АГРОХИМИЯ

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Sh.M. Maksudov[1]*

THE EFFECT OF DIFFERENT NORMS OF POTASSIUM FERTILIZER ON THE BIOMORPHOLOGICAL TRAITS AND PRODUCTIVITY OF TABLE BEET (*BETA VULGARIS* L. VAR. ESCULENTA)

*[1]Research Institute of Horticulture, a public legal entity, Mirza Fatali Akhundzade, AZ1135, Baku, Sabunchu, Azerbaijan, *e-mail: shabanmaxsudov@gmail.com*

Abstract. The paper discusses biomorphological traits and productivity of the beet plant grown at different norms of potassium fertilizer under the conditions of Absheron. Organic and mineral fertilizers were found to affect positively both the biomorphological traits and productivity of beet. A Bordo-237 variety of beet was used as research material. To calculate the productivity index, the average value of the productivity of one plant was multiplied by the number of plants per hectare. In all variants, biomorphological traits and productivity were higher than those of the non-fertilized (control) variant. The number of leaves and the height of the plant increase with an increasing amount of potassium fertilizer. The indicators of three years were summarized and the mean value was calculated. Depending on the fertilizer norms, the weight characteristics of the above-ground part of the beet plant and the root were studied for years, and the mean value was determined. Besides, depending on the fertilizer norms, the characteristics of the length and diameter of the root vegetable of beet were also studied and evaluated. Studying the effect of potassium fertilizer on the productivity of the beet plant (average over three years) showed the most productivity in the Background+$N_{120}P_{90}K_{120}$ fertilizer (998.8 cwt/ha) variant, while the least productivity was observed in the control variant (productivity 528.7 cwt /ha). The reliability of the yield trait was tested using the T-test statistical software. According to all indicators, the results of the Background + $N_{120}P_{90}K_{120}$ variant were superior and it was found to be the most optimal variant for growing beet under Absheron conditions.

Key words: organic and mineral fertilizers, fertilizer norm, table beet, productivity, biochemical composition

INTRODUCTION

Among the agrotechnical measures, the most important is providing the plant with nutrients according to its needs i.e. fertilizing. It is impossible to imagine modern agriculture without fertilizers. To get a high yield from beet, sandy and loamy soils are considered suitable. If 20-30 t/ha of rotted manure and nitrogen, phosphorus, and potassium fertilizers are applied to the soil before plowing, it is possible to get any crop [1].

Fertilizers and soil reserves are efficiently used by plants, and high-quality crops are obtained. If the fertilizers are not given at the correct rate and in proportion to the natural resources of the soil, the soil environment becomes polluted and the effect of fertilizers decreases. Unnecessary mineral compounds, especially nitrogenous and chlorine compounds increase in the plant organism. This creates conditions for the accumulation of unnecessary substances in fruits. As a result, productivity decreases and product quality deteriorates. Therefore, to obtain a high yield from beet, it is necessary to properly supply the plant with nutrients such as nitrogen, phosphorus, and potassium at all stages of development. Besides, the ratio of nutrients must be correct to get a high yield. If the amounts of nitrogen, phosphorus, and potassium elements do not correspond to the requirements of the plants, they cannot be fully nourished, which leads to a decrease in productivity [2].

When organic and mineral fertilizers are given to root crops together in the form of additional feeding three times during the vegetation period, the assimilation rate and productivity increase [3].

Table beet is widely used in households and has medicinal properties. Therefore, when all three of the mineral fertilizers are applied to the fields in parts, the plant is constantly supplied with nutrients until the end of the vegetation period and a high yield was gained [4].

The role of correct and efficient use of mineral fertilizers in increasing productivity has been confirmed, and the study of their application technology has been significantly improved. Along with other agrotechnical measures, the annual increase in the application of mineral fertilizers increases the productivity of agricultural plants [5].

Table beet (*Beta vulgaris* L. var. vulgaris) is a traditional and popular vegetable in many parts of the world. It is especially rich in fiber as well as sugar but has a moderate caloric value. Soluble and cell wall-associated phenolics are rich in bioactive compounds [6, 7]. In recent years, interest in the nutritional quality, composition, and health effects of beet has increased. Beet accumulates a lot of nutrients. Since red beet contains the mineral silicon, it helps the body use calcium, which is important for the health of the human musculoskeletal system and reduces the risk of osteoporosis. Moreover, it strengthens the connective tissue, the skin, and the wall of blood vessels and cleanses the human body of harmful substances [8-10].

