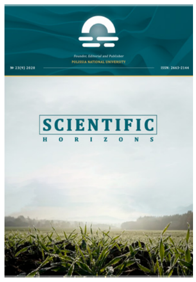
SCIENTIFIC HORIZONS

Journal homepage: https://sciencehorizon.com.ua

Scientific Horizons, 24(12), 25-31



UDC 633.15:631.555:631.811

DOI: 10.48077/scihor.24(12).2021.25-31

Efficiency of Microfertilizer Oracle Multicomplex in Corn Cultivation Technology

Myroslav Pashchak, Olexandra Voloshchuk*, Ihor Voloshchuk, Valentyna Hlyva

Institute of Agriculture of Carpathian Region National Academy of Agrarian Science
81115, 5 Hrushevskyi, v. Obroshyno, Lviv Region, Ukraine

Article's History:
Received: 22.09.2021
Revised: 23.10.2021
Accepted: 25.11.2021

Suggested Citation:
Pashchak, M., Voloshchuk, O., Voloshchuk, I., & Hlyva, V. (2021). Efficiency of microfertilizer oracle multicomplex in corn cultivation technology. *Scientific Horizons*, 24(12), 25-31.

Abstract. In recent years, the use of all types of fertilizers has sharply decreased, which negatively affected the state of the agroecosystem, its stability and constancy, therefore, it is extremely important to replenish nutrients, including microelements, to maintain the stability of yields. The increasing attention of scientists and industrialists deserves the question of the use of micronutrient fertilizers in the plant nutrition system, as an important element of the technology of growing crops. It is especially important to study the various forms, types and timing of their introduction. The article presents the research results for 2019-2021 according to the effect of microfertilizer Oracle multicomplex (1.5 l/ha) applied foliarly during the development phases of plants of the mid-early hybrid Orzhitsa 237 MB (VVSN 13-15, VVSN 16-18, VVSN 59) against the background of mineral nutrition – $N_{150}P_{90}K_{90}$. It has been established that on gray forest surface-gley soils of the Western Forest-Steppe zone, a high grain yield of the mid-early corn hybrid (FAO 200-299) of the Orzhitsa 237 MV ripeness group was provided both by favorable weather conditions and by the influence of the Oracle multicomplex. Foliar application of the Oracle multicomplex microfertilizer in the phase BBCH 13-15 (3-5 leaves) increased the yield increase versus control (without micronutrient fertilization) by 0.82 t/ha, by meeting the needs of plants of this period in available forms of phosphorus, nitrogen, zinc, when panicle axes were laid on the tops of the shoots, and lateral apical meristems (future cobs) formed in the leaf axils. The highest yield by 1.19 t/ha was obtained with foliar application of micronutrient fertilizer in the phase of 6-8 leaves (VVSN 16-18). In this phase, panicle flowers, pollen grains in the stamens, the number of ears and grains in a row were laid, therefore, the content of S, Ca, Mg, Mn, Zn in the fertilizer positively influenced the formation of the reproductive organs of maize plants. Under the influence of micronutrient fertility introduced into the phase of full panic appearance (VVSN 59), blooming and pollution of maize effectively taken place, which ensured an increase in grain yield – 1.27 t/ha. The difference in this indicator between the VVSN 16-18 and VVSN 59 phases was unreliable (0.09 t/ha). Balanced nutrition of plants with macroelements ($N_{150}P_{90}K_{90}$ with a gradual introduction of nitrogen) and micro – Mn, Cu, Zn, Fe, Co, S, Mo contributed to the formation of a 55-59 g higher weight of 1000 grains. The total yield of the coarse and medium grain fractions was 91.5-92.1%, the fine one decreased by 30.6%

Keywords: hybrid, FAO, ripeness group, yield, weight of 1000 grains, fractional composition

**Corresponding author*

INTRODUCTION

The modern strategy for the development of the agro-industrial complex of Ukraine is characterised by high knowledge intensity, in which the stabilisation of grain production, while improving the agrotechnological process of cultivation, is of great importance [1; 2]. Intensive cultivation technologies are based on the widespread use of mineral fertilizers and pesticides, but their uncontrolled use is economically unjustified and environmentally dangerous. Therefore, the search for alternative means of influencing the development of yield and product quality has been gaining more and more attention of researchers in recent years. Promising in this direction may be the introduction of microfertilizers into production, which in low doses can increase the potential of biological productivity of plants within the normal range of the genotype response, enhance their adaptive ability to environmental stress factors [3; 4].

