UDK 633.12.:631.55.001.891
DOROSHENKO E., Master of Agronomy, Senior Lecturer
Kamyanets-Podilsky State Agricultural and Technical University
e-mail: doroshenko2504@mail.ru

FORMATION OF BIOMETRIC INDICATORS OF PRODUCTIVITY OF BUCKWHEAT PLANTS IN THE CONDITIONS OF THE SOUTHERN PART OF WESTERN FOREST-STEPPE

The effect of various minerals on the formation of biometric indicators of productivity of buckwheat plants was studied in the research. Studies were conducted on three different biological and morphological features of buckwheat varieties. With the use of microelements it was shown a tendency of increasing the number of branches, inflorescences and seeds per plant, resulting in increased plant productivity.
Keywords: *Microelements, biometric indicators of productivity, plant height, first branching node, the number of racemes, number of grains, individual productivity*

Introduction. Buckwheat – a valuable cereal culture that is traditional for crop production in Ukraine. In Ukraine it is grown with the XV-XVI century and is of great economic importance due to the use of a wide range of grain and straw as food and raw materials for processing industries [1].

Due to the increase of yield and decrease of valuable elements in the soil, the importance of microelements became crucial. Boron, copper, manganese, zinc, molybdenum, cobalt, etc. are the catalyst for many enzyme processes in the plant cell that improve metabolism and positively affect the yield and the quality of grain. Microelements are used for pre-treatment of seeds or for foliar feeding. Improvement of existing agrotechnological cultivation techniques of buckwheat by applying fertilizing microelements, using different compositions in specific soil and climatic conditions – is a real way to solve the existing problem of productivity.

Analysis of recent research and publications. Microelements are included into fertilizing system because the technology that is used to cultivate crops applies highly concentrated fertilizers that do not contain microelements. Also the use of organic fertilizers has decreased dramatically. Therefore a need for using microelements has risen. Macroelements cease to be a limiting factor. Further growth of yield depends on the nutrition element, which is nowadays plainly represented [2].

Microelements cannot be replaced by other nutrients due to the grain’s inability to absorb high volumes of fertilizer. Thus, it causes the leak of the fertilizers from soil while polluting the environment. Therefore, the use of microelements has a double benefit: increase in the yield and product quality and decrease in the negative impact of modern technologies on the environment [2].

The purpose of the research was to study the effect of microelements on the morphological characteristics of buckwheat plants.

Material and methods. Field studies were conducted on the experimental field of the Institute of Grains PSATU. Experimental field is located in the southern part of Khmelnitsky region, which is very close to the southern agro-climatic region.

Studies were conducted on three different biological and morphological features of buckwheat varieties. Middle class – Victoria and Roxolana. Medium-late ripe variety Zelenokvitkova-90.

Predecessor on the field – winter wheat. Mineral fertilizers were made in the norm under winter wheat, calculated on the planned yield 60 hw/ha. Later in growing buckwheat fertilizers were adopted to detect unilateral reaction of buckwheat only on microelement. Sowing was carried out by seeder SKS-6-10. Agricultural technology in the experiments was consistent with adopted for areas technology, except investigated elements.

Seed treatment was carried out with solutions of mineral elements, followed by drying to their loose condition. To prepare the suspension an aqueous solution of microelements was used, – $ZnSO_4$ zinc sulphate, $CuSO_4$ copper sulfate, $MgSO_4$ magnesium sulfate, $(NH_4)_2MoO_4$ ammonium molybdate, H_3BO_3 boric acid. The studied minerals are soluble inorganic salt.

Treatment process of seeds took place 2-3 days before planting.

Results and discussion. According to the results of this research it should be noted that the use of microelements at the preliminary treatment of seeds to some extent affects the height of the buckwheat plant, the formation of branches per plant, the number of racemeson the branches, and the number of seeds.

As known, the potential productivity of buckwheat is largely determined by the number of vegetative and generative organs and their ability to accept certain conditions in response to changing environmental conditions. N.Z. Ivanova-Zubkov grants a special role to the height of buckwheat plants, suggesting that the higher the plant, the more it blossoms [3]. Also, a number of researchers established the relationship between the productivity of plants and the number of inflorescences and grains on the plant [4].

The data shows that the plant height varied depending on the various factors. A number of authors [5, 6] indicates that the variation in height of buckwheat plants happens due to genetic traits and growing conditions. In the studies we determined the resulting components of buckwheat productivity: plant height, node of 1st branching, number of nodes, branches, buds, seeds, individual productivity.

