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# High-yieldıng samples from the cotton genetic resources

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**ABSTRACT**

This study investigated six cotton varieties and 30 hybrid combinations derived from a complete differential cross. The varieties exhibited a range of up to 10 days in maturity. Notably, Nine hybrid combinations displayed heterosis for earliness, demonstrating faster maturation than either parent. Ten hybrid combinations exhibited intermediate inheritance patterns for earliness, with progeny leaning towards earlier or later maturity compared to the parental average. The varieties M-5027 and M-4007 demonstrated superior general combining ability for earliness and lower node of the first fruiting branch, indicating their potential as promising parents for breeding programs..

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## 1. Introduction

Cotton, a globally significant crop, encounters distinctive challenges in regions such as Turkestan, where the northernmost boundaries of its cultivation converge with the limitations of a brief growing season. The premature emergence of low autumn temperatures can impede the complete maturation of cotton plants, influencing yield and fiber quality. To address this, the development of early-maturing cotton varieties tailored to these conditions is of paramount importance (Shoeva, 2018)

The field of contemporary plant genetics and breeding, particularly in the context of cotton, has witnessed substantial progress in theoretical and practical applications. Researchers and breeders now utilize a range of well-established fundamental and applied methodologies, approaches, and techniques. (Kim. 2009; Urazaliev. 2021).

The trait of earliness is complex and multifaceted, with several factors influencing its expression. These include the duration of the vegetative phase, which encompasses the period from emergence to budding, as well as the time required for buds to develop into flowers and for one-day-old ovaries to mature into open bolls. The key milestones are the dates of initial and 50% bud formation, flowering, and boll opening, which serve as indicators for the inter-phase periods ().

One of the primary objectives for our breeders is the development of early-maturing cotton varieties that are well-suited to the Turkestan region. These varieties should exhibit a maturation period of 105-115 days and possess a desirable combination of agronomic traits.

The objective of this study was to evaluate a set of cotton varieties and to analyze the inheritance pattern of earliness and height of the first fruiting branch in their hybrid progeny.

## 2. Materials and methods

The initial material for hybridization was meticulously selected from the genetic collection of the LLP "Agricultural Experimental Station of Cotton Growing and Melon Growing." The following varieties were utilized in the hybridization process: M-4011, S-1604, M-5027, M-4007, S-1607, and Namangan-1. A comprehensive diallel crossing strategy was utilized to facilitate the hybridization process between these varieties, with guidance from the expertise of our research team. The experiments were conducted in accordance with the established breeding and seed production methodology, as outlined in the text entitled "Genetics." For further information, please refer to the following source:

Simongulyan, M. et al. (1980). Breeding and Seed Production of Cotton. The earliness of the plants in the field was evaluated based on the number of days elapsed between sowing and the occurrence of 50% boll opening. The height of the initial fruiting branch was ascertained by enumerating the nodes from the cotyledons to the initial sympodial branch. Phenological observations were recorded in accordance with the guidelines set forth in the document entitled "Guidelines for State Variety Testing of Agricultural Crops." The location of the experiment was Moscow. (2015).

Statistical data analysis was performed using the methods described by Dospekhov (1979). General combining ability (GCA) effects were estimated following the methodology outlined by Turbin, Tarutin, and Khotylyova in ‘Diallel Analysis.’

The dominance coefficient was calculated using the formula by S. Wright:

$$hp = \frac{F1 - MP}{P - MP} \quad (1)$$

F1 represents the mean value of the hybrid;
MP is the average value of the parental lines;
P represents the value of the superior parent.

Values greater than 1 (>1) indicate overdominance (heterosis);
Values less than 1 (<1) indicate partial dominance (intermediate inheritance);
Values equal to 1 (=1) indicate complete dominance of one parent. 2.)

## 3. Results and discussion

The results, as presented in Table 1, indicate that the earliest maturing cotton varieties were M-4007 and M-5027, exhibiting a time to maturity of 118.2 and 119.5 days, respectively. These varieties exhibited a maturation period that was 9–10 days earlier than that of the latest-maturing variety. The mean time to maturity for S-1607 was 128.5 days.

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The remaining varieties exhibited intermediate earliness, with growing periods ranging from 121.5 to 122.2 days.

