Current Trends in Natural Sciences
Vol. 14, Issue 27, pp. 195-202, 2025
https://doi.org/10.47068/ctns.2025.v14i27.022
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

RESEARCH ON THE RELATIONSHIP BETWEEN DETERMINED CHARACTERS AND PRODUCTION, UNDER THE INFLUENCE OF THE YMPACT BIOSTIMULATOR, IN WHEAT GROWN ON CHERNOZEM AT SCDA CARACAL

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Abstract
For 3 years (2021-2023) on the chernozem of Caracal, the influence of the Ympact biostimulator on the winter wheat variety Glosa was studied through the prism of numerous characters classified according to phenophases as follows: plant growth and development (number of sprouted plants/m2, number of siblings/plant, total plant biomass in spring, root biomass in spring, height); formation of generative organs (number of fertile siblings/m2, spike length, number of grains/spike, weight of grains/spike), production formation (number of spikes/m2, number of grains/m2, mass of 1000 grains); harvest production and its quality (production, total plant biomass, harvest index, hectoliter mass).
In addition to Ympact, the biostimulator Kerafol was also tested, both in two doses and 2 variants not treated with biostimulator. The correlations calculated for the entire experiment showed that production was correlated with the number of siblings/plant, root biomass, grain weight/ear, total dry biomass and harvest index, and those calculated strictly for the variants treated with Ympact revealed strongly positive correlations with the number of plants/m2 and total dry biomass.

Keywords: chernozem, correlations, production, wheat, Ympact.

1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most significant cereal crops important as a food product (Rosculete et al., 2023). Wheat providing a large part of the carbohydrates and proteins needed by humans and representing more than half of the calories consumed by mankind (Ișlicaru et al., 2021; Iacob et al., 2023; Dihoru et al., 2024; Păunescu et al., 2024; Radoi et al., 2024).
The biostimulant market in Europe is growing, with a value of $1.2 billion in 2020.
Biostimulants have become increasingly prominent in terms of economic value. The European Biostimulant Industry Council (EBIC) has estimated a market range of approximately USD 1.5 to USD 2 billion in 2022 and an annual growth rate of approximately 10 to 12% (EBIC, 2020).
Other estimates show that by 2025, the biostimulant market will almost double.

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According to the official website of MADR, there are 116 products approved in the category of biostimulants on the Romanian market. Of these, 18 products contain two active components. Currently, the Roullier group offers innovative solutions so that on the market, only at the level of the Timac Agro company, there are 62 approved products in the category of biostimulants, each containing at least three active components (URL 2).
Research with biostimulants has been extended worldwide, as a result of the above.
In the tests carried out both in the research plots and in the plots of farmers who used Ympact®, several advantages were observed: better twinning of the plants, the process being favored by a much more uniform emergence (up to 30% higher than the control variants); better wintering of the straw cereals, which entered the winter better developed; better fertility of the siblings due to uniform development (up to 45% of the more viable siblings per plant); a longer length of the ears, well-developed root mass, better feeding the plant that favored genetics to the maximum; a higher number of berries per ear, obtaining in most of the studied lots an increase of up to 30% in production, the plants being visibly greener, which demonstrated an improvement in photosynthetic processes; a better elasticity of the plant, with a lower percentage of fall. Although all soils were also treated with growth regulators, there was also a clear difference in the stability of the fields, due to the lignosulfonates in the Ympact® product; an improvement in the phytosanitary status of the plants, because a well-developed plant is even more resistant to diseases; a more uniform drying (2% less than untreated soils); the protein content, gluten, but also MMB, were also obviously better than in the control variants (URL 1). The most obvious differences, however, were observed in areas affected by water or heat stress (Ayed et al., 2022; Hřivna et al., 2024).
Numerous experiences have highlighted the role of biostimulants in plant development (Szczepanek et al., 2018; Bonciu, 2019; Bonciu et al., 2020; Olaru et al., 2020; Lozowicka et al., 2022; Hossain et al., 2024; Cioboată et al., 2025; Rossini et al., 2025).