Conditioned upon dynamic changes in environmental and technological situations and to reduce the pressure of environmental stressors on plant agrocenoses, including with great opportunities to use the achievements of domestic breeding, the need for systematic changes in cultivated hybrids in the direction of their greater adaptation to local conditions, ensuring a higher level of yield (10-15 t/ha) and stability over the years, preserving material resources, reducing the use of plant protection products and their impact on the environment and increasing the share of use of natural sources, in particular weather factors and soil nutrients [5-7].

Weather conditions in the Western forest-steppe zone have changed in the direction of warming in recent years. A higher sum of effective temperatures and sufficient moisture supply contribute to the cultivation of niche crops, in particular hybrids of early-maturing corn (FAO 150-199) and medium-early (FAO 200-299) ripeness groups, but low natural soil fertility does not always allow you to get a programmed crop. It is important to observe effective agricultural measures in the cultivation technology, of which the plant nutrition system accounts for up to 50% [8-10].

The basis of such technologies is optimisation of the level of nitrogen nutrition due to differential application by stages of organogenesis against the background of sufficient supply of phosphorus and potassium in combination with microfertilizers, growth stimulants, and retardant protection. Of particular importance is the use of microfertilizers in cases where the cultivation technology does not correspond to the genetic capabilities of the hybrid to ensure a sufficient degree of reliability and protection of the genotype from the adverse effects of biotic and abiotic environmental factors, which does not allow us to fully realise the potential capabilities of plants. The role of microfertilizers is to activate physiological processes in the plant, which is positively manifested in ensuring the maximum biological yield [11; 12].

Effect of trace elements on growth the development, quantitative and qualitative productivity of crops depends on the presence in the soil, which in turn is explained by factors of soil formation and determine the processes of solubility and precipitation of substances, migration, accumulation and redistribution in the soil profile. The most important are six trace elements-B, Mn, Cu, Zn, Co, Mo, which make up 0.01-0.001% per dry substance. However, plants absorb a small amount of them from the soil and only those that are in a mobile, easily accessible form, and inaccessible gross reserves can only be available after undergoing complex microbiological processes involving humic acids and root secretions. Therefore, the gross content of soil trace elements does not reflect the real picture of plant availability, and in the form of inorganic salts, they are available in very small quantities and mainly on acidic soils, only Molybdenum is absorbed by plants on slightly alkaline soils [13-15].

Today, production is offered a number of microfertilizers that stimulate seed germination, regulate growth processes, increase resistance to diseases, reduce crop losses, but the effectiveness of their action is different and this requires scientific justification and practical recommendations [16-18]. The natural soil fertility of the Western forest – steppe is estimated at 38 points, while the average for Ukraine is 55, that is, low, which provides 1.5-1.8 t/ha of grain products. Therefore, optimisation of corn plant nutrition elements at the expense of basic and additional nutrition is an extremely urgent issue that requires appropriate justification for the conditions of the region.

Research purpose it consisted in establishing the effectiveness of the use of microfertilizer Oracle multicomplex, introduced foliar in different phases of development on the productivity of corn in the soil and climatic conditions of the Western forest-steppe of Ukraine.