The analysis of OKS effects demonstrated that M-4007 and M-5027 were the most promising parents for transmitting earliness to their progeny, exhibiting OKS values (g1) of -0.9 and -1.2, respectively. It is essential to note that in this context, the negative sign should be interpreted as a positive effect. A negative value signifies a shorter vegetative period, which is indicative of greater earliness. This same interpretation of negative values also applies to the analysis of the height of the first fruiting branch. It is noteworthy that S-1607, despite being the latest maturing variety, exhibited the lowest OKS effect (g1 = 1.0). This suggests that S-1607 does not firmly transmit its late maturity to its offspring. Consequently, crosses with early-maturing varieties might yield early-maturing progeny. Similar results can be expected with the variety Namangan-1, which had an OKS value of g1 = 0.7.

**Table 1**. Indicators of average values for precocity and height of the first fruiting branch in cotton cultivars and their OKS effects ($g_1$)

| No | Cultivars | Precocity | | Height of the first sympodium bookmark | |
|---|---|---|---|---|---|
| | | Averages (days) | Effects of OKS (g1) | Average values (nodes) | Effects of OKS(g1) |
| 1 | M-4011 | 121.5 | 0.1 | 5.9 | 0.3 |
| 2 | S-1604 | 122.2 | 0.2 | 5.9 | 0.1 |
| 3 | M-5027 | 119.5 | -0.9 | 5.3 | -0.2 |
| 4 | M-4007 | 118.2 | -1.2 | 4.9 | -0.5 |
| 5 | S-1607 | 128.5 | 1.0 | 6.5 | 0.2 |
| 6 | Namangan-1 | 122.2 | 0.7 | 5.6 | 0.2 |

Regarding the height of the first fruiting branch (Table 1). M-4007 and M-5027 also exhibited notably lower values (4.9 and 5.3 nodes. respectively), indicating earlier initiation of fruiting branch development compared to other tested varieties. S-1607 displayed the highest value (6.5 nodes), signifying later fruiting branch development. The remaining varieties showed intermediate heights, ranging from 5.6 to 5.9 nodes.

OKS effect analysis for the height of the first fruiting branch further highlighted the superior performance of M-4007 (g1 = -0.5) and M-5027 (g1 = -0.2). These varieties exhibited this trait's most favorable OKS effects, indicating their potential for generating superior combinations with early fruiting branch development. The other varieties demonstrated relatively weaker combining abilities and did not differ significantly from each other. with values ranging from g1 = 0.2 to 0.3.

Analysis of the F1 hybrids (Table 2) revealed a wide range in earliness (117.2 to 128.5 days), with an 11-day difference between the earliest and latest maturing combinations. The M-5027 x S-1604 cross produced the earliest maturing hybrid (117.2 days),while the M-4011 x Namangan-1 resulted in the latest (128.5 days).

Dominance coefficient values provided valuable insights into the inheritance of earliness. Out of the 30 hybrid combinations, nine exhibited heterosis for earliness, surpassing the parental average. In five combinations, the late-maturing parent was dominant. Intermediate inheritance tended towards the late-maturing parent and was observed in four combinations;in contrast, six combinations showed intermediate inheritance with a tendency towards the early-maturing parent.

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Beyond the general inheritance patterns revealed by dominance coefficients, specific cases merit attention. For instance. the S-1604 x Namangan-1 hybrid exhibited a dominance coefficient 2.7/0. This indicates that the hybrid matured earlier than the average of the two parents. Since both parents had equal values, this signifies heterosis for earliness due to the negative value (-2.7). Additionally, the combinations M-5027 x M-4011 and M-4007 x Namangan-1 displayed values of 0/1.0 and 0/2.0. respectively. This suggests that the hybrid's values were equal to the parents' average, but one parent outperformed the hybrid, indicating intermediate inheritance.

For the height of the first fruiting branch, hybrid values ranged from 4.9 to 6.9 nodes. Six combinations. all involving M-5027 and M-4007. exhibited the lowest values (4.9 nodes). Dominance coefficient analysis revealed heterosis for this trait in only three combinations. involving S-1604. S-1607. and M-5027. with coefficients of -3.33. -5.67 and -2.50, respectively. Complete dominance of low fruiting branch height was observed in eight combinations, high fruiting branch height in five combinations. and values of both negative and positive ones were observed in various other combinations. Intermediate inheritance leaning towards the parent with a lower fruiting branch height was observed in four combinations.

In comparison, five combinations exhibited intermediate inheritance leaning towards the parent with a higher fruiting branch height. However, some combinations exhibited values like 0.7/0, where the hybrid surpassed the average of both parents, including the superior parent. This suggests a masked heterosis effect towards a higher fruiting branch height.