MATERIALS AND METHODS

The Bordo-237 variety of table beet was used as experimental material.

The amount of dry matter accumulated in table beet was studied using a pocket refractometer. The amount of nitrate accumulated in the root vegetable was determined by a nitrometer, and the amount of sugar was measured by a manual refractometer and the Bertrand method was used.

To calculate the productivity index, the average value of the productivity of one plant was multiplied by the number of plants per hectare.

RESULTS AND DISCUSSION

The effect of potassium fertilizer on bimorphological indicators of table beet was studied. The organic and mineral fertilizers were found to have a significant effect on the biomorphological characteristics of beet. As the amount of the effective substance of potassium fertilizer increased, the indicators of the studied bimorphological traits also increased significantly. The research was carried out from 2017 to 2019. The analysis of the results obtained each year was performed separately. Thus, the lowest indicator for all years was in the variant without fertilizer (control), and the highest indicator was in the Background+ $N_{120}P_{90}K_{120}$ variant.

In 2018, the indicators for all variants were superior to the indicators of 2017. In 2019, the indicators for all variants decreased again. The indicators of three years were summarized and the mean value was calculated (table 1).

The effect of fertilizers on the biometric characteristics of table beet was studied. Thus, in the control variant, the number of leaves of the plant was 22, and the height of the plant was 36.5 cm. In other variants, this indicator was as follows.

The number of leaves in the manure 20 t/ha (Background) variant was 31 and the height of the plant was 46.0 cm. The number of leaves in the Background+ $N_{120}P_{90}K_{60}$ was 35 and the height of the plants was 49.4 cm. The number of leaves was 37 in the Background + $N_{120}P_{90}K_{90}$ variant, the height of the plants was 51.1 cm, and in the Background+ $N_{120}P_{90}K_{120}$ variant, the number of leaves was 39, and the height of the plant was 53.8 cm.

Table 1 - Effect of potassium fertilizer on the number of leaves and plant height in table beet

The number of leaves					Plant height, cm				
Variants	2017	2018	2019	mean	Variants	2017	2018	2019	mean
Without fertilizer (control)	23	25	18	22	Without fertilizer (control)	35.4	41.0	33.1	36.5
Manure 20 t/ha Background	30	32	30	31	Manure 20 t/ha (Background)	44.9	50.0	42.0	46.0
Back-ground+$N_{120}P_{90}K_{60}$	35	39	30	35	Background +$N_{120}P_{90}K_{60}$	49.5	55.4	43.4	49.4
Background +$N_{120}P_{90}K_{90}$	36	43	32	37	Background +$N_{120}P_{90}K_{90}$	52.1	56.9	44.2	51.1
Background +$N_{120}P_{90}K_{120}$	37	46	34	39	Background +$N_{120}P_{90}K_{120}$	56.0	59.0	47.0	53.8

Indicators of the studied traits were higher in all variants compared to the control. The highest indicators were found in the Background+ $N_{120}P_{90}K_{120}$ variant. Thus, with an increasing amount of potassium fertilizer, the quantitative indicators such as the number of leaves and plant height increased in all variants.

The results of the study of the potassium fertilizer effect on the weight of the above-ground part and the root vegetable of beet are given in table 2.

Table 2 - The effect of potassium fertilizer on the weight of the above-ground part and the root vegetable of beet

Weight of above-ground parts, g					Weight of root vegetables, g				
Variants	2017	2018	2019	mean	Variants	2017	2018	2019	mean
Non-fertilized (control)	87.4	107.0	70.4	88.2	Non-fertilized (control)	218.0	239.0	198.0	218.2
Manure (Background) 20 t/ha	142.0	175.0	125.0	147.1	Manure (Background) 20 t/ha	303.3	320.1	265.3	296.3
Background +$N_{120}P_{90}K_{60}$	171.0	196.4	156.2	175.0	Background +$N_{120}P_{90}K_{60}$	355.2	385.0	338.1	359.4
Background +$N_{120}P_{90}K_{90}$	183.0	207.1	161.4	184.0	Background +$N_{120}P_{90}K_{90}$	379.0	417.0	352.5	383.0
Background Fon+$N_{120}P_{90}K_{120}$	198.0	215.1	171.0	194.4	Background +$N_{120}P_{90}K_{120}$	415.0	476.0	382.0	424.0

Depending on the fertilizer norms, the weight of the above-ground parts of the beet plant and the root vegetable were measured for years and the mean value was calculated.

