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СОДЕРЖАНИЕ

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INHERITANCE OF MORPHO-ECONOMIC TRAITS IN F_1 HYBRIDS BELONGING TO *PHASEOLUSAUREUS* L. SPECIES

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Abstract. *This article presents the results of determining the parameters of the traits for 1000 seeds weight, main stem length, and pod length in geographically distant genotypes of mung bean (Phaseolus aureus L.) and in F_1 hybrids obtained from their crossing, and in terms of these traits mainly positive dominant, over dominant, and intermediate states were observed in F_1 plants, that is, higher parameters were noted than the original forms. These F_1 plants are important from the point of view of genetic-selection, and as a result of continuing research work on these hybrids in subsequent generations, it is possible to obtain recombinant forms that are unique for the practical selection process.*

Key words: mung bean, cultivar, sample, pod, genotype, hybrid, hybridization, inheritance, dominant, heterosis.

НАСЛЕДОВАНИЕ МОРФО-ХОЗЯЙСТВЕННЫХ ПРИЗНАКОВ У ГИБРИДОВ F1, ПРИНАДЛЕЖАЩИХ К ВИДАМ *PHASEOLUS AUREUS* L.

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Аннотация. *В статье представлены результаты определения параметров признаков по массе 1000 семян, длине основного стебля и длине боба у географически удаленных генотипов маша (Phaseolus aureus L.) и гибридов F_1, полученных от их скрещивания, а также в условиях у растений F_1 эти признаки преимущественно наблюдались в положительном доминантном, над доминантном и промежуточном состояниях, то есть отмечались более высокие показатели, чем у исходных форм. Эти растения F_1 важны с точки зрения генетической селекции, и в результате продолжения исследовательской работы над этими гибридами в последующих поколениях можно получить уникальные для практического селекционного процесса рекомбинантные формы*

Ключевые слова. маш, сорт, образец, боб, генотип, гибрид, гибридизация, наследование, доминант, гетерозис.

Introduction. Among the grain legumes, mung bean (*Phaseolus aureus* L.) is a major crop that provides nutritious and non-harmful food value. The world's mung bean growing area is about 7.3 million, and the average yield is 721 kg/ha. The 5.3 million tons produced by India and Myanmar account for 30% of the world's mung bean production [10]. To ensure food security, there is an urgent need to increase production and productivity, which will improve the genetic yield potential of current cultivars through genotypic enrichment of mung bean. As a result, plant breeders must use heterosis to create superior hybrids for their plants [11].

In our republic, mung bean is grown annually as a rotation crop on more than 18,000-25,000 hectares. India is the leading in mung bean growing and consuming country. Also, Uzbekistan has a big place in the export of mung bean in the world market, up to 67 thousand tons of mung bean are exported per year [7].

In Uzbekistan, Turkmenistan, Tajikistan, the Caucasus and South Kazakhstan (on a small area), mung bean is planted as a main crop or as a rotation crop after winter wheat. The stem is herbaceous, pointed, multi-branched, trailing or prostrate, 15-120 cm tall, 30-60 cm on average, well-branched. The color of the stem is light green, yellowish green, hairy or hairless depending on the cultivar. Lateral branches are divided into monopodial and sympodial types, which grow from leaf axils. Monopodial (growing) branches develop from the bottom up on the stem, and sympodial (fruiting) branches develop from the top down [7].

In natural conditions, the growth and development of plants are affected by external environmental factors. For plants, external environmental factors (light, water, air, nutrients) have equal value and one of them cannot be replaced by another for plant growth. Although natural factors have the same value for the life of plants according to their physiological effects, they have different effects on their life processes and development periods. Plant growth, development, height, yield quantity, quality and duration of yield formation are the result of complex interaction of physiological processes occurring in the plant and the external environment [6].

After determining the grain yield in each experimental field when measuring the weight of 1000 grains of mung bean plant, samples were taken by 5 pieces from each of all variants of the experiment, then 1000 grains were weighed on a scale, and the average weight was determined. The average amount of organic matter accumulated in the above-ground part of the mung bean plant was determined by dry matter when the mung bean was fully mature. For this, in all replication of the experimental options, 100 plants from each of the 5 designated sites were separated from the above-ground part during full ripening, then dried and weighed on a scale, and the average amount of organic matter in one plant was determined through dividing by 100 [1].

