УДК: 635.652:631.527
DOI 10.31395/2415-8240-2019-95-1-19-30

INHERITANCE OF YIELD FORMULA IN F_1 HYBRIDS AND HYBRID SWARMS F_2 *PHASEOLUS VULGARIS* L.

O. V. MAZUR, *PhD of Agricultural Sciences*
Vinnytsia National Agrarian University
S. P. POLTORETSKYI, *Doctor of Agricultural Sciences*
N. M. POLTORETSKA, *PhD of Agricultural Sciences*
L. M. KONONENKO, *PhD of Agricultural Sciences*
Uman National University of Horticulture

Наведено результати трирічних досліджень з вивчення результатів успадкування елементів структури врожаю у гібридів F_1 і гібридних популяцій F2 квасолі звичайної (Phaseolus vulgaris L.*) в умовах центральної підзони Правобережного Лісостепу. В результаті проведених досліджень з гібридних популяцій виділено комбінації ♀UD0300565 × ♂UD0302256; ♀UD0301041 × ♂UD0300025 і ♀UD0300577 × ♂UD0301041 в гібридному потомстві яких, існують позитивні трансгресії за ознаками: – кількість зерен на рослині; маса 1000 зерен; зернова продуктивність рослин. Успадкування елементів структури врожаю відбувається за типом наддомінування.*

Ключові слова: *квасоля звичайна, гібрид, гібридна популяція, структура врожаю, гетерозис істинний, ступінь домінування, ступінь трансгресії, частота трансгресії.*

Introduction. Theoretically, the formative process under intrinsic hybridization, based on independent combining of genes, is unlimited. However, different types of gene interaction, the phenomenon of genetic linkage, and physiological correlations strongly limit the potential possibility of combining features in hybrids [1].

The study of quantitative characteristics controlled by polymer genes is rather complicated due to their significant variability, which depends on the environment [2], and the overall picture of their inheritance and variability is masked by the modifying effect of heterosis in the first generation. Newly created varieties should have balanced development of all elements of productivity and resistance to abiotic

and biotic factors, and not the maximum value of a separate characteristic [3–5].

Therefore, the **objective** of our research is to determine the level of variability and to identify patterns of inheritance of valuable economic and biological features for the selection of productive and adaptive forms of common bean (*Phaseolus vulgaris* L.) by hybridological analysis.

To achieve this goal, it was necessary to **solve the task** of creating the source material for the selection of high-yielding and adaptive varieties of common beans for the Right-bank Forest-Steppe.

Research methodology. The research was conducted during 2014–2016 in the conditions of the research plot of the Department of Plant Production, Selection and Bioenergetic Cultures of Vinnytsia National Agrarian University.

The region where the research was conducted by its natural conditions refers to the central subzone of the Right Bank Forest-Steppe. It is characterized by the distribution of gray forest soils of light medium-loam mechanical composition. The hydrothermal conditions of the 2014 and 2016 surveys were typical of the average yearly indices of the research area. The year 2015 was marked by a significant deficiency of precipitation and high temperature air conditions.

The research material were the varieties of common beans provided by the National Center for Plant Genetic Resources of Ukraine [6] and hybrid combinations obtained as a result of intervarietal crossings.

Sowing was carried out by the temperature regime of soil 10–12 °C at the depth of seeding and stable increase of average daily air temperature. The placement of the plots was consistent, the varieties were sown in a six-time repetition. The wide-row sowing with a width of rows of 45 cm was used. The total area of the plots was 1.35 m², and the account one is 1.0 m². Sowing was carried out manually, with the seeding rate of 18 similar seeds per 1 linear meter, the standard was placed in 10 numbers.

Accounts, analyzes and observations are performed according to the generally accepted methods [7].

The degree of phenotypic dominancy was calculated according to B. Griffing [8], and the degree and frequency of transgression of quantitative characteristics according to H. S. Voskresenska and V. I. Shpot [9].

The statistical processing of research results was performed using the dispersion and correlation-regression methods [10, 11].

Research results. In terms of grain yield, hybrids F_1 exceeded the quantitative expression of the best of parental forms (Table 1).

A similar pattern is observed in the hybrid combination F_1 ♀UD0300025 × ♂UD0301041, the weight of the grain from one plant was 5.10 g, and in the best

parent form – 4.32 g. True heterosis was at the level of 18.1%, the degree of phenotypic dominancy was 2,0. In the hybrid combination ♀UD0301041 × ♂UD0300025, grain yields in F_1 hybrids were 4.80 g, and in the best of their parent forms – 4.32 g. True heterosis was at the level of 11.2%, and the degree of phenotypic dominancy was 1.6.

