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Studies on The Influence of Doses of The Plant Bio Stimulator and Solid Organic Substrate on Improving soil Fertility

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Abstract: The paper presents the results obtained in a research project in which plant growth stimulators and bio fertilizers obtained by natural fermentation of plant remains wheat, barley, corn, sunflower and peas, under the influence of lignolitical microorganisms. Depending on the temperature, biodegradation may occur 7 to 14 days, after which extracts (infusion and soak) of medicinal and aromatic plants of the type *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 title compound (Biostimulator liquid - BIOSTIM) and a second product, represented by a solid organic substrate (generically called BRAISOL). 100% natural products, 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 the quality of agricultural and horticultural products. 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. Both have the very high nutritional value for bio stimulator liquid, the concentration of active substance is from 15.25g / l, consisting of macro-, meso- and micro-nutrients to be added to the active principles of medicinal plants and for a solid organic substrate 58.97% concentration of mineral substances, which were determined in ashes. In this paper, we are shown the beneficial effects that the two products have had on soil.

Keywords: bio fertilizer, bio stimulator, soil fertility, crops quality

Introduction

The total area of Romania is 23,839,100 ha, of which 14,684,900 ha are farmlands, of which 9,422,500 hectares of arable land, 3,313,800 ha pasture, 1,528,000ha hayfield, 215,400 ha vineyards and vineyards nurseries, , 205.200 ha orchards and tree nurseries (Romanian statistical Yearbook, 2010). Soil fertility is of great importance to farmers and may be characterized by a number of indicators that can be classified into four groups: physics indicators (texture, structure, porosity, compaction, volume edaphic useful index agro of soil fertility; hydro indicators, like movement of water in soil, water permeability (infiltration, the filtrate), the ability to retain water (the water area), the rise of capillary water (intake groundwater), chemical indicators (soil reaction, the ion exchange capacity, the degree of base saturation, nutrients contents), biologic indicators like: humus, biological activity, plant health (potential weed - supply of weed seeds and weed mapping, currently pests and diseases).

Soil organic matter is an essential component of fertility indices, acting as a reservoir of nutrients for the plants, the soil supporting structure and improving the physical environment and can store an amount of water approximately six times greater than its weight. Thus, soils rich in organic matter are more structured, improving water infiltration and reducing its susceptibility to compaction, erosion, desertification and landslides downhill. The reduction of soil organic matter gradually leads to degradation of the soil (Mihalache, 2006, 2008).

The organic matter has, namely to oppose any tendency of change of the reaction and concentration of ions (H^+, OH^-, $H_2PO_4^-$, K^+, NH_4^+, Ca_2^+, Mg_2^+) in the soil solution. The weak acid or weak alkaline soil organic matter acts as a buffer to maintain the pH and the respective parameters (Andries, 2017).

The plants can absorb nutrients both in the form of minerals (ions dissociated and dissolved salts), as well as in the form of water-soluble organic substances (molecules or organic residues) (Blaga, 2005). However, the absorption is influenced by many factors, among which the most important are: the species, age of the plant, positive ions exchange capacity of the roots, the soil pH, temperature and state of aeration of the soil, the state of supply of soil minerals, the type of ion and ionic interactions. The rate of penetration of the ions in the ion valence decreases with increasing plant:

- positive ions: $NH_4^+ > K^+ > Na^+ > Mg_2^+ > Ca_2^+ > Fe_2^+$
- negative ions: $NO_3^- > Cl^- > H_2PO_4^- > SO_4^{2-} > HPO_4^{2-} > PO_4^{3-}$

A number of nutritional disorder appear due to biotic stress (attack of pathogens or pests) or due to abiotic stress (pH and soil texture, deficiency or excess of mineral elements, excess water or drought, extreme temperatures, the phytotoxicity of due to the applied pesticides, soil or air plants, etc. suffer from dehydration or osmotic conditions of drought stress, salinity or low temperature conditions, causing reduction in the working of the water accessibility turgidity and maintain their cells (Tuteja, 2010).

