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Research Article

Early Maturity in Cotton; Statistical Overview

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Abstract

To concentrate on the connections between early maturity and morph-phonological properties in cotton six varities of upland Cotton named varamin, early developing mutant (Mutagenese), 818-132, Bul-539, B-557 and Chirpan-539 were planted and a half diallel mating configuration included parents investigated in Cotton Research Institute, deputy of Varamin. Six parents and 15 hybrids in the next year were planted in a randomized complete block design with three replications. 17 components were collected and analyzed. Through stepwise regression analysis, early maturity was considered as dependent variable and other properties as independent variables. Accordingly, the production rate index, mean maturity data and plant height were liable for about 75 percent of early maturity changes.

Path analysis results uncovered that direct and negative effects of the production rate index (-0.6682) was viable in the development of the correlation with early maturity of (-0.809**). In any case, the roundabout impacts of production rate index on account of mean maturity data and plant height were unimportant. Direct effects of mean maturity data in correlation of this factor with early maturity (0.455**) was also significant (0.2462). Assessing the selection index revealed that in terms of early maturity, parent plant 1 (539-Bul) and hybrids 1*3, 1*4, 3*5 and 1*6 are superior to other hybrids. Changes in yield of varieties followed roughly 95% the maturity changes (r^2 = 0.946). Generally speaking, results from this study illustrated that the production rate index, mean maturity data and the plant height could be utilized as an marker to choose early maturing varieties.

Keywords: Cotton; Stepwise Regression; Path Analysis; Selection Index

Introduction

Most properties for further developing cotton are inherited as quantitative traits. Factors like yield, earliness, lint percentage, furthermore, resistance to pests are molded by quantitative genes. Numerous specialists have been baffled in endeavoring to tackle their hereditary issues by utilizing basic hereditary models, wherein few hereditary boundaries are utilized to depict complex circumstances. Quantitative characteristics are challenging to is altered by natural and the executives changes; (2) a trait, such as yield, is a composite of numerous different characteristics, each affected by a larger number of genes, each of which has variable effects; (3) the expression of an individual gene is often modified by the expression of other genes; (4) linkage blocks are difficult to breakup; (5) the ideal genotype for guaranteed climate the board framework may require quality commitment from numerous assorted sources; also (6) the ideal genotype for any climate the board framework is possible and may be different from that for another system, Ahmed [1]. Earliness of yield development is a significant objective in most cotton breeding projects, albeit that's what the advancement factors decide it are not totally perceived. Early development is the outcome of a few development and fruiting cycles, or parts, which are interrelated, and which apparently can be controlled independently in the breeding process. The proficiency with which these controls can be impacted relies extensively upon what we figure out about the inheritance and interrelationships among the determinants of earliness. An audit of accessible writing shows impressive variety in how earliness is characterized, and a hazy image of how different parts of earliness are acquired and connected with one another. It likewise is obvious that no single basis gives a sufficient, practical mark of earliness, and that viable modification of development can best be accomplished by choosing for more than one component of earliness. Node number of first fruiting branch is one morphological property that can be utilized to show earliness of development [2]. Node number can be resolved right off the bat in the season, it very well may be effectively and unequivocally recognized, and it is in ward of complexities emerging from shedding of natural product structures. Whenever considered as far as pace of natural product advancement and development, earliness might be characterized. As the degree to which squaring, blooming, and boll opening happen comparative with season of planting [3]. This definition doesn't consider how much seed cotton delivered, however it includes phonological occasions that are promptly noticeable and quantifiable. Several other parameters have been used as indicators or estimators of earliness, including rates of blooming [4] and maturation [5], vertical and horizontal flowering intervals [6], vertical and horizontal flowering intervals [6], mean maturity [7], production rate index [8], and portion of crop harvested by specified dates [3]. The study reported here was designed to address to determine associations among components of earliness and also to obtain a causal link between different traits and early maturity to get the best parent or parents and hybrid by the help of selection criterion [9,10].

Materials and Methods

Genetic material the study utilized one standard commercial cultivar and five 'early' genotypes developed by breeders in various parts of IRAN and other countries, as follows:

- Varamin. This variety constituted the check for this study; it shows vivacious vegetative growth and full season maturity.
- 818312. It is a compact and early maturing.
- Early mutagenesis. It is a mutation derived variety.
- Chirpan-539. It is a moderately compact cultivar of diminutive conformation with early to very early maturity.
- Bul-539. It is a short season culti var. It is moderately early and intermediate in height and growth habit.
- B-557. It is early in maturity, moderately compact.