The weight of the above-ground part of the plant was 88.2 g, 147.1 g, 175.0 g, 184.0 g, and 194.4 g in the control, manure (Background) 20t/ha, Background + $N_{120}P_{90}K_{60}$, Background+ $N_{120}P_{90}K_{90}$, and Background + $N_{120}P_{90}K_{120}$ variants, respectively.

For the weight of the root vegetable, the indicators were as follows.

The weight of the root vegetable was 218.2 g, 296.3 g, 359.4 g, 383.0 g, and 424.0 in the control, manure (Background) 20t/ha, Background + $N_{120}P_{90}K_{60}$, Background+ $N_{120}P_{90}K_{90}$, and Background + $N_{120}P_{90}K_{120}$ variants, respectively.

The length and diameter of root vegetables of table beet were also evaluated depending on the fertilizer norms.

Depending on the fertilizer norms, the length of root vegetables in the table beet plant was measured for years and the mean value was calculated (table 3).

Table 3 - Effect of fertilizer norms on the root vegetable length of table beet

Variants	2017	2018	2019	Mean
Non-fertilized (control)	82.7	86.7	80.8	83.4
Manure 20 t/ha Background	105.2	113.0	99.2	105.8
Background $+N_{120}P_{90}K_{60}$	110.2	125.0	108.5	114.4
Background $+N_{120}P_{90}K_{90}$	115.3	131.0	111.5	119.1
Background $+N_{120}P_{90}K_{120}$	120.4	136.1	115.0	124.1

The root vegetable length was 83.4 mm, 105.8 mm, 114.4 mm, 119.1 mm, and 124.1 mm in the control, manure (Background) 20t/ha, Background + $N_{120}P_{90}K_{60}$, Background+ $N_{120}P_{90}K_{90}$, and Background + $N_{120}P_{90}K_{120}$ variants, respectively. Thus, the lowest value of this indicator was found in the control (83.4 mm) variant, while the highest value was detected in the Background + $N_{120}P_{90}K_{120}$ variant (124.1).

According to the fertilizer norms, the root vegetable of the table beet plant was also measured for years and the mean value was calculated. The root vegetable diameter was 74.0 mm, 88.0 mm, 101.2 mm, 107.0 mm, and 112.4 mm in the control, manure (Background) 20t/ha, Background + $N_{120}P_{90}K_{60}$, Background+ $N_{120}P_{90}K_{90}$, and Background + $N_{120}P_{90}K_{120}$ variants, respectively. The lowest value for the root vegetable diameter was found in the control (74.0 mm) variant, while the highest value was observed in the Background + $N_{120}P_{90}K_{120}$ variant (112.4 mm) (table 4).

Table 4 - Effect of fertilizer norms on the root vegetable diameter in table beet

Variants	2017	2018	2019	Mean
Non-fertilized (control)	75.0	78.3	69.7	74.0
Manure 20 t/ha Background	86.2	97.2	80.0	88.0
Background $+N_{120}P_{90}K_{60}$	100.2	104.5	98.9	101.2
Background $+N_{120}P_{90}K_{90}$	106.5	111.4	103.2	107.0
Background$+N_{120}P_{90}K_{120}$	112.0	119.0	107.0	112.4

According to the studied biomorphological traits, the Background + $N_{120}P_{90}K_{120}$ variant showed the highest results among all variants.

When studying the effect of potassium fertilizer on the productivity of the beet plant, (average over three years) the most productive was the Background + $N_{120}P_{90}K_{120}$ fertilizer (998.8 s/ha) variant, while the least productivity was recorded in the control variant (productivity 528.7 s/ha).

In other variants, this indicator was as follows.

