اللوزه ١٥,٨٧٪، التأثير المشترك لعدد اللوز المتفتح مع عدد الأفرع الثمرية ٤,٩١٪، التأثير المشترك لعدد اللوز المتفتح مع طول النبات ٤,٠٢٪ ومجموع مساهمة هذه العوامل يبلغ حوالى ٧٦,٦٦٪ من التباين الكلى لمحصول القطن الشعر.