MATERIALS AND METHODS

The experiments were laid down in the crop rotation of the Department of seed production and seed studies of the Institute of Agriculture of the Carpathian region of the National Academy of Sciences. The object of research was a medium – early hybrid of corn – Orzhitsa 237 MV (originator-state institution Institute of grain crops of the National Academy of Sciences, Dnipro) and complex universal microfertilizer – Oracle multicomplex (manufacturer – "Dolyna"). The application rate is 1.5 l/ha. The composition of microfertilizers includes the main elements of nutrition (NPK) and trace elements: Mn, Cu, Zn, Fe, Co, S, Mo, B, which are in chelated form. As a chelating agent, ethidronic acid (HEDP) is used, which is able to form highly resistant chelates with metals, and when it decomposes, compounds that are easily digestible by plants are formed. The total area of the sown area is 60 m^2, accounting – 50 m^2. The repetition is threefold, and the placement of options is systematic.

Agrotechnics of growing corn included its predecessor – winter rapeseed, the sowing period is optimal

(I decade of May), the seeding rate is 70 thousand similar to s./ha. Mineral nutrition background – $N_{150}P_{90}K_{90}$. Fungicidal mordant-Avicenna (0.5 l/t, d.r. – tebuconazole, 50 g/l + prochlorase, 250 g/l + cresoxime-methyl, 50 g/l). Herbicide-Adengo (0.5 l/ha, d.r. – isokzaflutol, 225 g/l + thiencarbazone-methyl, 90 g/l + ciprosulfamide, 150 g/l). Insecticide: salvo (1.2 l/ha, d.r. – chlorpyrifos, 500 g/l + cypermethrin, 50 g/l).

With the help of biometric and morphological diagnostics and phenological observations, changes in plant growth and development associated with the formation of organs – leaves, stems, cob (method of State Variety testing of agricultural crops, 2001) were established [19]. Crop accounting was carried out by direct combining of experimental sites, followed by weighing and recalculating the obtained data for standard grain humidity. Statistical data processing – by the method of variance analysis (Excel, Statistica 6.0) according to B.O. Dospekhov [20].

RESULTS AND DISCUSSION

Complex universal microfertilizer, when applied foliar, had a positive effect on the growth and development of corn, as can be seen from Figure 1.

***Figure 1**. General view of corn sowing for the introduction of microfertilizers Oracle multicomplex*
***Sources**: photo provided by the authors of the article*

Investigating the level of directed regulation of physiological processes in the plant body under the influence of the proposed nutrition system, which included microfertilizer Oracle multicomplex at a rate of 1.5 l/ha and the level of mineral nutrition $N_{150}P_{90}K_{90}$ with the gradual introduction of nitrogen in the phases of VVSN 13-15; 16-18; 59, the authors established reliable increases in the grain yield of the orzhitsa hybrid of 237 MV (Fig. 2).

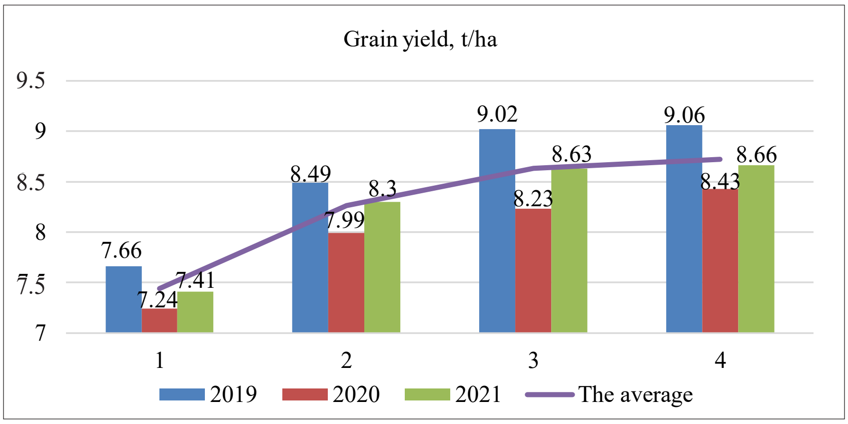


***Figure 2**. Corn grain yield depending on foliar application of microfertilizer Oracle multicomplex (2019-2021), t/ha*
***Note**: 1 – without micronutrient fertilization (control), 2 – BBCH 13-15 (3-5 leaves), 3 – BBCH 16-18 (6-8 leaves), 4 – BBCH 59 (full appearance of the panicle). Hybrid corn – Orzhitsa 237 MV, mineral nutrition background – $N_{150}P_{90}K_{90}$*

