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Innovative technology to obtain vegetal biostimulants by biodegradation of agricultural post-harvest waste and medicinal plants extracts

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Partners in project

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Coordinator:

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INTRODUCTION

- The project's idea started from the fact that every crop production needs a rich vegetative mass for photosynthesis, so the average ratio of production and vegetable mass is from 1: 1 to 1: 3.
- This means as in any culture, the mass of residual plant after harvest is higher than production.

: 1

Barley

: 1,3

Wheat

: 1,5

Rye

INTRODUCTION

1 : 1,6

Corn

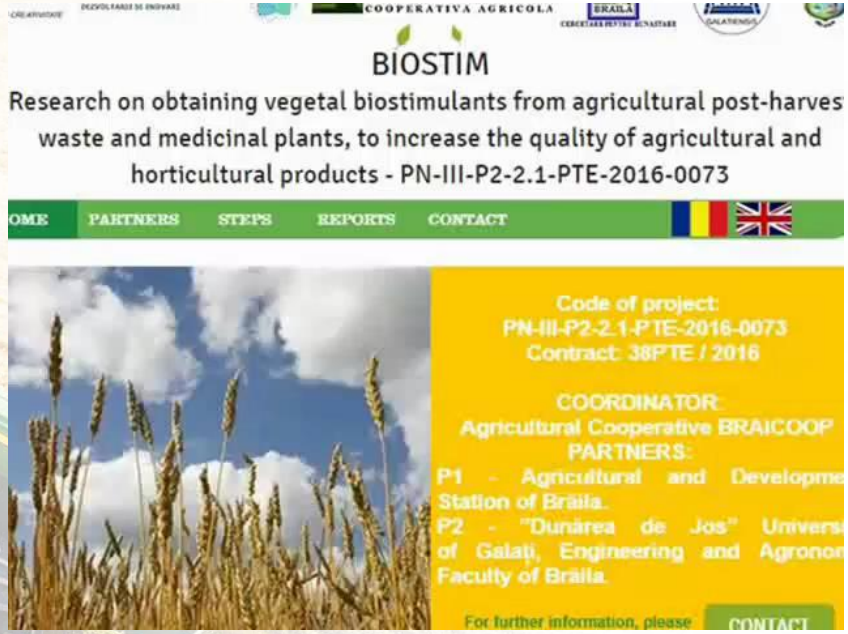
1 : 3

Sunflower

1 : 3

Rapeseed

The main objective of the project



Our researches from last years showed that by chopping and burying the residual vegetative mass after harvesting, we can improve the soil properties, but the degradation of biomass in soil is during a long time and the next crop can't use all the nutrients that were incorporated into the soil.

The main objective of our project is to reuse the biodegradable resources by reinserting them in the natural cycle of nutrients in a much shorter time.

So we designed and build an automated platform for biodegradation of the agricultural waste, whereby to obtain bio-stimulants and bio-fertilizers in only two weeks.

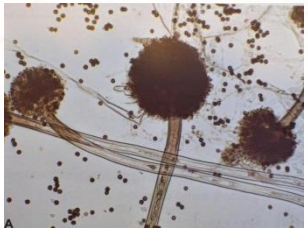
The technological flow is very simple:

- weighing and loading the vegetal waste on the conveyor belt;
- chopping waste and loading in biodegradation platform by a cyclone;
- mixing the chopped crop residues with bio-inoculum of microorganisms;
- homogenization and monitoring indices of aerobic biodegradation for 7 days;
- adding hot water and mixing to stop the aerobic biodegradation for 7 days, addition of herbal extracts with antibacterial and fungicidal effects;
- separating the liquid from the solid part by pressing of compost with their quality control;
- packaging and labeling the solid bio-fertilizer in bags;
- bottling and labeling the vegetal bio-stimulant and distribution.

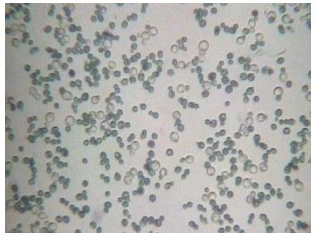
Microorganisms for bioinoculum

- **We obtained several recipes for bio-stimulants provides of various plant residues, which were added selected microorganisms for speeding the biodegradation and various extracts of herbs with antibiotic preventive effects against diseases and pests.**
- **To speed up the aerobic fermentation of strains were used the following microorganisms:**

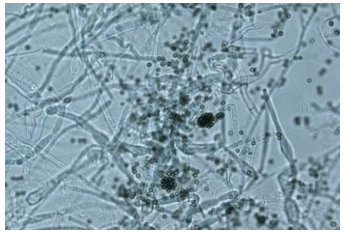
Aspergillus niger



Saccharomyces cerevisiae

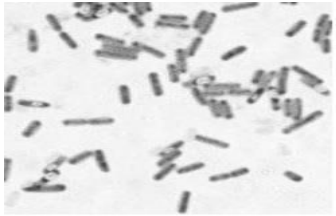


Trichoderma viridae



Bacillus licheniformis

Bacillus globigii



Herbal extracts

- For the fungicide and insecticide effects were obtained and tested the extracts of the following herbs:

Tagetes patula

Bioactive extracts exhibit fungicidal and insecticidal activity (attributed to thienyls), and the biocidal components of the essential oil from flowers and leaves are terpenoids. The major constituents were piperitone (33.77 %), trans-β-ocymene (14.83 %), terpinolene (13.87 %) and β-caryophyllene (9.56 %).

Herbal extracts

Artemisia dracunculus

A. dracunculus **oil contained predominantly phenylpropanoids such as methyl chavicol (16.2%) and methyl eugenol (35.8%), with antibiotic and insecticide effects.**

Herbal extracts

Mentha piperita

Peppermint yields 0.1–1% of volatile oil composed primarily of menthol (29–48%), menthone (20–31%), menthofuran (6.8%) and menthyl acetate (3–10%) with antimicrobial and antiviral effects.

Herbal extracts

Ocimum basilicum

The main constituents found in the oil were methyl chavicol (52.4%), linalool (20.1%), epi-α-cadinol (5.9%) and trans-α-bergamotene (5.2%).

Herbal extracts

Thymus vulgaris

The major components of *Thymus vulgaris* were p-cymene (8.41%), γ-terpinene (30.90%) and thymol (47.59%), with antimicrobial activity.

Herbal extracts

Capsicum annuum

The most important antibiotic constituents of Capsicum is capsaicin ($C_{18}H_{27}NO_3$) the vanillyl amide of isodecenoic acid. Besides capsaicin (69% or 10 - 800 mg %of herb), the pungent principle contains dihydrocapsaicin (22%), nordihydrocapsaicin (7%), homo-capsaicin (1%), and homodihydrocapsaicin (1%).

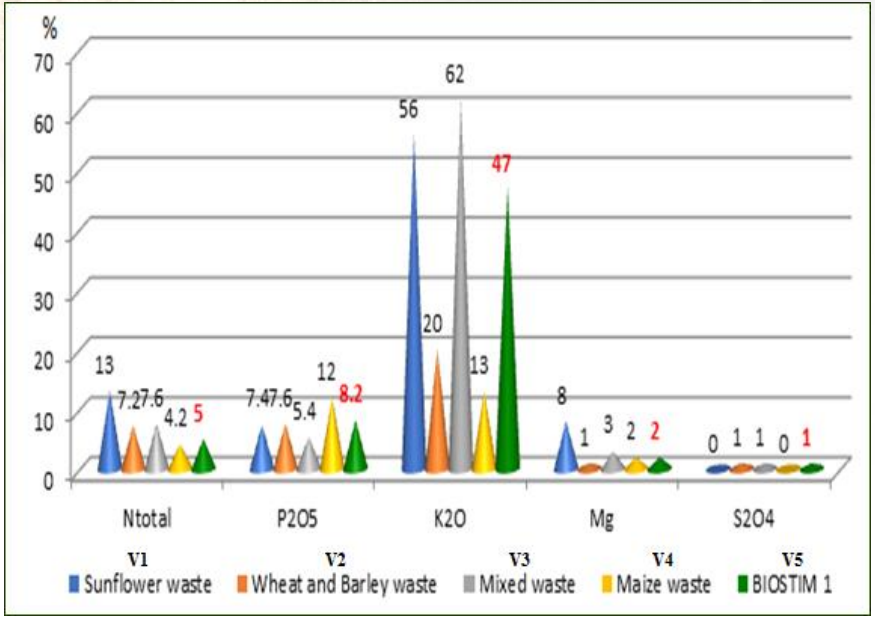
Herbal extracts

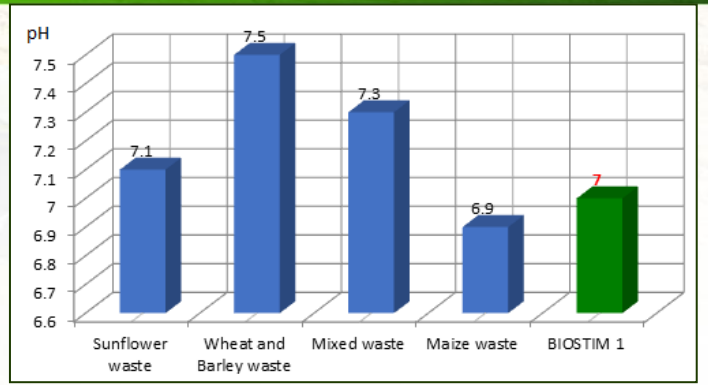
Lavandula angustifolia L.

