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EFFECTIVENESS TESTING OF DIFFERENT ORGANIC FERTILIZERS ON CROP YIELDS UNDER CLIMATIC CONDITIONS OF ARGES COUNTY

Roxana Maria MADJAR[1], Nicolaie IONESCU[2], Traian Mihai CIOROIANU[3], Gina VASILE SCĂEȚEANU[1]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, 011464, Bucharest, Romania
[2]Agricultural Research and Development Station Pitești, 5 Pitești-Slatina Road, 117030, Pitesti, Romania
[3]National Research and Development Institute for Soil Science, Agrochemistry and Environment - ICPA Bucharest, 61 Marasti Blvd, District 1, 011464 Bucharest, Romania

Corresponding author email: ginavasile2000@yahoo.com

Abstract

Application of organic fertilizers has proven a lot of benefits which converge to better yield parameters and food of high quality. The objectives of our study were to research the efficiency of three fertilizers accepted for organic agriculture (CODAMIX - F1, ECOAMINOALGA - F2 and ECOAMINOALGA PLUS - F3) on four different field crops, to evaluate their effects on yield parameters and to compare the results with those obtained in a previous experimental year. The study was developed in Albota, Argeș County during 2020-2021 and the field crops subjected to this investigation were winter wheat (Trivale variety), sunflower (PG4 hybrid), maize (T.332 hybrid), soybean (Raluca TD variety). The experimental scheme was composed from four plots and four variants (control, F1, F2, F3) for each crop. Organic fertilizers (F1, F2, F3) were applied for all field crops as two foliar treatments during vegetation period. The obtained results evidenced that application of organic fertilizers increased yield parameters and the efficiency of treatments is following the order F3>F2>F1. The results obtained during 2020-2021 are in good agreement with those reported for 2019-2020.

Key words*: crop, foliar application, organic fertilizer, yield components.*

INTRODUCTION

Finding new fertilizers and formulations destined for organic agriculture has gained a lot of interest lately because are environmentally friendly, may contribute to higher yields and improve soil characteristics. Furthermore, organic production regulations allow the use of specific inputs that has to comply strict standards, the accepted products being regulated by Commission Regulation (EC) No 889/2008 and by Regulation (EC) No 2003/2003 of the European Parliament and of the Council. For instance, protein hydrolysates of plant and animal origin and different amino acids fertilizers tested on field (Mihalache et al., 2014; Mihalache & Stanescu, 2017; Nicu et al., 2021) or on horticultural crops (Colla et al., 2017; Rouphael et al., 2021; Soteriou et al., 2021) has proven their efficiency. Other study (Moosavi et al., 2013) evidenced positive effects of a formulation based on free aminoacids on maize grain yield.

Panayotova (2019) tested the efficiency of organic seaweed bioproduct Bioalpha (Alga 300) on seven sunflower hybrids grown under organic farming conditions. Among all tested hybrids, DKF2120 achieved higher yields and was most adaptable to be use din organic conditions.

Furthermore, the effectiveness of various combinations of organic manures (green manure - GM, farm yard manure - FYM, poultry litter - PL, press mud - PM, sewage sludge - SS) at a rate of 10 t/ha on a spring wheat cultivar evidenced that variant consisting from GM+PL+SS treatment produced maximum yield that was 137% higher than control variant with no fertilization (Hammad et al., 2011). Moreover, use of two green manure crops (red and white clover) on organically grown maize hybrids under climatic conditions from Greece has proven the efficiency on grain yield and protein content (Kanatas et al., 2020). Also, a meta-analysis using 133 maize studies developed worldwide evidenced that rational

use of organic and mineral fertilizers improved maize yield, reduced N and C losses and increased soil organic carbon sequestration (Wei et al., 2020).

Alam et al. (2018) investigated the impact of crop rotations using green manure, green manure incorporation timing and application of pelletized dehydrated poultry manure on organic wheat production. The results demonstrated that leguminous green manure and organic inputs significantly enhanced wheat biomass, yields and protein content.