Table. 1. Characteristics of F_1 hybrids and their parent forms according to grain yield from a plant, 2015

Combination of hybridization	Mean performance level			True heterosis, %	Degree of dominancy
	♀	♂	F_1		
UD0300025 × UD0301041	2,72	4,32	5,10	18,1	2,0
UD0301041 × UD0300025	4,32	2,72	4,80	11,2	1,6
UD0300577 × UD0301041	6,7	4,32	7,80	16,3	1,9
UD0300565 × UD0302256	8,35	7,38	9,40	12,6	2,7
UD0302683 × UD0300856	7,99	7,38	8,70	8,9	3,3

The highest degree of heterosis was observed in the hybrid combination ♀UD0300577 × ♂UD0301041 – 16.3%, and the degree of phenotypic dominancy was 1.9. A slightly lower heterosis effect was observed when crossing the hybrid combination ♀UD0300565 × ♂UD0302256, but the higher values for the quantitative expression of the F_1 characteristic were 9.40 g. True heterosis was 12.6%, and phenotypic dominancy was 2.7. The hybrid combination ♀UD0302683 × ♂UD0300856 showed the lowest heterosis effect at the level of 8.9%, and phenotypic dominancy was 3.3.

Subsequently, the study of the inheritance of the characteristics of the number of grains per plant and thousand-kernels weight was conducted, since these elements determine grain yield of common bean variety samples (Table 2 and 3).

Table. 2. Characteristics of hybrids F_1 and their parent forms by the number of grain per plant, 2015

Combination of hybridization	Mean performance level			True heterosis, %	Degree of dominancy
	♀				
UD0300025 × UD0301041	15,81	24,88	32,8	31,8	2,7
UD0301041 × UD0300025	24,88	15,81	25,0	0,45	1,0
UD0300577 × UD0301041	24,1	24,88	26,4	6,1	4,8
UD0300565 × UD0302256	45	42	49	8,9	3,7
UD0302683 × UD0300856	39	42	45	7,14	3,0

According to the number of grains per plant, the highest heterosis effect was obtained in the hybrid combination ♀UD0300025 × ♂UD0301041. At the same time, mean performance level in hybrids F_1 was 32.8 pieces, while in the best of the parent forms – 24.9. True heterosis was at the level of 31.8%, and the degree of phenotypic dominancy was 2.7.

The lowest heterosis effect was observed in the hybrid combination ♀UD0301041 × ♂UD0300025. True heterosis was at the level of 0.45%, and the degree of phenotypic dominancy was 1.0.

In the hybrid combination ♀UD0300577 × ♂UD0301041, in F_1 hybrids, heterosis was observed at the level of 6.1%, and the degree of phenotypic dominancy was 4.8. Similar values of heterosis effect of F_1 hybrids were observed in the hybrid combinations ♀UD0300565 × ♂UD0302256 and ♀UD0302683 × ♂UD0300856. The level of heterosis in F_1 hybrids was 8.9 and 7.14%, while the degree of phenotypic dominancy was 3.7 and 3.0.

Inheritance of thousand-kernels weight by F_1 hybrids was carried out according to the type of positive superdominancy in four hybrid combinations and depression in one hybrid combination. In the hybrid combination ♀UD0300025 × ♂UD0301041 there was a depression with thousand-kernels weight.

The level of depression in F_1 hybrids was negative and amounted to 10.4%,

and the degree of phenotypic dominance was 31.7.

Positive superdominancy was observed in the hybrid combination ♀UD0301041 × ♂UD0300025. The level of heterosis in F_1 hybrids was 10.7%, and the degree of phenotypic dominancy was 25.7.

Table. 3. Characteristics of hybrids F_1 and their parent forms according to the weight of 1000 grains (2015), *g*

Combination of hybridization	Mean performance level			True heterosis, %	Degree of dominancy
	♀				
UD0300025 × UD0301041	172,4	173,5	155,5	-10,4	-31,7
UD0301041 × UD0300025	173,5	172,0	192,0	10,7	25,7
UD0300577 × UD0301041	278,8	173,5	295	5,8	1,3
UD0300565 × UD0302256	196	187	203	3,6	2,6
UD0302683 × UD0300856	217	184	229	5,52	1,72

Hybrid combinations $UD0300577xc5'UD0301041 and ♀UD0302683 × ♂UD0300856 provided almost the same level of heterosis in F_1 hybrids at 5.8% and 5.5%, and the degree of phenotypic dominancy was 1.3 and 1.72 respectively.

