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Biostimulant effect of quantitative indicators of winter rape (*Brassica napus* L.) quantitative indicators

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Abstract. In recent years, one of the major challenges for plant breeders has been the control of abiotic environmental stresses (drought, UV stress, salt concentration, water pressure). Increasingly variable and unpredictable weather anomalies are a warning of the detrimental effects they have on the growth of our crops and prevent us from reaching the potential of our genetic potential and nutrient supply. To prevent and reduce losses, the potential to protect plant health and increase plant resistance to stress must be anticipated and applied in the future if we are to be successful in agricultural production. One element of this is plant biostimulation. Today, crop producers use biostimulants as a compliance pressure, to obtain more subsidies (Agri-ecological Programme). Biostimulants applied inappropriately (mixed with herbicides), targeted, and at the right time, can have the opposite effect. This also induce irreversible processes in the crop plant. Although the winter swede rape area has been significantly reduced in our country, there are those who persevere despite the difficulties of growing it. Rapes can be successfully grown today with great care and intensive technology, and the weather conditions of recent years have consistently shown that environmental anomalies have a significant impact on its yield. In rapes, the use of biostimulators and fertilising products is considered common. Our studies with Quantis in rapes have clearly proven its effectiveness. In this article we would like to present the effect of biostiumulant (Quantis) on the production of rapes.

1 Introduction

Stress is a stressful situation in which an organism behaves in a way that is different from "normal" behaviour. According to Selye [1], stress is the overloaded, overstrained state of the body, the body's a specific reaction to all kinds of stress. A specific reaction: it is always the same regardless of the stressor. According to Tischler [2], stress is a situation which is abnormal and which stresses the organism but does not directly threaten its life. Larcher defines stress as a stress condition in which increased stress on the plant, after an initial

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destabilisation of functions, leads to an increase in resistance through a normalisation and then, when the tolerance limit is exceeded, to permanent damage or even death [3]. Stress is an external adverse effect on a plant, of biotic or abiotic origin, such as infection, heat, water deficit, and anoxia. In most cases, the impact of stress is characterised by survival traits or by measuring yield, yield gain (biomass accumulation) or primary assimilation processes [4].

The most promising solution to address abiotic and biotic stress tolerance factors and effects may be the use of plant biostimulants (PB), which are called "substances and/or microorganisms containing substances", which, when applied to plants or rhizosphere, function to stimulate natural processes to enhance/benefit nutrient uptake, nutrient efficiency, tolerance to abiotic stresses and/or crop quality, irrespective of its nutrient content [5].

Biostimulators as a concept are very difficult to understand in one sentence. There are several formulations available in the literature, but perhaps the most succinct and to the point is "plant biostimulant is any substance or microorganism applied to plants with the aim of improving nutritional efficiency, abiotic stress tolerance, and/or yield quality traits, regardless of nutrient content [6]." They can also vary in composition. They are plant extracts, algae, humic acids, amino acids, etc. They form a subset between pesticides in the classical sense and crop enhancers. There is also a tendency to refer to biostimulant preparations as crop enhancers. It is more appropriate to say that the use of these substances reduces the stress on the plant, reduces the expected yield and helps to preserve the genetic potential of the plant [7].

2 Quantis

Quantis is a mononatural biostimulant rich in organic carbon compounds (mainly sugars), but also contains many other nutrients and amino acids that are useful and essential for plants and is fortified with various nutrients during the production process. The calcium content of Quantis is unique and should be highlighted. Calcium ion plays an important role in the stress signalling process. Also worth mentioning is the potassium content, which plays an important role in plant physiological processes and stress tolerance. It also contains nitrogen, phosphorus, boron, zinc, manganese, and sulphate (Table 1). It has an average amino acid content of 2%, of which 0.4-0.6% is free amino acid. It is characterised by high concentrations of aspartic acid, glutamic acid, and alanine but also contains proline and glycine, among others. These are important for protein synthesis, have antioxidant and chelating activities, and also act as osmoprotectants.

Table 1. Physical – chemical properties.

Parameter	Value
pH (in original material)	6.2
density (kg/dm3)	1.34
Dry matter content (m/m %)	50-55
organic C content (m/m%)	15
N content (m/m %)	1.9
Phosphorus pentoxide content (m/m%) d.m.	0.87
Potassium oxide content (m/m%) d.m.	17.4
Calcium oxide content (m/m%) d.m.	2.8
Sulphate (mg/l)	0.2-0.4
Amino acid contect (m/m%)	1.8-2.2
Free amino acid congtect (m/m%)	0.4-0.6
Boron (mg/l)	7.5-20
Zink (mg/l)	7-20
Manganese (mg/l)	10-20
Water Solubility (%)	99

Quantis can activate the cellular system (genes and defence pathways involved in metabolic processes) thanks to its ingredients, if applied correctly before stress occurs. When stress occurs, the effect of Quantis ingredients is first felt at the cellular and organ level and can be measured at the physiological level, which can result in the maintenance and improvement of the yield [8].