Mung bean is a heat-loving crop. Seeds begin to germinate when the temperature in the soil is 12-15 ºC. The optimum temperature for seed germination is 20-25 ºC. The

growing period is 80-110 days, depending on the cultivar, agrotechnics, and the time of sowing. The plant dies when the temperature is -1.º C. Mung bean is a moisture-loving plant. It is mainly grown in irrigated lands in Uzbekistan.

The pods of mung bean split once matured, however, since the pods of erect growing cultivars of mung bean created through new introductions (the initial stage of acclimatization) have white, fuzzy hairs on the inside of their pods, these pods do not split, their grains do not fall out, and their coat is characterized by a tough texture (parchment shell) and thickness. Each plant can have an average of 46-78 pods. Each pod contains an average of 8-12 seeds [2].

The higher the seed weight, the higher the quality. In addition, it provides a high yield. The weight of 1000 grains in crops depends on the cultivar, soil-climatic conditions, agrotechnic practices, including predecessors in crop rotation, fertilizers, etc. Determining the weight of 1000 grains allows evaluate the nutrient reserves in seeds, that is, the higher the weight of 1000 grains, the higher the amount of nutrients in this crop [1].

The difference of mung bean from other legumes is 1.5-2 times higher in nutritional value and 1.5 times higher in nutrition. The nutritional value of all food with mung bean is increased. The protein contained in mung bean helps to quickly digest food in the stomach, and its digestibility reaches 86% [3].

Mung bean plant is semi-bush plant, 60-70 cm tall. The flower is large yellow, 6-8 flowers bloom in one cluster. Pod is cylindrical, sparsely fuzzy with 10-14 grains. The grain is medium-sized, long, cylindrical, dark green, smooth, shiny, septum-separated and white centre. The weight of 1000 grains is 39.0-49.0 g. The taste quality of the cultivar is good: the protein content is 24.0-27.0% [7].

On average, there are 39-40 pods per plant, which are located at a height of 15-16 cm from the bottom of the stem. The length of the pods was 8.5-14.5 cm when harvested and 8.0-14.1 cm when dried after harvesting. The number of grains in pods is in the range of 6-15 pieces, and it was found that the number of grains per pod is on average 9.0-10.1 pieces. It was noted that the average mass of pods is in the range of 7.1-7.8 g, and the mass of grains in them is in the range of 6.6-7.2 g. Their mean square deviation is between 2.9-3.2 g and 2.1-2.9 g, respectively. The seeds are cylindrical in shape with a blunt end, and the mass of 1000 seeds varies depending on the cultivar. The weight of 1000 grains of the Marjon cultivar is 40-50 g, the weight of 1000 grains of the Navroz cultivar is 39-40 g, and the weight of 1000 grains of the Zilola cultivar is 45-67 g. The average number of pods per plant was 21.0-29.8 pieces [4].

García-Fernández, C. et al. [9] conducted molecular studies on common bean and analyzed the traits such as the number of seeds in a pod, pod length and its cross-section, pod color. Based on the results of the experiment, 17 morphological traits of the plant were successfully described and 16 quantitative traits were also studied. It was

observed that the number of seeds per pod, which determines the productivity, is from 2.2 to 8.3, and the length of the pod is from 7.1 to 26.4 cm. Also, in this experiment, it was found that there is a positive correlation between the length of the pod and its cross section.

Research object and methods. Research was carried out at the experimental site of the department of "Genetics and Evolutionary Biology" of the Faculty of Natural Sciences of the Chirchik State Pedagogical University.

Research object was K-2 (China), K-236 (Manchuria), K-338 (China), K-413 (Vietnam), K-414 (Vietnam), K-418 (Philippines), K-599 (India), K-716 (Afghanistan), K-181 (Taiwan), K-255 (India), K-489 (mestniy Uzbekistan) samples, Turon (Uzbekistan), Durdona (Uzbekistan) cultivars and F_1 hybrids of mung bean plant belonging to *Phaseolus aureus* L. species.