It was found that the level of grain yield of the hybrid significantly varied over the years of research. The highest grain yield was obtained in favorable weather conditions in 2019. In the control (without microfertilizers), this indicator was 7.66 t/ha and increased to 9.06 t/ha during the VVSN 59 application phase (complete panicle appearance). The lowest yield was recorded in 2020 – 7.24-8.43 t/ha. The average yield in the control (without microfertilizers) was 7.44 t/ha when applied to the VVSN 13-15 phase (3-5 leaves) significantly increased by 0.82 t/ha ($Nir_{0.05}$=0.17-0.30). It was in this phase that the formation of vegetative parts of the stem was completed, panicle axes were laid at the top of the shoot, and lateral apical meristems (future heads) were formed in the leaf axils. Microfertilizer, providing the need for available forms of phosphorus, nitrogen, and zinc during this period, had a positive effect on plant productivity.

Large increases in control were obtained with foliar application of Oracle multicomplex in the phase of VVSN 16-18 (6-8 leaves) – 1.19 t/ha. This phase coincides with differentiation of panicle flowers, the formation of pollen grains in stamens, cobs and grains in a row, so providing an optimal level of mineral nutrition and trace elements: S, Ca, Mg, Mn, Zn was extremely effective. Later, foliar application of microfertilizers in the VVSN 59 phase (complete appearance of panicles), when the growth of staminate filaments in the panicle, ovary columns of the ear, the formation of germ sacs took place, weather factors and microelements were greatly influenced, which affected photosynthetic productivity (Mg, Mn), water consumption (Zn), fertility (B). Under their influence, corn was effectively blooming and pollinated, so the increase in grain yield was 1.27 t/ha. The difference in this indicator between the VVSN 16-18 and VVSN 59 phases was unreliable (0.09 t/ha).

A balanced level of nutrition of corn plants with macro- and microelements contributed to the formation of a high mass of 1000 grains (Fig. 3). This indicator is genetically determined, but it can change under the influence of weather conditions, research years and microfertilizer application phases. In the experiments conducted by the authors, the mass of 1000 grains in 2019 was in the range of 356 g (control – without microfertilizers) – 421 g for introduction into the VVSN 59 phase (complete appearance of panicles). Compared to the control variant, significant gains were: 39-65 g (2019), 35-55 g (2020) and 41-58 g (2021) for NIR_{05}=16, 10, 11 g. The average mass index ranged from 346 to 405 g, with a difference between 39-59 g.

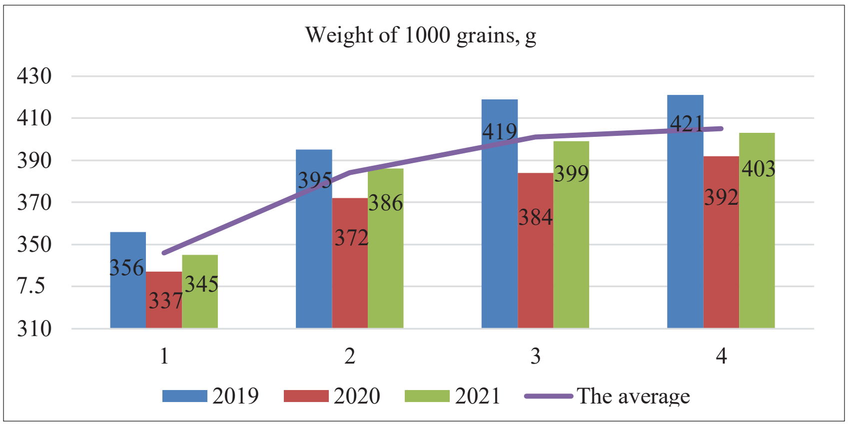


***Figure 3**. Weight of 1000 corn grains depending on foliar application of microfertilizer Oracle multicomplex (2019-2021), g*

