

Original Research Article

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Genotypic Path Coefficient Analysis of Cotton Derived through Introgression

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A B S T R A C T

Present investigation was carried out with 38 cotton genotypes including both the species *G. arboreum* and *G. hirsutum* in randomized complete block design with three replications. The observations were reported from three randomly selected plants from each treatment and replication on 17 characters viz., Plant height (cm), number of nodes per plant, length of internodes (cm), number of monopodia per plant, number of sympodia per plant, number of bolls per plant, Boll weight (g), seed cotton yield per plant (g), ginning out turn (%), lint index (g), seed index (g), fibre quality traits including 2.5% span length, fineness (MIC), bundle strength, Fibre elongation, uniformity ratio (UR) and short fibre index (SFI). Path coefficient analysis revealed positive direct genotypic effect on seed cotton yield per plant through boll weight, number of bolls per plant, seed index, ginning out turn, number of sympodia per plant, 2.5% span length, length of internodes, short fibre index, fibre elongation and number of monopodia per plant while negative direct effect was observed with lint index, plant height, bundle strength, number of nodes per plant and micronaire value except lint index that had positive direct phenotypic effect on seed cotton yield per plant. The positive direct effect on seed cotton yield per plant through boll weight, number of bolls per plant, seed index, ginning out turn, number of sympodia per plant, 2.5% span length, length of internodes, short fibre index, fibre elongation and number of monopodia per plant reveals that these traits can be directly manipulated for increased yield and fibre quality.

Keywords

Path coefficient,
G. hirsutum,
G. arboreum,
Introgression.

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Introduction

Cotton is one of the oldest fibers known to mankind. The Indus Valley Civilization traces the history of cotton fabric in Indian subcontinent to 4300 years B.C (Gulati and Turner, 1928). The first improvement in spinning technology was the spinning wheel, which was invented in India between 500 and 1000 A. D. (Smith and Cothren, 1999). Cotton is the most important textile fiber crop and is the second most important oil seed crop in the world (Cherry and Leffler, 1984). The genus, *Gossypium* that belongs to the family

Malvaceae and tribe *Gossypieae*, comprises about 50 species of tree, shrubs and herbs (Fryxell, 1971). Out of these, 45 species are diploid and 5 allopolyploid, which are distributed throughout the arid and semi-arid regions of Africa, Australia, Central & South America, the Indian subcontinent, Arabia and Hawaii. A peculiarity among the 50 species identified and described so far in *Gossypium*, four species are cultivated and remaining are wild species (Endrizzi *et al.*, 1985). All the species of Cotton have an aggregate

geographical range that encompasses most tropical and Sub-tropical regions of the world. These cultivated species consists considerable genetic diversity as they are acclimatized to coastal as well as desert ecosystems which reveal the diverse nature of genes present in cotton, which are of high commercial value with tolerance to many environmental vagaries. Path coefficient analysis revealed that boll number had a high positive direct effect on yield. While, other traits contributed indirectly through sympodia number and boll number in upland cotton (Singh *et al.*, 1981). A positive direct effect of various traits viz., plant height (Sumathi and Nadarajan, 1995) and boll number (Manimaran, 1999). However, negative direct effect of mean fiber length (Jahangir *et al.*, 1990) was also observed.

In the present investigation, path coefficient analysis was carried out using genotypic correlation coefficients and taking the seed cotton yield as the dependent variable in order to see the causal factor and to identify the best components which are responsible for producing seed cotton yield per plant.