Productivity was 708.7 s/ha, 867.4 s/ha, and 938.7 s/ha in the manure (Background) 20t/ha, Background + $N_{120}P_{90}K_{60}$, Background + $N_{120}P_{90}K_{90}$ variants, respectively.

The increase in productivity was calculated compared to the control. Productivity increased by 139.3 s/ha (33.9 %), 338.7 s/ha (64.0 %), 410.1 s/ha (77.5 %), and 470.1 s/ha (88.9 %), respectively, in the manure 20t/ha (Background), Background + $N_{120}P_{90}K_{60}$, Background+ $N_{120}P_{90}K_{90}$, and Background + $N_{120}P_{90}K_{120}$ variants compared to the control. The number of plants per square meter was 28.57 in all variants (table 5).

Table 5 - Effect of potassium fertilizer on the productivity of the table beet plant

Variants	Productivity s/ha			Mean, s/ha	Increase in productivity		The number of plants per 1m²
	Years –Mean				s/ha	%	
	2017	2018	2019				
Non-fertilized (Control)	551.4	573.8	461.0	528.7	-	-	28.57
Manure (Background) 20t/ha	737.5	747.7	639.0	708.0	179.3	33.9	28.57
Background + $N_{120}P_{90}K_{60}$	843.5	935.6	823.1	867.4	338.7	64.0	28.57
Background + $N_{120}P_{90}K_{90}$	922.6	1025.4	868.3	938.7	410.0	77.5	28.57
Background + $N_{120}P_{90}K_{120}$	1042.3	1142.3	911.9	998.8	470.1	88.9	28.57

The reliability of the productivity index was checked by T-test statistical software for years. The results are given in tables 6, 7 and 8.

Table 6 - Results of T-test analysis of productivity index according to fertilizer norms (2017)

Comparisons with the control	Mean value	Standard deviation	Standard error	t- value	Degrees of freedom	Significance level
Manure 20t/ha (Background)	-186.07	36.1026	20.8438	-8.927	2	0.012
Background + $N_{120}P_{90}K_{60}$	-292.07	35.9667	20.7653	-14.065	2	0.005
Background + $N_{120}P_{90}K_{90}$	-371.2	17.4519	10.0758	-36.840	2	0.001
Background + $N_{120}P_{90}K_{120}$	142.4	537.383	310.258	.459	2	0.691

Table 7 - Results of T-test analysis of productivity index according to fertilizer norms (2018)

Comparisons with the control	Mean value	Standard deviation	Standard error	t- value	Degrees of freedom	Significance level
Manure (Background) 20t/ha	-173.9	24.67630	14.24687	-12.206	2	.007
Background + $N_{120}P_{90}K_{60}$	-361.8	15.74939	9.09292	-39.793	2	.001
Background + $N_{120}P_{90}K_{90}$	-451.6	17.68304	10.20931	-44.234	2	.001
Background + $N_{120}P_{90}K_{120}$	-568.47	9.17188	5.29539	-107.351	2	.000

The T-test analysis of the results obtained in 2017 showed 95 % reliability in the productivity index of the manure 20 t/ha (Background) variant. In the Background $+N_{120}P_{90}K_{60}$ and Background $+N_{120}P_{90}K_{90}$ variants, reliability was 99 %, while in the Fon$+N_{120}P_{90}K_{120}$ variant, this indicator was significantly small.

The T-test analysis of the experimental results obtained in 2018 showed 99 % reliability in the productivity index in the manure 20 t/ha (Background), Background $+N_{120}P_{90}K_{60}$, Background $+N_{120}P_{90}K_{90}$ variants and 100% in the Background$+N_{120}P_{90}K_{120}$ variant.

Table 8 - Results of T-test analysis of productivity index according to fertilizer norms (2019)

Comparisons with the control	Mean value	Standard deviation	Standard error	t - value	Degrees of freedom	Significance level
Manure (Background) 20t/ha	-178.03	14.10	8.14	-21.867	2	.002
Background + $N_{120}P_{90}K_{60}$	-362.13	22.97	13.26	-27.303	2	.001
Background + $N_{120}P_{90}K_{90}$	-407.27	30.20	17.43	-23.360	2	.002
Background + $N_{120}P_{90}K_{120}$	-450.87	6.70	3.87	-116.55	2	.000

The T-test analysis of the results obtained in 2019 showed 99 % reliability in the manure 20 t/ha (Background), Background + $N_{120}P_{90}K_{60}$, Background $+N_{120}P_{90}K_{90}$ variants, and 100 % reliability in the Background$+N_{120}P_{90}K_{120}$ variant.