***Note**: 1 – without micronutrient fertilization (control), 2 – BBCH 13-15 (3-5 leaves), 3 – BBCH 16-18 (6-8 leaves), 4 – BBCH 59 (full appearance of the panicle). Hybrid corn – Orzhitsa 237 MV, mineral nutrition background – $N_{150}P_{90}K_{90}$*

When determining the yield of grain fractions: large (9-10 mm), medium (7-8 mm), and small (5-6 mm), it was found that in the control, the average for years of research, the yield of small fractions was 38.5%, medium – 44.1%, large – 17.4% (Table 1).

***Table 1**. Fractional composition of corn grain depending on foliar application of microfertilizer Oracle multicomplex (2019-2021), mm*

Microfertilizer application phases	Year 2019			2020			2021			Average		
	Large (9-10)	Average (7-8)	Small (5-6)	Large (9-10)	Average (7-8)	Small (5-6)	Large (9-10)	Average (7-8)	Small (5-6)	Large (9-10)	Average (7-8)	Small (5-6)
Without microfertilizer (control)	18.1	36.6	45.3	17.1	42.5	40.4	16.2	45.4	38.4	17.4	44.1	38.5
VVSN 13-15 (3-5 sheets)	31.5	48.2	20.3	29.8	44.7	25.5	26.3	50.1	23.6	29.2	47.7	23.1
VVSN 16-18 (6-8 sheets)	39.0	56.1	4.9	34.3	55.5	10.2	32.0	59.3	8.7	35.1	57.0	7.9
VVSN 59 (full appearance of panicles)	36.8	55.4	7.8	33.5	57.4	9.1	31.8	59.6	8.6	34.0	57.5	8.5

***Note**: hybrid corn – Orzhitsa 237 MV, mineral nutrition background – $N_{150}P_{90}K_{90}$*

Foliar application of Oracle multicomplex microfertilizer in the VVSN 13-15 phase (3-5 maize leaves) affected the redistribution of these fractions in the direction of increasing large (29.2%) and medium (47.7%) and decreasing small (23.1%). The highest total yield of large and medium grain fractions (92.1%) and the smallest small (7.9%) was obtained from the introduction of microfertilizers in the VVSN 16-18 phase (6-8 leaves), for the introduction of VVSN 59 phase (complete appearance of panicles), respectively – 91.5 and 8.5%.

The data obtained by US confirm the scientific publications of a number of scientists around the world that depending on the need of corn plants for certain elements of nutrition that are insufficient in soil types, with different systems of basic mineral nutrition and the direction of corn use, the increase in grain yield and quality is significant [21; 22]. Thus, Polish researchers have determined that when higher potassium standards are applied to corn, the content of zinc (Zn) in the soil, and especially nickel (Ni), increases, and when nitrogen is applied, the content of manganese (Mn), chromium (Cr), nickel (Ni) and cadmium (Cd) increases, and lead (Pb) decreases [23]. In the soil and climatic conditions of Belarus, the best fertilizer system for growing corn for silage is organomineral with foliar use of zinc-containing microfertilizers [24]. According to studies conducted in the southern agricultural zone of the Amur region in the experimental field of the Far Eastern State agrarian university, it was found that foliar application of microfertilizers has a more effective effect on the accumulation of dry matter in corn than seed treatment. The greatest effect was shown by the variant with the use of cobalt in seed treatment and spraying of plants [25]. In southern Bulgaria, foliar application of Microfertilizer Amalgerol in the 4-6-leaf phase against the background of mineral nutrition of plants (200 kg/ha DW) contributed to an increase in corn grain yield by 31% [26].

Our research on the high efficiency of foliar feeding with micronutrients in easily accessible form, in particular with the balanced microfertilizer Oracle multicomplex, confirms the scientific developments of the Ternopil State Agricultural Experimental Station of Institute of Feed Research and Agriculture of Podillya [27].