During the experiment, the inheritance of the traits of 1000-seed weight, main stem length, and pod length was studied in the original forms and F_1 plants of *Phaseolus aureus* L.species grown in the field experiment site.

The degree of dominance of the traits in the studied hybrids of the first generation was calculated according to the formula of S. Wright presented in the works of G. E. Beil and R. E. Atkins [3]:

$$hp = \frac{F_1 - MP}{P - MP}$$

hp – dominance coefficient;

F_1 – the arithmetic mean of the hybrid;

MP – the arithmetic mean of both parent traits;

P – the arithmetic mean of the traits of the best paternal or maternal form.

hp = 0 – no dominance;

0 <hp<±1,0 – intermediate dominance;

hp = ±1,0 – complete dominance;

hp> ±1,0 – over dominance.

Research results. In the analyzed original forms, it was observed that the parameters differed sharply (45.3-81.2 grams) in terms of 1000 seed weight. In particular, a large seed according to this trait was observed in the foreign K-181 (Taiwan) sample (81.2 grams), while small seeds were detected in the K-414 (Vietnam) sample (45.3 grams). The weight of 1000 seeds in local Turon and Durdona cultivars was 63.7-71.6 grams. An intermediate state was observed in the remaining foreign samples (diagram 1).

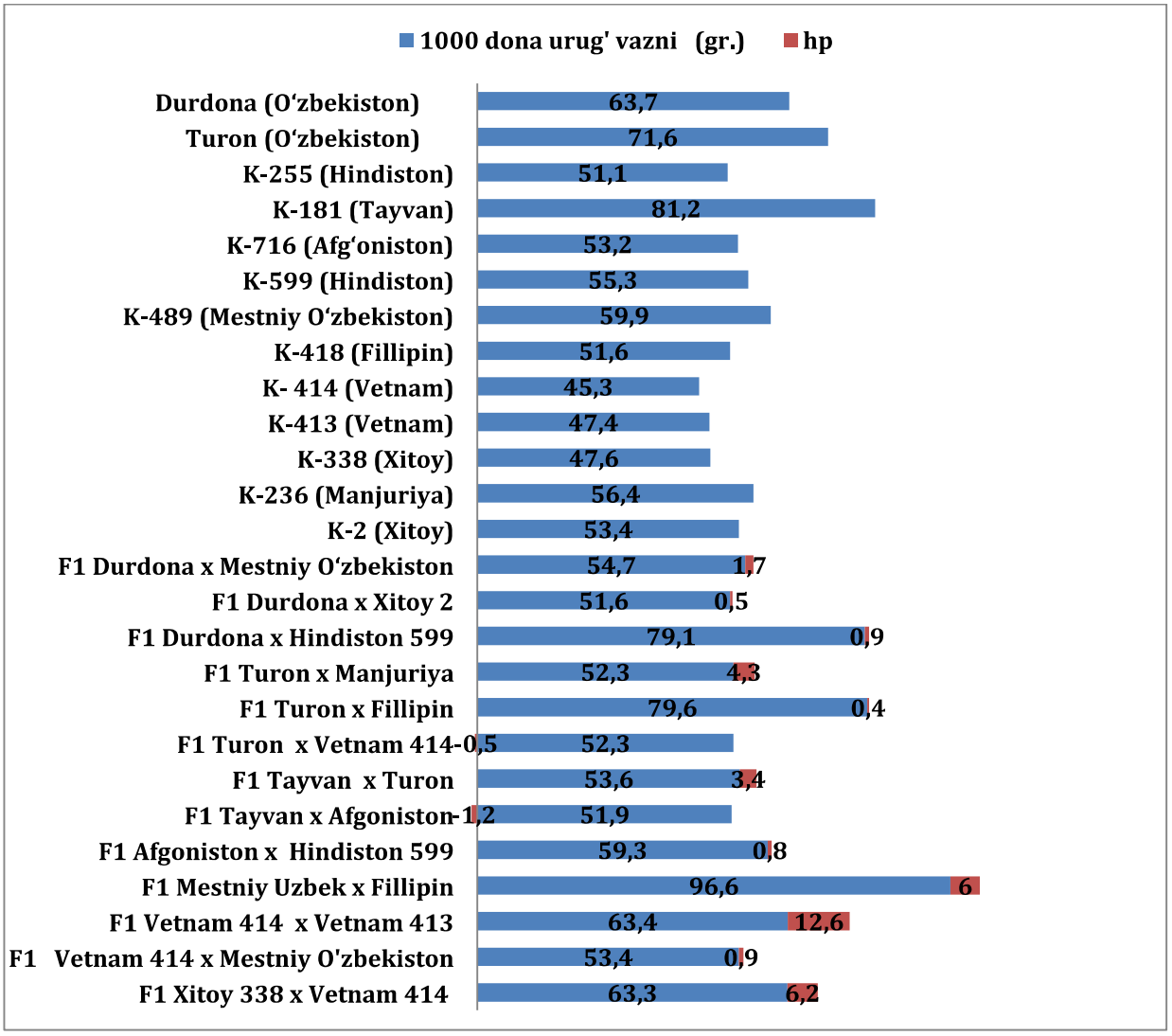

Diagram 1. Inheritance of the trait of 1000-seed weight in original forms and F_1 plants.

Different results were observed for the 1000 seed weight trait in F_1 plants obtained from hybridization of geographically distant cultivars and samples belonging to *Phaseolus aureus* L.species. The weight of 1000 seeds of hybrid combinations was 50.1-96.6 grams. The amplitude of variability was high, and the coefficient of variation was 2.9-7.8%, respectively. In the F_1 Turon x Manchuria combination obtained as a result of hybridization, the weight of 1000 seeds was 96.6 grams, and the inheritance of this trait was observed with over dominance (hp=4.3). In addition, for F_1 Vietnam 414 x Mestniy Uzbekistan, F_1 Afghanistan x India 599, F_1 Turon x Vietnam 414, F_1 Turon x Phillipin, F_1 Durdona x India 599, F_1 Durdona x China 2 combinations the inheritance was observed in positive intermediate state (hp=0.4 to hp =0.9) (diagram 1).