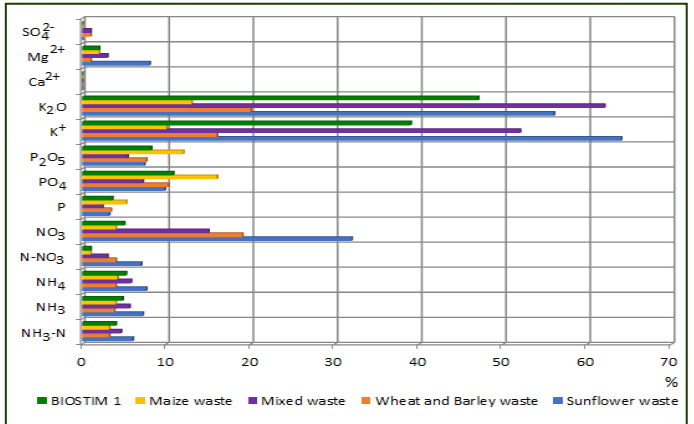
The exact composition of lavender essential oil varies from species to species but consists primarily of linalool and linalyl acetate dominate, with moderate levels of lavandulyl acetate, terpinen – 4 –ol and lavandulol 1,8 – cineole and camphor, with antibiotic effect.

Chemical results

After the chemical analysis, we obtained the following values of chemical indices for the bio-stimulants.

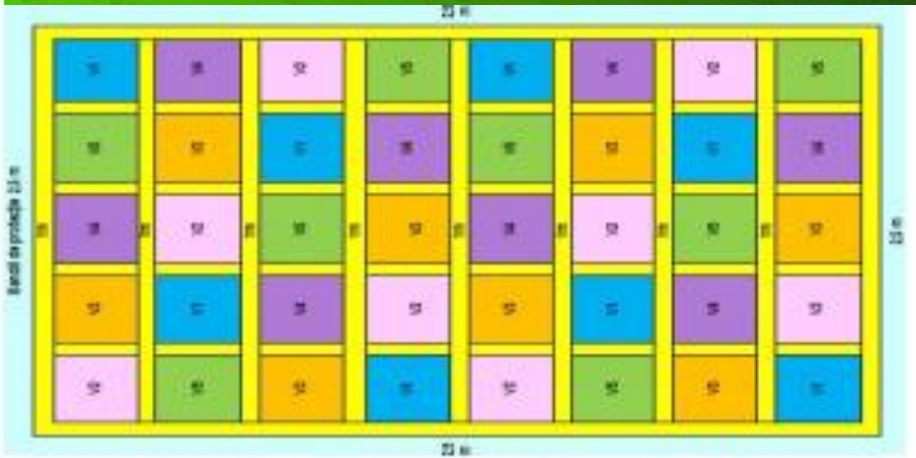






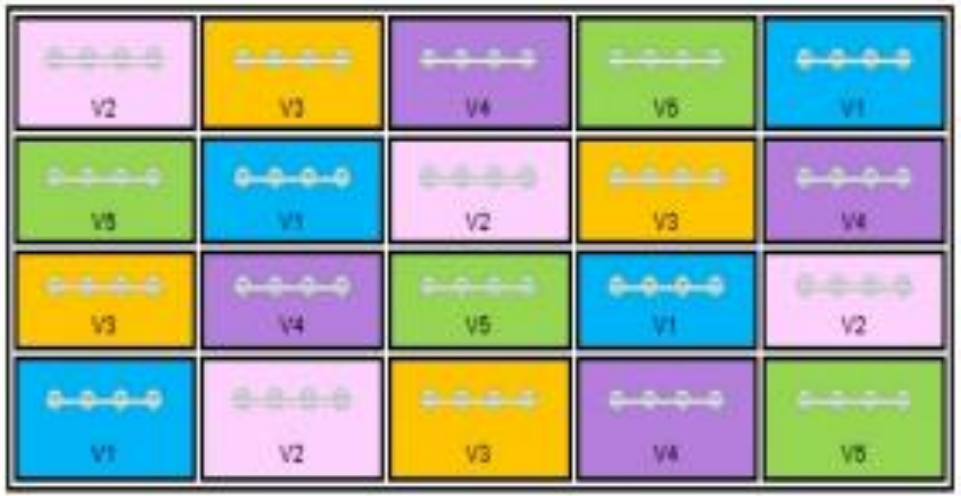
Tests on the fields

The best chemical composition was for the variant V5, obtained from mixed wasted from wheat, barley, sunflower, and corn, and we tested it on field experiences, in different dosages and with 2 and 3 applications, in winter crops (wheat, barley, rape) and spring crops (corn, soybean, sunflower) and also in horticultural crops (cherry, apricot, raspberry, apple, plum), experimental variants were as follows:



The general scheme of agricultural experiences for testing plant biostimulants

- V1 – variant traits with 0.5l/ha;
- V2 – variant traits with 1 l/ha;
- V3 – variant traits with 1,5 l/ha;
- V4 – variant traits with 2 l/ha;
- V5 – variant without traits – the control.



The general scheme of horticultural experience testing plant biostimulants

- V1 – variant traits with 1 l/ha;
- V2 – variant traits with 2 l/ha;
- V3 – variant traits with 3 l/ha;
- V4 – variant traits with 4 l/ha;
- V5 – variant without traits – the control.

Tests on the fields:

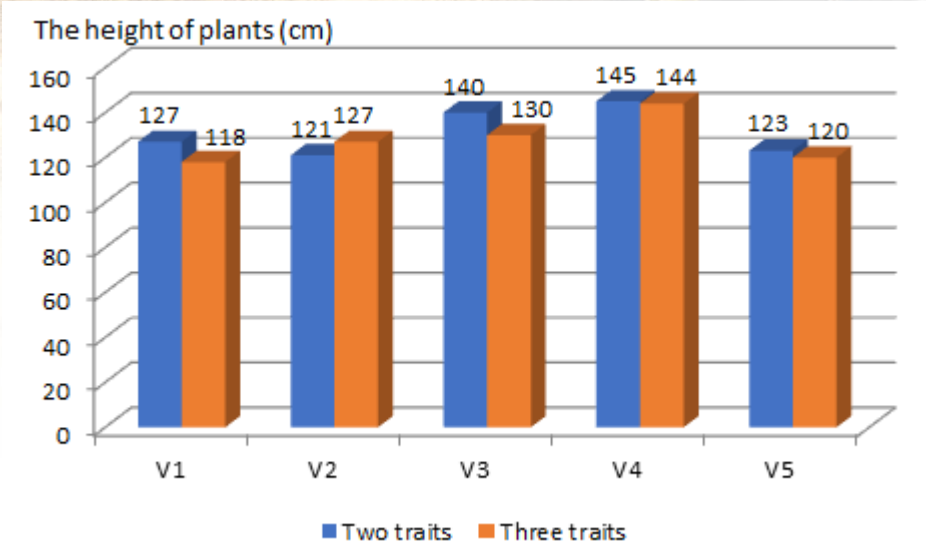
- **The biostimulants have been tested in the experimental fields of Agricultural Research and Development Station Braila and at two farms from BRAICOOP Agricultural Cooperative to determine the optimal doses and the time of applications, in the soil and climatic conditions of North Baragan Plain, from Romania.**

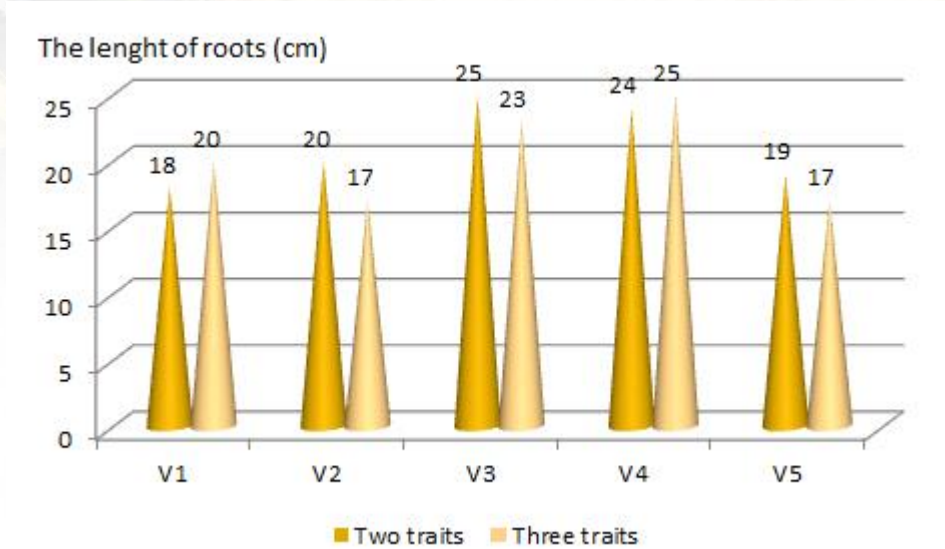
These bio-stimulants promotes plant growth and development, along cycle the growing crop from seed germination to maturity, with the following effects on plants:

- Improving the efficiency of plant metabolism in order to increase production and quality of agricultural products;
- Increasing the biotic stress tolerance of plants to pests and diseases;
- Facilitate nutrients uptake, translocation and use them effectively;
- Improved products quality, including protein content in grain, oil content in technical plants, sugar content, flavor and color of horticultural products.
- Increasing more efficiently the extraction of ground water;
- Increasing soil fertility, particularly by stimulating the development of soil microorganisms (when are applied on the ground).

