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Comparative Analysis of The Influence of Different Doses of Vegetal Bio Stimulator on Agricultural Productions

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Abstract: The paper shows how an experimental bio stimulator derived from agricultural waste and herbs can help the roots absorption of mineral elements and quality of agricultural products. The cultures that were tested the experimental bio stimulator were wheat, barley, rape, maize, sunflower, soybean. The main product of the project (BIOSTIM) that was tested had the following composition: N - 4.1 g / l; P_2O_5 - 6g / l; K_2O - 14g / l; Ca - 8 g / l; Mg - 1 g / l; Fe - 61,5mg / l; Mn - 50mg / l; Zn - 7,6mg / l; vegetal antibiotics; amino acids (Trifan, 2018). Four doses were used, ranging from 0.5 l / ha and 2L / ha, in two and three treatments, on the intense development stage to flowering, in comparison with the untreated control. The results of chemical analyzes of soil and plant extracts, could follow the evolution of absorption of mineral elements in correlation with the biometric measurements and productivity elements. The results of experiments showed highly significant positive correlation between bio stimulator dose, intensity of nutrients uptakes with production and quality of agricultural products, and the stimulator is recommended to use it, both in conventional agriculture, as well as traditional agriculture.

Keywords: bio stimulators, absorption of nutritive elements, production

Introduction

Currently, the global population has grown to 7.6 billion and is projected by 2100 to increase to 11.2 billion people, which will lead to increasing demand for food by 30%, while the natural resources will be the same or will decrease (Max and Esteban, 2017). On the other hand, the current climate changes greatly affects the productivity of the crop is necessary to adapt the technology by the use of varieties adapted to drought, disease and pest resistance and increased productivity (Mars, 2005).

It should be taken into account by enhancing soil fertility and preserving organic matter and the execution of the fertilizer according to the required state of each crop and soil minerals supply (Berca, 2010). This paper presents experimental results on the use of bio stimulator derived from agricultural waste and herbs as part of a research project that was implemented between 2016 - 2018, in partnership with Braicoop Agricultural Cooperative - Coordinator, Agricultural Research and Development Station of Braila - partner 1, and "Dunarea de Jos" University of Galati - partner 2.

The bio stimulator was obtained experimentally by the natural fermentation of the agricultural waste from wheat, barley, corn, sunflower and peas crop, under the influence of microorganisms' bioinocculum. Depending on the temperature, the biodegradation may occur 7 to 14 days, after which is added water at 70°C and extracts (infusion and soak) of medicinal and aromatic plants of the following types *Tagetes patula* (marigold), *Ocimum basilicum* (basil green and red) *Artemisia dracunculus* (tarragon), *Mentha piperita* (peppermint), *Thymus vulgaris* (thyme), *Lavandula angustifolia* (lavender), *Capsicum annuum* (pepper). By squeezing the compost fermented to obtain the main

product (a bio stimulator liquid - BIOSTIM) and a second product, represented by a solid organic substrate (BRAISOL). There are a number of products acting stimulator for plants such as CropMax (CROPMAX HOLLAND), Razormin (ATLANTICA AGRICOLA, Spanish), Tecamin flower (Agritecno Fertilizantes), TeraSorb (Aectra), Atlante (Atlantica), Aminosol (Lebosol), Asfac-BCO 4 (SC ROMCHIM PROTECT SA), containing different proportions of macro-, meso- and micro-elements, together with the amino acids and phyto-hormones for growth (Paun, 2010). The main technical problem which the draft and proposed it was to make a product with a complex activity for protection and plant nutrition, in the same time, based on the use of post harvest agricultural waste, to which is added to extracts of medicinal plants, for the addition of amino acids and vegetal antibiotics. The products (a liquid bio stimulator and a solid organic substrate) are 100% natural, with nutritional properties and to improve the metabolism of plants with increased tolerance to abiotic and biotic stress, facilitating the absorption of mineral elements, translocation and efficient use, improve quality of agricultural and horticultural products. Bio stimulator concentration of the active substances (nutrients) is 15.25g/l, with the following composition: N - 4.1 g/l; P_2O_5 – 6 g/l; K_2O - 14g/l; Ca - 8 g/l; Mg - 1 g/l; Fe - 61, 5mg/l; Mn – 50 mg/l; Zn - 7,6 mg/l; natural antibiotics and amino acids (Trifan, 2018).