In the context of our previous researches concerning effects of fertilization on quality and yield parameters for different crops (Mihalache et al., 2015; Mot et al., 2017; Madjar et al., 2018; Ilie et al., 2018; Ilie et al., 2018; Madjar et al., 2018; Madjar et al., 2019; Mihalache et al., 2020; Ilie et al., 2020; Madjar et al., 2021), we have developed an experiment with the aim to investigate the effects of organic inputs (CODAMIX - F1, ECOAMINOALGA - F2 and ECOAMINOALGA PLUS - F3) on different field crops (winter wheat, sunflower, maize, soybean) and to compare their effects on yield performances.

MATERIALS AND METHODS

Experiment location

The experimental study was developed during 2020-2021 in Albota, Argeș County, where the dominant soil type is albic luvisols (Mihalache et al., 2015). Albota is located in the south part of Argeș County, at 10 km far from Pitești (Figure 1).

Figure 1. Position of Albota on geographical map

Experiment description

To achieve the proposed objectives, it was chosen for testing the following species: winter wheat, sunflower, maize and soybean. The details of the experiment are presented in Table 1.

Table 1. Experiment characterization

Field crop	Winter wheat	Sunflower	Maize	Soybean
Variety/hybrid	Trivale	PG 4	T.332	Raluca TD
Sowing date	22.10.2020	05.05.2021	11.05.2021	28.04.2021
Harvest date	08.07.2021	16.09.2021	24.09.2021	01.10.2021
Lot surface*	500 m^2	500 m^2	500 m^2	500 m^2

*4 variants/lot and 3 repetitions/variant

Soil agrochemical characterization

The experiment was developed on albic luvisol with clay texture. Soil reaction (pH = 5.27) is moderately acidic, humus content is considered as medium level (2.21%). Mobile phosphorus (P_{AL} = 35 mg/kg) and mobile potassium (K_{AL} = 84 mg/kg) are associated with medium content in soil, meanwhile inorganic sulphur level is 21 mg/kg and corresponds to high content. Microelements' contents are depicted in Table 2.

Characterization of used fertilizers

To fulfil the objectives, for this study was chosen three inputs accepted for organic agriculture: CODAMIX (coded F1), ECOAMINOALGA (coded F2) and ECOAMINOALGA PLUS (coded F3).

The inputs' full chemical characterizations are presented in Table 3 and Table 4.

Table 2. Soil microelements' content

Microelement	Total form, mg/kg	Mobile form, mg/kg
Co	7	-
Cu	15	2.6
Mn	603	58
Ni	23	-
Zn	50	1.6

Table 3. CODAMIX (F1) chemical characterization

Guaranteed analysis	%w/w	%w/v
Iron (Fe) complexed and water soluble	4.00	5.12
Manganese (Mn) complexed and water soluble	2.00	2.56
Zinc (Zn) complexed and water soluble	0.50	0.64
Copper (Cu) complexed and water soluble	0.12	0.15
Boron (B) water soluble	0.30	0.38
Molybdenum (Mo) water soluble	0.08	0.10
Complexing agent: lignosulfonates		

Table 4. ECOAMINOALGA (F2) and ECOAMINOALGA PLUS (F3) chemical characterizations

Parameter	F2	F3
	Content, %	
Organic nitrogen	3	3
Organic matter	46	45
Phosphorus (P_2O_5)	-	0.2
Potassium (K_2O)	6	7.7
Iron (Fe)	-	0.03
Manganese (Mn)	-	0.01
Zinc (Zn)	-	0.005
Copper (Cu)	-	0.06
Boron (B)	-	0.01

Fertilization scheme

In Table 5 are presented treatments for each experimental crop. The foliar treatments with F1, F2 and F3 inputs were applied twice for each experimental crop during vegetation, using 2.5L solution 0.5%/ha/treatment. Total applied volume was 150 L.