Results and discutions about agricultural winter crops

Results for rapeseed – *Brassica napus L. ssp. oleifera*:





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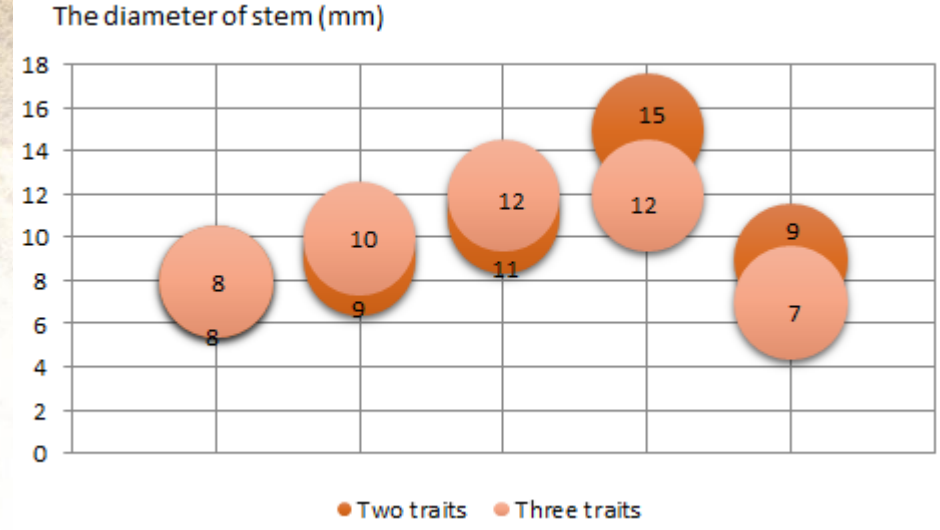

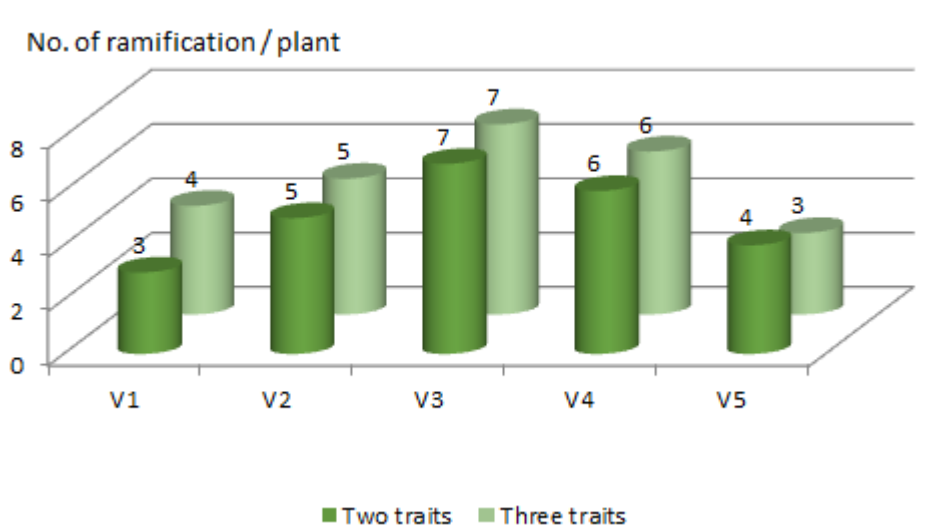

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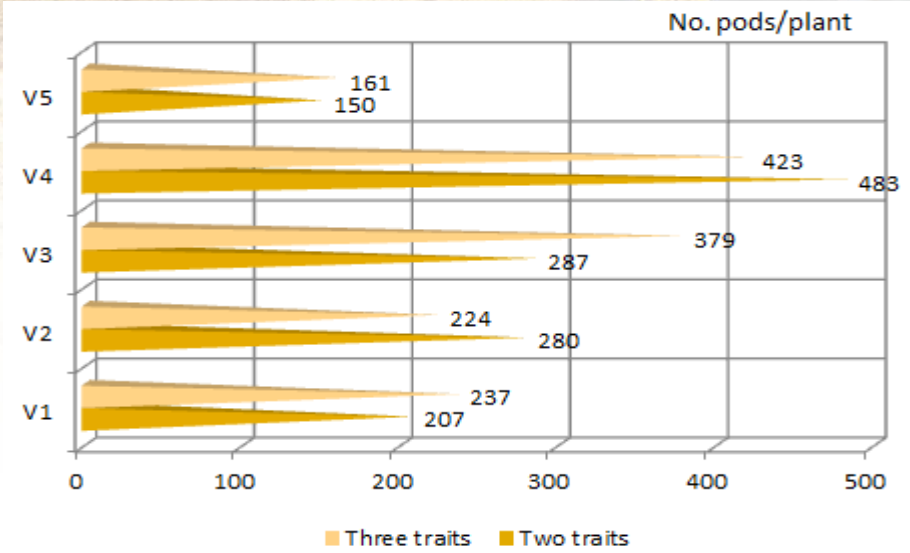

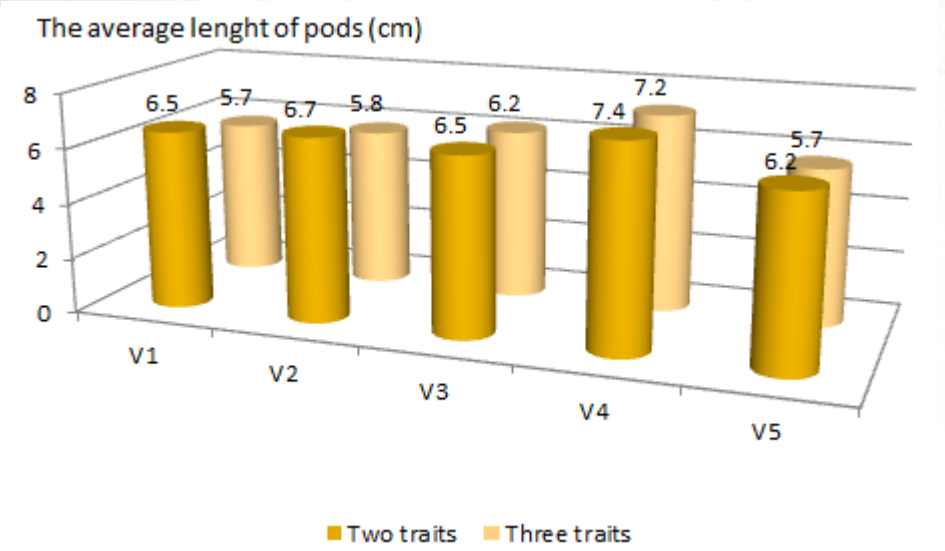

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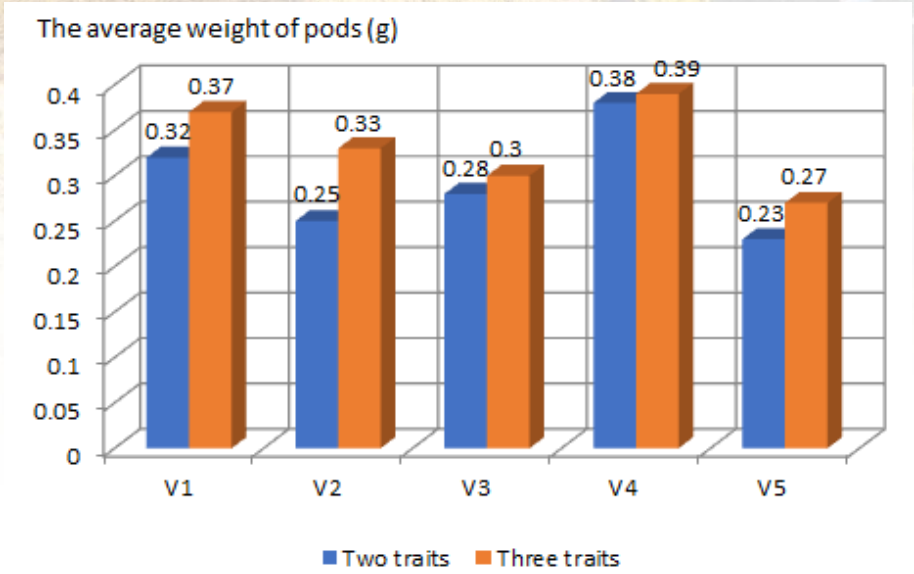