Bio fertilizers and bio stimulators produced from agricultural waste and herbs can be used with the methods of chemical fertilizer and the treatment of the cultures, as have been tested so far, but at the same time, they can be used in organic farming, where the organic waste from biological cultures. These products fully meet the Thematic Strategy for soil protection, maintenance of soil capacity to fulfill the ecological, economic and social (Agora, 2014).

Materials and Methods

The experimental bio stimulator for plants was tested in Chiscani Experimental Center of Agricultural Research and Development Station Braila, Romania, in four doses between 0.5 l/ha and 2l/ha, in two and three treatments, from the stage of intense development of leaves to flowering, compared with untreated control. There was made chemical analyzes of extract soil: distilled water by 1: 5 and of extract plants: distilled water by 1: 100 and we was able to study the dynamics of the mineral elements absorption in relation to the biometric elements and with productivity elements measurements. The experiments were carried out on three winter crops (wheat, barley and rapeseed) and three spring crops (maize, sunflower and soybean), placed in the rectangle Latin with five variants randomized in four repetitions, and with two treatments and three treatments (Figure 1).

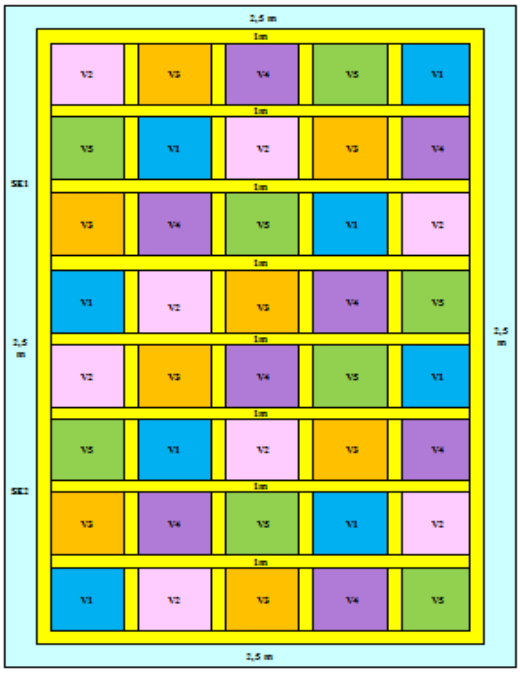

Figure 1. The scheme of fields experiences with different doses of bio stimulator

From the fourth repetition were taken plants and soil samples, before each application of the treatment and at harvest, and another three repetitions were used in the statistical interpretation of the results for average production compared to the untreated control. They have made analysis of soil and plant macronutrients (N, P, K) along the growing season to study the dynamics of the absorption by the analysis

of plant extracts. At harvest were performed biometrics of production elements and quality control for all six crops.

Statistical interpretation of results was done by graphical methods for dynamic absorption of mineral elements, by Anova test for productions and by Correlation test to establish optimal dose bio stimulator. Based on the results of the production increases and costs, it made a financial exercise for the experimental bio stimulator with the estimate turnover growth for end-user, which in this project is Braicoop Agricultural Cooperative.

Results and Discussion

The study in dynamic revealed that the root absorption is different in different stages, depending on the crop species also. Thus, in winter wheat nitrogen absorption is increasing from the germination to tillering, then decreases to Heather, and then increases again up to the maturity stage (Figure 2). The absorption of phosphorus increases from germination to tillering, and then remains constant up of ears apparition and then decreases gradually until harvest.