CONCLUSION

Summarizing the results, we can say that the most optimal variant for growing table beet under Absheron conditions is the fertilizer norm of Background+ $N_{120}P_{90}K_{120}$.

REFERENCES

1 Gasimov N. Granulometric dynamics of soils in the northern foothill-plain semizone of the Lesser Caucasus// News, Journal of Nakhchivan Division of ANAS. – 2017. - № 2. - P. 175-181.

2 Marko Petek, Marija Pecina, Tomislav Karaz,et. al. Beet mineral composition affected by mineral and organic fertilization. September 2019 . - № 14(9). - P. 91-95.

3 Olayini J.O., Adelasoye K.A., Jegede C.O. Influence of nitrogen fertilizer on the growth, yield and quality of grain amaranth varieties. World. J. Agric. - 2008. - № 4 (4). - P. 506-513.

4 Department of Soil, Crop and Climate Sciences Faculty of Natural and Agricultural Sciences University of the Free State Bloemfontein. Growth, Yield and quality response of Beet (Beta vulgaris L.) to nitrogen. Gabriel Rantao (2008091346). June. - 2013. - P. 326-331.

5 Guliyev Sh. Fertilizer, product, and quality. Azernashr. - 1981. - P. 25.

6 Kugler M. B. Valuing thoughts, ignoring behavior: The introspection illusion as a source of the bias blind spot. *Journal of Experimental Social Psychology, 43*(4). - 2007. - P. 565–578.

7 Rubóczki T., Raczkó V., Takácsné Hájos M. Evaluation of morphological parameters and bioactive compounds in different varieties of beet (*Beta vulgaris* L. ssp. *esculenta* gurke var. *rubra* L.) Int. J. Hortic. Sci. – 2015. – 21. - P. 31–35.

8 Green, W. The Greatest Guide To Slimming & Healthy Living. Greatest Guides. - 2011. - 160 p.

9 Hyun, K., Yun-Jung, B., Mi-Kyeong, C., Yoon-Sok, C. Silicon Supplementation Improves the Bone Mineral Density of Calcium-De cient Ovariectomized Rats by Reducing Bone Resorption. Biological Trace Element Research. 128 (3): 2009. – P. 239–247.

10 Bailey S. J., Winyard P., Vanhatalo A. et. al. Dietary nitrate supplementation reduces the O2 cost of low-intensity exercise and enhances tolerance to high-intensity exercise in humans. Journal of Applied Physiology. – 2009. - Vol. 2. - № 3. - P. 362-367.

ТҮЙІН

Ш.М. Максудов[1]*

КАЛИЙ ТЫҢАЙТҚЫШТАРЫНЫҢ ӘРТҮРЛІ НОРМАЛАРЫНЫҢ БИОМОРФОЛОГИЯЛЫҚ БЕЛГІЛЕРГЕ ЖӘНЕ АСХАНА ҚЫЗЫЛШАСЫНЫҢ ӨНІМДІЛІГІНЕ ӘСЕРІ (BETA VULGARIS L. VAR. ESCULENTA)

[1]Көкөніс шаруашылығы ғылыми-зерттеу институты, Мірза Fатали Ахиндхаде, AZ1135, Баку, Сабунцу, Әзірбайжан, e-mail: shabanmaxsudov@gmail.com