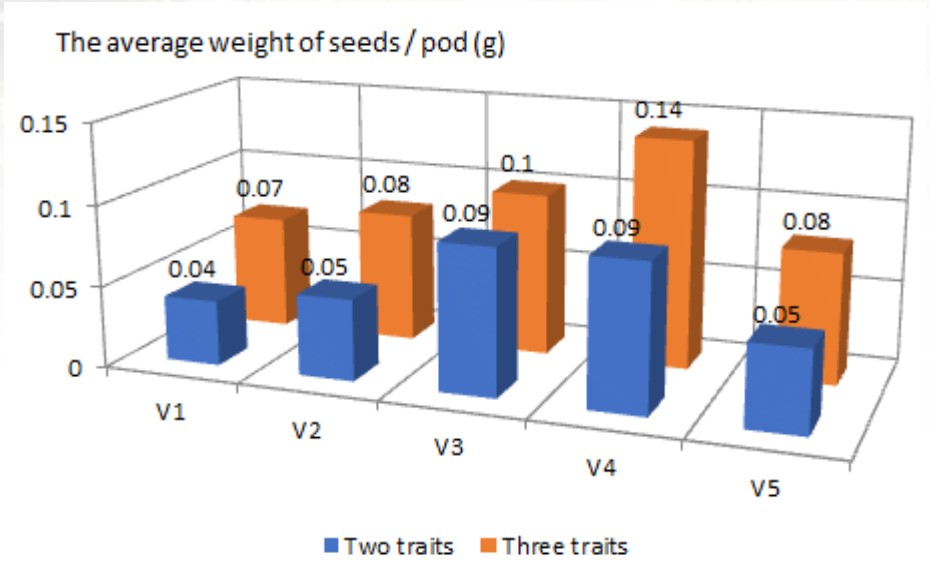

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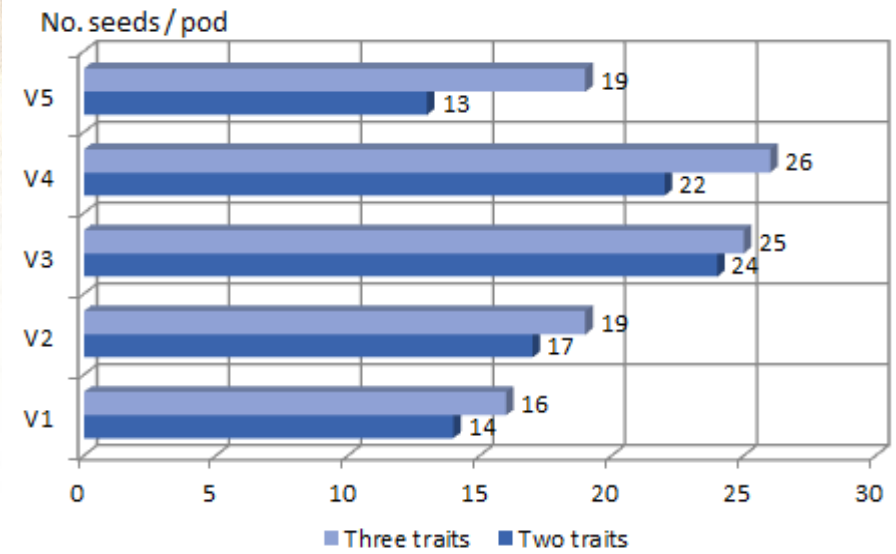

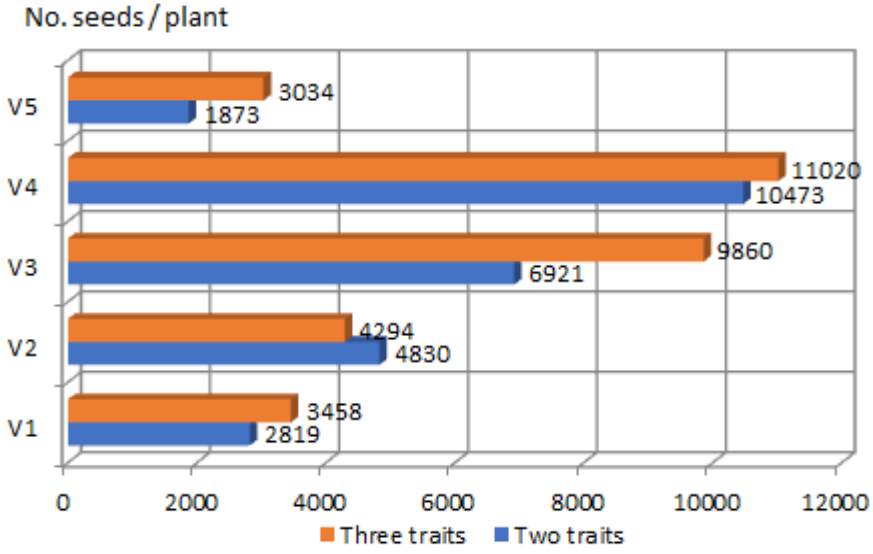

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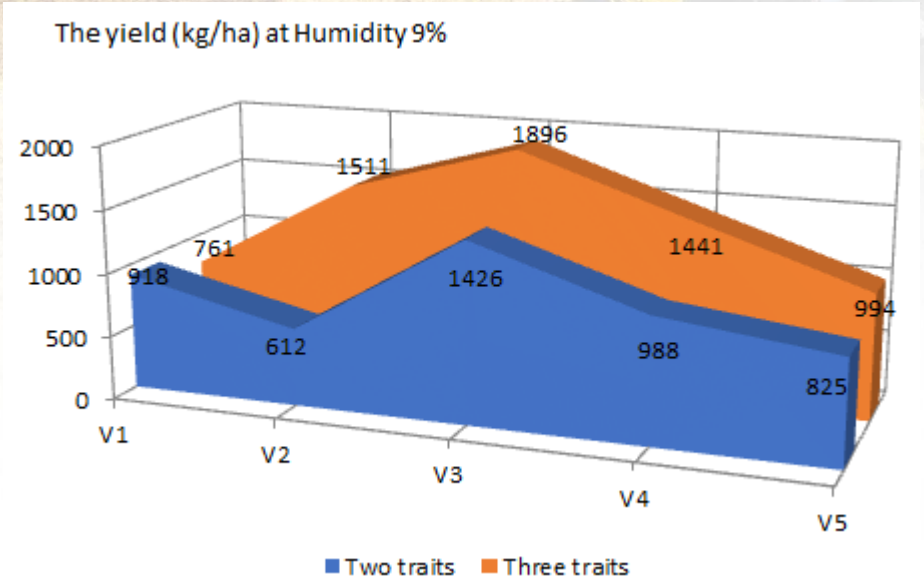

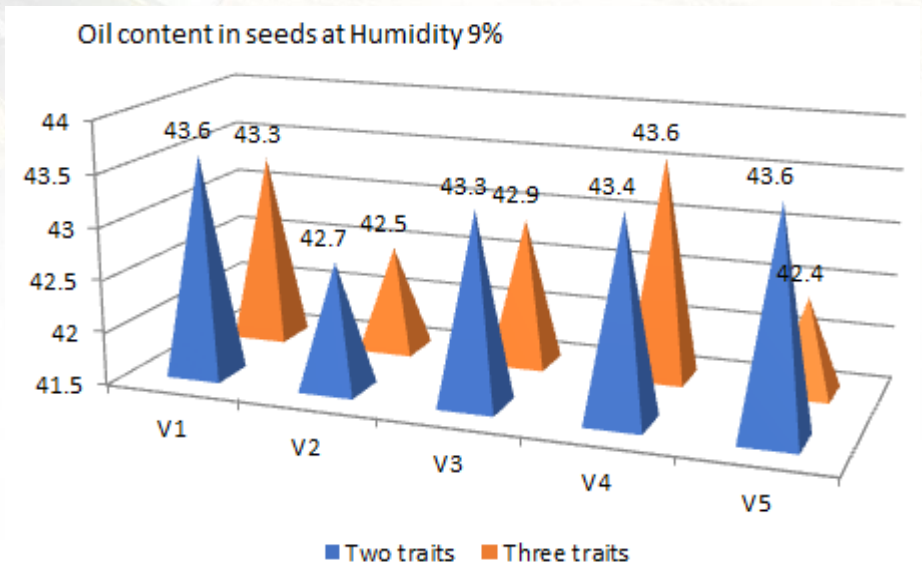

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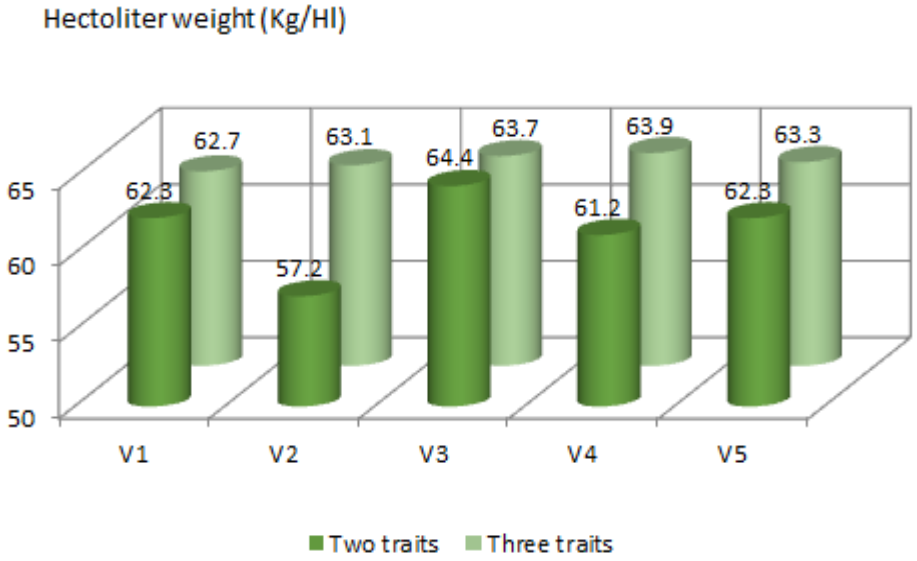