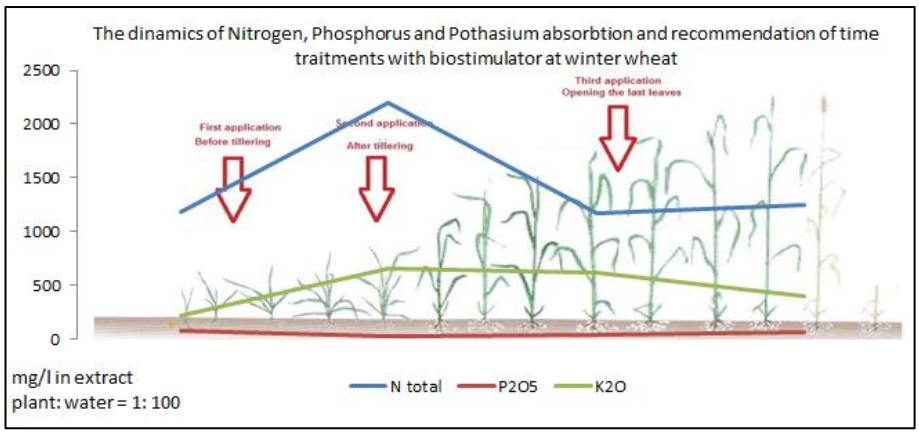

Figure 2. Dynamics of major elements in winter wheat absorption and the recommendation for time treatments of bio stimulator

For winter barley (Figure 3) and winter rapeseed (Figure 4), the nitrogen absorption is uniform from germination until spring, and then increases until flowering, and after flowering decreases gradually until the harvest, while the absorption of phosphorus, and potassium are constants throughout the growing season, an increase in flowering stage.

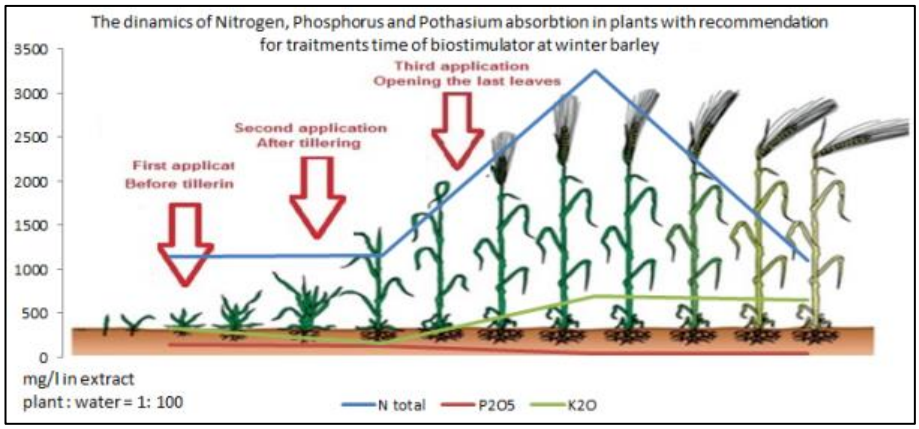

Figure 3. Dynamics of major elements in winter barley absorption and the recommendation for time treatments of bio stimulator

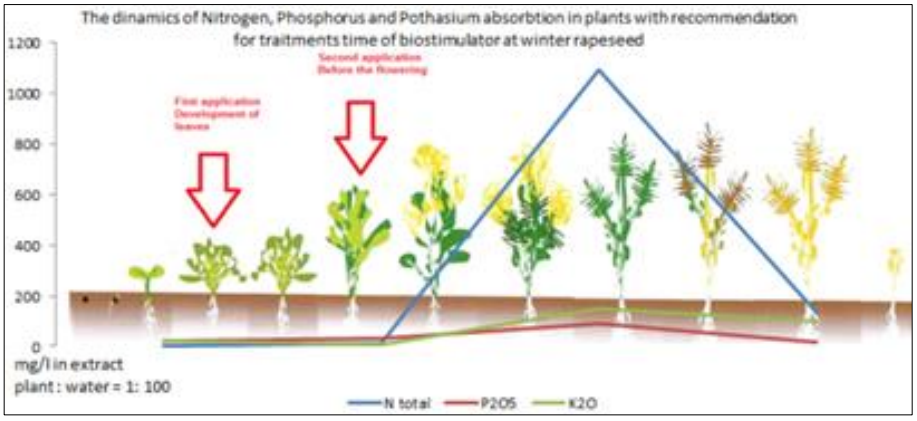

Figure 4. Dynamics of major elements in winter rapeseed absorption and the recommendation for time treatments of bio stimulator

For the spring crops, the study of nitrogen absorption showed an increase from the germination up to the full development of foliage at sunflower (Figure 5), while in maize (Figure 6) and soybean (Figure 7) nitrogen absorption is maximum in the early stages of growth and gradually decreases until flowering.