Materials and Methods

The experiment location is situated at 332 meter above the mean seas level. It is included in Nimar valley zone under 15 D2 agro-ecological zones. The ruling climate is hot semiarid with an average precipitation of 500-1000 mm. The present study was carried out with 38 genotypes of cotton derived through introgression including both the species *G. arboreum* L. and *G. hirsutum* L. The important wild species used for introgression breeding are *G. tomentosum* L., *G. riomondii* L., *G. stocksii* L. and *G. anomalum* L. (List of 38 genotypes and their sources have been presented in Table 1.1) in randomized block design with three replication at Region Research Station,

Khandwa under the JNKVV, Jabalpur (MP). Each entry consisted 2 rows of 6 m length with inter and intra row spacing of 60x60 cm. The observations were recorded on three randomly selected competitive plants from each genotype in each replication for seventeen components characters viz., Plant height (cm), number of nodes per plant, length of internodes (cm), number of monopodia per plant, number of sympodia per plant, number of bolls per plant, boll weight (g), seed cotton yield per plant (g), ginning out turn (%), lint index (g), seed index (g), fibre quality traits including 2.5% span length, fineness (MIC), bundle strength, fibre elongation, uniformity ratio (UR), short fibre index (SFI).

Results and Discussion

Path coefficient analysis was carried out for yield per plant as dependent variables and component characters including fibre quality traits at genotypic level which is represented in Table 1.2. The direct and indirect effects of various yield contributing traits showed similarly in their direction for the dependent variables. A highest positive direct effect was observed for boll weight with an estimate of 0.95 and 0.82 at genotypic and phenotypic level respectively. Whereas, lowest estimates were obtained by number of monopodia with an estimate of 0.05 and 0.00 at genotypic and phenotypic level respectively. However, negative genotypic and phenotypic direct effect of low magnitude was seen with number of nodes per plant, plant height, micronaire value and bundle strength.

Genotypic analysis

It indicated on genotypic basis revealed that boll weight (0.95), number of bolls per plant (0.56), seed index (0.39), ginning out turn (0.29), number of sympodia per plant (0.28), 2.5% span length (0.18), length of internode

(0.12), short fibre index (0.06), fibre elongation (0.05) and number of monopodia per plant (0.05) had positive direct effect on seed cotton yield per plant. While, other traits viz., lint index (-0.32), plant height (-0.15), bundle strength (0.11), number of nodes per plant (-0.09) and micronaire value (0.02) has made negative direct effect with seed cotton yield per plant.

Number of nodes per plant

Positive indirect effect on seed cotton yield recorded through boll weight (0.04), 2.5% span length and seed index (0.02). However, its negative indirect effect on seed cotton yield per plant (0.26), number of nodes per plant (-0.09), plant height (-0.07), number of sympodia per plant (-0.06), length of internode (-0.05), ginning out turn (-0.04), number of monopodia per plant (-0.02), number boll per plant (-0.02), lint index (-0.01), uniformity ratio (0.01) and fibre elongation (-0.02).

Length of internode (cm)

It reflected positive indirect effect with plant height (0.10), number of nodes per plant (0.06), number of sympodia per plant (0.05), ginning out turn (0.04), number of monopodia (0.02), number of bolls per plant (0.02), bundle strength (0.02), fibre elongation (0.01), lint index (0.01) and short fibre index (0.01) and negative indirect effect with seed cotton yield per plant (-0.11), boll weight (0.03), seed index (-0.02) and 2.5% span length (-0.01).

Number of monopodia per plant

It showed indirect positively effect on plant height (0.02), number of bolls per plant (0.02), number of sympodia per plant (0.02), seed cotton yield per plant through number of nodes (0.01), length of internode (0.01), bundle strength (0.01) and fibre elongation

(0.01). Whereas, negative indirect coefficient effect with seed cotton yield per plant (-0.13) was observed.

Boll weight (g)

Direct contribution of this trait on seed cotton yield per plant was found highly positive, whereas indirect positive effect was recorded viz., seed cotton yield per plant (0.77), uniformity ratio (0.23), seed index (0.09), lint index (0.02) and micronaire value (0.02). However, the trait viz., number of sympodia per plant (-0.52), number of nodes per plant (-0.47), number of monopodia per plant (0.43), plant height (-0.35), length of internode (-0.29), number of bolls per plant (-0.23), bundle strength (-0.22), short fibre index (0.13), fibre elongation (-0.09), ginning out turn (-0.05) and 2.5% span length (-0.02) had negatively indirect effect.