The highest plants were generated in Victoria variety using boron after preliminary treatment of seeds, namely 113,2 cm, which exceeded the control by 8,2 cm. Also crops of buckwheat were tall when used molybdenum, magnesium, copper, plant height varied from 112,3 to 112,9 cm Markedly lower buckwheat plants were generated using zinc – 106,2 cm (*table 1*).

Table 1

Formation of structure elements of buckwheat yield depending on the use of microelements

Microelements (factor B)	Plant height, cm	Nod of 1st branching	Amount				Grain weight, g
			nodes	bran-ches	race-mes	grains	
Victoria variety							
Control	105,0	3	25,4	2	20,9	57,1	1,4
Zinc $ZnSO_4$	106,2	3	25,6	3	22,4	57,0	1,4
Copper $CuSO_4$	112,3	4	26,2	3	22,4	60,4	1,5
Magnesium $MgSO_4$	112,4	4	26,0	3	22,3	60,3	1,6
Molybdenum$(NH_4)_2MoO_4$	112,9	4	25,9	3	22,7	60,5	1,6
Boron H_3BO_3	113,2	4	25,9	2	22,4	60,5	1,6
Roxolana variety							
Control	95,0	3	26,0	2	20	56,6	1,6
Zinc $ZnSO_4$	100,8	4	26,0	2	21,4	56,3	1,6
Copper $CuSO_4$	103,8	4	26,2	3	21,5	59,3	1,7
Magnesium $MgSO_4$	102,9	4	26,3	2	21,2	59,6	1,7
Molybdenum $(NH_4)_2MoO_4$	102,6	4	26,3	3	21,2	60,6	1,7
Boron H_3BO_3	103,6	4	26,4	2	21,4	59,7	1,9
Zelenokvitkova-90 variety							
Control	101,9	4	30,0	4	23,8	98,9	2,5
Zinc $ZnSO_4$	109,2	4	30,0	4	23,8	100,8	2,6
Copper $CuSO_4$	110,2	4	30,3	4	26,0	102,6	2,7
Magnesium $MgSO_4$	110,6	4	30,5	4	25,8	103,8	2,7
Molybdenum $(NH_4)_2MoO_4$	109,7	4	30,3	4	25,8	102,7	2,7
Boron H_3BO_3	110,0	4	30,5	4	25,9	107,1	2,6

The highest plants were generated in Roxolana variety using copper – 103,8 cm, boron – 103,6 cm, magnesium – 102,9 cm and molybdenum – 102,6 cm. Lower buckwheat plants were generated using zinc – 100,8 cm (*table 1*).

In Zelenokvitkova-90 variety the highest plants were generated using copper, namely 110,6 cm, which exceeded the control by 8,7 cm. Also crops of buckwheat were tall using magnesium, boron, molybdenum, plant height of these variants changed from 109,7 cm to 110,2 cm (*table 1*).

Analysis of the morphology of buckwheat plants showed that in various embodiments, the first sprout is laid on the node with the value of 3-4. Maryahina I.Ya. and Mykulovych T.P., exploring the branching of buckwheat, concluded that differences in branching plants of the same variety are dependent on micro conditions [7].

The sequence number of the first branching node is correlated with the number of clusters (r = 0,54-0,76), number of branches (r = 0,51-0,58), number of grains (r = 0,61-0,95), height of plants (r = 0,53-0,94). Variation of the correlation coefficient is due to varietal characteristics of buckwheat plants. An undersized Roxolana variety is characterized by relatively lower laying of the first branching node.

Number of nodes on the stem is one of the varietal characteristics that with changing conditions of growing varies greatly. The increase of nodes in fruiting area promotes to greater productivity and thus stem plants in general. The number of nodes in the area of branching is a sign that defines the earliness of buckwheat and its growth opportunities [8].

Describing the nodes number, it should be noted that different buckwheat varieties had between 24,5-30,5. The plants of buckwheat Zelenokvitkova -90 variety have the largest number of nodes, to the characteristics of the variety, number of nodes ranged from 30,0 to 30,5. The buckwheat plants preliminary treated with boron and molybdenum had the highest number of nodes – 30,5 units . Number of nodes of plants of buckwheat Roxolana variety ranged from 26,0 to 26,4 units. Plants preliminary treated with boron had the highest number of nods - 26.4 units. Also it was experienced the impact of microelements on the number of nodes in plants of buckwheat of Victoria variety, this indicator differs from 25,4 to 26,2 units, plants treated with copper had the largest number of nodes – 26,2 units (*table 1*).