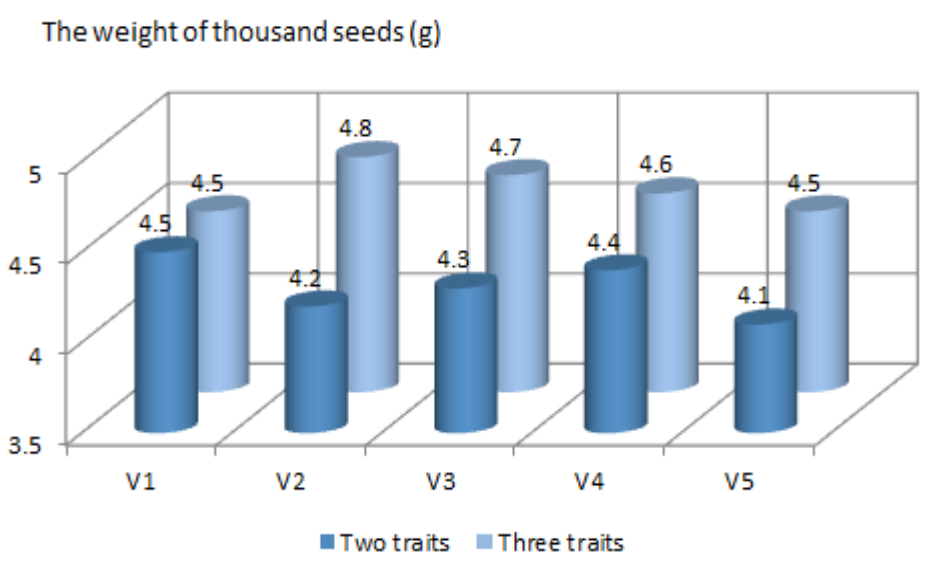

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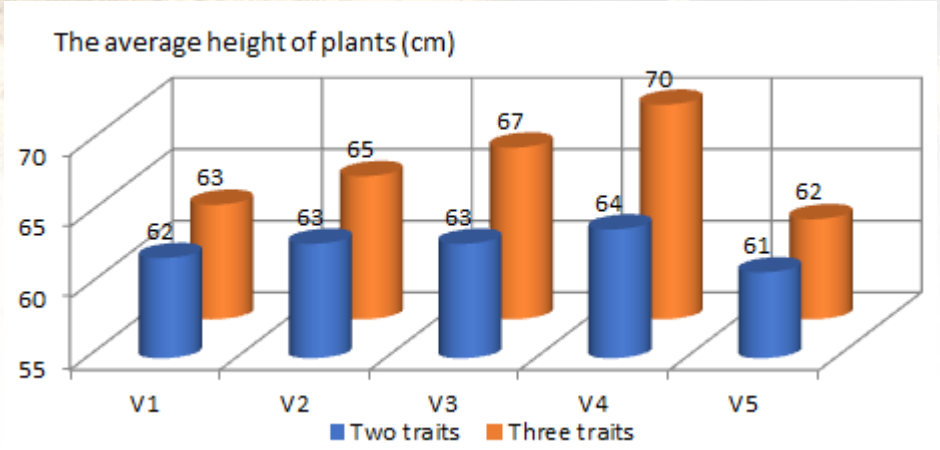
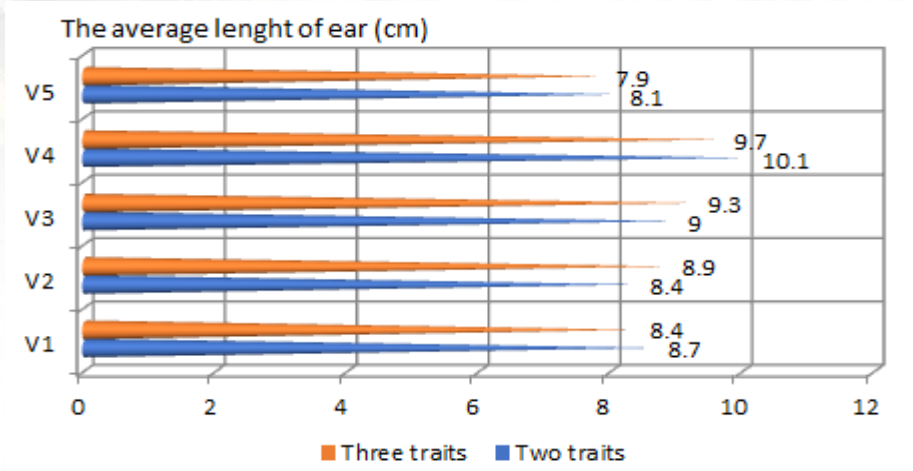
Results and discutions about agricultural winter crops

Results for winter wheat – *Triticum aestivum* L. :





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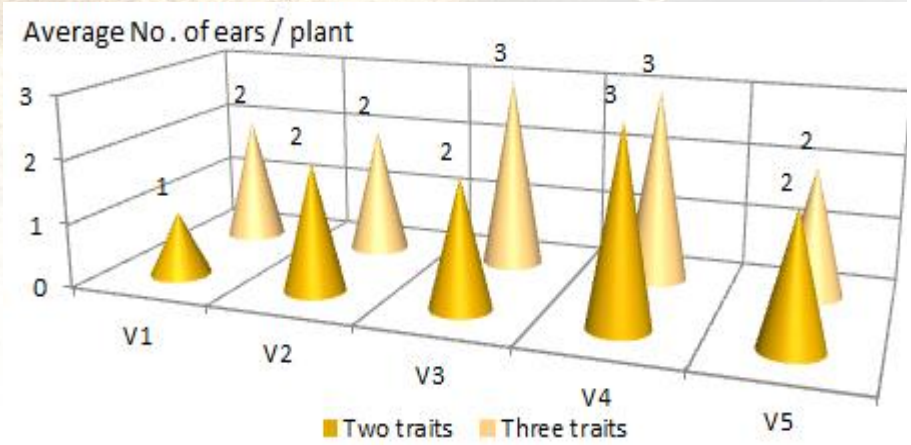

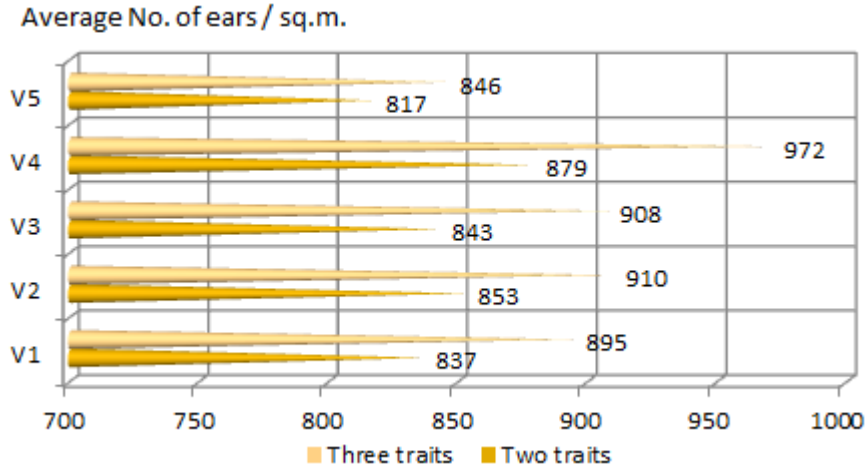

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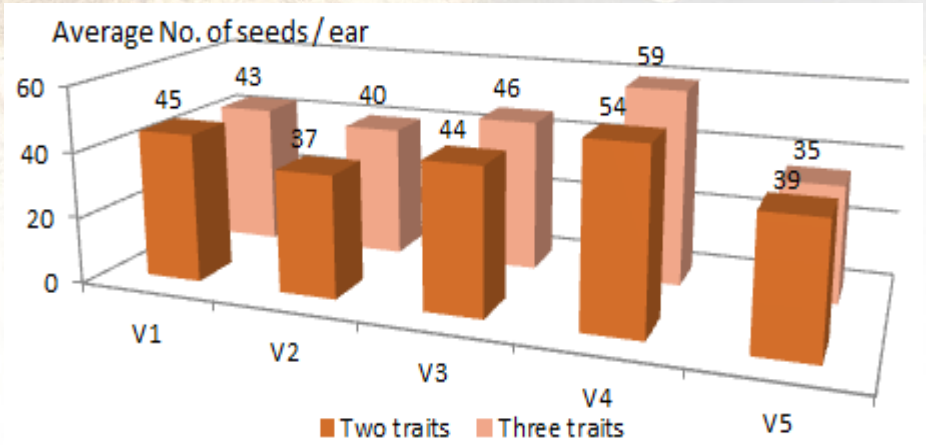