Plant height (cm)

Indirect positive effect through seed index (0.03), 2.5% span length (0.01) and micronaire value (0.01) and negative indirect effect through seed cotton yield per plant (-0.16), plant height (0.15), number of nodes per plant (-0.13), length of internode (0.12), number of sympodia per plant (-0.09), number of monopodia per plant (-0.06), ginning out turn (-0.05), fibre elongation (-0.05), number of bolls per plant (-0.04), bundle strength (-0.03) and uniformity ratio (-0.01) was observed.

Number of bolls per plant

It had a positive indirect effect on seed cotton yield per plant through seed cotton yield per plant (0.40), number of sympodia per plant (0.38), number of monopodia per plant (0.25), number of nodes per plant (0.16), plant height (0.15), length of internode (0.13), uniformity ratio (0.13), ginning out turn (0.11), micronaire value (0.11), bundle strength

(0.07), short fibre index (0.04) and fibre elongation (0.02). Negative indirect effect was observed with seed index (-0.17), 2.5% span length (-0.13) and lint index (-0.06).

Number of sympodia per plant

Positive indirect effect on seed cotton yield per plant through number of nodes per plant (0.15), number of bolls per plant (0.14), plant height (0.13), length of internode (0.09), number of monopodia per plant (0.07), ginning out turn (0.07), short fibre index (0.06), fibre elongation (0.05), uniformity ratio (0.03), micronaire value (0.03), bundle strength (0.02), and negative indirect effect with boll weight (-0.11), seed index (-0.10), 2.5% span length (-0.07), lint index (-0.04) and seed cotton yield per plant (0.04) were found.

Lint index

It contribute a positive indirect effect on seed cotton yield per plant through short fibre index (0.11), micronaire value (0.08), number of sympodia per plant (0.06), fibre elongation (0.06), number of bolls per plant (0.03), number of monopodia (0.01), and negative indirect effect with lint index (-0.32), short fibre index (0.22), ginning out turn (-0.14), 2.5% span length (-0.08), number of nodes per plant (-0.03), length of internode (-0.03), bundle strength (-0.03), plant height (-0.02), seed cotton yield per plant (0.02) and uniformity ratio (-0.01).

Ginning out turn (%)

It extended a positive indirect effect on seed cotton yield per plant through plant height (0.29), number of nodes per plant (0.13), lint index (0.13), length of internode (0.11), number of sympodia per plant (0.10), short fibre index (0.09), uniformity ratio (0.07) and number of bolls per plant (0.06). Whereas, negative indirect effect on seed cotton yield per plant through 2.5% span length (-0.12),

seed index (-0.08), bundle strength (-0.07), fibre elongation (-0.01), and boll weight (-0.01) was observed.

2.5% span length (mm)

Positive indirect effect on seed cotton yield per plant through seed index (0.11), bundle strength (0.07) and lint index (0.04) was observed. The traits viz., seed cotton yield per plant (-0.16), short fibre index (-0.14), micronaire value (-0.10), length of internode (0.10), uniformity ratio (-0.09), ginning out turn (-0.07), number of sympodia per plant (-0.06), number of bolls per plant (-0.04), number of nodes per plant (-0.02), plant height (-0.02) and number of monopodia per plant (-0.01) showed negative indirect effect on seed cotton yield per plant.

Uniformity ratio

It had positive indirect effect on seed cotton yield per plant through micronaire value (0.03), boll weight (0.02), number of bolls per plant (0.02), ginning out turn (0.02), plant height (0.01), number of sympodia per plant (0.01), and number of nodes per plant (0.01). However, negative indirect effect on seed cotton yield per plant through 2.5% span length (-0.05), bundle strength (-0.01), short fibre index (-0.01) and seed index (-0.01) was revealed.

