Plant Archives Volume 21, No 1, 2021 pp. 1261-1264 *e-ISSN:2581-6063 (online), ISSN:0972-5210*

Plant Archives

Journal home page: www.plantarchives.org

DOI Url: https://doi.org/10.51470/PLANTARCHIVES.2021.v21.no1.167

PECULIARITIES OF SOYBEAN PRODUCTIVITY FORMATION UNDER THE EFFECT OF MICROFERTILISERS AND GROWTH REGULATORS

Sabluk V. T., Baida M. P. and Prysiazhniuk O. I.*

Institute of Bioenergy Crops and Sugar Beet NAAS, 25 Klinichna St., Kyiv, 03110, Ukraine

*Email: ollpris@gmail.com

(Date of Receiving-11-01-2021; Date of Acceptance-25-03-2021)

ABSTRACT

In the experiment, we studied the efficiency of growing soybean varieties 'Ustia', 'Cordoba' and 'Estafeta', as well as the influence of the following technology factors: microfertiliser Yara Vita Mono Molytrac appliedin the budding stage (0.25 l/ha); Yara Vita Mono Molytrac applied in the budding stage (0.25 l/ha) + in the flowering stage (0.25 l/ha); growth regulators (Biosil, Radostim). According to the research results, it was found that the best yield of 'Cordoba' variety was obtained with the application of Yara Vita Mono Molytrac in the budding stage + Radostim (3.03 t/ha), and Yara Vita Mono Molytracapplied twice in combination with Biosil (3.03 t/ha) or Radostim (3.07 t/ha). Similarly, in 'Estafeta' variety, the maximum yield was obtained for the combination of Yara Vita Mono Molytracin the budding stage + Radostim, and for application of Yara Vita Mono Molytracapplied twice in combination with Biosil or Radostim. The protein content was the bestin 'Cordoba' variety for treatment with Yara Vita Mono Molytracin the budding stage + Radostim (43.5%), and for application of Yara Vita Mono Molytracin the budding stage + at the flowering stagein combination with Biosil (43.3%) or Radostim (46.6%).However, the best treatments in terms of oil content in'Cordoba'variety were the use of Yara Vita Mono Molytrac + Radostim (21.3%), and Yara Vita Mono Molytrac appliedtwice in combination with Biosil (21.5%) or Radostim (23.2%). The best productivity of soybean variety 'Estafeta' was under the combination of Yara Vita Mono Moly tracapplied twice and Biosil, which ensured oil content of 22.3%.

Keywords: soybean, yield, protein, oil, microfertiliser, growth regulator

INTRODUCTION.

In recent decades, technologies for the use of microfertilisers and plant growth regulators have spread from experimental fields to commercial cropping not only in Ukraine but around the world. Moreover, this agricultural measure is considered as a constantly used element of cultivation technology, which complements the application of pesticides or other components of plant care technology(Tarariko and Ilienko, 2015; Patyka and Patyka 2014).

However, despite the proven effectiveness of the use of microfertilisers and growth regulators, there are quite diverse data on their efficiency in influencing plant productivity in research publications. Thus, the yield of cereals can increase compared to untreated variants of the experiment from 0.4 to 1.3 t/ha, while sugar beet root yield can increase from 2.0 to 3.0 t/ha (Mosondz. 2014).

However, according to other studies, it is mentioned that biological products and plant growth regulators applied in pre-sowing treatment of spring barley showed an efficiency of 16.1−40.9% and the largest increase in yield was obtained for treatment with growth regulator Vympel (0.99 t/ha) and biological product Kladostim (0.86 t/ha). However, other researchers have determined that it is possible to obtain a yield increase from the use of plant growth regulators and micro fertilisers from 0.08 to 0.28 t/ha (Petrychenko *et al.,* 2006; Moisiienko and Didora, 2010).

