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THE EFFICIENCY OF ORGANIC BIOSTIMULANTS FOR KOHLRABI SEEDS AND PLANTS TREATMENT

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ABSTRACT

The research reveals a versatile positive effect of organic bio stimulants Regoplant, Stimpo, and Emochka on kohlrabi cabbage plants. Soaking the seeds for 12 hours and foliar dressing of plants during vegetation with solutions of growth regulators contributed not only to increase the total yield of stems but also to enhancing growth indices of kohlrabi plants and at the same time ensuring better resistance to adverse growing conditions. The highest yield was obtained for the soaking seeds for 12 hours and 2 foliar dressings. Thus, in kohlrabi varieties 'Delikatesna Bila' and 'Violeta', the highest yield of stems (23.9–25.2 t/ha) was obtained under the influence of growth regulators Regoplant and Stimpo. In the experiment, a high yield of commodity stems was obtained in variety 'Delikatesna Bila' (86–93%) and in variety 'Violeta' (86–91%), which was on average higher by 8.0 and 5.6% than in the control treatment. The use of biostimulants ensured the yield of soluble dry matter higher by 0.2%, 0.4%, 0.8% in 'Delikatesna Bila' and by 0.8%, 1.0%, 0.3% in 'Violeta', respectively, compared to the control treatment.

INTRODUCTION

Among the family of *Brassicaceae*, white cabbage, kohlrabi, broccoli, Brussels sprouts, Chinese cabbage, and headed Chinese cabbage are the most popular in Ukraine. They have good palatability traits, high dietary and nutritional properties.

Among the common species, kohlrabi is a valuable vegetable plant, the cultivation of which in the open and closed ground can significantly expand the range of vegetables consumed by population in the autumn-winter and early spring periods. Accordingly, advanced cabbage growing technologies should be aimed at the use of environmentally friendly practices based on the use of biological plant products (Shamset al., 2013; Shehata et al., 2011).

Biostimulants applied as foliar dressing lead to improved yield and quality, efficient absorption of nutrients, and increased resistance to stress (Spinelli et al., 2010; Shams, 2012; Morsy et al., 2017). The use of physiologically active substances promotes an increase in the photosynthetic apparatus, an increase in the content of total carbohydrates, starch, amino acids, and protein (Raupp & Oltmanns, 2006; Uddin et al., 2009).

Studies on different crops show the effectiveness of biostimulants and a significant increase in vegetative growth and yield, as well as the increased content of N, P, and protein in the leaves (Abd El-Mawgoud et al., 2010) of strawberry (Shalaby & El-Ramady 2014; Abo Sedera et al., 2010; Spinelli et al., 2010), garlic (Elarroussi et al., 2016), tomatoes, and fennel (Abd El-Aleem et al., 2017).

It should also be emphasized that organic vegetable production is in great demand in terms of the health and

nutritional benefits. There is little information on the use of bio stimulants of organic origin in vegetable growing. Consequently, different growth regulators do not affect plants equally effectively, which complicates their choice for practical application (Pise et al., 2010; Papenfus et al., 2013; Morsy et al., 2018). Therefore, the study of the effect of bio stimulants on the yield, quality, and chemical characteristics of kohlrabi is an extremely important research issue.

The purpose of the research was to study the effectiveness of bio stimulants in the treatment of kohlrabi seeds and plants.

MATERIALS AND METHODS.

We studied kohlrabi varieties 'Delikatesna Bila' and 'Violeta' in the treatment with growth regulators Regoplant, Emochka, and Stimpo.

'Violeta' is a late-ripening variety with a vegetation period of 90–110 days. Green leaves have purple veins, leaf rosette has 60 to 80 cm in diameter. The stem is round, slightly flattened, purple, with the weight of 0.8–1.2 kg and 8–12 cm in diameter. The white flesh is juicy and crispy.

'Delikatesna Bila' is a medium-ripening variety, with vegetation period of 60–80 days. The stem has a light green colour, round-flattened, medium size, white in section, with a weight of 0.5–1.5 kg.

New biotechnological formulations are produced based on the fungus-micromycete extract from the root system of ginseng, and active ingredients from the metabolic products of *Streptomyces savenmitilis*.

Regoplant (Agrobiotech) contains a complex of

Table 1. The total yield of kohlrabi stems as affected by the factors of the experiment (t/ha)

Treatment	Yield (t/ha)		
	Soaking the seeds for 12 hours	Soaking the seeds for 12 hours and 1 spraying	Soaking the seeds for 12 h; 2 sprayings
‘Delikatesna Bila’			
Water (control)	18.1	19.2	20.2
Regoplant	19.6	20.8	25.2
Stimpo	19.8	20.6	23.9
Emochka	18.7	19.7	21.8
LSD0.05	1.1	1.0	0.6
‘Violeta’			
Water (control)	17.8	18.8	20.7
Regoplant	18.7	19.9	23.9
Stimpo	18.5	19.7	22.9
Emochka	18.0	19.3	21.1
LSD0.05	0.6	0.9	1.2

Table 2. The total yield of kohlrabi stems (t/ha)

Treatment	Yield (t/ha)				
	2017	2018	2019	average	± to control
‘Delikatesna Bila’					
Water (control)	21.3	19.0	20.5	20.2	-
Regoplant	25.6	24.8	25.4	25.2	5.0
Stimpo	24.8	23.2	23.8	23.9	3.7
Emochka	22.8	21.0	21.6	21.8	1.6
LSD0.05	1.0	1.1	0.8	0.6	
‘Violeta’					
Water (control)	22.0	18.8	21.5	20.7	-
Regoplant	25.6	22.4	23.7	23.9	3.2
Stimpo	24.8	21.2	22.8	22.9	2.2
Emochka	22.3	19.7	21.3	21.1	0.4
LSD0.05	1.2	0.8	1.0	1.2	