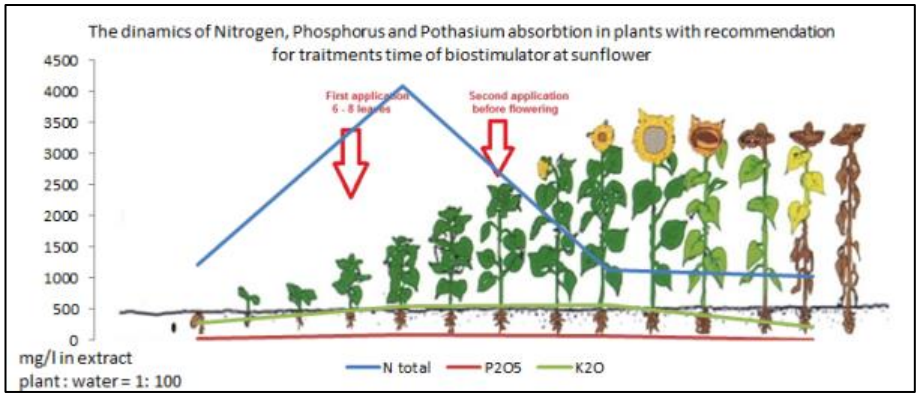

Figure 5. Dynamics of major elements in sunflower absorption and the recommendation for time treatments of bio stimulator

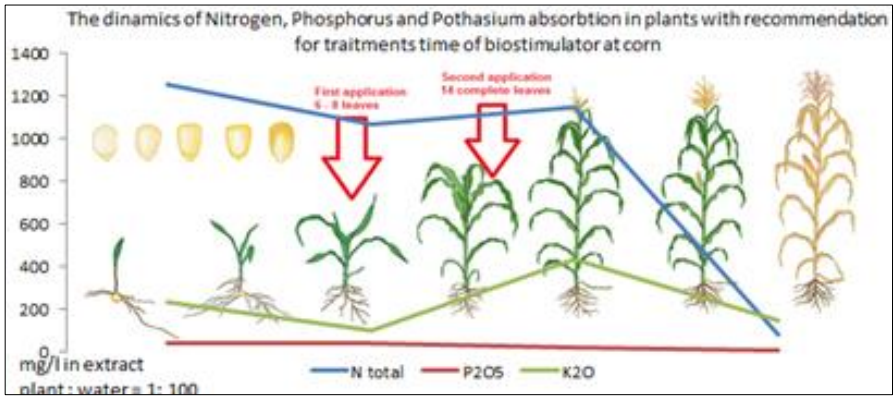

Figure 6. Dynamics of major elements in corn absorption and the recommendation for time treatments of bio stimulator

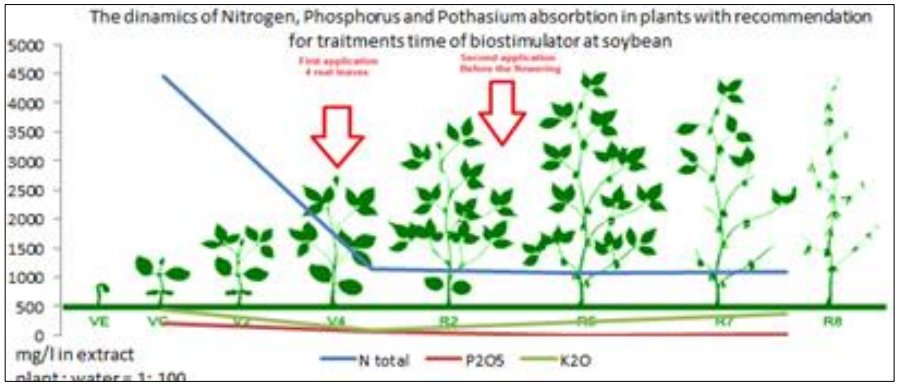

Figure 7. Dynamics of major elements in soybean absorption and the recommendation for time treatments of bio stimulator

At all spring species studied, the phosphorus absorption is greatest during flowering, while absorption of potassium is constant throughout the growing season.