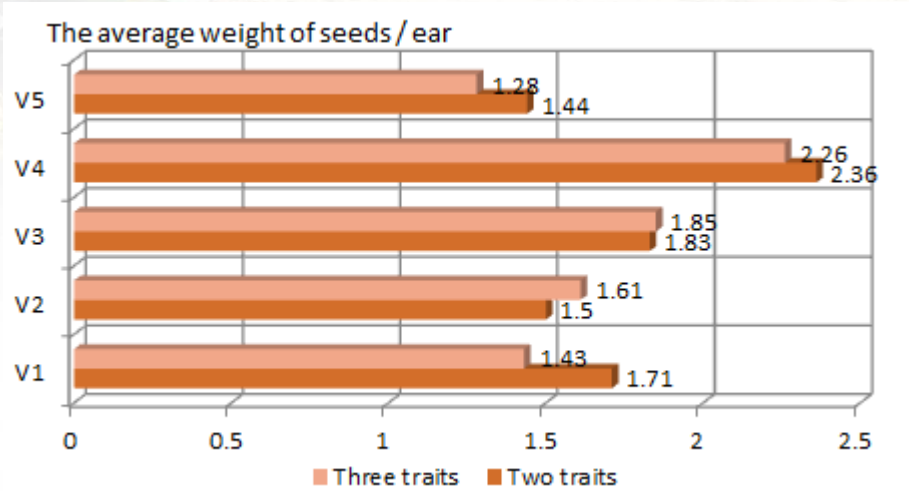

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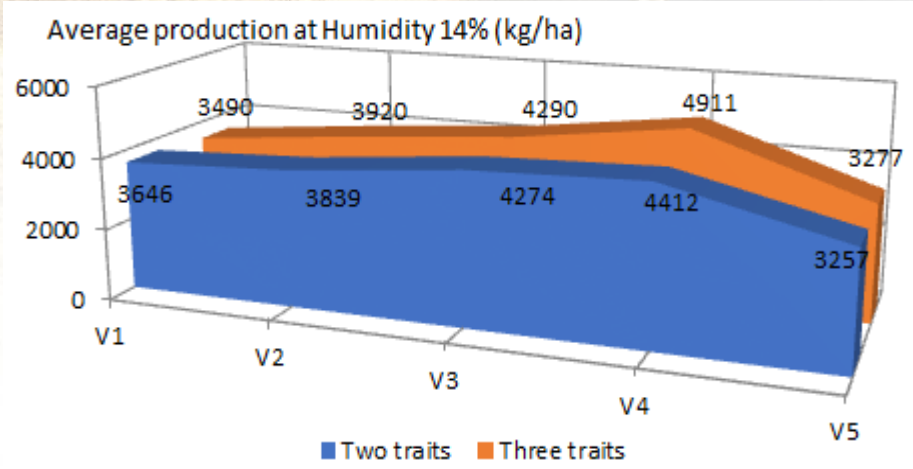

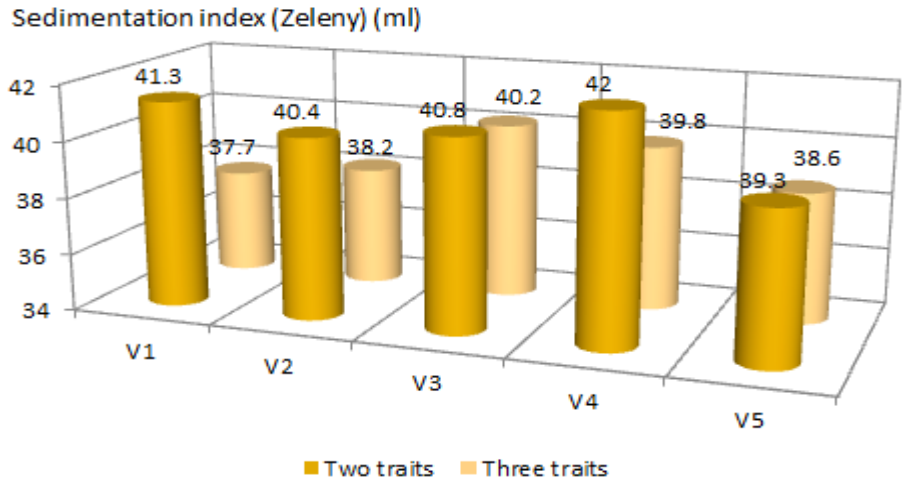

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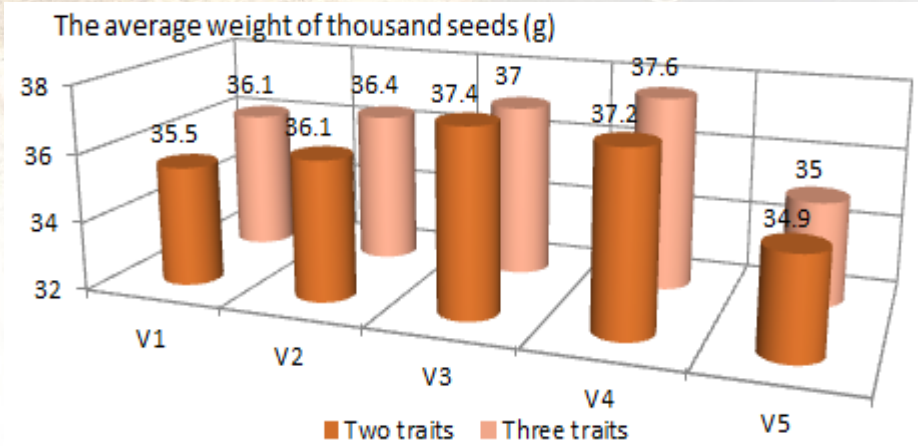

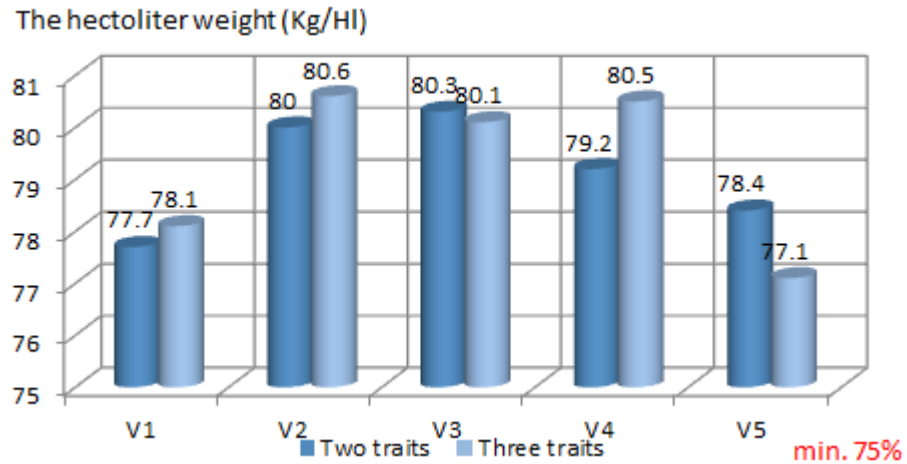

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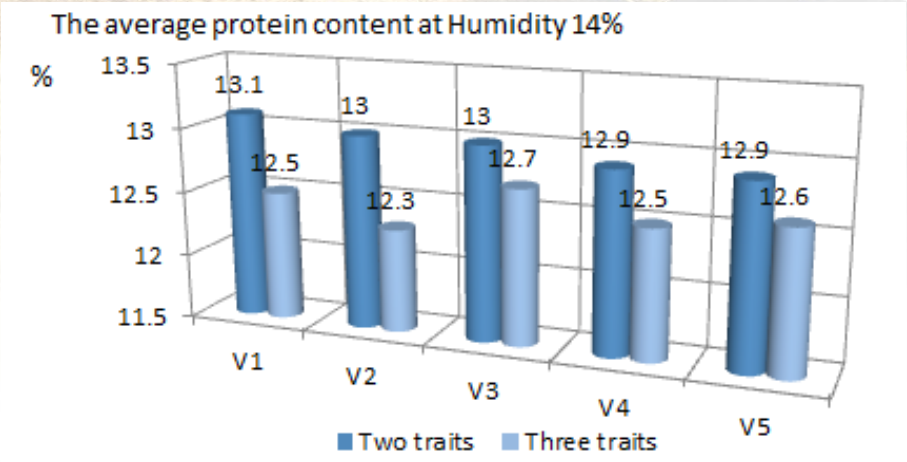