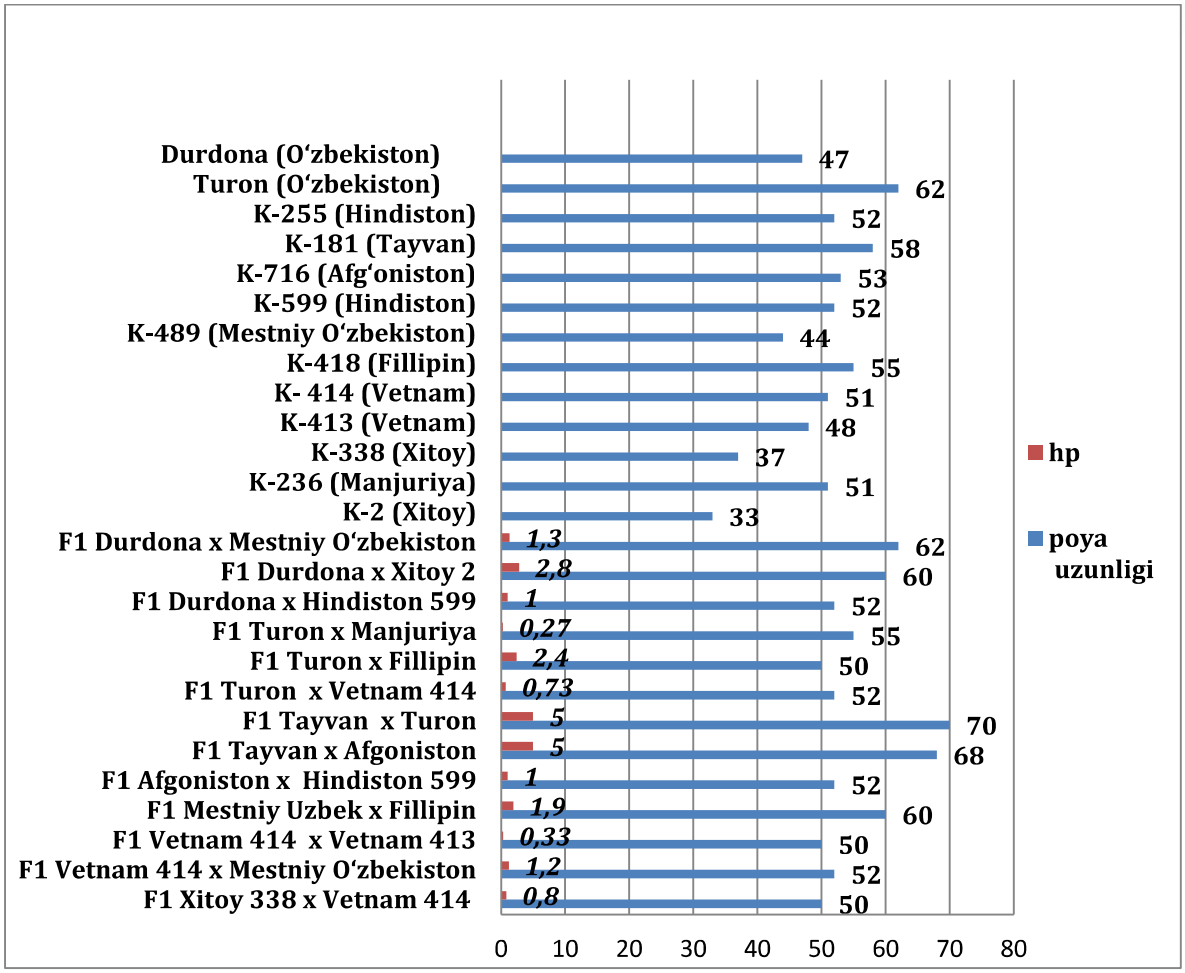

Diagram 2. Inheritance of the trait of main stem length in original forms and F1 plants.

The main stem length trait was analyzed in the original forms and F1 hybrids of *Phaseolus aureus* L.species. The level of heritability was different. Of the original forms selected for the study, the highest indicator was observed in the Turan (Uzbekistan) sample, 62.0 cm long, while the lowest indicator was recorded in the K-2 (China) sample, 33.0 cm. In the analyzed F1plants, positive intermediate, dominant, and overdominant inheritance was detected for the main stem length trait. In particular, in the combinations F1 K-181 (Taiwan) x Turan and F1 K-181 (Taiwan) x K-716 (Afghanistan) positive dominant (hp=5.0) inheritance was observed for this trait, while in the combinations F1 K-716 (Afghanistan) x K-599 (India) and F1 Durdona x K-599 (India) dominant (hp=1.0) inheritance was detected for the main stem length trait (diagram 2).

The yield indicators of leguminous crops also depend on the length of the pod, the longer the pod, the higher the yield of the cultivar, it has been determined in many scientific studies.