Based on these results, we were able to make recommendations for dosage and times of bio stimulator applications, irrespective:

- for winter cereals 2 l/ha x 3 treatments: before the tillering, after tillering in spring, and before the opening of the last leaf;
- for winter rape 1,5 l/ha x 2 treatments: at intensive development of leaves, and before flowering;
- for spring crops 2 l/ha x 2 treatments: first at four true leaves in soybeans, and 6-8 leaves in maize and sunflower, and the second before flowering.

The results of analysis and production levels have shown that the bio stimulator has nutritional properties and improving the metabolism of plants with increased tolerance to abiotic and biotic stress, facilitating the absorption of mineral elements, translocation and efficient use, to increase production and improve the quality of agricultural products. The correlation between the doses of bio stimulator and production levels were significantly positive, both in winter crops (Figure 8), the coefficient of correlation were between +0.451 at rapeseed and +0.970 at winter wheat, and for the spring crops (Figure 9), with the correlation coefficients between +0.403 at sunflower and +0,931at soybean.

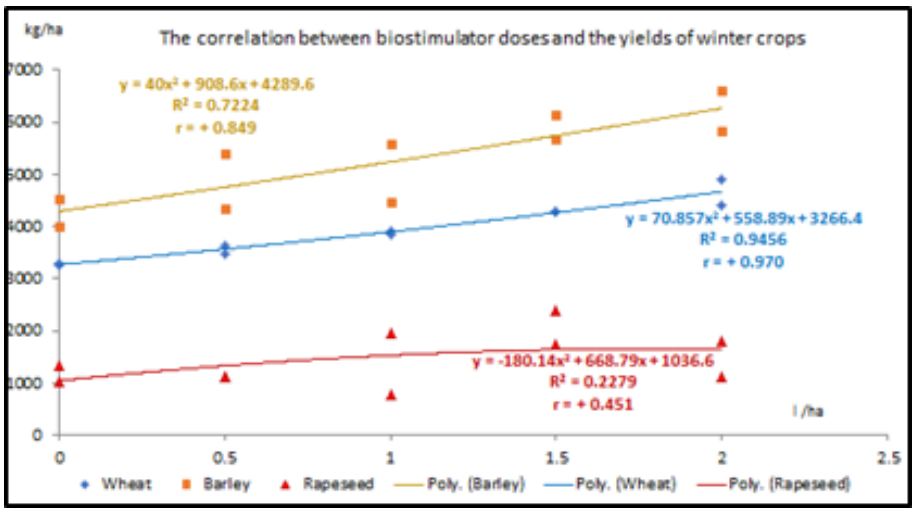

Figure 8. The graph of correlations between bio stimulator doses and productions at winter crops

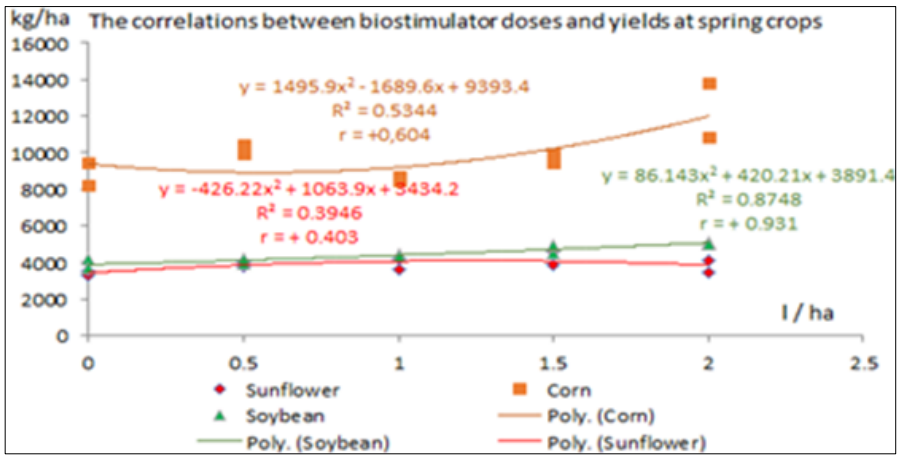

Figure 9. The graph of correlations between bio stimulator doses and productions at spring crops