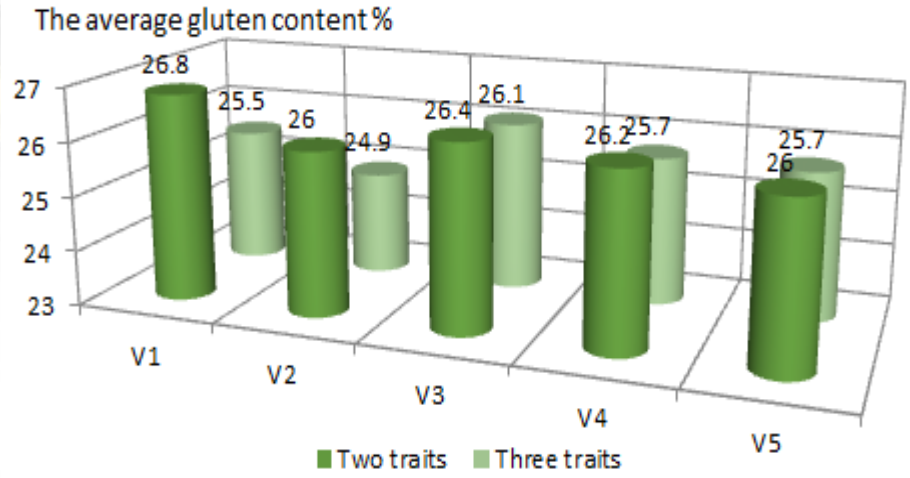

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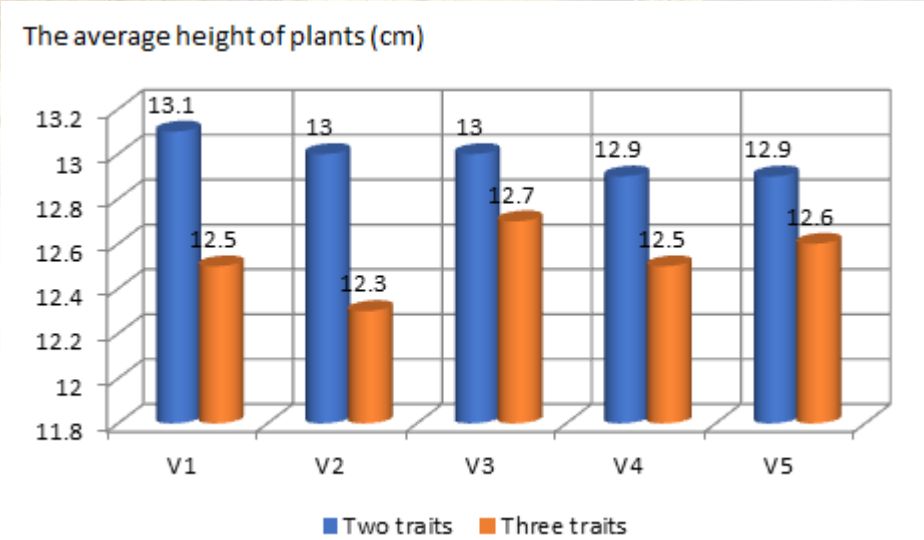
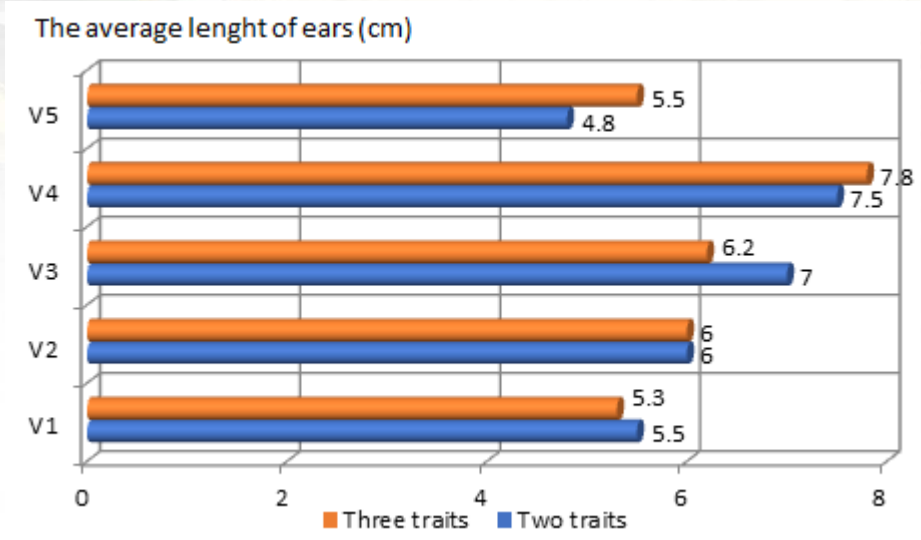
Results and discutions about agricultural winter crops

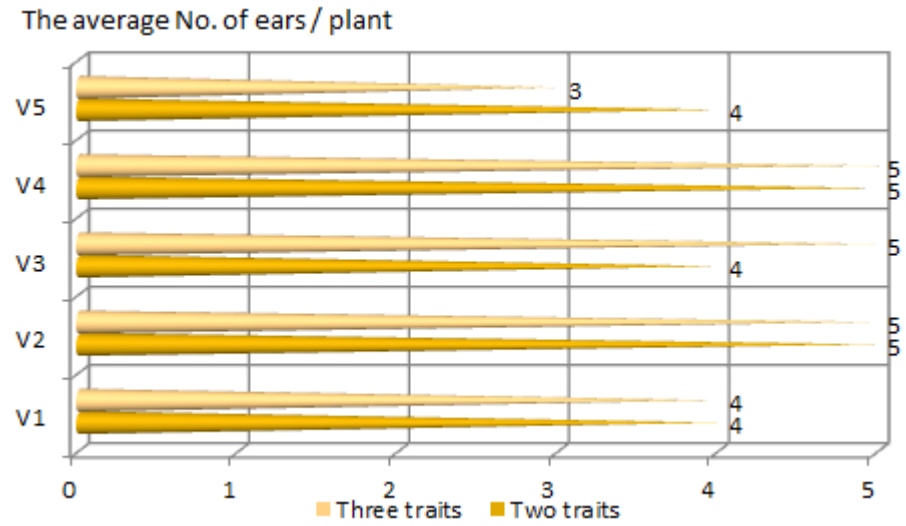
Results for winter barley – *Hordeum vulgare* L. :

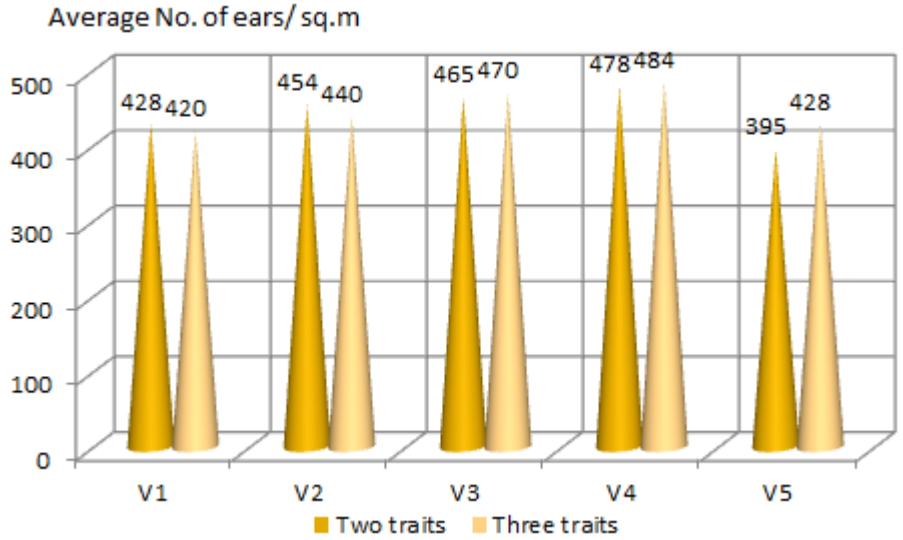




V1 – variant traits with 0.5 l/ha; V2 – variant traits with 1 l/ha; V3 – variant traits with 1.5 l/ha; V4 – variant traits with 2 l/ha; V5 – variant without traits – the control.

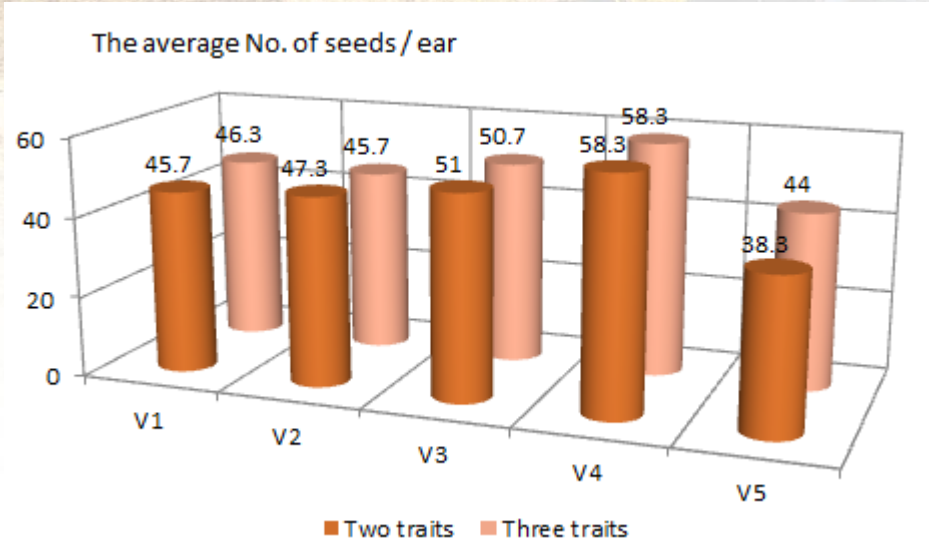
Results for winter barley – *Hordeum vulgare* L. :

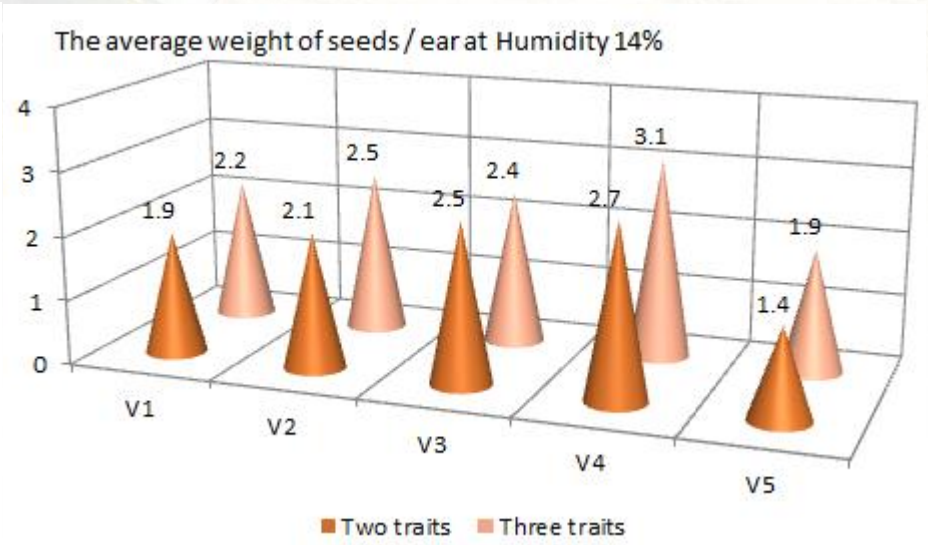




V1 – variant traits with 0.5 l/ha; V2 – variant traits with 1 l/ha; V3 – variant traits with 1.5 l/ha; V4 – variant traits with 2 l/ha; V5 – variant without traits – the control.