The slightest heterosis effect was observed in the hybrid combination ♀UD0300565 × ♂UD0302256, the percentage of true heterosis was 3.6%, and the degree of phenotype dominancy was 2.6.

The nature of the inheritance of grain weight from the plant in hybrid swarm F_2 is shown in Table 4.

Inheritance of grain productivity in common bean variety samples showed that in the combination ♀UD0300025 × ♂UD0301041 it was higher in hybrid swarm F_2 (8.6 g) compared with the best of the parent forms (7.5 g), the degree of transgression was 14.7%, and its frequency was 11.2%.

A similar pattern was observed in the hybrid combination ♀UD0301041 × ♂UD0300025, grain yield of F_2 was 8.2 g, the degree of transgression was 9.0%, and its frequency was 10.0%.

Table. 4. Inheritance of grain weight from beans plant of hybrids F_2, 2016

Combination of hybridization	Degree of dominancy in hybrids F_1	Kernel weight from a plant, g			
		Max ♀♂	F_2	Degree of transgression, %	Frequency of transgression, %
UD0300025 × UD0301041	2,0	7,5	8,6±0,22	14,7	П,2
UD0301041 × UD0300025	1,6	7,5	8,2±0,21	9,0	10,0
UD0300577 × UD0301041	1,9	7,5	11,4±0,27	52,0	19,1
UD0300565 × UD0302256	2,7	12,6	14,1±0,32	10,6	12,3
UD0302683 × UD0300856	3,3	11,8	13,4±0,29	13,6	15,1

At the same time, in the hybrid population of F_2 of common beans ♀UD0300577 × ♂UD0301041, grain yield of population F_2 (11.4 g) was characterized by the highest transgression among all hybrid swarms – 52.0% with the frequency of 19.0%. The lower degree of transgression was observed in hybrid combinations ♀UD0300565 × ♂UD0302256, as well as ♀UD0302683 × ♂UD0300856 – 10.6 and 13.6% with the frequency of 12.3 and 15.1%, respectively.

The nature of inheritance of individual grain yield of pieces per plant in hybrids F_2 is shown in Table 5.

In the hybrid swarm F_2 of the combination ♀UD0300025 × ♂UD0301041, the inheritance of individual grain yield was higher, the degree of transgression was 19.2%, and its frequency was 10.9%. In the hybrid combinations ♀UD0300565 × ♂UD0302256 and ♀UD0302683 × ♂UD0300856, the inheritance in F_2 common bean common populations was higher compared to the best of the parent forms (62.0 and 70.0 pieces per plant). The degree of transgression was 8.8 and 6.1%, and its frequency was 7.7 and 5.9%.

Table. 5. Inheritance of individual grain productivity of plants of common bean hybrid F_2 (2016), pieces per plant

Combination of hybridization	Degree of dominancy in hybrids F_1	Kernel weight from a plant, g			
		Max ♀♂	F_2	Degree of transgression, %	Frequency of transgression, %
UD0300025 × UD0301041	2,7	30,8	36,7±0,9	19,2	10,9
UD0301041 × UD0300025	1,0	30,8	31,4±0,8	2,0	5,6
UD0300577 × UD0301041	4,8	30,8	30,99±0,7	0,7	5,1
UD0300565 × UD0302256	3,7	57,0	62,at 1,4	8,8	7,7
UD0302683 × UD0300856	3,0	66,0	70,0±1,6	6,1	5,9

According to thousand-kernel weight, the vast majority of F_2 hybrid swarms, three out of five showed a high degree of positive transgression and two negative ones (Table 6).

6. Inheritance of thousand-kernel weight in beans of hybrids F_2, 2016

Combination of hybridization	Degree of dominancy in hybrids F_1	Kernel weight from a plant, g			
		Max ♀♂	F_2	Degree of transgression, %	Frequency of transgression, %
UD0300025 × UD0301041	-31,7	243,6	234,3±4,1	-3,8	4,5
UD0301041 × UD0300025	25,7	243,6	261,1±4,6	7,2	2,3
UD0300577 × UD0301041	1,3	309,3	367,8±9,5	15,9	6,9
UD0300565 × UD0302256	2,6	284,0	289,8±5,9	2,0	3,4
UD0302683 × UD0300856	1,72	262,0	256,0±6,3	-2,3	4,6

Inheritance in hybrid swarms F_2 of common bean showed that thousand-kernel weight in the hybrid combinations ♀UD0300565 × ♂UD0302256 та ♀UD0301041 × ♂UD0300025 і ♀UD0300577 × ♂UD0301041 was higher in F_2 (289.8, 261.1, and 367.8 g) compared with the best of the parent forms 289.8; 261.1 and 367.8 g. The degree of transgression was high and amounted to 2.0; 7.2 and 15.9% with the frequency of 3.4; 2.3 and 6.9%.