The researches on the absorption of the mineral elements of the plant depending on the soil pH revealed that macro-elements shaping the development of plant N, P, K (nitrogen, phosphorus, and potassium) are treated as follows: the nitrogen is assimilated to a pH of 6 - 8 5, the phosphorus at pH 6.5 to 8, and potassium at a pH > 6. Other elements assimilates the pH of the soil following: sulfur pH > 6, calcium and magnesium at a pH from 6.5 to 8 5, iron at pH < 6.5, manganese from pH 4.5 - 6.5, boron, copper and zinc at a soil pH of 5 – 7 (Udrescu, 2006).

In the same time, various forms of nitrogen absorption lowers or raising the pH of the soil around the roots, thus the absorption of ammonia nitrogen lowers the pH because the release of hydrogen ions by the plants, and the absorption of nitrate nitrogen increases the pH of the soil near the roots by the release of hydroxide ions by the plants (Kennelly, 2012).

The main aim of this study was to see how we could increase the fertility of soil and productivity by using two experimental products, made from agricultural waste and medicinal plants.

Materials and Methods

The paper shows how two experimental products obtained by natural fermentation of agricultural waste and herbs extracts can influence the agricultural production growth with preservation and even increasing soil fertility (Figure 1). Research has been undertaken within a project during 2016 - 2018, with BRAICOOP Agricultural Cooperative as coordinator and two partners: Agricultural Research and Development Station of Braila, and “Dunarea de Jos" University of Galati.

For winter crops we used different doses of bio-stimulator (BIOSTIM), with two applications (Figure 2), and in spring crops experience has been divided into two sub-experiences, one with the application of the substrate BRAISOL, and one without the application thereof (Figure 3) and different doses of Biostim in two applications.

For spring crops, the soil samples were taken before and after application of bio stimulator, in order to observe how the two products improve fertility of the soil and root absorption. The used method in chemical analysis have made by photometry in extract soil : water 1:5, and in extract plant : water 1:100.

We made biometric measurements of plants (plant height, number of leaves per plant, length of root, length of average leaf, diameter of steam), soil and plant analysis, and the statistical interpretation was made by comparative graphical method and correlations.

Figure 1. Location of experiences at Experimental Centre Chiscani

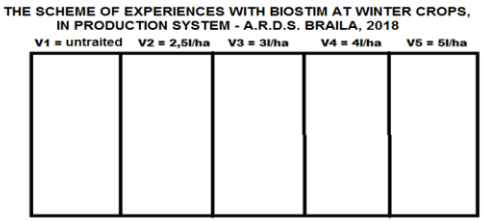

Figure 2. The experiences with BIOSTIM at winter crops

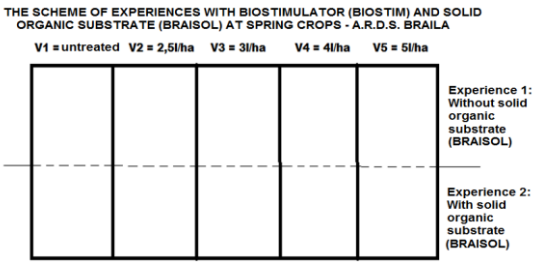

Figure 3. The experiences with BIOSTIM and BRAISOL at spring crops

Results and Discussion

By the application of solid organic substrate prior to sowing, on the same cernozem cambic soil type, for different spring crops (maize, sunflower and soybean), there was an increase in the organic matter content of 15.54% (corn), to 35.16% (sunflower), and 35.48% (soybean) (Figure 4).

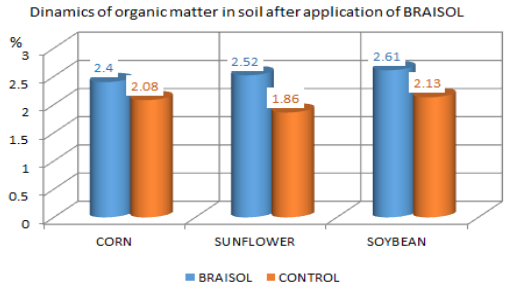

Figure 4. The dynamics of soil organic matter by applying BRAISOL

Soil pH dynamic tracking the application of different doses of BIOSTIM and BRAISOL, decreasing values with increasing dose applied (Figure 5).