Branching of plants meets the conditions of growth and is one of the main distinguishing features of buckwheat ecotypes [6]. The number and degree of development of branches were among the main features of the selection for high yield and earliness. A significant impact on the number of branches of microelements is not seen. This indicator only differed depending on the variety and the more it was higher in Zelenokvitkova-90 variety.

The value of the number of branches in the buckwheat is determined by genotype and degree of development of the fruiting zone, due to unbounded growth model, varies widely. A number of inflorescences changes largely. A number of researchers that have worked with buckwheat put forward the theory of plant productivity that depends on the characteristics of buckwheat racemes (their number, distribution on plants, etc.). Taranenko L. and Bober A. [9] used in breeding work performance metric of racemes (the ratio of grain mass to the number of racemes per plant) and Gorina O. [10] proposed a fertility rate of elementary clusters (the ratio of the number of filled fruits in clusters of elementary additions). The top of branch, usually ends with complex of racemes. Part of tops of racemes is in conceive condition and retains the ability to continue its development for a long time.

These calculations of the clusters and grains numbers indicate that preliminary treatment of buckwheat seeds with magnesium, molybdenum and boron, had better results (*table 1*). These indicators are closely linked by correlation in all varieties: Victoria variety - r = 0,66, Roxolana - r = 0,54, Zelenokvitkova-90 - r = 0,83. These indicators were higher in Zelenokvitkova-90 variety due to varietal characteristics.

Analysis of data showed strong correlation between yield and number of grains, the correlation coefficient for varieties is r = 0,79 (Victoria), r = 0,64 (Roxolana) r = 0,67 (Zelenokvitkova-90), and the coefficient of determination (r^2) indicates that productivity of Victoria variety depends on 62% of the grains, Roxolana – 40 %, Zelenokvitkova-90 – 44 %. The value of the criterion of significance shows that the correlation is valid.

It is noted in the works of Fesenko N.V., Taranenko L.V. and other authors that the most causing yield signs are individual seed productivity of genotypes, expressed as the number and weight of grains per plant, generative weight - expressed in the number and length of racemes. Plants productivity – is a complex trait that results from the interaction set of morphological characteristics and properties that define the features of plant growth and development. The value of each individual signs of general complex is different. Summarizing characteristics of all components are graininess and grain weight per plant [11, 12].

The interval between the minimum and maximum level of productivity is 1.4 g, with the least productivity – 1,4 and greatest – 2,8 g per plant. Zelenokvitkova-90 was the best variety in productivity, grain weight was equal to an average of 2,6 g, variety treated with copper, magnesium, molybdenum had the highest productivity – 2,7 g. An average productivity on the plants of buckwheat Victoria and Roxolana varieties was 1,5 g and 1,7 g, respectively (*table 1*).

Mathematical analysis of long-term observations showed strong correlation between the amount of racemes, grain weight and plant height (r = 0,78, r = 0,64 and r = 0,84) in Victoria variety.

Statistical analysis of the results of research in the form of Roxolana variety found correlation dependence on the number of grain yield, number of clusters, grain weight that was r = 0,63, r = 0,77 and r = 0,73.

During the experiments tendency of strong correlation remained in Zelenokvitkova-90 variety. The correlation coefficients in this version were: depending on the amount of grain yield r = 0,66, the number of clusters r = 0,67 and productivity of plant height r = 0,81.

Analyzing the process of structural elements of yield of different buckwheat varieties depending on the use of microelements it can be concluded that microelements affected the height of the plants, laying unit of the 1st branching, number of nodes, branches, buds, seeds , individual productivity. Positive dynamics was observed in the application of all the microelements. Zelenokvitkova-90 is the most productive among other varieties, which is determined by its genetic characteristics.

Conclusions. Microelements used as a preliminary treatment for buckwheat seeds have a significant effect on the morphology of buckwheat plants. There was an increase in the number of branches, racemes and seeds per plant when using all microelements, resulting in significant increase in plant productivity.

The prospect for further research is to identify the influence of microelements on the features of plant growth and development of buckwheat. Further studies will be used to search for compositions of microelements for creating effective micro fertilizers.