Of the hybrid swarms of F_2, three combinations were identified: ♀UD0300565 × ♂UD0302256; ♀UD0301041 × ♂UD0300025 and cf) UD0300577x (5'UD0301041 in hybrid offspring of which positive transgressions were obtained by characteristics (the number of grains per plant, thousand-kernel weight and grain yield of plants and the duration of the growing phase-time period of flowering-ripening.) Positive transgressions were separated in hybrid populations F_2, in which the inheritance of the elements of yield formula and the duration of the interfacial maturation period in F_1 hybrids occurred by the type of superdominancy.

Conclusions. As a result of conducted research, hybrid combinations ♀UD0300565 × ♂UD0302256; ♀UD0301041 × ♂UD0300025 і ♀UD0300577 × ♂UD0301041 were separated out of hybrid swarms, in hybrid progeny of which there are positive transgressions by characteristics – the number of grains per plant, thousand-kernel weight, grain yield of plants. Inheritance of the elements of yield formula takes place by the type of superdominancy.

Література

1. Васильківський С. П., Власенко В. А. Розширення генетичного різноманіття вихідного матеріалу в селекції зернових культур: наук. – техніч. бюл. Миронів. ін. пшениці ім. Ремесла. 2002. Вип. 2. С. 12–17.

2. Мазер К., Джинкс Дж. Биометрическая генетика. Москва: Мир, 1985. 463 с.

3. Безуглий І. М. Створення вихідного матеріалу для селекції сортів гороху з детермінантним типом росту: дис … канд. с.–г. наук: 06.01.05. Селекція і насінництво. Харків, 2004. 128 с.

4. Варлахов М. Д. Применение селекционно-генетических методов в оценке селекционного материала для селекции гороха: автореф. дис. на здобуття наук. ступеня канд. с.–г. наук: 06.01.05 – селекція і насінництво. Ленинград, 1976. 18 с.

5. Родин Е. А. Влияние крупности семян на урожай гороха. Селекция и семеноводство. 1971. № 5. С. 41–42.

6. Безугла О. М., Кобизєва Л. Н. Генетичні ресурси рослин у

вирішенні проблем селекції квасолі в Україні. Зб. наук. пр. Селекційно-генетичного інституту. 2015. Вип. 26. С. 74–83.

7. Методические указания по изучению образцов мировой коллекции фасоли. Под ред. Н. М. Чекалина. Ленинград, 1987. 27 с.

8. Griffing B. Analysis of guatitative gene-acrion by constant parent regression and related technigues. *Genetics,* 1950. V. 35. P. 303–321.

9. Воскресенская Г. С., Шпота В. И. Трансгрессия признаков Brassica и методика учета этого явления. Доклады ВАСХНИЛ. 1967. №7. С. 18–20.

10. Єщенко В. О., Копитко П. Г., Костогриз П. В., Опришко В. П. Основи наукових досліджень в агрономії. Вінниця: ПП «ТД «Едельвейс і К»», 2014. 332 с.

11. Боровиков В. П. Statistica. Искусство анализа данных на компьютере: для профессионалов. 2-е изд. СПб.: Питер, 2003. 688 с.

References

1. Vasylkivskyj S. P., Vlasenko V. A. (2002). Rozshyrennya genetychnogo riznomanittya vyxidnogo materialu v selekciyi zernovyx kultur [Extension of the genetic diversity of the source material in the selection of grain crops]. Nauk. – texnich. byul. Myroniv. in. pshenyci im. Remesla. V. 2, pp. 12–17. (In Ukrainian).

2. Mazer K., Dzhinks Dzh. (1985). Biometricheskaya genetika [Biometric genetics]. Moskva: Mir, 463 p. (In Russian).

3. Bezuglyj I. M. (2004). Stvorennya vyxidnogo materialu dlya selekciyi sortiv goroxu z determinantny`m typom rostu [Creation of source material for selection of pea varieties with a deterministic type of growth]. Dys. … kand. s. – g. nauk: 06.01.05. Selekciya i nasinnycztvo. Xarkiv, 128 p. (In Ukrainian).