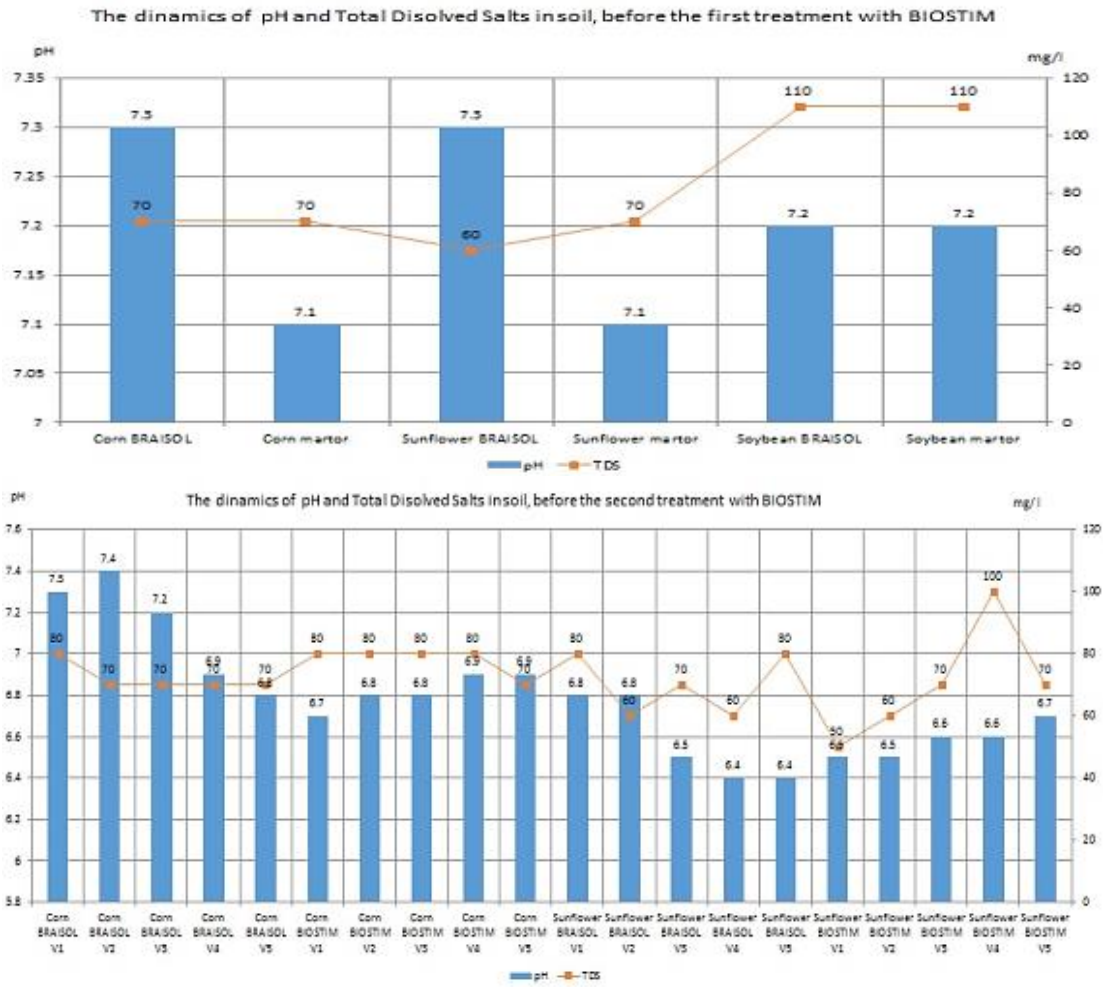

Figure 5. Dynamics of pH and content of soluble salts in soil before the first and second treatments with BIOSTIM

Total ammonium nitrogen absorption before the first treatment was greater in corn untreated in comparison with sunflower and soybean where it was higher in the variants treated with BRAISOL, the concentration of Nitrogen in plants negatively correlated with the Nitrogen concentration in the soil (Figure 6 and Figure 7).