CONCLUSIONS

Based on the obtained three-year data, it can be stated that in the conditions of the Western forest-steppe, on Gray forest surface-ogled soils, for a combination of the main mineral nutrition of plants in the norm of $N_{150}P_{90}K_{90}$ with the gradual introduction of nitrogen and additional foliar top dressing of plants with microfertilizer Oracle multicomplex at a rate of 1.5 l/ha in the phase of VVSN 16-18 and VVSN 59, the realization of the genetic potential of the medium – early hybrid Orzhitsa 237 MV was the highest – 8.63-8.72 t/ha.

The highest grain yield was obtained in favorable weather conditions in 2019 – 7.66-9.06 t/ha, and the lowest in 2020 – 7.24-8.43 t/ha. The average yield in the control (excluding microfertilizers) was 7.44 and was significantly higher by 0.82-1.28 t/ha when applying microfertilizers. Providing the need of plants for available forms of nutrients by development phases, microfertilizer had a positive effect on the formation of generative organs.

When microfertilizers were applied in the VVSN 16-18 and VVSN 59 phases, the mass of 1000 grains increased by 55-59 G, the total yield of large and medium grain fractions was 91.5-92.1%, and small ones decreased by 30.6%.

REFERENCES

[1] Ilchuk, M.M., Konoval, I.A., Baranovska, O.D., & Yevtushenko, V.D. (2019). Development of the grain market in Ukraine and its stabilization. *Ekonomika APK*, 4, 29-38. doi: 10.32317/2221-1055.201904029.

[2] Talavirya, M.P., & Vashchenko, I.V. (2018). Formation and functioning of the corn market in Ukraine. *Ekonomika APK,* 9, 28-33.

[3] Gozh, O.A. (2013). Productivity of maize hybrids depending on microfertilizers and growth stimulants under irrigation in the South of Ukraine. *Irrigation Agriculture*, 61, 118-120.

[4] Marchenko, T.Yu., Glushko, T.V., Sova, R.S., & Gozh, O.A. (2015). Productivity of maize hybrids depending on microfertilizers and growth stimulants in the conditions of irrigation of the south of Ukraine. *Agrarian science: Development and perspectives*: *Materials of the international scientific and practical Internet conference* (p. 6). Mykolaiv.

[5] Lavrinenko, Yu.O., & Gozh, O.A. (2016). Growth and development of plants of hybrids of corn FAO 180-430 under the influence of growth regulators and microfertilizers under irrigation conditions in the South of Ukraine. *Irrigated Agriculture,* 65, 128-131.

[6] Duvnjak, M., Kljak, K., & Grbeša, D. (2021). Nitrogen storage in crops: Case study of zeins in Maize. In T. Ohyama, & K. Inubushi (Eds.), *Nitrogen in agriculture – Physiological, agricultural and ecological aspects*. IntechOpen. doi: 10.5772/intechopen.95380.

[7] Pelekh, L.V. (2017). Formation of corn productivity depending on treatment with plant growth stimulants in the conditions of the Right Bank Forest-Steppe. *Agriculture and Forestry*, 5, 54-61.

[8] Voloshchuk, O.P., Voloshchuk, I.S., Hlyva, V.V., & Pashchak, M.O. (2019). Biological requirements of maize hybrids for growing conditions in the Western Forest-Steppe. *Foothill and Mountain Agriculture and Stockbreeding,* 65, 22-36. doi: 10.32636/01308521.2019-(65)-3.