4. Varlahov M. D. (1976). Primenenie selektsionno-geneticheskih metodov v otsenke selektsionnogo materiala dlya selektsii goroha [The use of selection and genetic methods in the evaluation of breeding material for the selection of peas]. avtoref. dis. na zdobuttya nauk. stupenya kand. s.–g. nauk: 06.01.05 – selektsIya i nasInnitstvo. Leningrad, 18 p. (In Russian).

5. Rodin E. A. (1971). Vliyanie krupnosti semyan na urozhay goroha [The effect of grain size on pea yield]. Selektsiya i semenovodstvo, № 5. S. 41–42. (In Russian).

6. Bezugla O. M., Kobyzyeva L. N. (2015). Genetychni resursy roslyn u vyrishenni problem selekciyi kvasoli v Ukrayini [Genetic resources of plants in solving the problems of bean breeding in Ukraine]. Zb. nauk. pr. Selekcijno-

genetychnogo instytutu. V. 26, pp. 74–83 (In Ukrainian).

7. Metodicheskie ukazaniya po izucheniyu obraztsov mirovoy kollektsii fasoli [Guidelines for the study of samples of the world collection of beans]. N. M. Chekalin. Leningrad, 1987. 27 p. (In Russian).

8. Griffing B. (1950). Analysis of guatitative gene-acrion by constant parent regression and related technigues. Genetics. V. 35, pp. 303–321. (In English).

9. Voskresenskaya G. S., Shpota V. I. (1967). Transgressiya priznakov Brassica i metodika ucheta etogo yavleniya [Transgression of Brassica traits and the method of accounting for this phenomenon]. Reports of the VASHNIL. №7, pp. 18–20. (In Russian).

10. Jeshhenko, V. O., Kopytko, P. G., Opryshko, V. P., Kostogryz, P. V. (2014). Osnovy naukovyh doslidzhen v agronomii [Basic research in agronomy]. Vinnytsia: PP «TD «Edelvejs i K»», 332 p. (In Ukrainian).

11. Borovikov, V.P. (2003). Statistica. Iskusstvo analiza dannyih na kompyutere: dlya professionalov [Statistica. The art of computer data analysis: for professionals]. Piterburg: SPb.: Piter, 688 p. (In Russian).

Аннотация

Мазур А. В., Полторецкий С. П., Полторецькая Н. Н., Кононенко Л. М.
Наследование элементов структуры урожая у гибридов F_1 и гибридных популяций F_2 Phaseolus vulgaris L.

Изучение количественных признаков, контролируемых полимерными генами, достаточно осложняется вследствие их значительной изменчивости, зависит от условий среды, а общая картина их наследования и изменчивость маскируется модифицирующим действием гетерозиса в первом поколении. Новые сорта должны иметь сбалансированное развитие всех элементов продуктивности, устойчивость к абиотическим и биотическим факторам, а не только максимальное значение отдельного признака. ***Целью исследований*** *было определении уровня изменчивости и выявлении закономерностей наследования ценных хозяйственно-биологических признаков для селекции продуктивных и адаптивных форм фасоли обыкновенной (Phaseolus vulgaris L.) путем гибридологического анализа.* ***Методика исследований.*** *Исследования проводились в течение 2014–2016 годов в условиях опытного участка кафедры растениеводства, селекции и биоэнергетических культур Винницкого национального аграрного университета. Регион проведения исследований по характеру природных условий относят к центральной подзоне Правобережной Лесостепи. Гидротермические условия 2014 и 2016 лет исследований были типичными до среднемноголетних показателей зоны, а 2015 год отличился значительным дефицитом осадков и высоким температурным режимом воздуха.*

Материалом для исследований были сортообразцы фасоли обыкновенной предоставлены Национальным центром генетических ресурсов растений Украины и гибридные комбинации полученные в результате проведенных межсортовых скрещиваний. Сев осуществляли на фоне температурного режима почвы 10–12 °С на глубине заделки семян и устойчивого повышения среднесуточных температур воздуха. Размещение участков последовательное, шестикратная повторность. Способ сева – широкорядный, с шириной междурядий 45 см. Общая площадь участков составила – 1,35 м², учетная – 1,0 м². Сев осуществляли с нормой высева 18 схожих семян на 1 погонный метр, вручную, стандарт размещали через 10 номеров. Учеты, анализы и наблюдения выполнены согласно общепринятых методик. Статистическую обработку результатов исследований выполняли с использованием дисперсионного и корреляционно-регрессионного методов. ***Выводы****. В результате проведенных исследований гибридных популяций выделено комбинации ♀UD0300565 × ♂UD0302256; ♀UD0301041 × ♂UD0300025 и ♀UD0300577 × ♂UD0301041 в гибридном потомстве которых существуют положительные трансгрессии по признакам: количество зерен на растении; масса 1000 зерен; зерновая продуктивность растений. Наследование элементов структуры урожая происходит по типу сверхдоминирования.*