Field procedures

All possible crosses, excluding reciprocals, were made among the six parental stocks, and field evaluation of the parents and 15 F1 were made at the Experiment Station, at Varamin, Tehran, Iran in a randomized complete block design with four replications. Plots consisted of two rows of 20 plants each, with plants spaced 20 cm apart. Agricultural practices followed were those thought about typical for the area, and included great pest control.

Collection of data

Subsequent to seedling plants became deep rooted, five representative, undamaged plants were chosen in each plot furthermore, set apart for identification. These five plants were observed and labeled to give the accompanying phonological information:

- Date of first square (DFS) - Number of days from planting to appearance of first square.
- Date of first flower (DFF) - Number of days from planting to appearance of first flower.
- Date of first open boll (DFOB) - Number of days from planting to opening of the first boll.
- Boll maturation period (BMP) - The time from anthesis of the flower until the resulting boll was sufficiently open to see the lint.
- Vertical flowering interval (VFI) - The number of days between flowerings at corresponding nodes on successive fruiting branches, up the main stem.
- Horizontal flowering interval (HFI) - The number of days between anthesis of flower at the first and second position on same fruiting branch.

Ten plants in the other row of each plot were utilized to collect data for the following variables:

- Percentage of crop harvested (PCH-I) - Ratio of weight of seed cotton harvested at the first picking to total weight of seed cotton harvested, expressed as a percentage.
- Percentage of crop harvested (PCH-2) - Ratio of weight of seed cotton harvested in combined first and second pickings to total weight of seed cotton harvested, expressed as a percentage.
- Bloom index (BI) - A weighted ratio calculated by dividing the total number of blooms recorded by the summation of the number of blooms per day x days from planting x 100. This index was recorded for the first 30 days of production of blooms.

- Maturity index (MI) - A weighted proportion determined by separating the complete number of open bolls recorded by the summation of the quantity of open bolls each day x days from establishing x 100. This index was determined by utilizing the complete number of open bolls.
- Mean maturity data (MMD) - The procedure to calculate MMD was the one given by Christidis and Harrison (1955).
- Production rate index (PRI) - The total seed cotton plot weight divided by the MMD.

Statistical analysis

The data for each recorded data were tabulated and analyzed by analysis of variance using plot means. Simple correlation coefficients (r) were calculated to determine the associations among the properties. Correlation and regression analyses were performed utilizing SPSS 22.0. The path analysis was performed using worked out example of Dewey and Lu (1959) and formula suggested by Wright (1921). Statistical associations between different traits and earliness were tested using stepwise multiple linear regressions with $p \leq 0.01$ as the criterion for prediction of regression equation.

Results and Discussion

Test of normality was conducted in all traits. Some of these traits did not show normal distribution so; one or two parents with the greatest variance were excluded.

The table of variance analysis is as follows.

S.O.V	D.F	DFF	Earliness	MI	NMON	Yield	MMD
Rep	2	13.14ns	0.003 ns	0.0014 ns	2.8 ns	0.77 ns	0.044 ns
Genotype	20	23.51 ns	0.012**	0.003 ns	2.11 ns	0.48 ns	0.12 **
Error	40	12.86	0.004	0.002	0.24	0.43	0.13
S.O.V	**D.F**	**HFI**	**DFOB**	**PRI**	**TB**	**D.F**	**PH**
Rep	2	0.79 ns	9.46 ns	0.00005 ns	1.187 ns	2	81.66 ns
Genotype	20	0.27 ns	41.57**	0.0001**	0.97*	14	541.47**
Error	40	0.19	10.69	0.00004	0.438	28	132.06
S.O.V	**D.F**	**BW**	**VFI**	**BMP**	**D.F**	**BI**	**DFS**
Rep	2	0.13 ns	5.29 ns	2.1 ns	2	0.000**	0.001 ns
Genotype	14	0.91 ns	12 ns	21.6 ns	9	0.004**	0.003 ns
Error	28	0.54	12.62	15.65	18	0.0014	0.009

Table 1: Analysis of genotypes' variance.

Regarding dependent variable of cotton earliness, the rate of measured traits participation as an independent variable on the PCH was computed by multiple stepwise regression analysis. Related co-efficient to each of introduced traits have been presented in the model of table 2. The regression equation showed that production rate index (coefficient of determination 0.653), mean maturity index (coefficient of determination 0.076) and plant height (coefficient of determination 0.026) remained with totally coefficient of determination 75.5 percent should be considered as target traits for improvement of cotton seed yield.

Steps	Independent variables	Intercept	(B)			R2	SE
			Production rate index (X1)	Mean maturity (X2)	Plant height (X3)		
1	Production rate index (X1)	4.822	-8.431	---	----	0.653	0.049
	Mean maturity (X2)						
2	Plant height (X3)	4.398	-7.745	0.0667	----	0.729	0.044
3		4.124	-6.961	-0.0583	-0.00088	0.755	0.042

Table 2: Fitting best stepwise multiple regression model for early maturity as dependent variable (y) and other traits as independent variables (x).