2. MATERIALS AND METHODS

For three agricultural years (2020-2021, 2021-2022, 2022-2023) a bifactorial experiment was placed according to the method of subdivided plots, in 3 repetitions.
The factors studied were: **factor A** – fertilization level with 4 graduations and **factor B** – seed treatment with biostimulator with 6 graduations.
The influence of the Ympact biostimulator has been studied in the winter wheat variety Glosa in terms of numerous traits classified according to phenophases as follows: plant growth and development (number of sprouted plants/sqm, number of siblings/plant, total plant biomass in spring, root biomass in spring, size); formation of generative organs (number of fertile siblings/sqm, ear length, number of grains/ear, weight of grains/ear), production formation (number of ears/sqm, number of grains/sqm, mass of 1000 grains (MMB)); harvest production and its quality (production, total dry biomass of plants, harvest index (HI), hectoliter mass (MH)). In addition to Ympact, the Kerafol biostimulator was also tested, both in two doses but also 2 variants not treated with biostimulator.
24 variants resulting from the interaction of factors A and B were studied, of which only 8 included the Ympact biostimulator. This biostimulant applied to seeds before sowing acts in three ways: inside the seed, as an interface between seed and soil as well as a combination of mycoelements (URL 1).
These variants are recorded in Table 1:

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Table 1. The variants tested in 2021-2023 on the Caracal chernozem

Variant	FACTOR A	FACTOR B
1	a1 fertilized with NPK in autumn	B1 not treated with fungicide and biostimulant
2		B2 Fungicide-treated/non-biostimulator-treated
3		b3 treated with fungicide and YMPACT 0.7 l/t
4		b4 treated with fungicide and YMPACT 0.35 l/t
5		b5 treated with fungicide and KERAFOL 1 l/t
6		b6 treated with fungicide and KERAFOL 0.5 l/t
7	a2 fertilized with NPK in autumn + ammonium nitrate in spring	B1 not treated with fungicide and biostimulant
8		B2 Fungicide-treated/non-biostimulator-treated
9		b3 treated with fungicide and YMPACT 0.7 l/t
10		b4 treated with fungicide and YMPACT 0.35 l/t
11		b5 treated with fungicide and KERAFOL 1 l/t
12		b6 treated with fungicide and KERAFOL 0.5 l/t
13	a3 fertilized with NPK in autumn + foliar in spring	B1 not treated with fungicide and biostimulant
14		B2 Fungicide-treated/non-biostimulator-treated
15		b3 treated with fungicide and YMPACT 0.7 l/t
16		b4 treated with fungicide and YMPACT 0.35 l/t
17		b5 treated with fungicide and KERAFOL 1 l/t
18		b6 treated with fungicide and KERAFOL 0.5 l/t
19	a4 fertilized with NPK in autumn + ammonium nitrate and foliar in spring	B1 not treated with fungicide and biostimulant
20		B2 Fungicide-treated/non-biostimulator-treated
21		b3 treated with fungicide and YMPACT 0.7 l/t
22		b4 treated with fungicide and YMPACT 0.35 l/t
23		b5 treated with fungicide and KERAFOL 1 l/t
24		b6 treated with fungicide and KERAFOL 0.5 l/t

Variety used: The Glosa variety was approved in 2005. It was obtained at INCDA Fundulea. His parents were Delabrad"S"/Dor"S"//Bucur. The variety was obtained by individual selection from the hybrid combination presented above. In recent years, the Glosa variety has been cultivated between 30-37% of the country's surface, enjoying much appreciation among farmers from all areas of the country. It is easily adaptable and has a higher production potential compared to previously created varieties. He is currently registered in Hungary under the name of Khungloria, which denotes his good behavior at international level as well (URL 2).

3. RESULTS AND DISCUSSIONS

The production limits were between 6550 kg/ha for the version treated with Ympact with the recommended dose of 0.7 l/ha on a background fertilized with NPK in autumn + ammonium nitrate and foliar in spring and 7128 kg/ha for the version not treated with biostimulator on a background fertilized with NPK in autumn + foliar in spring.

The production of all tested variants (with or without Ympact) was strongly positively correlated with the number of siblings/plant, root biomass and harvest index (P>5%) and very strongly correlated with total dry biomass (P>1%). It was also strongly correlated but in a negative sense with the number of grains/ear (Table 2 and Table 3).

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Table 2. Correlations of production with the characters determined in the variants tested on the Caracal chernozem (I)