Table 5. Fertilization scheme

Experimental crop	Winter wheat	Sunflower	Maize	Soybean
Preceding crop	Maize	Wheat	Sunflower	Wheat
Basal fertilization*	300 kg/ha	300 kg/ha	300 kg/ha	300 kg/ha
First treatment application (phenophase)#	28.04.2021 (boot)	23.05.2021 (4-5 leaves)	27.05.2021 (5 leaves)	22.05.2021 (2rd trifoliate leaf)
Second treatment application (phenophase) #	16.05.2021 (heading)	04.06.2021 (7 leaves)	08.06.2021 (7 leaves)	07.06.2021 (4th trifoliate leaf)

*Basal fertilization complex NPK 20:20:0. #Foliar fertilization with F1, F2, F3

RESULTS AND DISCUSSIONS

*1. The efficiency of foliar fertilization with CODAMIX, ECOAMINOALGA and ECOAMINOALGA PLUS on **winter wheat** yield parameters*

Foliar application of organic fertilizers produced positive effects and, excepting TKW after F1, all yield parameters increased (Table 6). The best results were obtained after F3 treatment in comparison with control. Consequently, yield parameters (total biomass, spikes biomass, seeds biomass, TKW) after F3 increased with 73.64%, 69.27%, 79.97% and 13.42% respectively, in comparison with control (Figure 2).

The efficiency of treatments on yield parameters is following the order F3>F2>F1. The proper climatic conditions, during experiment influenced positively the results.

The superiority of F2 as against F1 on winter wheat yield parameters was already reported in a previous paper (Madjar et al., 2021).

Table 6. The efficiency of foliar fertilization on **winter wheat** yield parameters

Experimental variant (dose; number of treatments)	**Total biomass, kg/ha**	**Spikes biomass, kg/ha**	**Seeds biomass, kg/ha**	**TKW, g**
Control	7333	3840	2167	35.0
F1 (2.5 L/ha; 2)	8867	4307	2367	34.7
F2 (2.5 L/ha; 2)	12200	6157	3733	38.0
F3 (2.5 L/ha; 2)	12733	6500	3900	39.7*
DL 5% =	6100	3610	2177	4.6
DL 1 % =	10310	5460	3299	7.0
DL 0.1% =	16570	8780	5303	11.3

F1= CODAMIX; **F2** = ECOAMINOALGA; **F3** = ECOAMINOALGA PLUS; *significant difference; **distinct significant difference ***very significant difference.

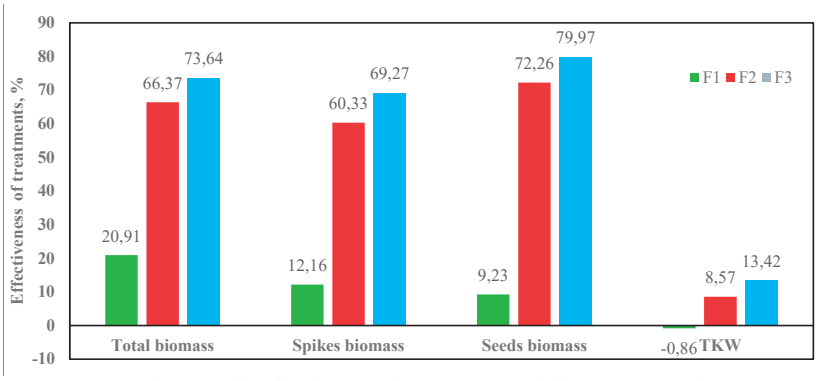

Figure 2. The effectiveness of treatments on yield parameters (%) for **winter wheat** in comparison with control variant

*2. The efficiency of foliar fertilization with CODAMIX, ECOAMINOALGA and ECOAMINOALGA PLUS on **sunflower** yield parameters*

Applied treatments on sunflower crop evidenced the same trend for yield parameters, as in the case of winter wheat. Excepting calatidium biomass which remained constant after F1 treatment in comparison with control variant, all the other registered values presented increases (Table 7). It has been proven that treatment with F3 produced the highest increases of yield parameters in comparison with control, as if follows: 23.37%, 30.12%, 11.40% and 17.64%, respectively (Figure 3).