Path analysis

Results of causality analysis based on phenotypic correlations on early maturity as dependant variable (y) and separation of direct and indirect impacts of production rate index, mean maturity index and plant height as independent variable (x) in regression model showed that there is a correlation r = -0.808 between production rate index and early maturity which statistically is1 percent significant on level 1 (Table 3). The direct impacts of mean maturity index in correlation of this factor with early maturity are impressive (p = 0.2462). However, this indirect factor has major impact on early maturity through production rate index which based on the regression model for early maturity is as follows:

(Maturity) y = 4.124 – 6.961X3 -0.0583 X2 – 0.00088X3

Trait	Correlation with maturity	Direct impact	Total indirect impact	Indirect impacts of trait		
				Plant height	Mean maturity index	Production rate index
Production rate index	-0.809	-0.6682	-0.06574	-0.00834	-0.0574	_
Mean maturity index	0.455	0.2462	0.1908	0.0351	_	0.1557
Plant height	-0.557	-0.158	-0.3721	_	-0.0707	-0.3014

Table 3: Path analysis, direct and indirect impacts of production rate index, mean maturity index and plant height on early maturity in Cotton.

R2 = 0.755 remained impacts = 0.245.

Bilbro and Quisenberry (7) studies correspond with Ray and Richmond (13) researches. Direct impacts of plant height on the formation of correlation with early maturity ratio of (r = -0.557) is low (p = -0.185). But this impact is indirectly considerable via production rate index (p = -0.3014). In this way, production rate index and mean maturity with considerable direct impacts on early maturity can be considered as selection criterion. Also, plant height is the third priority as a selection criterion for early maturity. These three factors can explain 75 percent of the early maturity changes and can be appropriate criteria for premature line selection.

Selection criterion

In this study in order to select the best hybrid or parent from the early maturity point of view with the aid of index and via evaluated traits, early maturity (X1) along with production rate index (X2), mean maturity index (X3) and plant height (X4) which in causality analysis had great direct impacts on early maturity, were used to evaluate the selection criterion.

The obtained value of the index (b) for early maturity (X1) was -5.17, for production rate index (X2) was 21.67, for mean maturity index (X3) was 0.102 and for plant height (X4) was 0.797. The results of calculating the best hybrids or parents based on the following index shows that parent 1 (Bul – 539) and hybrids 1*3, 1*4. 3*5 and 1*6 in the case of early maturity factor are superior compared to other hybrids (with selection criterion of 62.27, 64.79, 66.53, 71.80 and 73.20).

I = - 5.17 1x + 21.67 2x + 0.102 3x + 0.797 4x

In addition, Figure 1 illustrates the correlation and regression between the selection criterion and early maturity. The correlation coefficient of (r = -0.712) shows a strong correlation between selection criteria and early maturity.

Calculating the accuracy of selection criteria value about 0.83 marks the suitability of attributes used in determining the selection criterion to obtain the maximum early maturity. It should be noted that due to the fact that the smallest numeric index value and the rate of greatest early maturity mean premature genotype; so, the relationship between selection criterion and early maturity is a strong relation with negative algebraic symbol (Figure 1).

To understand the relationships between maturity and genotypes' function, correlation and regression among traits determined results of which shown in figure 2.

Figure 1: Regression of selection criterion and early maturity.

Figure 2: Regression of genotype function and early maturity.

Between early maturity (x) and genotypes' function (y), the obtained correlation value was r = 0.973 which is significant in level 1. Thus, it can be concluded that changes in genotypes' function 95 percent follows the changes in genotypes' early maturity. (r^2 = 0.946). Therefore, it is expected that via selecting genotypes based on the early maturity or using the selection criteria at the same time yielding genotypes could be selected. In this case, the linear relationship for carries tests is as follows: y = 5.81 x – 2.41.

Conclusion

According to the fact that production rate, mean maturity and plant height indexes have been entered into the regression model, these attributes can be used as suitable indicators for selecting premature varieties.

Production rate index has direct and negative impacts (p = -0.668) on early maturity and consequently has a major role in the process of electing the premature varieties. After production rate index, respectively, mean maturity and plant height indexes can also be considered as second and third selection criteria for early maturity.

Due to the strong but with negative algebraic symbol correlation between selection criterion and early maturity rate, the more premature types can be selected via selecting the genotypes with smaller selection criterion.

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Conflict of Interest

The author declares that he has no competing interests.

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