Micronaire value

It showed indirect positive effect on seed cotton yield per plant through 2.5% span length (0.01) and bundle strength (0.01).

Bundle strength

It had indirect effect on seed cotton yield per plant recorded through micronaire value (0.05), short fibre index (0.04), boll weight (0.02), ginning out turn (0.02) and uniformity ratio (0.01) were positive.

Table.1 List of 38 genotypes

Sr. No.	Entry Sr. No.	Source	Sr. No.	Entry Sr. No.	Source
1.	GISV-33	Surat	20.	TCH-1648	Coimbatore
2.	GISV-61	Surat	21.	TCH-1649	Coimbatore
3.	GISV-203	Surat	22.	TCH-1652	Coimbatore
4.	GISV-206	Surat	23.	TCH-1691	Coimbatore
5.	GISV-216	Surat	24.	TCH-1692	Coimbatore
6.	GISV-238	Surat	25.	TCH-1695	Coimbatore
7.	GISV-240	Surat	26.	TCH-1696	Coimbatore
8.	G.Cot. 11 x AH-36-1	Surat	27.	KWIS-11	Khandawa
9.	G. Cot. 11 x AH-32-3	Surat	28.	KWIS-19	Khandawa
10.	G. Cot. 11 x Hh-1	Surat	29.	KWIS-27	Khandawa
11.	Digvijay x Hh-2	Surat	30.	KWIS-28	Khandawa
12.	AKH-0301	Akola	31.	KWIS-36	Khandawa
13.	AKH-0302	Akola	32.	KWIS-60	Khandawa
14.	AKH-0303	Akola	33.	HD-453	Hisar
15.	AKH-0304	Akola	34.	HD-446	Hisar
16.	AKH-0305	Akola	35.	IS-14/21	Nanded
17.	AKH-0306	Akola	36.	IS-30/68	Nanded
18.	AKH-0311	Akola	37.	Khandwa-2(c)	Check <i>G.hirsutum</i>
19.	AKH-0312	Akola	38.	Jawahar Tapti (c)	Check <i>G.arboreum</i>

Table.2 Genotypic path coefficient showing direct and indirect effect of quantitative and fibre quality traits on seed cotton yield per plant