Results for winter barley – *Hordeum vulgare* L. :





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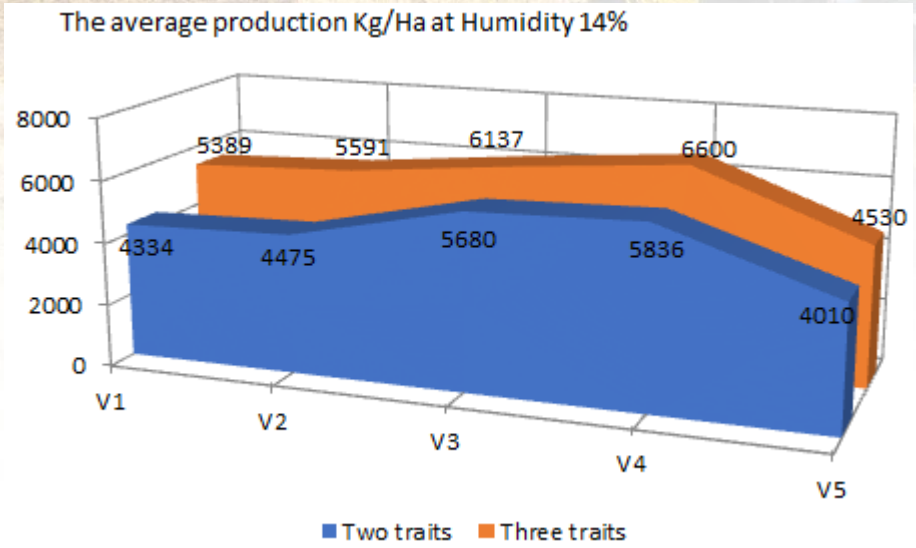
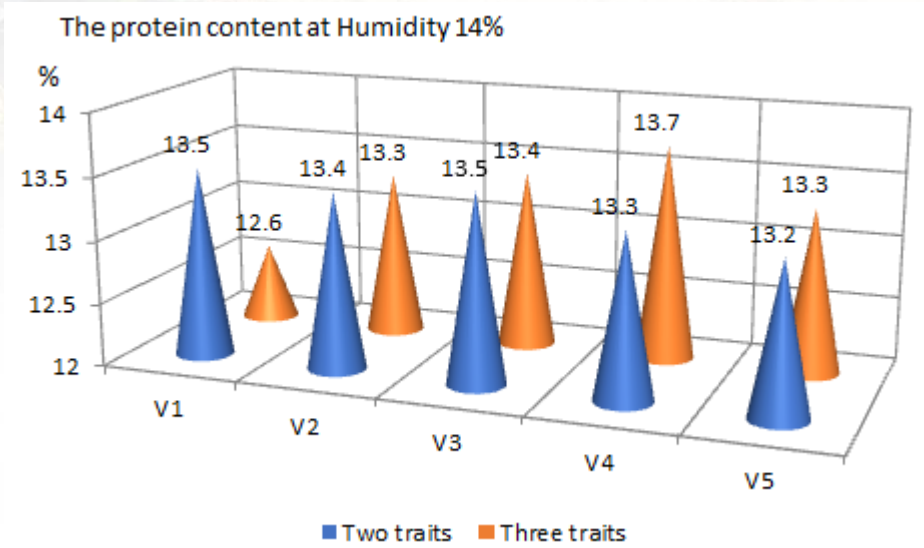
Results for winter barley – *Hordeum vulgare* L. :





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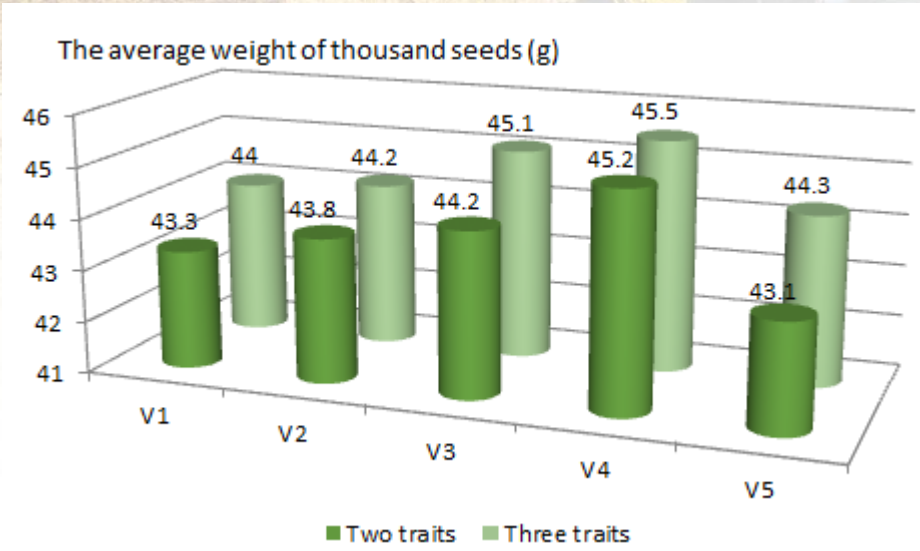
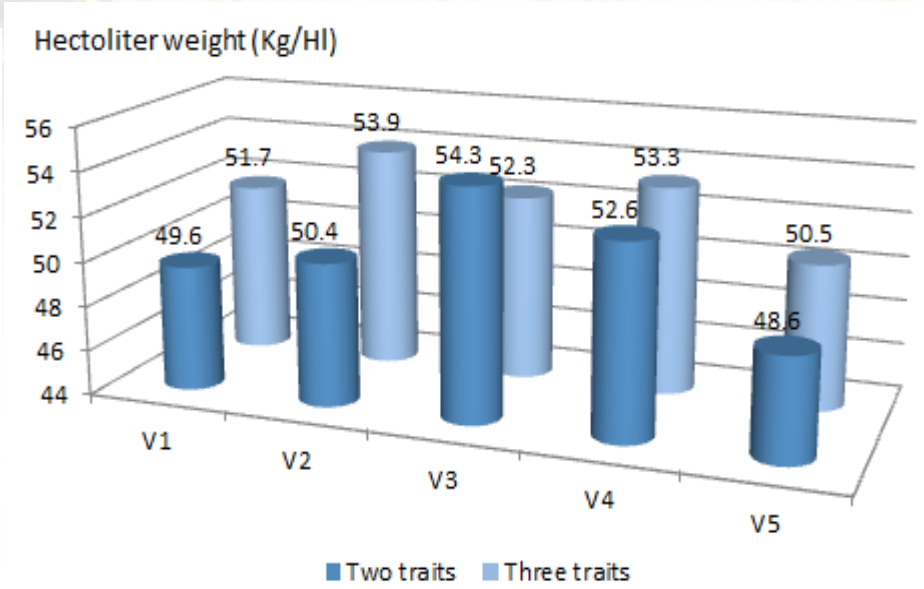
Results for winter barley – *Hordeum vulgare* L. :





V1 – variant traits with 0.5 l/ha; V2 – variant traits with 1 l/ha; V3 – variant traits with 1.5 l/ha; V4 – variant traits with 2 l/ha; V5 – variant without traits – the control.

Correlations

Coefficients of correlations between the doses and different indices at winter rapeseed

Height of plants (cm)	Length of roots (cm)	Diameter of stems (mm)	No. branch/ plant	No. pods/plant	Length of pods	Weight of pods	No. seeds/pod	Weight of seeds/pod	Production Kg/ha	Hectoliter Weight (Kg/Hl)	Weight of thousand seeds (g)	Oil content (%)
0.647	0.609	0.727	0.702	0.797	0.548	0.305	0.719	0.616	0.296	0.039	0.150	0.078

Coefficients of correlations between the doses and different indices at winter wheat

Height of plants (cm)	No. ears/plant	No. ears / sq.m	Length of ear (cm)	No. seeds/ear	Weight of seeds/ear	No. ears/sq.m	Production (Kg/Ha)	Weight of thousand seeds (g)	Hectoliter Weight (Kg/Hl)	Sedimentation index Zeleny (ml)	Protein content (%)	Gluten content (%)
0.534	0.642	0.574	0.683	0.654	0.683	0.574	0.832	0.847	0.452	0.327	0.006	0.039

Coefficients of correlations between the doses and different indices at winter wheat

Height of plants (cm)	No. ears/plant	No. ears / sq.m	Length of ear (cm)	No. seeds/ear	Weight of seeds/ear	Production (Kg/Ha)	Protein content (%)	Weight of thousand seeds (g)	Hectoliter Weight (Kg/Hl)
0.854	0.698	0.779	0.884	0.747	0.820	0.786	0.233	0.728	0.417

Conclusions:

- The innovative technology BIOSTIM can used to obtain different recipes customized for each agricultural and horticultural crops, depends by the specific consumption of nutrients and using medicinal plants with antibiotic effects for specific pests and diseases of crops.
- The prototype of biodegradation platform will be patented in the near future and will can be given for sale to all farmers who wish to obtain their own organic fertilizers and foliar bio-stimulants by using the agricultural waste from own farms.

- For more information, please visit the project website:

http://biostim2016.wixsite.com/english