Ключевые слова*: фасоль обыкновенная, гибрид, гибридная популяция, структура урожая, гетерозис истинный, степень доминирования, степень трансгрессии, частота трансгрессии.*

Annotation

Mazur O. V., Poltoretskyi S. P., Poltoretska N. M., Kononenko L. M.
Inheritance of yield formula in F_1 hybrids and hybrid swarms F_2 Phaseolus vulgaris L.

The study of quantitative characteristics controlled by polymer genes is rather complicated due to their significant variability, depends on the environment conditions, and the general picture of their inheritance and variability is masked by the modifying action of heterosis in the first generation. New varieties should have a balanced development of all elements of productivity, resistance to abiotic and biotic factors, and not just the maximum value of the individual characteristic. The ***research objective*** *was to determine the variability level and to identify the patterns of inheritance of valuable commercial-biological traits for the selection of productive and adaptive forms of common bean (Phaseolus vulgaris L.) by hybridologic analysis.* ***Research methodology****. The research was conducted during 2014–2016 in the conditions of the research plot of the Department of Plant Production, Selection and Bioenergetic Cultures of Vinnytsia National Agrarian University. The region of the research by its natural conditions refers to the central subzone of the Right Bank Forest-Steppe. The hydrothermal conditions of the 2014 and 2016 surveys were typical of the average yearly indices of the research area and the year 2015 was characterized by a significant deficiency of precipitation and high temperature air conditions. The research material were the varieties of common bean provided by the National Center for Plant Genetic Resources of Ukraine and hybrid combinations obtained as a result of intervarietal*

crossings. Sowing was carried out by the temperature regime of soil 10–12 °C at the depth of seeding and stable increase of average daily air temperature. The placement of the plots was consistent, the varieties were sown in a six-time repetition. The wide-row sowing with a width of rows of 45 cm was used. The total area of the plots was 1.35 m², and the account one is 1.0 m². Sowing was carried out with the seeding rate of 18 similar seeds per 1 linear meter, the standard was placed in 10 numbers. Accounts, analyzes and observations are performed according to generally accepted methods. Statistical analysis of the results of the research was carried out using dispersion and correlation-regression methods. ***Conclusions****. As a result of conducted research, hybrid combinations ♀UD0300565 × ♂UD0302256; ♀UD0301041 × ♂UD0300025 і ♀UD0300577 × ♂UD0301041 were separated out of hybrid swarms, in hybrid progeny of which there are positive transgressions by characteristics – the number of grains per plant, thousand-kernel weight, grain yield of plants. Inheritance of the elements of yield formula takes place by the type of superdominancy.*

Key words*: common bean, hybrid, hybrid swarm, yield formula, true heterosis, degree of dominancy, degree of transgression, frequency of transgression.*

УДК 633.39-021.361:631.84
DOI 10.31395/2415-8240-2019-95-1-30-44

КОРМОВІ ВЛАСТИВОСТІ ЗЕРНА ТРИТИКАЛЕ ЯРОГО ЗАЛЕЖНО ВІД ДОЗ І СТРОКІВ ЗАСТОСУВАННЯ АЗОТНИХ ДОБРИВ

В. В. ЛЮБИЧ, *доктор сільськогосподарських наук*
Уманський національний університет садівництва

Проведеними дослідженнями впливу різних доз і строків застосування азотних добрив встановлено формування кормових властивостей зерна (вміст крохмалю та протеїну, вихід обмінної енергії і кормових одиниць з урожаю зерна) тритикале ярого. Експериментальними дослідженнями встановлено, що застосування азотних добрив одноразово під передпосівну культивацію істотно покращує кормові показники якості зерна. Вплив азотних підживлень тритикале ярого на ці показники був неістотним порівняно з варіантами, де їх застосовували одноразово.

Ключові слова: *тритикале яре, кормові властивості, зерно, протеїн, кормова одиниця, обмінна енергія.*

Постановка проблеми. Важливим чинником підвищення продуктивності тваринництва є ефективне використання зернофуражних