[9] Voloshchuk, O.P., Voloshchuk, I.S., Hlyva, V.V., & Pashchak, M.O. (2020). Productivity of maize hybrids depending on different rates of mineral fertilizers in the Western Forest-Steppe of Ukraine. *Foothill and Mountain Agriculture and Animal Husbandry,* 68(I), 51-65. doi: 10.32636/01308521.2020-(68)-1-4.
[10] Voloshchuk, O.P., Stasiv, O.F., & Pashchak, M.O. (2021). Influence of pre-sowing treatment of seeds with microfertilizers on the productivity of maize hybrids in the Western Forest-Steppe of Ukraine. *Foothill and Mountain Agriculture and Animal Husbandry*, 69(I), 44-61. doi: 10.32636/01308521.2021-(69)-3.
[11] Araus, J.L., Slafer, G.A., Royo, C., & Serret, M.D. (2008). Breeding for yield potential and stress adaptation in cereals. *Critical Reviews in Plant Sciences*, 27(6), 377-412. doi: 10.1080/07352680802467736.
[12] Anjorin, F.B., Adejumo, S.A., Are, K.S., & Ogunniyan, D.J. (2017). Seedling establishment, biomass yield and water use efficiencies of four maize varieties as influenced by water deficit stress. *Cercetări Agronomice în Moldova*, 50(2), 21-34. doi: 10.1515/cerce-2017-0012.
[13] Prado, S.A., Sadras, V.O., & Borras, L. (2014). Independent genetic control of maize (Zea mays) kernel weight determination and its phenotypic plasticity. *Journal of Experimental Botany*, 65, 4479-4487. doi: 10.1093/jxb/eru215.
[14] Palamarchuk, V.D., & Kovalenko, O.A. (2018). Influence of foliar fertilization on the formation of the leaf surface area of maize hybrids. *Bulletin of Agrarian Science of the Black Sea Coast,* 2(98), 32-38.
[15] Ammani, A.A., Ja'afaru, A.K., Aliyu, J.A., & Arab, A.I. (2012). Climate change and maize production: Empirical evidence from Kaduna State. *Journal of Agricultural Extension*, 16(1). doi: 10.4314/jae.v16i1.1.
[16] Vlashchuk, A.N., Pryshchepo, N.N., & Kolpakova, A.S. (2017). Influence of agricultural techniques on the yield of maize hybrids of different maturity groups. *Bulletin of the Belarusian State Agricultural Academy*, 4, 105-108.
[17] Tkalich, Yu.I. (2016). Influence of microfertilizers and plant growth stimulants on sunflower productivity in the Northern Steppe of Ukraine. *Scientific and Technical Bulletin of the Institute of Oilseeds of the National Academy of Sciences,* 23, 169-177.
[18] Anjorin, F., Adebayo, A., Omodele, T., Adetayo, A., & Adediran, J. (2021). Effects of soil nutrient amendments on growth and grain yield performances of quality protein maize grown under water deficit stress in Ibadan, Nigeria. *Acta Agriculturae Slovenica*, 117/4, 1-14, doi: 10.14720/aas.2021.117.4.1887/.
[19] Volkodav, V.V. (Ed.). (2003). Methods of examination and state testing of plant varieties of cereals, cereals and legumes. In *Protection of plant varieties: Official bulletin.* (Vol. 2. Part 3). Kyiv: Alefta.
[20] Dospekhov, B.A. (1973). *Methods of field experience (with the basics of statistical processing of research results).* Moscow: Kolos.
[21] Dudka, M.I., Yakunin, O.P., & Pustovyj, S.I. (2020). Influence of foliar feeding on the formation of grain productivity of corn for its cultivation after sunflower. *Taurian Scientific Bulletin*, 115, 42-48.
[22] Moldovan, J.A., & Sobchuk, S.I. (2018). Estimation of indicators of individual productivity of maize plants by pre-sowing seed treatment and foliar feeding. *Cereals,* 2(1), 101-108.
[23] Brodowska, M.S., Wyszkowski, M., & Bujanowicz-Haraś, B. (2022). Mineral fertilization and maize cultivation as factors which determine the content of trace elements in soil. *Agronomy*, 12(2), article number 286. doi: 10.3390/agronomy12020286.
[24] Wildflush, I.R., Mosur, S.S., & Pirahouskaya, G.V. (2020). Influence of organic, macro, microfertilizers and growth regulator on photosynthetic activity of crops, yield and quality of corn while cultivated for silos on sod-podzolic light loamy soil. *Soil Science and Agrochemistry*, 1, 205-220.
[25] Kalashnikov, N.P., Tikhonchuk, P.V., & Fokin, S.A. (2020). The influence of micronutrients on the productivity of corn during cultivation on green mass in the southern zone of Amur region. *IOP Conference Series Earth and Environmental Science*, 547(1), article number 012043. doi: 10.1088/1755-1315/547/1/012043.
[26] Kalinova, St., Kostadinova, S., & Hristoskov, A. (2014). Nitrogen use efficiency and maize yield response to nitrogen rate and foliar fertilizing. *Bulgarian Journal of Agricultural Science*, 20(1), 178-181.
[27] Scientific and practical recommendations for the developed agricultural measures in the Western forest-steppe of Ukraine. (2015). Khorostkiv: Ternopil DSGDS ICSGP NAAS.