References

1. Електронна енциклопедія сільського господарства [Електронний ресурс]. – Режим доступу : http://agroscience.com.ua/plant/633-vnesennya-mikrodobryv-ozymu-pshenytsyu.

2. Лихочвор В. В. Мінеральні добрива та їх застосування / В. В. Лихочвор. – Львів, 2008. – 311 с.

3. Иванова-Зубкова Н. З. Высота гречихи – прогностический показатель условий формирования урожая зерна / Н. З. Иванова-Зубкова // Труды Гидрометцентра СССР. – 1968. – 78 с.

4. Тараненко Л. К., Бобер А. Ф. Озернённость и ее связь с урожайностью гречихи / Л. К. Тараненко, А. Ф. Бобер // Генетика, селекция, семеноводство и возделывание гречихи. – М. : Колос, 1976. – С. 133-137.

5. Москалева Г. И. К анатомии стебля гречихи / Г.И. Москалева // Труды по прикл. ботанике, генетике и селекции. – Л., 1973. – Т. 51, Вып. 1. – 265 с.

6. Кротов А. С. Гречиха / А.С. Кротов. – М.-Л., Сельхозиздат,1963. – 256 с.

7. Марьяхина И. Я. Особенности ветвления гречихи в связи с развитием и ростом вегетативных и генеративных органов / И. Я. Марьяхина, Т.П. Микулович // Морфогенез. – М., 1961. – С. 401-404.

8. Кадырова Л. Р. Морфология вегетативных и репродуктивных органов растений *Fagopyrum esculentum* Moench ssp. vulgare Stolet: автореф. дис. на соиск. ученой степени канд. биол. наук : 03.00.05 «Ботаника» / Кадырова Луиза Равилевна; Татарский научно-исследовательский институт сельского хозяйства. – Казань, 2004. – 24 с.

9. Тараненко Л. К. Озернённость и ее связь с урожайностью гречихи / Л. К. Тараненко, А. Ф. Бобер // Генетика, селекция, семеноводство и возделывание гречихи. – М. : Колос, 1976. – С. 133-137.

10. Горина Е. Д. Фертильность соцветий гречихи и селекционное значение этого явления / Е. Д. Горина // Генетика, селекция, семеноводство и возделывание гречихи. – М. : Колос, 1976. – С. 68-78.

11. Фесенко А. Н. Новые методы селекции грачихи : автореф. на соиск. науч. степ. доктора биол. наук : спец. 06.01.05 «Селекция и генетика» / Алексей Николаевич Фесенко. – Орел, 2009. – 24 с.

12. Тараненко Л. К. Вдосконалення архітектоніки генотипів гречки методами селекції / Л. К. Тараненко, П. П. Каражбей, М. Ф. Пальчук // Науковий вісник НУБіП України : збірник наукових праць. – Вип. 162., Ч. 1. Серія "Агрономія" / Ред. Д. О. Мельничук. – К. : НУБіП України, 2011. – С. 118-123.

Анотація

Дорошенко О.Л.

Формування біометричних показників продуктивності рослин гречки в умовах південної частини Лісостепу західного

В дослідженнях вивчався вплив різних мікроелементів на формування біометричних показників продуктивності рослин гречки. Дослідження проводились на трьох різних за біологічними та морфологічними особливостями сортах гречки. Із застосуванням мікроелементів спостерігалась тенденція збільшення кількості гілок, суцвіть та зерен на рослині, в результаті чого підвищилась продуктивність рослин.

Ключові слова: *мікроелементи, біометричні показники продуктивності, висота рослин, вузол першого галуження, кількість суцвіть, кількість зерен, індивідуальна продуктивність*

Аннотация

Дорошенко Е.Л.

Формирование биометрических показателей продуктивности растений гречихи в условиях южной части Лесостепи западной

В исследованиях изучалось влияние различных микроэлементов на формирование биометрических показателей продуктивности растений гречихи. Исследования проводились на трех различных по биологическим и морфологическим особенностям сортах гречихи. С применением микроэлементов наблюдалась тенденция увеличения количества ветвей, соцветий и зерен на растении, в результате чего повысилась продуктивность растений.

Ключевые слова: *микроэлементы, биометрические показатели продуктивности, высота растений, узел первого ветвления, количество соцветий, количество зерен, индивидуальная продуктивность*