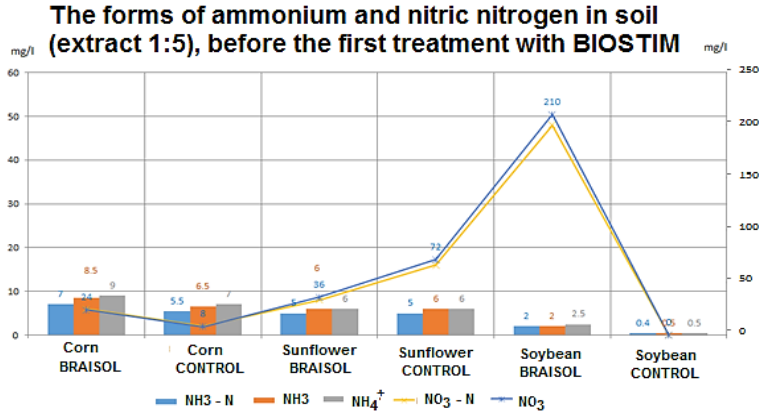

Figure 6. Concentration of ammonium and nitric nitrogen in the soil before the first treatment with BIOSTIM

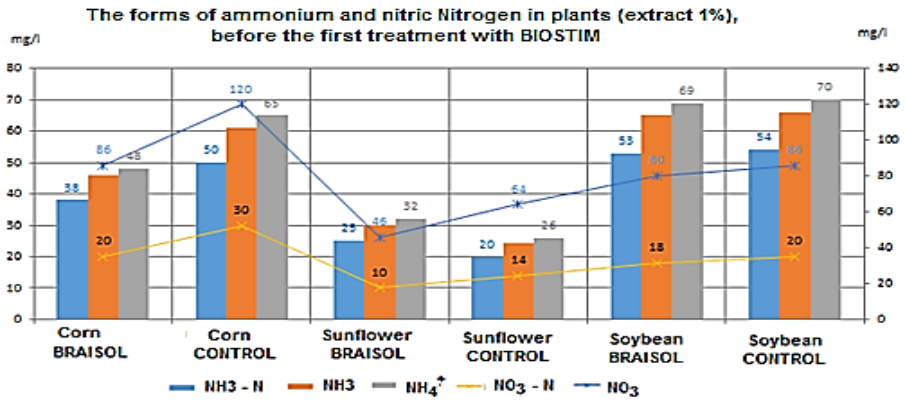

Figure 7. Concentration of ammonium and nitric Nitrogen in plants before the first treatment with BIOSTIM

In contrast, the uptake of phosphorus by the plants was greater in corn and sunflowers treated with BRAISOL and in soybean untreated, while the absorption of potassium was more intense in corn and soybeans treated with BRAISOL and sunflower untreated (Figure 8 and Figure 9).

The influence of the BRAISOL was observed in results of biometric measurement of corn and sunflower plants, we observed an increase in plant height at the variants treated with positive differences 7 cm in maize and 5 cm sunflower, correlated with an increasing of roots in control variants.

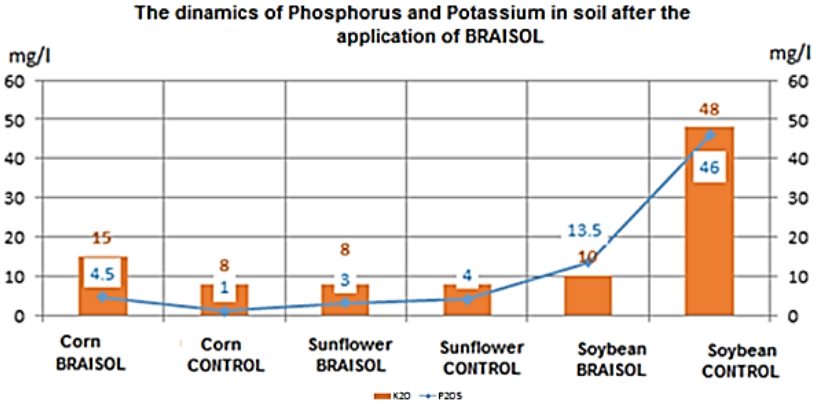

Figure 8. Concentration of phosphorus and potassium mobile forms in soil after BRAISOL application