In terms of productions quality, the correlation established between the bio stimulator doses and different quality indicators have been positive, but the regression coefficients smaller than the correlation between the doses and the productions quantity (Figure 10).

The application of experimental biostimulator results obviously increase agricultural production and products quality in the same time.

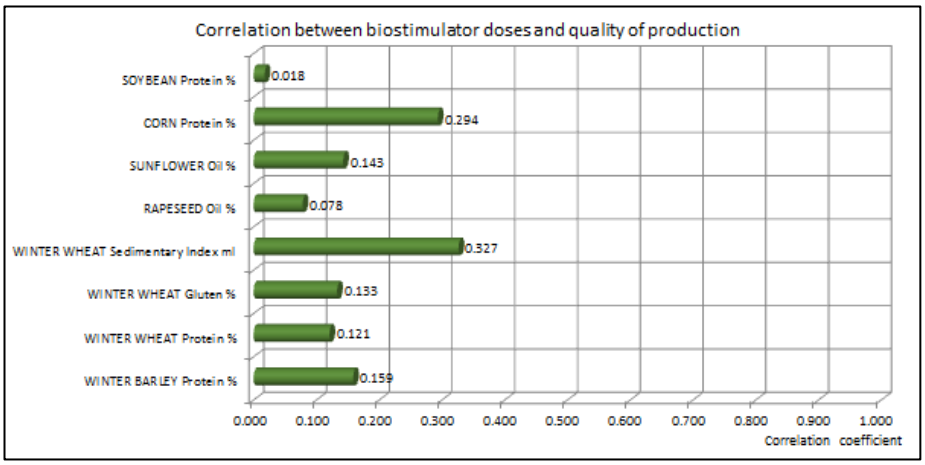

Figure 10. The graph of correlations established between bio stimulator doses and quality indexes of agricultural products

The biometrics carried out at harvest have revealed that bio stimulator acting both promoting in plant growth and on the elements of productivity, as shown in Table 1.

Based on experimental results, there was a financial calculation of economic efficiency for using dose bio stimulator recommended for each crop (Table 2) and estimates of the performance expected when using bio stimulator on the entire surface exploited by Braicoop Agricultural Cooperative (Table 3). Thus, it can be seen that if all farmers from this cooperative should be used on all surfaces the experimental bio stimulator, the increase of annual turnover would be from 42058725 lei, as estimated sales in 2018 to 60,143,977 lei, that means with 43% higher.

Table 1. The bio stimulating activity of plants grown and on increasing of agricultural productions at tested crops