The efficiency of F1 and F2 treatments in comparison with control were reported previously (Madjar et al., 2021) and in that case it was found better values after F1 in comparison with F2 for calatidium biomass, seeds biomass and TKW.

Literature data provide information regarding influence of different foliar treatments on sunflower crop. For example, Akuaku et al. (2020) reported that foliar application of organic inputs produced increase of protein content and seed yield.

Table 7. The efficiency of foliar fertilization on **sunflower** yield parameters

Experimental variant (dose; number of treatments)	Total biomass, kg/ha	Calatidium biomass, kg/ha	Seeds biomass, kg/ha	TKW, g
Control	9267	5533	2780	61.2
F1 (2.5 L/ha; 2)	10667	5533	2890	63.0
F2 (2.5 L/ha; 2)	10900	7167	3093	65.3
F3 (2.5 L/ha; 2)	11433*	7200	3097	72.0**
DL 5% =	1961	2199	431	5.1
DL 1 % =	2513	3359	653	9.8
DL 0.1% =	4069	5215	1049	13.2

F1=CODAMIX; F2=ECOAMINOALGA; F3=ECOAMINOALGA PLUS; *significant difference; **distinct significant difference ***very significant difference.

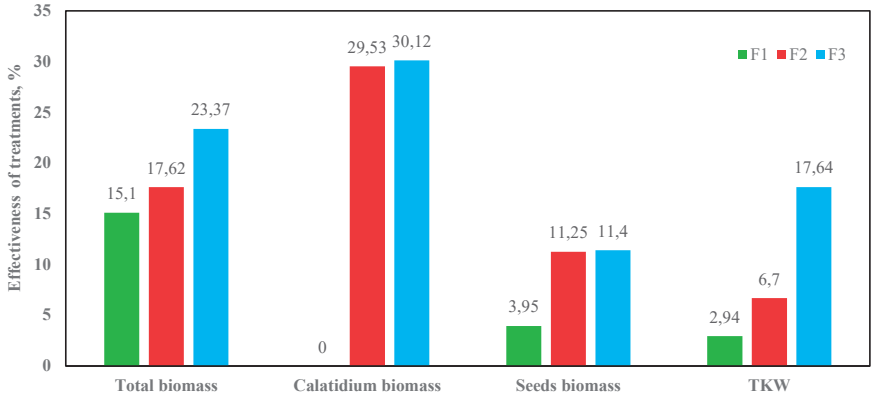

Figure 3. The effectiveness of treatments on yield parameters (%) for **sunflower** in comparison with control variant

Other study (Mihalache & Stanescu, 2017) evidenced that foliar fertilizers based on protein hydrolysates presented a favorable influence on accumulation of biomass and increasing the number of seeds/capitulum.

*3. The efficiency of foliar fertilization with CODAMIX, ECOAMINOALGA and ECOAMINOALGA PLUS on **maize** yield parameters*

Treatments with organic fertilizers presented positive effects on yield parameters for maize crop in comparison with control variant, excepting TKW value after F1 treatment (Table 8). The highest values were registered after F3 in comparison with control variant, the increases being of 31.56%, 27.57%, 24.64% and 11.49%, respectively (Figure 4).

Values for total biomass, cobs biomass and seeds biomass in the case of maize hybrid used in the experiment (T.332) were higher than those obtained in previous experimental year for other maize hybrid (F 376) in similar conditions and using the same fertilizers (F1 and F2) (Madjar et al., 2021).

Table 8. The efficiency of foliar fertilization on **maize** yield parameters

Experimental variant (dose; number of treatments)	Total biomass, kg/ha	Cobs biomass, kg/ha	Seeds biomass, kg/ha	TKW, g
Control	18440	8920	7060	287
F1 (2.5 L/ha; 2)	21640	10520	8100	282
F2 (2.5 L/ha; 2)	22200	10980	8200	290
F3 (2.5 L/ha; 2)	24260	11380	8800	320
DL 5% =	6860	3981	3376	95
DL 1 % =	10382	6029	5112	144
DL 0.1% =	16688	9685	8213	232

F1=CODAMIX; F2=ECOAMINOALGA; F3=ECOAMINOALGA PLUS; *significant difference; **distinct significant difference ***very significant difference.