Мақалада Абшерон жағдайында калий тыңайтқыштарының әртүрлі нормаларында өсірілген қызылша өсімдіктерінің биоморфологиялық белгілері мен өнімділігі қарастырылады. Органикалық және минералды тыңайтқыштардың биоморфологиялық белгілерге де, қызылшаның өнімділігіне де оң әсері анықталды. Зерттеу материалы ретінде Бордо-237 қызылшасы қолданылды. Өнімділік индексін есептеу үшін бір өсімдіктің орташа өнімділігі сол гектардағы өсімдіктер санына көбейтілді. Барлық нұсқаларда биоморфологиялық белгілер мен өнімділік тыңайтылмаған (бақылау) нұсқасынан жоғары болды. Калий тыңайтқыштары көбейген сайын жапырақтардың саны мен өсімдіктің биіктігі артады. Үш жылдағы көрсеткіштерді қорытындылап, орташа мәнді есептеді. Тыңайтқыштардың нормаларына байланысты олар қызылша өсімдігі мен тамырдың жер үсті бөлігінің салмақ сипаттамаларын жылдар бойынша зерттеп, орташа мәнін анықтады. Сонымен қатар, тыңайтқыштардың нормаларына байланысты қызылша тамырының ұзындығы мен диаметрінің сипаттамалары да зерттеліп, бағаланды. Калий тыңайтқыштарының қызылша өсімдіктерінің өнімділігіне әсерін зерттеу (үш жылдағы орташа) ең жоғары өнімділік Фон+тыңайтқыш $N_{120}P_{90}K_{120}$ (998,8 ц/га) нұсқасында, ал ең азы бақылауда (өнімділік 528,7 ц/га) байқалғанын көрсетті. ц/га).Өнімділік белгісінің сенімділігі t-test статистикалық бағдарламалық жасақтамасының көмегімен тексерілді. Барлық көрсеткіштер бойынша Фон+$N_{120}P_{90}K_{120}$ нұсқасының нәтижелері жоғары болды және ол Абшерон жағдайында қызылша өсіру үшін ең оңтайлы деп танылды.

Түйінді сөздер: Органоминералды тыңайтқыштар, тыңайтқыш нормасы, асхана қызылшасы, өнімділік, биохимиялық құрам.

РЕЗЮМЕ

Ш. М. Максудов[1]*

ВЛИЯНИЕ РАЗЛИЧНЫХ НОРМ КАЛИЙНЫХ УДОБРЕНИЙ НА БИОМОРФОЛОГИЧЕСКИЕ ПРИЗНАКИ И ПРОДУКТИВНОСТЬ СТОЛОВОЙ СВЕКЛЫ (BETA VULGARIS L. VAR. ESCULENTA)

[1]Научно-Исследовательский Институт Овощеводства. Публичное юридическое лицо, Мірза Fатали Ахиндхаде, AZ1135, Баку, Сабунцу, Азербайджан, e-mail: shabanmaxsudov@gmail.com

В статье рассмотрены биоморфологические признаки и продуктивность растений свеклы, выращенной при различных нормах калийных удобрений в условиях Апшерона. Установлено положительное влияние органических и минеральных удобрений как на биоморфологические признаки, так и на продуктивность свеклы. В качестве материала исследований использовали свеклу сорта Бордо-237. Для расчета индекса продуктивности среднее значение продуктивности одного растения умножали на количество растений на гектаре. Во всех вариантах биоморфологические признаки и продуктивность были выше, чем у неудобренного (контрольного) варианта. Количество листьев и высота растения увеличиваются при увеличении количества калийных удобрений. Показатели за три года суммировали и рассчитывали среднее значение. В зависимости от норм удобрений изучали весовые характеристики надземной части растения свеклы и корня по годам и определяли среднее значение. Кроме того, в зависимости от норм удобрений также изучались и оценивались характеристики длины и диаметра корнеплода свеклы. Изучение влияния калийных удобрений на урожайность растений свеклы (средняя за три года) показало, что наибольшая продуктивность отмечена на варианте Фон + удобрение $N_{120}P_{90}K_{120}$ (998,8 ц/га), а наименьшая – на контроле (урожайность 528,7 ц/га). ц/га). Надежность признака урожайности была проверена с использованием статистического программного обеспечения T-test. По всем показателям результаты варианта Фон + $N_{120}P_{90}K_{120}$ были выше, и он признан наиболее оптимальным для выращивания свеклы в условиях Абшерона.

Ключевые слова: органоминеральные удобрения, норма удобрения, столовая свекла, продуктивность, биохимический состав.

INFORMATION ABOUT AUTHOR

Shaban Mustafa Makhsudov, head of the department, Research Institute of Horticulture, a public legal entity, potato farming, doctoral student, e-mail: shabanmaxsudov@gmail.com