Char acter		NON /p	INL (cm)	NOM /p	BW (g)	PH (cm)	NOB /p	NOS /p	LI	GOT %	2.5% SL	UR	MIC	BS	FE	SFI	SI	SCY /p
NON/p	G	-0.09	-0.05	-0.02	0.04	-0.07	-0.02	-0.06	-0.01	-0.04	0.01	-0.01	0.00	0.00	-0.02	0.00	0.02	-0.26
INL (cm)	G	0.06	0.12	0.02	-0.03	0.10	0.02	0.05	0.01	0.04	-0.01	0.00	0.00	0.02	0.01	0.01	-0.02	-0.11
NOM/p	G	0.01	0.01	0.05	-0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	-0.13
BW (g)	G	-0.47	-0.29	-0.43	0.95	-0.35	-0.23	-0.52	0.02	-0.05	-0.02	0.23	0.02	-0.22	-0.09	-0.13	0.09	0.77
PH (cm)	G	-0.13	-0.12	-0.06	0.05	-0.15	-0.04	-0.09	0.00	-0.05	0.01	-0.01	0.01	-0.03	-0.05	0.00	0.03	-0.16
NOB/p	G	0.16	0.13	0.25	-0.13	0.15	0.55	0.38	-0.06	0.11	-0.13	0.13	0.11	0.07	0.02	0.04	-0.17	0.40
NOS/p	G	0.15	0.09	0.07	-0.11	0.13	0.14	0.20	-0.04	0.07	-0.07	0.03	0.03	0.02	0.05	0.06	-0.10	-0.04
LI	G	-0.03	-0.03	0.01	0.00	-0.02	0.03	0.06	-0.32	-0.14	-0.08	-0.01	0.08	-0.03	0.06	0.11	-0.22	-0.02
GOT %	G	0.13	0.11	0.00	-0.01	0.11	0.06	0.10	0.13	0.29	-0.12	0.07	0.01	-0.07	-0.01	0.09	-0.08	0.12
2.5% SL	G	-0.02	-0.10	-0.01	0.00	-0.02	-0.04	-0.06	0.04	-0.07	0.18	-0.09	-0.10	0.07	0.00	-0.14	0.11	-0.16
UR	G	0.01	0.00	0.00	0.02	0.01	0.02	0.01	0.00	0.02	-0.05	0.09	0.03	-0.01	0.00	-0.01	-0.01	0.38
MIC	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	-0.02	0.01	0.00	0.00	0.00	0.13
BS	G	0.00	-0.02	-0.03	0.02	-0.02	-0.01	-0.01	-0.01	0.02	-0.04	0.01	0.05	-0.11	-0.05	0.04	-0.03	-0.14
FE	G	0.01	0.00	0.01	0.00	0.01	0.00	0.01	-0.01	0.00	0.00	0.00	0.00	0.02	0.05	0.00	0.00	-0.05
SFI	G	0.00	0.00	0.00	0.00	0.00	0.00	0.01	-0.02	0.02	-0.05	0.00	0.02	-0.02	0.00	0.06	-0.04	-0.08
SI	G	-0.08	-0.05	-0.01	0.03	-0.07	-0.10	-0.16	0.23	-0.10	0.22	-0.05	-0.13	0.11	-0.05	-0.22	0.33	-0.10

Bold figure in diagonal represent direct path effect

However, negative indirect effect with fibre elongation (0.05), 2.5% span length (-0.04), seed index (-0.03), number of monopodia per plant (-0.03), length of internode (-0.02), plant height (-0.02), number of bolls per plant (-0.01), number of sympodia per plant (-0.01), lint index (-0.01) and seed cotton yield per plant was observed.

Fibre elongation

The established positive direct effect on seed cotton yield per plant through bundle strength (0.02), number of nodes per plant (0.01), number of monopodia per plant (0.01), plant height (0.01), number of sympodia per plant (0.01). The trait showed negative indirect effect on seed cotton yield per plant through ginning out turn (-0.01).

Short fibre index

Positive indirect effect on seed cotton yield per plant through number of ginning out turn (0.02), micronaire value (0.02), sympodia per plant (0.01) and negative indirect effect with seed cotton per plant (-0.08) and seed index (-0.04).

Seed index

It extended a positive indirect effect on seed cotton yield per plant through lint index (0.23), 2.5% span length (0.22), bundle strength (0.11) and boll weight (0.03). However, negative indirect effect with short fibre index (-0.22), number of sympodia per plant (0.16), number of bolls per plant (-0.10), ginning out turn (-0.10), micronaire value (-0.13), number of nodes per plant (-0.08), length of internode (-0.08), plant height (-0.07), uniformity ratio (-0.05), fibre elongation (-0.05), and number of monopodia per plant (-0.01).

The direct and indirect effect of seed cotton yield per plant showed that boll weight

contributes highest magnitude of positive direct effect on seed cotton yield per plant followed by number of bolls per plant, 2.5% span length, uniformity ratio, fibre length, short fibre index, except lint index. Therefore, these characters showed the true relationship and direct selection of these traits will be effective. Internode length had negative correlation with seed cotton yield and positive direct effect indicated restricted simultaneous selection model need to be followed.

Restriction may be imposed via plant height to attain high seed cotton yield per plant. Fibre elongation and short fibre index had negative correlation with seed cotton yield per plant but positive direct effect. Under these circumstances, a restricted simultaneous selection model is to be followed for 2.5% span length and bundle strength, to make use of direct effect.

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