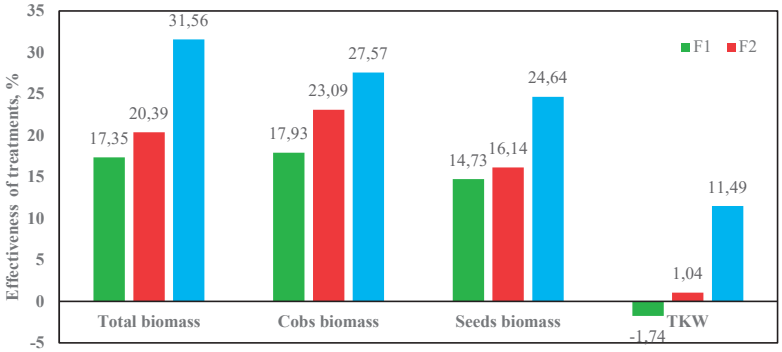

Figure 4. The effectiveness of treatments on yield parameters (%) for **maize** in comparison with control variant

*4. The efficiency of foliar fertilization with CODAMIX, ECOAMINOALGA and ECOAMINOALGA PLUS on **soybean** yield parameters*

Even if all yield parameters for soybean crop are higher after treatments with organic fertilizers, in comparison with control variant, the differences between them are small (Table 9). The superiority of treatment F3 is confirmed by recorded values of yield parameters that increased with 7.84%, 4.49%, 11.75% and 20.4% respectively, in comparison with control variant (Figure 5). The efficiency of organic inputs F1 and F2 on yield parameters for soybean crop has been previously reported (Madjar et al., 2021).

Table 9. The efficiency of foliar fertilization on **soybean** yield parameters

Experimental variant (dose; number of treatments)	**Total biomass, kg/ha**	**Siliques biomass, kg/ha**	**Seeds biomass, kg/ha**	**TKW, g**
Control	5022	2605	1744	98
F1 (2.5L/ha; 2)	5334**	2688	1918*	110*
F2 (2.5L/ha; 2)	5380***	2695	1933**	111*
F3 (2.5L/ha; 2)	5416***	2722	1949**	118**
DL 5% =	155	120	126	10.2
DL 1 % =	229	178	186	15.1
DL 0.1% =	355	275	289	23.4

F1=CODAMIX; F2=ECOAMINOALGA; F3=ECOAMINOALGA PLUS; *significant difference; **distinct significant difference ***very significant difference.

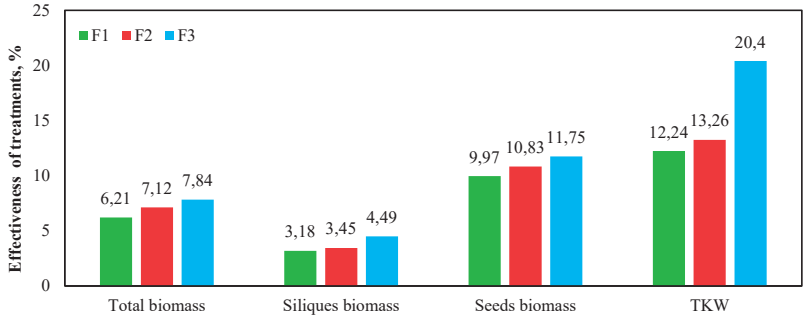

Figure 5. The effectiveness of treatments on yield parameters (%) for **soybean** in comparison with control variant

CONCLUSIONS

Evaluation of the efficiency of three selected inputs accepted for organic agriculture (CODAMIX, ECOAMINOALGA, ECOAMINOALGA PLUS) on different field crops (wheat, sunflower, maize, and soybean) evidenced positive effects on yield parameters in comparison with control variant. For all investigated crops it has been evidenced that F3

treatment provided the best results, followed by F2 and F1. This experiment confirmed and extended our previous results regarding the efficiency of organic fertilizers on field crops.

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