When applied prior to the onset of environmental stress, the yield stabilising effect of Quantis is due to several factors:

- Reduction of the damaging effects of stressors, senescence (ageing retarding effect):
  - o Primarily abiotic (environmental stress): drought, heat, atmospheric drought, cold, etc.
  - o Anthropogenic effect (phytotoxicity caused by pesticides)
- Improvement of fertility and reproductive processes:
  - o Activation of enzymes and plant hormones
  - o Improved fertility rate by strengthening the plant
- Plant nutrition:
  - o Macro and microelements to prevent and/or restore nutrient deficiencies

3 Characteristics of the plot area

The parcels designated for the experiments are located in the administrative area of Tarján and Naszály, geographically belonging to the Kisalföld Great Plain, Komárom-Esztergomi Plain Central Plain, Győr-Tatai-Teraszföld.

The Győr-Tatai terrain is a low-lying, poorly dissected, terraced alluvial cone plain. The Danube floodplain, which gradually descends from 120 mbf eastward to 110 mbf, rises in steps through parallel terraces to a line of terraced islands 150-180 m high, which close the landscape from the D. The highest point is 201 m west of Tata. The floodplain is wetter due to the proximity of groundwater, while the terraced islands provide drier land for cultivation.

The alluvial cone plain along the Danube and the tributary stream valleys are covered by silty-sandy sediments of the present period. The surface of the next level is covered by alluvial sands, and the still higher level by wind-blown sand layers. The terrace island hills are made up of gravel, so they stand out from their surroundings. Underlying them are semi-clayey Miocene-Pleistocene sediments, which are rarely good reservoirs.

The depth of the water table is generally between 2 and 4 metres, except in the floodplains, where it rises above 2 metres but drops below 6 metres on the terraced islands that close the landscape from the D. The chemical character is mainly calcium, magnesium, and hydrogen carbonate, but sodium is also present in a large area to the south of Komárom.

The area is characterised by a moderately warm and dry climate. The annual mean temperature is slightly above 10 °C, reaching 16,6 ° C during the growing season. The average duration of mean temperatures above 10 °C is 182 days between 13 April and 16 October. Frost-free days are also expected during the same period. The multiannual average rainfall is 570-590 mm, of which 330-340 mm fall during the growing season. The prevailing wind direction is north-west, but there is also a significant proportion of winds from the DK.

4 Field experiments

The first annual experiment was set up in the outskirts of Tarján in the crop year 2021/22.110 plots, each plot size (3x7m) 21m2.11 treatments in 5 replicates. Four different substances in different doses were: zinc, zinc-enriched, quantis, wuxal boron.

The second year of the 2022/23 experiment was set up on the outskirts of Naszály. Here 65 30 m2 plots (3x10m) of 30m2 were assigned in 13 treatments in 5 replicates. Only spring treatments were applied, six different substances were applied: zinc, zinc-enriched, Quantis, Wuxal boron, humic acid, and fulvic acid.

In the third year of the 2023/24 trial year, it will also be set up on the outskirts of Naszály, where 65 plots (3x10m) of 30m2 have also been designated.

5 Material and method

Zinc tetramine hydroxide and zinc tetramine hydroxide + copper tetramine hydroxide produced from zinc and zinc enriched industrial waste. Quantis is an amino acid biostimulant consisting of 12-19% organic carbon (fermented sugar cane molasses), 1.8-2.2% amino acid (glutamic acid, alanine, glycine, etc.), 1.9% nitrogen (urea), 0.9%P2O5 (phosphoric acid), 17%K2O (potassium chloride), 2.8% CaO (calcium oxide). And wuxal boron, which is a high phosphorus and boron foliar fertiliser, was included in the experiment because it is a constant in the cultivation of oilseed crops.

In the second year of the experiment, two other substances were included, a preparation containing humic acid (Hymagrosol) and a preparation containing fulvic acid, which has no authorisation.

In the first-year trial, two treatments were performed, one in autumn and one in spring at bbch 16-18 and then at emergence. Zinc tetramine hydroxide was applied at 4 different doses (2,5,10,20 l/ha), zinc enriched at 2 different doses (5 and 10 l/ha) and Quantis at the manufacturer's prescribed rate of 2 l/ha (Table 2). In 2021 the biostimulant was not yet licenced, but this has changed now because it can be marketed in Hungary from 2023. We have also added the biostimulant with zinc and zinc enriched and wuxal boron in the prescribed amounts. The different doses were applied using a Euro Pulvé parcella sprayer to apply the appropriate doses. In the fall, we measured root mass, root neck thickness, and looked at SPAD values. For roots, 10 to 10 samples were taken per plot for SPAD testing, 20 to 20 leaf tests per plot were performed. For spring treatments, a SPAD test was performed and then leaf samples were taken for leaf analysis on the eighth day after treatment. After being dried and ground, the samples were processed. Harvesting was done with a plot harvester to avoid edge effects; only the centre of the plot was harvested 1 m wide. Mininfra smart T.