The researchers who studied the features of the influence of plant growth regulators on soybean yield found that variety 'Ustia', depending on the product used, provided a yield increase of 0.13−0.34 t/ha, variety 'Aratta' 0.18−0.31 t/haand 'Sofiia' 0.12−0.40 t/ha. At the same time other researchers have shown much lower efficiency of this agricultural measure and theyield increase from the application of growth regulators in variety 'Masha' was 0.06 t/ha, in 'Sedmytsia' 0.08 t/ha, in 'Lara' 0.18 t/ha. Other researchers have shown that with the use of plant growth regulator alone, the yield of soybean variety 'Romantyka' increased by 0.30 t/ha, 'Annushka' by 0.28 t/ha, and with the combined use of seed inoculation by 0.48 and 0.50 t/ha, respectively (Petrychenko *et al.,*2005; Prysiazhniuk and Hryhorenko, 2018; Zabolotnyi, 2006).

Usually, plant growth regulators and microfertilisers have little effect on the formation of plant productivity and their contribution ranges between 5 and 15%. At the same time, there are publications where the contribution of this class of products to yield formation is estimated in the range from 20 to 30%. However, in our opinion, this is possible with a good enough supply of plants with other nutrients and a significant need for micro fertilisers (Prysiazhniuk *et al.,* 2018; Stryzhak. 2014).

Thus, the contribution of growth regulators and microfertilisers to yield cannot be assessed unambiguously, and some issues, especially concerning the complex interaction of products, need further study.

MATERIALS AND METHODS

The research was carried out in the years 2018–2020 at the Verkhniaky Research and Breeding Station of the Institute of Bioenergy Crops and Sugar Beet National Academy of Agrarian Sciences of Ukraine (Khrystynivska district, Cherkasy region).

According to hydrothermal conditions, the territory belongs to the zone of unstable humidity of the Right-Bank Forest-Steppe of Ukraine. At the same time, despite the fact that weather conditions in the years of research differed from the average long-term values, they were favourable for plant growth and development.

The soil of the experimental plots was podzolic chernozem with the following characteristics: humus content of 3.36–4.89%, hydrolytic acidity of 2.2–3.8 mmol per 100 g of soil, the content of mobile phosphorus and potassium 90–140 and 70–100 mg/kg of soil, respectively, easily hydrolysed nitrogen content of 100–120 mg/kg of soil, and absorbed alkaliof 28–30 mmol per 100 g of soil (Ermantraut *et al.,* 2014).

In the experiment, we used soybean varieties 'Ustia', 'Cordoba' and 'Estafeta'. The experimental design included the following experimental factors of cultivation technology: microfertiliser: Yara Vita Mono Molytracapplied in the budding stage (0.25 l/ha); Yara Vita Mono Molytrac applied in the budding stage (0.25 l/ha) + in the flowering stage (0.25 l/ha); growth regulators (Biosil, Radostim). The accounting plot of the site was 35 m^2. The plots were randomized with four replications. Row spacing was 45 cm.

RESULTS AND DISCUSSION

According to the results of research, it was found that the use of plant growth regulators alone makes a minimal effect on the yieldformation in the studied soybean varieties (Table 1).

Compared with other traits, the contribution of the treatments with combined microfertilisers and plant growth regulators to yield formation was the highest in all the varieties under study.

It was found that in'Cordoba' variety,the maximum yield

Table 1. Soybean productivity as affected by microfertilisers and plant growth regulators (2018-2020)