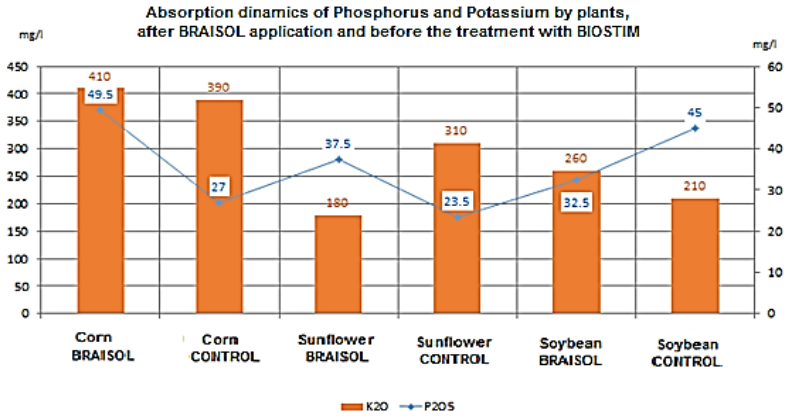

Figure 9. The absorption dynamics of phosphorus and potassium after BRAISOL application

At soybean plants, the treatment effect was increasing of roots length, and for all species studied, the effect of BRAISOL treatment was increasing of foliar surface and at maize was observed an increase of the diameter of the stem (Table 1). After the treatment with BIOSTIM, we have examined the correlation between the applied doses and intensity of absorption of nutrients and have achieved significant positive correlations between doses of bio-stimulator and the absorption of nitrogen (Figure 10), the phosphor (Figure 11) and potassium (Figure 12,13,14) in all the analyzed species compared to untreated controls.

Table 1. The results of the biometric measurements at variants treated with BRAISOL compared to untreated controls

Variant	Plant height cm	Number of leaves per plant	Length of root cm	Length of average leaf cm	Width of average leaf cm	Diameter of steam cm
Corn BRAISOL	54	7	14	33	4	1.5
Corn CONTROL	47	7	18	26	3	1.3
Sunflower BRAISOL	36	9	14	12.5	10.5	1.1
Sunflower CONTROL	31	9	17	12.5	10.5	1.1
Soybean BRAISOL	25	4	13	22	13.7	0.5
Soybean CONTROL	26	4	11	15.8	10.5	0.5

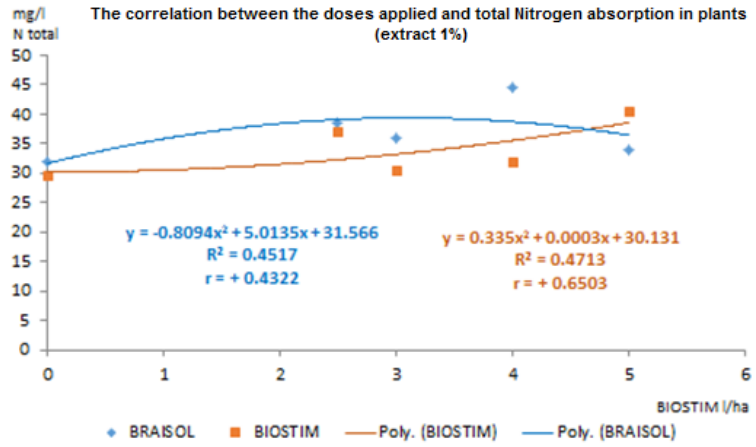

Figure 10. Correlations established between BIOSTIM doses and total Nitrogen uptake by plants