In the second year of trials, one treatment was applied at the time of rape emergence. SPAD measurements were taken on the experimental plots, on the eighth day after application, and leaf samples were taken on all plots for leaf analysis. The field temperature was -4 °C for two days on the fifth day after application (Figure 1). Our question was whether this stress was expected.

Fig. 1. 2-day frost effect in rapes

Table 2. Substances and doses applied in field experiments in Tarján 2021/22 and Naszály 2022/23.

Productson year 2021/22				
Treatments		Dose	Weighed ml/3l	Application
1.	Untrt. Check			Autumn (BBCH 16-18)
2.	Zn	2l/ha	13,5	
3.	Zn	6l/ha	40,5	
4.	Zn	10l/ha	135	
5.	Zn	20l/ha	270	
6.	Zn entriched	5l/ha	34	
7.	Zn entriched	10l/ha	40,5	
8.	Quantis	2l/ha	13,5	
	Quantis	2l/ha	13,5	
9.	Zn	10l/ha	40,5	
	Quantis	2l/ha	13,5	
10.	Zn entriched	5l/ha	34	
11.	Wuxal Boron	2,5l/ha	16,8	
12.	Untrt. Check			Start of spring stem
13.	Zn	2l/ha	13,5	
14.	Zn	6l/ha	40,5	
15.	Zn	10l/ha	135	
16.	Zn	20l/ha	270	
17.	Zn entriched	5l/ha	34	
18.	Zn entriched	10l/ha	40,5	
19.	Quantis	2l/ha	13,5	
20.	Quantis	2l/ha	13,5	
	Zn	10l/ha	40,5	
	Quantis	2l/ha	13,5	
21.	Zn entriched	5l/ha	34	

Productson year 2022/23				
Treatments		Dose	Weighed ml/5l	Application
1.	Untrt. Check			Start of spring stem
2.	Zn	2l/ha	32	
3.	Zn	6l/ha	96	
4.	Zn	10l/ha	160	
5.	Zn	20l/ha	320	
6.	Zn entriched	5l/ha	80	
7.	Zn entriched	10l/ha	160	
8.	Quantis	2l/ha	32	
	Quantis	2l/ha	32	
	Zn	10l/ha	160	
	Quantis	2l/ha	32	
	Zn entriched	5l/ha	80	
11.	Wuxal Boron	2,5l/ha	40	
12.	Hymagrosol	2l/ha	32	
13.	Fluvic acid	2l/ha	32	

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6 Results and evaluation

In the first-year experiments, no significant differences were found in yield and oil content in both the fall and spring treatments.

In the second-year experiment, a significant difference in yield was found for rapeseed stress (P = 10 -%) (Figures 2-4).

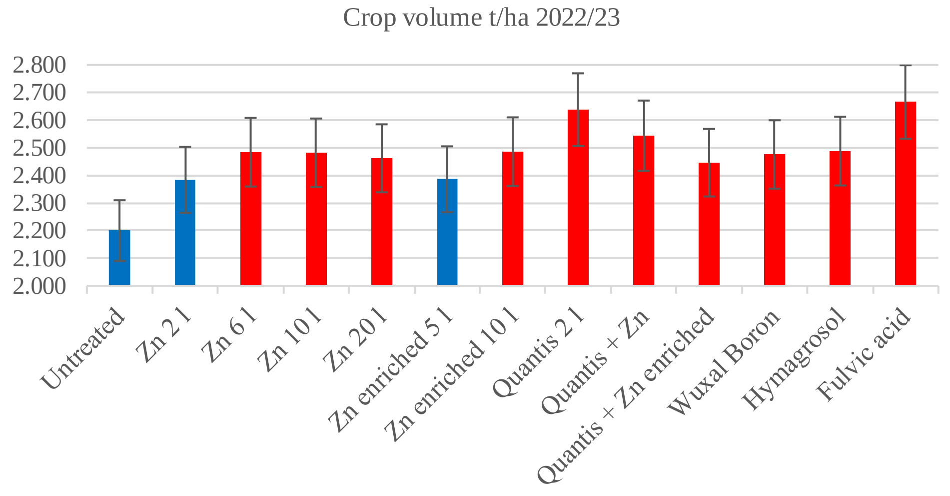

Fig. 2. F-test: significant at P10% except for Zn 2 l/ha and Zn enriched 5 l/ha.