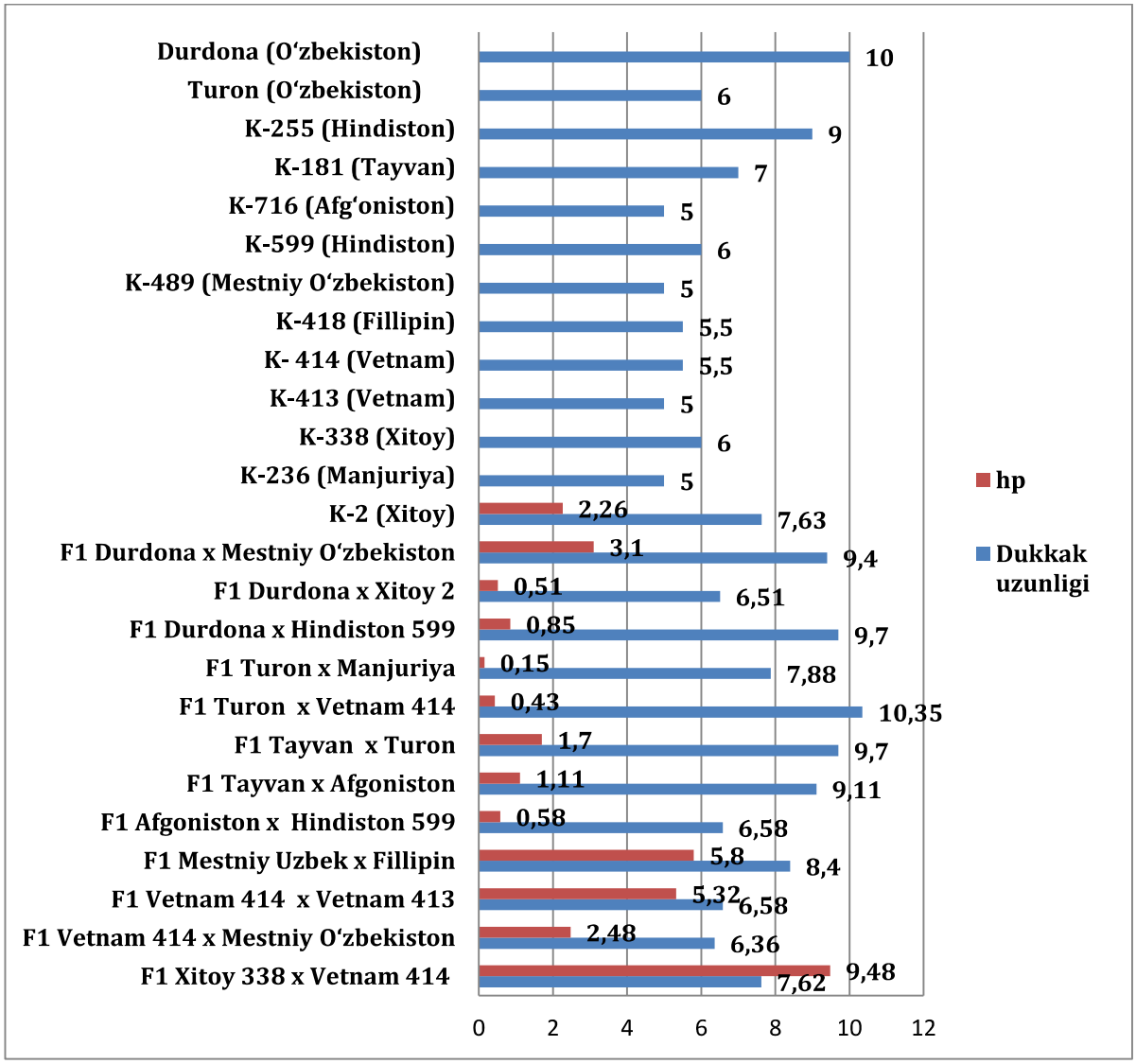

Diagram 3. Inheritance of the pod length trait in the original forms and F₁ plants.

As a result of studying the trait of pod length of the original forms selected for the experiment, high indicators were observed in the K-255 (India) (10.0 grains), Durdona (Uzbekistan) (7.0 grains), the K-716 (Afghanistan) (7.0 grains) samples and cultivars, while low indicators (5.0 grains) were determined in the K-489 (Uzbekistan), K-414 (Vietnam), K-338 (5.0 grains) and K-2 (China) samples, in the remaining original forms this indicator averaged 6.0-9.0 grains (Diagram 3).

In the studied F₁ plants, different results were observed for the trait of pod length, and it was found that in hybrid combinations, the trait was inherited in a positive intermediate, over dominant state. For example, in the F₁ combination K-388 (China) x K-414 (Vietnam), the average indicator for the pod length trait was 7.62 grains, the dominance coefficient for this trait was hp=9.8, and inheritance was observed in over dominant state, while in the F₁ combination K-716 (Afghanistan) x K-599 (India) (hp=0.58), positive intermediate inheritance was detected. Positive results were also observed for the pod length trait in the remaining hybrid combinations.

Conclusion. Analysis of the conducted studies showed that when analyzing the original forms and F_1 hybrids of the *Phaseolus aureus* L. species for 1000-seed weight, main stem length, and pod length, F_1 plants mainly showed positive dominant, overdominant, and intermediate state, i.e., higher indicators were detected compared to the original forms. These F_1 plants are of great importance from a genetic breeding point of view, indicating that, as a result of continued research on these hybrids in subsequent generations, it is possible to obtain recombinant forms that are unique for the practical breeding process.

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According to the decision of the Higher Attestation Commission of the Republic of Uzbekistan dated March 31, 2023 No. 332/5/6, the publication of the main scientific results of dissertations in biological sciences is included in the list of recommended national scientific publications.

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