Ефективність мікродобрива оракул мультикомплекс в технології вирощування кукурудзи

Мирослав Олександрович Пащак, Олександра Петрівна Волощук, Ігор Степанович Волощук, Валентина Вікторівна Глива

Інститут сільського господарства Карпатського регіону НААН
81115, вул. Грушевського, 5, с. Оброшине, Львівська обл., Україна

Анотація. За останні роки обсяги застосування всіх видів добрив різко зменшилися, що негативно позначилося на стані агроекосистеми її стійкості і сталості, тому надзвичайно важливим є поповнення елементів живлення, зокрема мікроелементів для збереження стабільності урожаїв. Все більшої уваги науковців і виробничників заслуговує питання застосування мікродобрив у системі живлення рослин, як важливий елемент технології вирощування культур. Особливо важливим є вивчення різних форм, видів і строків їх внесення. У статті наведено результати досліджень за 2019–2021 рр. з впливу мікродобрива оракул мультикомплекс (1,5 л/га), внесеного позакоренево у фази розвитку рослин середньораннього гібриду Оржиця 237 МВ (BBCH 13–15, BBCH 16–18, BBCH 59) на фоні мінерального живлення – $N_{150}P_{90}K_{90.}$ Встановлено, що на сірих лісових поверхнево-оглеєних ґрунтах зони Західного Лісостепу, високий урожай зернової продуктивності гібриду кукурудзи середньоранньої (ФАО 200–299) групи стиглості Оржиця 237 МВ, був забезпечений як сприятливими погодними умовами в роки досліджень, так і ефективністю листкової обробки посівів мікродобривом оракул мультикомплекс. Позакореневе внесення мікродобрива Оракул мультикомплекс у фазу BBCH 13–15 (3–5 листки) збільшувало приріст урожайності до контролю (без мікродобрива) 0,82 т/га, за рахунок забезпечення потреби рослин цього періоду в доступних формах фосфору, азоту, цинку, коли на верхівках пагонів закладалися осі волоті, а в пазухах листків утворювались бічні апікальні меристеми (майбутні качани). Вищу урожайність на 1,19 т/га було отримано за позакореневого внесення мікродобрива в фазу 6–8 листків (BBCH 16–18). У цій фазі закладалися квітки волоті, пилкові зерна в тичинках, кількість качанів і зерен в ряду, тому вміст у добриві S, Ca, Mg, Mn, Zn позитивно впливав на формування репродуктивних органів рослин кукурудзи. Під впливом мікродобрива, внесеного у фазу повної появи волоті (BBCH 59), ефективно проходило цвітіння та запилення кукурудзи, що забезпечило приріст урожайності зерна – 1,27 т/га. Недостовірною (0,09 т/га) була різниця за даним показником між фазами BBCH 16–18 і BBCH 59. Збалансоване живлення рослин макроелементами ($N_{150}P_{90}K_{90}$ з поетапним внесенням азоту) і мікро- – Mn, Cu, Zn, Fe, Co, S, Mo сприяло формуванню вищої на 55–59 г маси 1000 зерен. Сумарний вихід крупної і середньої фракцій зерна складав 91,5–92,1 %, дрібної зменшувався на 30,6 %

Ключові слова: гібрид, ФАО, група стиглості, урожайність, маса 1000 зерен, фракційний склад