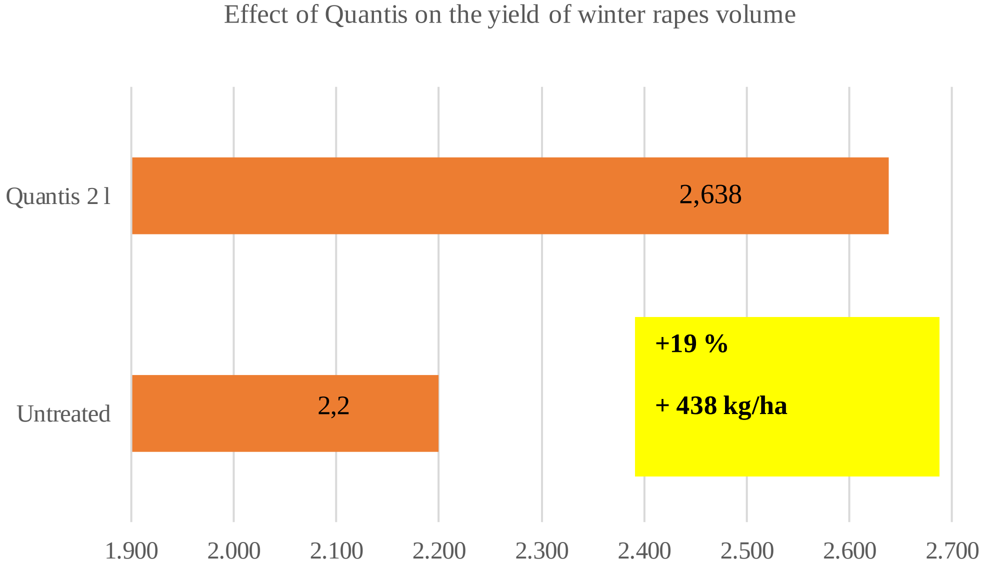

Fig. 3. The yield was increased by 438 kg per hectare, resulting in a 19% increase in yield compared to the control.

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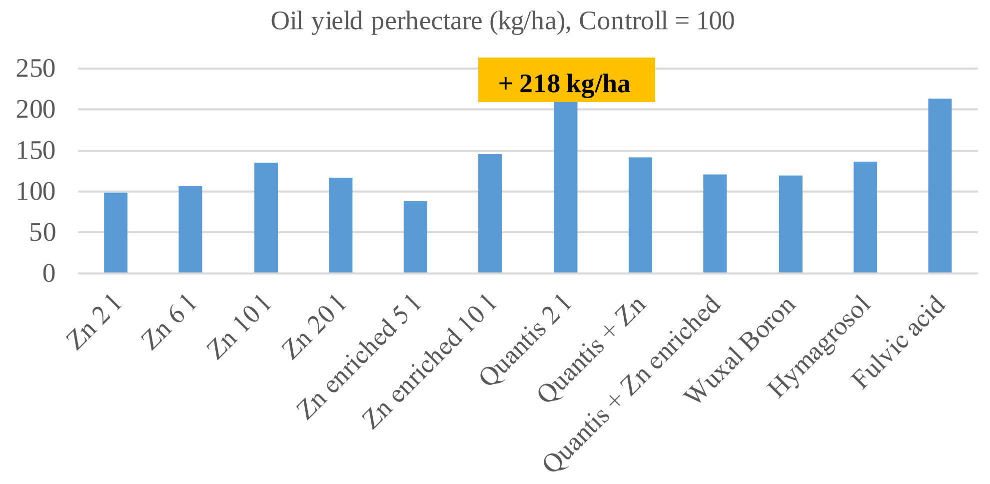

Fig. 4. The yield was increased by 438 kg per hectare, resulting in a 19% increase in yield compared to the control.

7 Conclusions

In conclusion of the experiments, it can be stated, that the areas treated at the start of spring stem yielded a yield surplus of 19%, which amounted to +438 kg of yield per hectare. The night temperature was -4 °C for two days from the fifth day after application. Also, the frost event occurred two days after the treatment time. Biostimulants should not be considered as yield enhancers but rather as yield savers.

According to Nagy [9], in winter wheat, 80 experiments have shown 85% yield increases as a result of single flag leaf or flowering treatment. The yield increase resulting from the Quantis treatment was 6% on average, which amounted to 183 kg of crop per hectare. In a Hungarian developer study conducted in 2019, a single Quantis treatment applied at a dose of 2 l/ha on flag leaves was able to cause a yield increase of 5.7%.

A development experiment in sunflowers using Quantis once in starbud condition showed a yield surplus of 5.9%, which meant an extra 192 kg per hectare. The Hungarian results are in line with the foreign figures. Studies in Bulgaria showed an increase of 6% with Quantis applied once and 13% with twice application.

Our study confirmed that Quantis is a preventing product of the field crops. As a technological suggestion the practical application period of the product is before the stress event.

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