Variety	Microfertiliser	Plant growth regulator	Yield (t/ha)	Protein content (%)	Oil content (%)
'Ustia'	Without microfertiliser	Without growth regulator	2.51	38.6	17.9
		Biosil	2.51	39.3	18.2
		Radostim	2.52	40.5	18.5
	Yara Vita Mono Molytrac in the budding stage (0.25 l/ha)	Without growth regulator	2.78	40,8	19.5
		Biosil	2.81	41.1	19.5
		Radostim	2.88	41.3	19.7
	Yara Vita Mono Molytrac in the budding stage (0.25 l/ha) + in the flowering stage (0.25 l/ha)	Without growth regulator	2.81	40.5	20.4
		Biosil	2.89	44.3	21.1
		Radostim	2.87	46.1	22.1
'Cordoba'	Without microfertiliser	Without growth regulator	2.70	39.5	18.8
		Biosil	2.70	40.0	19.1
		Radostim	2.72	40.5	19.3
	Yara Vita Mono Molytrac in the budding stage (0.25 l/ha)	Without growth regulator	2.91	41.4	20.1
		Biosil	2.94	41.6	20.2
		Radostim	3.03	43.5	21.3
	Yara Vita Mono Molytrac in the budding stage (0.25 l/ha) + in the flowering stage (0.25 l/ha)	Without growth regulator	3.02	41.9	20.9
		Biosil	3.03	43.3	21.5
		Radostim	3.07	46.6	23.2
'Estafeta'	Without microfertiliser	Without growth regulator	2.60	36.6	20.6
		Biosil	2.60	37.3	21.0
		Radostim	2.61	37.4	21.1
	Yara Vita Mono Molytrac in the budding stage (0.25 l/ha)	Without growth regulator	2.99	38.4	21.1
		Biosil	3.03	39.0	21.4
		Radostim	3.06	38.9	21.3
	Yara Vita Mono Molytrac in the budding stage (0.25 l/ha) + in the flowering stage (0.25 l/ha)	Without growth regulator	2.99	38.2	22.0
		Biosil	3.05	40.1	22.3
		Radostim	3.06	43.3	21.8
LSD0.05			0.15	0.9	0.20

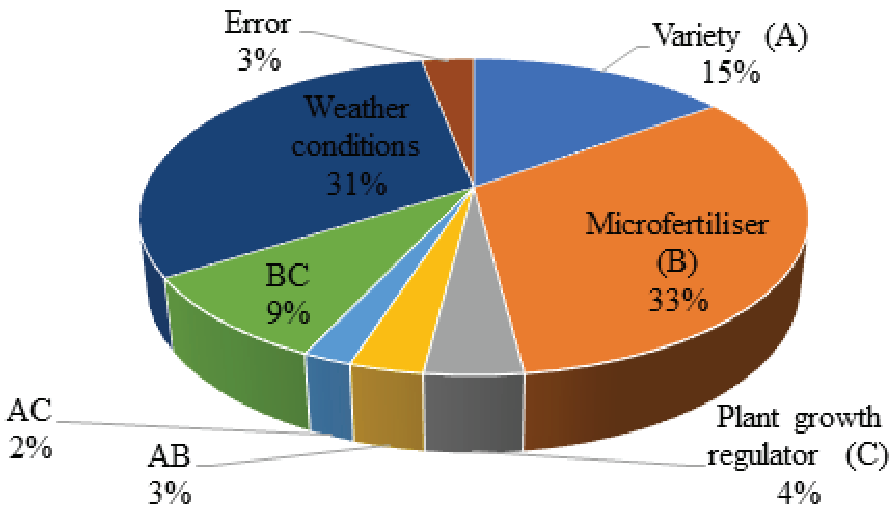

Figure. 1. Influence of the experimental factors on soybean yield

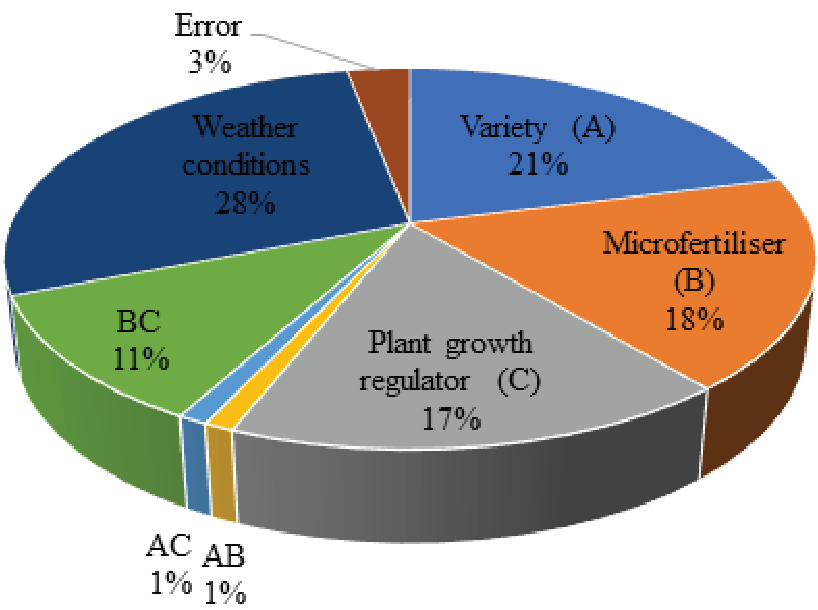

Figure. 2. Influence of the experimental factors on protein content in soybean seeds