No	Prod (kg/ha)	No plants/sqm	No. sibling/plant	Biomass to 5 pl (g)	Root biomass at 5 pl (g)	Waistline (cm)	No. of fertile siblings/sqm	Ear length (cm)
1	6880	451	2.5	8.02	1.5	84.8	202	8.4
2	6707	457	2.3	6.42	1.3	86	253	8.6
3	6900	451	2.4	9.39	2.47	84.8	218	8.6
4	6790	440	2.2	8.03	1.44	84.8	197	8.6
5	6764	389	2	9.61	2.36	84.6	254	8.5
6	6984	418	2.4	9.75	2.14	85.2	211	8.5
7	6863	429	2.4	10.52	2.39	86.1	263	8.6
8	6839	421	2.1	9.22	2.46	85	267	8.8
9	6790	418	2.2	10.02	2.41	85.9	202	8.5
10	6932	455	2.2	9.92	2.27	85.9	235	8.7
11	6883	444	2.3	10.03	2.37	86.1	257	8.5
12	6831	421	2.5	10.27	2.39	86.4	247	8.7
13	6937	421	2.6	8.76	2.22	86.5	267	8.5
14	7128	452	2.5	7.87	2.14	86.9	250	8.2
15	6914	440	2.4	9.25	2.06	86.4	257	8.3
16	6894	459	2.3	8.59	2.08	86.5	210	8.4
17	6722	428	2.5	9.67	2.41	86.7	268	8.3
18	7028	508	2.5	9.49	2.3	86.9	233	8.3
19	6565	412	2.1	10.19	1.91	85.7	250	8.8
20	6780	413	2.2	8.41	1.87	85.9	268	8.6
21	6550	445	2.1	8.86	1.87	86.7	260	8.4
22	6653	439	2.6	8.98	1.64	86.5	294	8.5
23	6611	454	2.1	8.89	1.77	86	250	8.4
24	6773	460	2.2	8.58	1.74	86.8	254	8.2
		0.283	**0.494**	**0.018**	**0.402**	**0.0434**	**-0.314**	**-0.249**

P>5% 0.4 **P>1% 0.52**

For the variants treated only with Ympact with different doses on different agrofunds, the production limits were between 6550 kg/ha for the variant treated with Ympact with the recommended dose on a background fertilized with NPK in autumn + ammonium nitrate and foliar in spring and 6932 kg/ha for the variant treated with Ympact with a dose of 0.35 l/t on a background fertilized with NPK fertilized in autumn + ammonium nitrate in spring.

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If we take into account only the variants treated with Ympact, the correlations decrease in number. Production in this case was very strongly positively correlated only with total dry biomass (r = 0.953) (Table 4 and Table 5).

Table 3. Correlations of production with determinate characters in the variants tested on the Caracal chernozem (II)

No	Prod (kg/ha)	No.grains/ spike	Weight grains/spike (g)	No.sp/ sqm	No.grains/ sqm	MMB (g)	Dry biomass (kg/ha)	HI	MH (kg/hl)
1	6880	42	1.72	638	26827	40.2	15728	0.45	73.2
2	6707	42	1.77	637	27360	42.1	15529	0.44	73.3
3	6900	43	1.81	637	28005	40.9	15854	0.44	74.1
4	6790	43	1.75	619	26851	39.9	15941	0.44	74.1
5	6764	46	1.87	638	29654	41.2	16022	0.44	74.1
6	6984	43	1.79	638	27788	40.2	16337	0.44	75.2
7	6863	46	1.86	661	30063	40.1	16045	0.43	73
8	6839	44	1.86	623	27194	42.8	16134	0.43	72.7
9	6790	43	1.82	582	24598	40.9	15716	0.44	73.7
10	6932	44	1.84	649	28367	40.7	16034	0.44	73
11	6883	45	1.88	642	28475	41.6	16100	0.43	73.1
12	6831	45	1.88	631	28232	41.6	16005	0.43	73.1
13	6937	44	1.81	656	28976	40.3	15877	0.44	73.8
14	7128	40	1.68	657	26141	41.4	16336	0.44	74.2
15	6914	43	1.77	648	27734	40.9	16086	0.43	74.7
16	6894	42	1.78	636	26885	40.7	15917	0.44	74.2
17	6722	43	1.8	671	29197	40.4	15697	0.44	74.7
18	7028	42	1.72	611	24711	40.9	16067	0.44	73.9
19	6565	44	1.85	617	26575	42	15118	0.43	74.1
20	6780	45	1.82	637	28527	41.2	15726	0.43	73.9
21	6550	44	1.85	648	28230	40.7	15116	0.43	73.6
22	6653	44	1.87	683	30063	41.7	15340	0.43	73.8
23	6611	42	1.82	629	26413	43.4	15513	0.42	74.2
24	6773	43	1.77	651	27458	40.9	16200	0.42	73.2
		-0.299	**-0.501**	**0.010**	**-0.192**	**-0.370**	**0.840**	**0.464**	**0.070**

P>5% 0.4 **P>1% 0.52**

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Table 4. Correlations of production with the characters determined in the variants treated with Ympact on the Caracal chernozem (I)

No	Prod (kg/ha)	No.plants/ sqm	No.sibl/ plant	Biomass to 5 plants(g)	Root biomass at 5 plants (g)	Waistline (cm)	No. of fertile siblings/sqm	Long spike (cm)
3	6900	451	2.4	9.39	2.47	84.8	218	8.6
4	6790	440	2.2	8.03	1.44	84.8	197	8.6
9	6790	418	2.2	10.02	2.41	85.9	202	8.5
10	6932	455	2.2	9.92	2.27	85.9	235	8.7
15	6914	440	2.4	9.25	2.06	86.4	257	8.3
16	6894	459	2.3	8.59	2.08	86.5	210	8.4
21	6550	445	2.1	8.86	1.87	86.7	260	8.4
22	6653	439	2.6	8.98	1.64	86.5	294	8.5
		0.319	**0.104**	**0.288**	**0.521**	**-0.375**	**-0.481**	**0.223**