**Table 2.** Indicators of average values of $F_1$ hybrids for precocity and height of the first fruiting branch setting and their dominance coefficients (hp)

| No | Hybridcombinations | Precocity | | Height of the first sympodium bookmark | |
|---|---|---|---|---|---|
| | | Averages (days) | Dominance coefficient(hp) | Average values (nodes) | Dominance coefficient(hp) |
| 1 | M-4011 x S-1604 | 120.8 | -3.00 | 6.6 | 0.7/0 |
| 2 | M-4011 x M-5027 | 122.2 | 1.70 | 6.6 | 0.40 |
| 3 | M-4011 x M-4007 | 122.5 | 1.61 | 6.9 | 3.00 |
| 4 | M-4011 x S-1607 | 120.5 | -1.29 | 6.9 | 2.33 |
| 5 | M-4011 x Namangan-1 | 128.5 | 19.00 | 5.9 | 1.00 |
| 6 | S-1604 x M-5027 | 127.2 | 4.70 | 5.9 | -1.00 |
| 7 | S-1604 x M-4007 | 120.5 | 0.15 | 5.9 | 1.00 |
| 8 | S-1604 x S-1607 | 123.8 | -0.49 | 5.2 | -3.33 |
| 9 | S-1604 x M-4011 | 118.5 | -9.57 | 6.2 | 0/0.3 |
| 10 | S-1604 x Namangan-1 | 119.5 | -2.7/0 | 5.9 | 1.00 |
| 11 | M-5027 x M-4007 | 119.2 | 0.54 | 4.9 | -1.00 |
| 12 | M-5027 x S-1607 | 118.2 | -1.29 | 6.6 | -0.50 |
| 13 | M-5027 x M-4011 | 120.5 | 0/1.0 | 5.9 | -1.00 |
| 14 | M-5027 x S-1604 | 117.2 | -2.70 | 6.2 | -0.40 |
| 15 | M-5027 x Namangan-1 | 118.8 | -1.52 | 5.9 | -0.54 |
| 16 | M-4007 x S-1607 | 118.2 | -1.00 | 4.9 | -1.00 |
| 17 | M-4007 x M-4011 | 120.2 | 0.21 | 5.9 | 1.00 |
| 18 | M-4007 x S-1604 | 119.2 | -0.50 | 4.9 | -1.00 |
| 19 | M-4007 x M-5027 | 119.5 | 1.00 | 4.9 | -1.00 |
| 20 | M-4007 x Namangan-1 | 120.2 | 0/2.0 | 5.5 | 0.71 |
| 21 | S-1607 x M-4011 | 118.8 | -1.77 | 5.9 | -1.00 |
| 22 | S-1607 x S-1604 | 122.5 | -0.90 | 6.2 | 0/0.3 |
| 23 | S-1607 x M-5027 | 121.5 | -0.56 | 6.2 | -2.50 |

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|---|---|---|---|---|---|
| 24 | S-1607 x M-4007 | 120.8 | -0.50 | 5.9 | 0.25 |
| 25 | S-1607 x Namangan-1 | 120.8 | -1.44 | 6.2 | 0.33 |
| 26 | Namangan-1x M-4011 | 119.8 | -5.86 | 5.9 | 1.00 |
| 27 | Namangan-1x S-1604 | 122.2 | 0.0 | 4.9 | -5.67 |
| 28 | Namangan-1x M-5027 | 121.2 | 0.26 | 5.9 | -0.54 |
| 29 | Namangan-1x M-4007 | 122.5 | 1.15 | 4.9 | -1.00 |
| 30 | Namangan-1x S-1607 | 124.2 | -0.37 | 6.2 | 0.33 |

## 4. Conclusion

This study successfully differentiated cotton varieties based on earliness and height of the first fruiting branch. M-5027 (119.5 days) and M-4007 (118.2 days) emerged as the earliest maturing varieties,while others ranged from 121.5 to 128.5 days. These two varieties also exhibited the most favorable GCA effects.

Nine hybrid combinations demonstrated heterosis for earliness. Intermediate inheritance for earliness, with progeny tending towards earlier or later maturity compared to the parental average, was observed in 10 hybrid combinations.

Like earliness, M-5027 and M-4007 exhibited the lowest height of the first fruiting branch and the most favorable GCA effects for this trait - three combinations involving S-1604. S-1607. and M-5027 displayed heterosis. Eight hybrid combinations showed complete dominance of high fruiting branch height, while five exhibited complete dominance of low fruiting branch height.

Based on these findings, the varieties M-5027 and M-4007 are recommended as promising parents for breeding programs aiming to develop superior hybrids with early maturity and a lower height of the first fruiting branch.

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