Vita Mono Molytrac in the budding stage + Radostim (43.5%), and when using Yara Vita Mono Molytrac in the budding stage + at the flowering stage in combination with Biosil (43.3%) or Radostim (46.6%).

Analysis of the oil content showed that if we compare the experiment treatmentswith the control, without the use of growth regulators, then we obtained an oil content increase with the use of Biosil (0.10–0.70%), and Radostim (0.20–2.30%). As forthe treatment with microfertilisers alone, without the use of growth regulators, we obtained an increase of 0.50–1.60% for the single application of Yara Vita Mono Molytrac and1.40–2.50% for the double application.

The best treatmentsin terms of oil content in‘Cordoba’ variety were the combinations of Yara Vita Mono Molytrac + Radostim (21.3%), and the combination of Yara Vita Mono Molytrac applied twice + Biosil (21.5%)or Radostim (23.2%). However, the best oil content in ‘Estafeta’ variety (22.3%) was observed under the combination of Yara Vita Mono Molytrac applied twice + Biosil.

was obtainedin the treatments with the combined useof Yara Vita Mono Molytrac in the budding stage + Radostim (3.03 t/ha), and with the use of Yara Vita Mono Molytracapplied twice in combination with Biosil (3.03 t/ha)or Radostim (3.07 t/ha). Similarly, in ‘Estafeta’ soybean variety we obtained the maximum yield values for the combination of Yara Vita Mono Molytrac in the budding stage + Radostim and the use of Yara Vita Mono Molytracapplied twice in combination with Biosil or Radostim.

It was found that for the treatment of plants with growth regulators, a yield increase was obtained for the application of Biosil (0.50–0.70%), and Radostim (0.80–1.90%). In the case of treatmentswith microfertilisers alone, without growth regulators, we obtainedthe following results: for the use of Yara Vita Mono Molytrac in the budding stage the increase in protein content was 1.80–2.20%, while for the use of Yara Vita Mono Molytrac in the budding stage and flowering stage it was 1.90–2.40%.

In general, if we analyse the experiment treatments, then in ‘Cordoba’ soybean variety, we obtained the best protein content in the treatmentswith the combinations of Yara

In fact, despite the general potential of the use of microfertilisers and plant growth regulators for the increase in protein and oil content, we noted variety-specific features of the oil accumulation in seeds.

The analysis of the influence of the experimental factors shows significant importance of the factor of microfertiliser (33%), weather conditions during vegetation (31%), and varietal characteristics (15%) on the formation of soybean yield (Fig.1).

Thus, despite the significant role of other factors in the technology of soybean cultivation, the use of microfertilisers and growth regulators not only improves the general physiological condition of plants but also contributes to the formation of a higher level of productivity. That is, in the case of the low cost of plant care products their implementation in commercial cultivation is promising.

According to the results of determining the effect on protein content, wefound a large significance of the factor of weather conditions during vegetation (28%), varietal characteristics (21%), microfertilisers (18%), and growth regulator (17%) (Fig. 2).

Besides, microfertilisers and growth regulators interacted quite significantly, at the level of 11%, while the rest of the interactions between the experimental factors were rather insignificant.

CONCLUSIONS

It was found that the best yield of 'Ustia' variety was for the combinationof Yara Vita Mono Molytrac in the budding stage and microfertiliser Radostim (2.88 t/ha), and in the treatments with Yara Vita Mono Molytrac applied twice in combination with growth regulators Biosil (2.89 t/ha), and Radostim (2.87 t/ha). The yield of 'Cordoba' soybean variety in the same combinations of plant products was 3.03 t/ha, 3.03 t/ha, and 3.07 t/ha, respectively. In the same way, the best level of 'Estafeta' variety productivity was obtained in the mentionedtreatments.