P>5% 0.71 P>1% 0.83

Table 5. Correlations of production with the characters determined in the variants treated with Ympact on the Caracal chernozem (II)

No	Prod (kg/ha)	No.grains/ spike	Weight grains/spike (g)	No.spike/ sqm	No.grains/ sqm	MMB (g)	Dry biomass (kg/ha)	HI	MH (kg/hl)
3	6900	43	1.81	637	28005	40.9	15854	0.44	74.1
4	6790	43	1.75	619	26851	39.9	15941	0.44	74.1
9	6790	43	1.82	582	24598	40.9	15716	0.44	73.7
10	6932	44	1.84	649	28367	40.7	16034	0.44	73
15	6914	43	1.77	648	27734	40.9	16086	0.43	74.7
16	6894	42	1.78	636	26885	40.7	15917	0.44	74.2
21	6550	44	1.85	648	28230	40.7	15116	0.43	73.6
22	6653	44	1.87	683	30063	41.7	15340	0.43	73.8
		-0.534	**-0.537**	**-0.217**	**-0.258**	**-0.212**	**0.953**	**0.583**	**0.228**

P>5% 0.71 P>1% 0.83

The reduction in the number of correlations in the variants treated with Ympact suggests that the biostimulator tested does not have the desired impact in stimulating production. In other words, it is not possible to intervene on any of the studied traits that would lead to an increase in production.
The coefficient for determining the relationship between production and total dry biomass shows that the variability of production is ensured in a proportion of 90.8% of the variability of total dry

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biomass. For each increase in production by 100 kg/ha, the total dry mass increases by 239 kg/ha of dry biomass according to the linear equation, for the analyzed interval (Figure 1).
The variants that are in total agreement with the mentioned correlation are those that obtained yields over 6900 kg/ha and dry biomass over 16000 kg/ha – treated with Ympact at both doses tested on agrofund of NPK in autumn + ammonium nitrate in spring and NPK in autumn + foliar in spring.

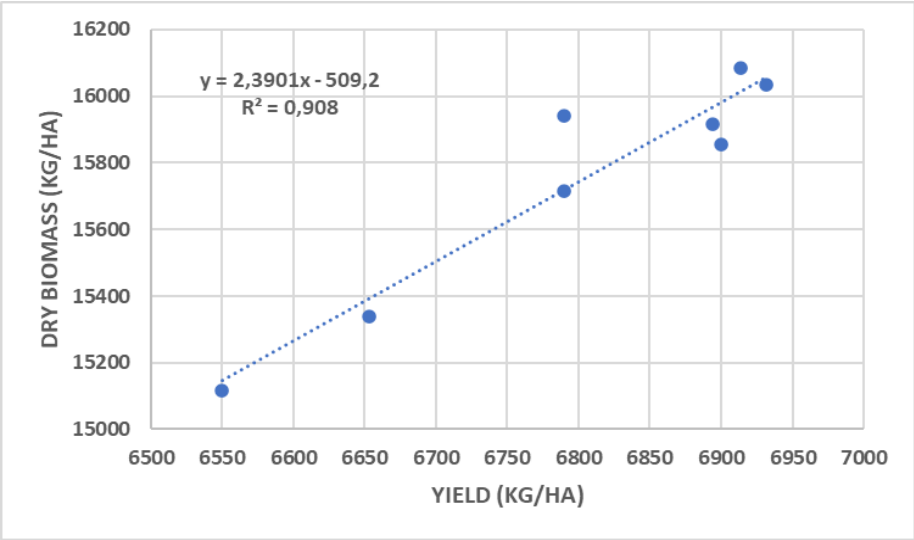

Figure 1. Correlation between production and total dry biomass in Ympact-treated variants tested in 2021-2023 on the Caracal chernozem

4. CONCLUSIONS

The correlations calculated for the entire experiment showed that the production was correlated with the number of siblings/plants, root biomass, grain weight/ear, total dry biomass and harvest index and those calculated strictly for the variants treated with Ympact showed a very strongly positive correlation with the total dry biomass.
The reduction in the number of correlations in the variants treated with Ympact suggests that the biostimulator tested does not have the desired impact in stimulating production. It is not possible to intervene on any of the studied traits that would lead to an increase in production. The only correlation, which is otherwise very strong, is logical in the context in which a high production leads to a large dry biomass.

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