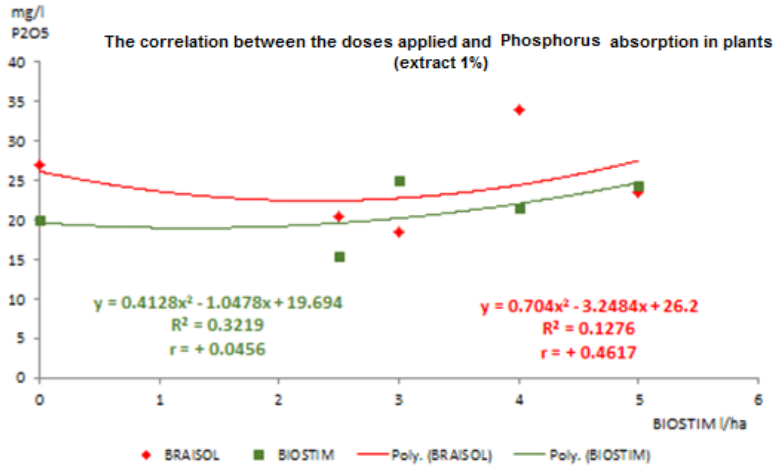

Figure 11. Correlations established between BIOSTIM doses and phosphorus uptake by plants

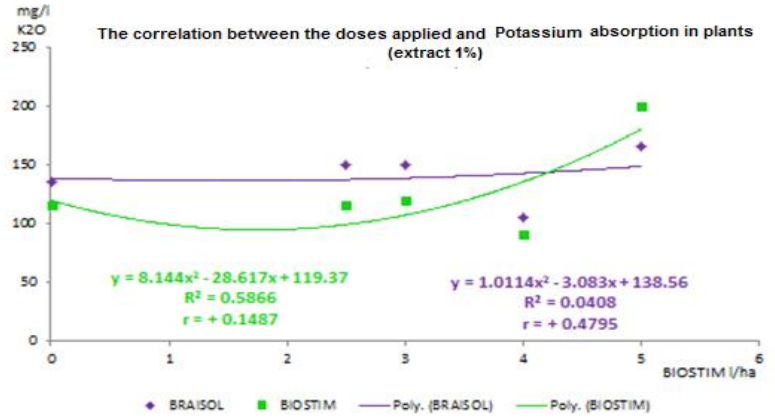

Figure 12. Correlations established between BIOSTIM doses and potassium uptake by plants

The winter crops that have already been harvested this year, the influence of plant bio-stimulator has been positive, both in terms of quantity and in terms of production quality also.

For the winter rapeseed, the influence of the treatments with different doses of BIOSTIM was positive in all cases, with an increase in oil content by 0.3% compared to untreated control, at the dose of 2.5 l / ha.

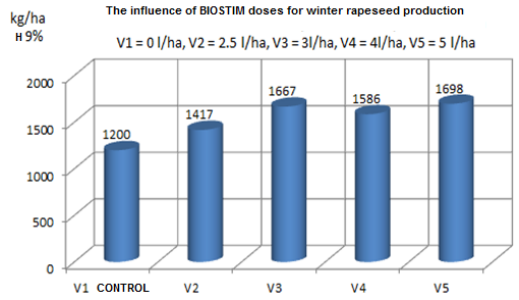

Figure 13. The graph with yields obtained at winter rapeseed, depending on the BIOSTIM doses compared with untreated control

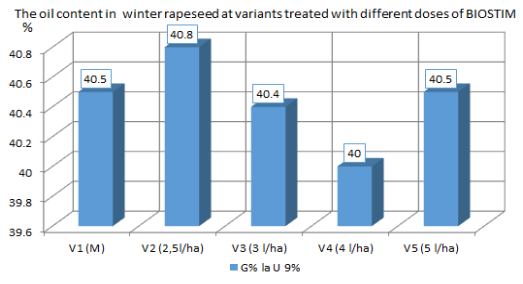

Figure 14. The graph with oil content in rapeseed for variants treated with different BIOSTAT doses, compared to untreated control