Experimental variant		Plant length (cm)	No. seeds/plant	Seeds weight/plant (g)	Average production at STAS moisture (kg/ha)	Increase of production compared with control (%)	The weight of a thousand seeds (g)	Hectoliter weight (kg/hl)
Winter wheat	2 l /ha	64 – 70	162 – 177	6,78 – 7,08	4412 – 4911	148 – 155	37,2 – 37,6	79,2 – 80,5
	Untreated (C)	61 – 62	70 – 78	2,56 – 2,88	3257 – 3277	100	34,9 – 35	77,1 – 78,4
Winter barley	2 l /ha	98 – 102	273 – 311	13,2 – 16,7	6064 – 6710	142 – 144	45,2 – 45,5	52,6 – 53,3
	Untreated (C)	88 – 89	132 – 141	5,1 – 5,6	4252 – 4669	100	43,1 – 44,3	48,5 – 50,5
Winter rapeseed	2 l /ha	144,0 – 145,0	10473–11020	45,4 – 59,4	1153 – 1841	111 – 136	4,4 – 4,6	61,2 – 63,9
	Untreated (C)	120,0 – 122,7	1873 - 3034	8,4 – 12,2	1038 – 1348	100	4,1 – 4,5	62,3 – 63,3
Corn	2 l /ha	223 – 227	1326 – 1462	435 – 537	10866–13837	132 – 146	364 – 384,8	75 – 76
	Untreated (C)	192 – 210	924 – 1120	328 – 409	8235 – 9457	100	332 – 338,2	75 – 76
Sunflower	2 l /ha	195 – 199	1085 – 1132	123 – 123,4	3477 – 4137	105 – 116	55,7 – 61,1	36,4 – 36,7
	Untreated (C)	179 – 187	909 – 945	79,3 – 89,9	3322 – 3551	100	54,7 – 56,2	36,0 – 36,1
Soybean	2 l /ha	75 – 80	84 – 125	35 – 36	5039 – 5078	121 – 137	140 – 144	70 – 71,1
	Untreated (C)	74 – 75	225 – 234	12 – 17	3674 – 4164	100	128 – 133	69,8 – 71,1

Table 2. Economic efficiency for using of bio stimulator in field experiences at ARDS Brăila

Crop	Expenses for production (lei/ha)	Average yield at untreated (C)	Treated with BIOSTIM	Sale price (lei/kg)	Price for production untreated (lei/ha)	Price for production treated (lei/ha)	Profit at untreated (lei/ha)	Profit at treated (lei/ha)	Difference of profit (lei/ha)
Winter wheat	1779	3267	4661.5	0.65	2123.55	3029.975	344.55	1250.975	906.4
Winter barley	1786	4270	6218	0.58	2476.6	3606.44	690.6	1820.44	1129.8
Winter rapeseed	2383	1490	2068	2	2980	4136	597	1753	1156.0
Corn	2557	8846	12351.5	0.7	6192.2	8646.05	3635.2	6089.05	2453.9
Sunflower	1884	3436	4220	1.3	4466.8	5486	2582.8	3602	1019.2
Soybean	2952	3752.5	5058.5	1.5	5628.75	7587.75	2676.75	4635.75	1959.0

Table 3. Financial projections when using bio stimulator (BIOSTIM) over the entire area exploited by BRAICOOP Agricultural Cooperative

Crops	Cultivated surfaces in 2018	Average yields t/ha BRAICOOP		Total productions (tones)		Sale price for yield (Lei / tone)	PROJECTIONS OF SALE VALUES IN 2018	
		Untreated	Treated	Untreated	Treated		Untreated	Treated
Winter wheat	3506.69	4.57	6.54	16025.57	22916.57	686	10993543	15720767
Winter barley	756.75	4.49	6.42	3397.81	4858.86	688.5	2339390	3345328
Barley for beer	667.35	4.99	7.14	3330.08	4762.01	812	2704022	3866752
Winter rapeseed	800	2.35	3.36	1880.00	2688.40	1521	2859480	4089056
Corn	2011.3	7.26	10.38	14602.04	20880.91	643.5	9396411	13436868
Sunflower	2569.53	2.68	3.83	6886.34	9847.47	1392	9585786	13707674
Soybean	792.86	2.57	3.68	2037.65	2913.84	1560	3178734	4545590
Peas	501.18	2.7	3.86	1353.19	1935.06	740	1001358	1431941
						Turnover:	**42058725**	**60143977**

Conclusion

Obtaining plant bio stimulators from agricultural waste and medicinal plants, agricultural waste is an effective method for practicing sustainable agriculture, by appropriate use of natural resources, agricultural waste management system of circular agriculture, such being in the natural circuit of mineral elements. The immediate effects of using agricultural waste for the production and use of plant bio stimulator were observed on increased production and quality of agricultural products, which increases efficiency and profit per hectare. In the long term, the use of agricultural wastes for production of bio stimulators and bio fertilizers lead to environmental protection by reducing nutrient load applied, by increasing the organic matter in the soil, that leads to the increase of the soil fertility also.

Acknowledgment

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