Table 3. Qualitative indicators of kohlrabi yield (average for 2017–2019)

Variety	Treatment	Stem diameter (cm)	The average weight of the stems (kg)	Commodity (%)
Delikatesna Bila	Water (control)	8.2	0.35	81
	Regoplant	9.5	0.43	93
	Stimpo	9.7	0.47	88
	Emochka	9.3	0.41	86
Violeta	Water (control)	8.1	0.32	83
	Regoplant	9.7	0.43	91
	Stimpo	9.3	0.38	89
	Emochka	9.1	0.35	86

biologically active compounds, metabolic by products (saturated and unsaturated fatty acids (C14-C28) of fungi-micromycetes (0.3 g/l), polysaccharides, 15 amino acids, analogues of phytohormones of cytokinin and auxin nature), nutrient complex (1.75 g/l) containing potassium salt of alpha-naphthylacetic acid (1 mg/l), aversectin C (a product of actinomycete activity of *Streptomyces savermytilis*).

Stimpo (Agrobiotech) is a complex of biologically active

compounds that are metabolic by products of saturated and unsaturated fatty acids (C14-C28) of fungi-micromycetes (1 g/l), polysaccharides, 15 amino acids, analogues of phytohormones of cytokinin and auxin nature, a complex of biogenic microelements (0.014 g/l), and aversectin C.

Emochka (BioAg) is a micro fertilizer based on bacterial cultures and yeast, enriched with compositions of minerals and plant extracts using structured water and natural nutrient medium.

Table 4. Chemical characteristics of kohlrabi stems (average for 2017–2019)

Variety	Treatment	Dry soluble substance (%)	Ascorbic acid (mg/%g)	Nitrates (mg/kg)
Delikatesna Bila	Water (control)	7.5	48.5	465
	Regoplant	7.9	57.8	387
	Stimpo	7.7	51.7	435
	Emochka	8.3	53.6	398
Violeta	Water (control)	6.5	50.8	406
	Regoplant	7.3	54.5	395
	Stimpo	7.5	53.7	348
	Emochka	6.8	51.9	389

The research was carried out in the years 2017–2019 at the research plots of the Research and Production Department of Uman National University of Horticulture. The accounting plot area was 12 m². The experiment was carried out in four replications. The planting design was 70 cm x 25 cm that is 57.1 thousand plants per hectare.

According to the experiment design, the following activities were carried out: soaking of kohlrabi seeds for 12 hours; soaking the seeds for 12 hours and 1 spraying; soaking the seeds for 12 hours and 2 sprayings. The foliar dressing was carried out during vegetation using growth regulators Regoplant (0.5 ml per 3 l of water), Stimpo (0.2 ml per 3 l of water), and Emochka (100 ml per 3 l of water). The first spraying was carried out after transplanting plants in open ground and the second one during the period of active stem formation.

Yield recording in all experimental treatments was carried out by a weight method with the division of a crop into a commodity and non-commodity parts.

Laboratory studies involved the determination of dry soluble and insoluble substances, sugar, ascorbic acid, nitrates.

RESULTS AND DISCUSSION

Studies have shown yield fluctuation in varieties 'Delikatesna Bila' and 'Violeta' over the experimental treatments. Thus, for soaking the seeds for 12 hours and 2 sprayings, the highest yield of the studied varieties was noted, while the lowest yield was for the soaking seeds only. It should also be noted that the use of stimulants Rego plant and Stimpo allowed obtaining higher yields compared to Emochka in all treatments of the experiment (Table 1).

It should be noted that the total stem yield was significantly affected by the weather conditions. Thus, in the productive year 2017, there was slightly more precipitation during the stem formation period, which positively affected crop quality, while in 2018, the lowest yield was obtained.

The use of the same formulations Regoplant and Stimpo in 'Delikatesna Bila' contributed to the stem yield higher by 5.0 and 3.7 t/ha than in the control. In 'Violeta', these indices were higher by 3.2 and 2.2 t/ha, respectively (Table 2).

In the structure of the commodity crop, the largest diameter of the stem of kohlrabi, 9.2–9.6 cm, was obtained in all treatments with biological products, while in the control it was 8.0–8.2 cm (Table 3).

In the experiment, there were few non-commodity stems, while in the control treatment, commodity stems amounted to 81–83%. Specifically, in 'Delikatesna Bila' commodity stems ranged from 86 to 93% and in 'Violeta', from 86 to 91%, that was higher by 8.0 and 5.6%, respectively.

The use of formulations contributed to obtaining good indicators of ascorbic acid content: in 'Delikatesna Bila' it ranged from 51.7 to 57.8 mg /%g, in 'Violeta' from 51.9 to 54.5 mg /% g, compared to control treatment.

Determination of dry soluble substance in stems indicated that in the treatments with bio stimulants, their content in 'Delikatesna Bila' was by 0.2%, 0.4% and 0.8% higher compared to the control treatment, and in 'Violeta', by 0.8%, 1.0 % and 0.3% higher, respectively.

CONCLUSIONS

The studies showed the high efficiency of the organic bio stimulants Regoplant, Stimpo, and Emochka for kohlrabi plant treatment. The highest stem yield of 'Delikatesna Bila' and 'Violeta' varieties was obtained for soaking the seeds for 12 hours carrying out 2 foliar dressings during vegetation.

Bio stimulants Regoplant and Stimpo demonstrated a positive effect on the diameter, average weight, and marketability of the stems. In addition, the treatment of plants with these formulations contributed to the formation of good indicators of dry soluble matter and ascorbic acid content in the kohlrabi stems.

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