For winter wheat, all the variants treated with BIOSTIM obtained increases of production between 4.8% at variant V2 (2.5l / ha x two treatments) and 23.8% at variant V4 (4 l / ha x two treatments) (Figure 15). The quality of production for winter wheat has been influenced only to the variant V4 (4L / ha x two treatments), V5 (5 l / ha x two treatments) (Figure 16). Therefore, winter wheat is recommended to apply the dose of 2.5l / ha in three treatments or 4l / ha in two treatments in the same time with other treatments for weeds or pests.

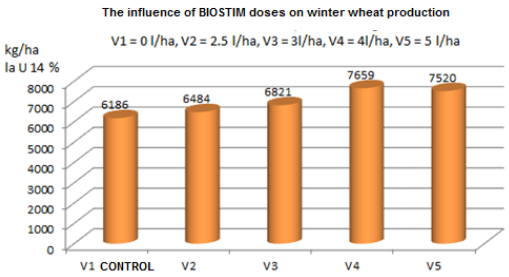

Figure 15. The graph of winter wheat production, according to the BIOSTIM doses

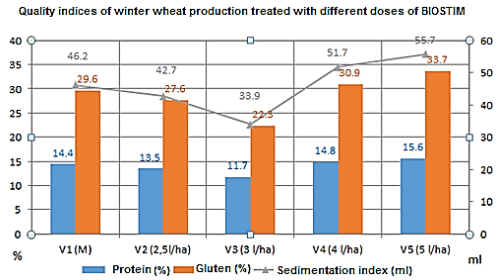

Figure 16. The graph of quality production of winter wheat variants treated with BIOSTIM compared with untreated control

In winter barley for fodder consumption, all of the treated variants have obtained increases of production with the best results in variants V5 (5 l / ha x two treatments) - with an increase of 10.6% and V4 (4l / ha x two Treatments) - with an increase of 10.4% (Figure 17).

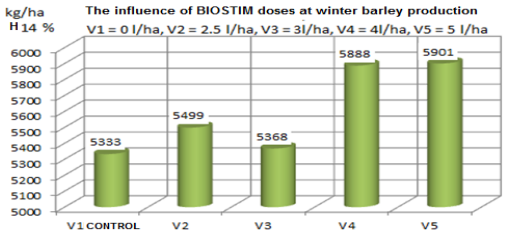

Figure 17. The graph of winter barley yields for fodder consumption, depending on the BIOSTIM doses compared with untreated control

The influence of BIOSTIM doses applied to winter barley for fodder consumption was positive in all cases, compared with the untreated control (Figure 18), the best result was the V5 (5 l / ha x 2 treatments), with an increase by 3.6% protein compared with untreated control.

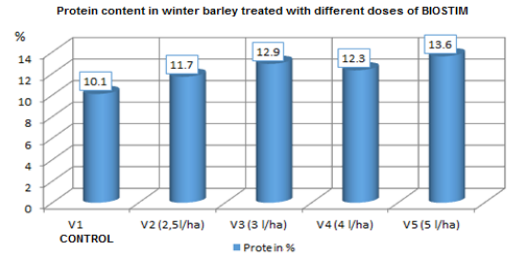

Figure 18. The graph of protein content in winter barley for fodder consumption at variants treated with BIOSTIM, compared with untreated control

Conclusion

Compared with manure using, when the soil is weeding very quick, the advantage of bio fertilizer and bio stimulator using obtained by the BIOSTIM method, we seen immediately how plants grow into vigorous compared to the untreated control, without any danger of disease and pests.

Both products stimulate germination, root absorption, and enhance photosynthesis by increasing foliar area, yield and quality of production increases correlated with increasing doses.

It is recommended to apply a dose of the solid substrate 600kg per hectare, and the liquid bio stimulator dose of 2.5 l / ha in two - three times during the vegetation period, until the flowering, along with the other treatment for weeds or pests control.

Acknowledgment

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