We found that the highest protein content in 'Ustia' variety was obtainedwith the use of Yara Vita Mono Molytracapplied twice in combination with growth regulator Biosil (44.3%) or Radostim (46.1%). But in the Cordoba soybean variety, the best results were obtained in the treatments with Yara Vita Mono Molytrac + Radostim (43.5%), and Yara Vita Mono Molytracapplied twice in combination with Biosil (43.3%) or Radostim (46.6%). In 'Estafeta' variety, the use of Yara Vita Mono Molytracapplied twice with Biosil or Radostim provided protein content in the seeds 40.1% and 43.3%, respectively.

For 'Ustia' variety, the best in terms of oil content were combinations of Yara Vita Mono Molytrac applied twicewith Biosil growth regulator (21.1%) and Radostim (22.1%). However, in 'Cordoba' variety, the best results were obtained with the use of Yara Vita Mono Molytrac + Radostim (21.3%), and Yara Vita Mono Molytrac applied twice in combination with Biosil (21.5%) or Radostim (23.2%). As for 'Estafeta' variety, the best treatment was with Yara Vita Mono Molytrac applied twice in combination with Biosil, which provided 22.3% of oil content in the seeds.

REFERENCES

Ermantraut, E. R., Hoptsii, T. I., Kalenska, S. M., Kryvoruchenko, R. V., Turchynova, N. P., & Prysiazhniuk, O. I. (2014). Method of selection experiment (crop). Kharkiv: N.p.

Moisiienko, V. V., & Didora, V. H. (2010). Agroeconomic substantiation of the role of soybean in solving the problem of vegetable protein in Ukraine. Bulletin of Zhytomyr National Agroecological University, 1, 153–166.

Mosondz, N. P. (2014). Formation of soybean productivity as affected by agronomical practices under the conditions of the northern part of the Forest-Steppe. *Agriculture*, 1–2, 74–78.

Patyka, M. V., &Patyka, V. P. (2014). Current issues of biodiversity and climate fluctuation. *Bulletin of Agricultural Science*, 6, 5–10.

Petrychenko, V. F., Babych, A. O., &Ivaniuk, S. V. (2006). The role of climatic factors in the formation of breeding policy in the Forest-Steppe zone of Ukraine. *Plant Breeding and Seed Production*, 93, 60–67.

Petrychenko, V. F., Babych, A. O., &Kolisnyk, S. I. (2005). Ways of increasing the productivity of soya in the conditions of the Forest-Steppe of Ukraine. *Plant Breeding and Seed Production*, 90, 50–58.

Prysiazhniuk, O. I., &Hryhorenko, S. V. (2018). Status and Prospects of Soybean Production in Ukraine. Scientific support for soy production: challenges and perspectives. Blagoveshchensk: OOO «IPK «ODEON». pp. 264–271

Prysiazhniuk, O. I., Hryhorenko, S. V., &Polovynchuk, O. Yu. (2018). Peculiarities of realization of biological potential of soybean varieties depending on technological methods of cultivation in the conditions of the Forest-Steppe of Ukraine. *Plant Var. Stud. Prot*., 14(2), 215–223. doi: 10.21498/2518-1017.14.2.2018.134773

Stryzhak, A. M. (2014). Studying the response of soybean of various maturity groups to drought under the conditions of the Central Forest-Steppe zone of Ukraine. Breeding and genetics of legumes: modern aspects and prospects: *Proc. Int. Sci. Conf.* (pp. 224–227). June 23–26, 2014, Odesa, Ukraine.

Tarariko, O. H., &Ilienko, T. V. (2015) Predicting the impact of weather conditions on the yield of grain crops. *Agriculture*, 2, 66–72.

Zabolotnyi, O. H. (2006). Problems of increasing the efficiency of soybean production and processing technology. *Vinnytsia: Knyha-Veha*.