Scientific Papers. Series A. Agronomy, Vol. LXIV, No. 2, 2021
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

COMPARATIVE PERFORMANCES OF ORGANIC FERTILIZERS ON DIFFERENT CROPS IN CLIMATIC CONDITIONS OF ARGEȘ COUNTY

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Abstract

The aim of the research was to investigate the efficiency of two fertilizers accepted for organic agriculture (CODAMIX - F1 and ECOAMINOALGA - F2) on different field crops and to compare their effects on yield performances. The experimental study developed during 2019-2020 in Albota, Argeș County is based on investigation of the variability of yield components for wheat, sunflower, maize and soybean crops under influence of organic fertilizers application. The experimental scheme was composed from four plots and three variants (control, F1 and F2) for each crop. Organic fertilizers (F1, F2) were applied foliar during vegetation period as one treatment for wheat and two treatments for the other field crops. For wheat (Trivale variety), all investigated yield parameters increased after foliar fertilization, a significant increase of total biomass and spikes biomass being noticed after F2 treatment. As concerning the sunflower (Puntasol CL hybrid) and maize (F376 hybrid) crops, the results indicated significant and distinct significant differences between treatments and control variant. In the case of soybean (Florina F variety) crop, application of organic fertilizers influenced positively all yield parameters but considering drought conditions of the year the yield was generally affected.

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

INTRODUCTION

Nowadays, organic farming is equally recognized by scientists and consumers as well, as a suitable manner to generate healthy food products by avoiding chemical fertilizers and pesticides and to contribute therefore to decrease of environmental pollution. The 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.

Even if organic fertilizers may contribute to higher crop yield without depleting soil quality (Cen et al., 2020), many farmers are concerned that crop yield may decrease in the early stages of transition from conventional to organic systems (Tu et al., 2006). Nevertheless, some studies evidenced that application of compost and liquid manure in organic deficient soils showed better yield performances for maize crop than those obtained under conventional farming practices (combined application of manure and mineral fertilizers) (Onduru et al., 2002).

In organic agriculture are used different traditional inputs, as compost (Erhart & Hartl, 2010), green (Carr et al., 2020) and animal manure (Adesoye et al., 2014; Carr et al., 2020; Krauss et al., 2020), crop straw (Wang et al., 2018), sewage sludge (Hammad et al., 2011) and their efficiency has been investigated. Some researchers (Cen et al., 2020) reported the efficiency of three organic fertilizers (rapeseed meal, soybean meal and cattle manure) on crop yield for a winter wheat-summer maize rotation system. Accordingly, winter wheat and summer maize presented yield increases of 161%, 299% and 256% after

rapeseed meal, soybean meal and cattle manure treatment, respectively in comparison with control variant.

Other researchers (Hammad et al., 2011) investigated the efficiency of organic manures on a spring wheat cultivar. Hence, application of different 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 evidenced that variant consisting from GM+PL+SS treatment produced maximum yield that was 137% higher than control variant with no fertilization.

Recently, the objectives of scientists are to obtain new materials, environmental friendly, accepted for organic agriculture, which may contribute to yield increase and improvement of soil characteristics. Thus, it has been obtained compounds and mixtures that can be used to synthesize new effective fertilizer formulas. Among them, it could be mentioned protein hydrolysates of animal and vegetal origin (Mihalache et al., 2014; Mihalache & Stanescu, 2017), products that contain humic acids (Russo & Berlyn, 1991; Ekin, 2019) and seaweed extracts (Russo & Berlyn, 1991) or microgranule fertilizers fortified with proteins (Olbrycht et al., 2020).

Having in view the importance of organic agriculture from both environmental and consumers' perspectives, it was designed an experiment with the purpose to investigate the efficiency of two fertilizers accepted for organic agriculture (CODAMIX - F1 and ECOAMINOALGA - F2) on different field crops (autumn wheat, sunflower, maize, soybean) and to compare their effects on yield performances.

MATERIALS AND METHODS

Experiment location

The experimental study was developed during 2019-2020 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: autumn wheat, sunflower, maize and soybean. The details of the experiment are presented in Table 1.

Table 1. Experiment characterization

Field crop	Autumn wheat	Sunflower	Maize	Soybean
Variety/hybrid	Trivale	Puntasol CL	F 376	Florina F
Sowing date	10.10.2019	17.03.2020	08.04.2020	13.04.2020
Lot surface*	500 m^2	600 m^2	600 m^2	500 m^2

*3 variants/lot and 3 repetitions/variant

Soil agrochemical characterization

The experiment was developed on albic luvisol with clay texture. Soil reaction (pH = 5.30) is moderately acidic, meanwhile humus content is considered as low level, even if during years, due to different cultural practices has increased to 2.41%. Mobile phosphorus content (P_{AL} = 39 mg/kg) corresponds to good provision level, mobile potassium (K_{AL} = 83 mg/kg) is associated with medium content, meanwhile inorganic sulphur level is 23 mg/kg and corresponds to high content.

Microelements' contents are depicted in Table 2.

Table 2. Soil microelements' content

Microelement	Total form, mg/kg	Mobile form, mg/kg
Co	9	-
Cu	14	2.8
Mn	618	51
Ni	25	-
Zn	51	1.5

Characterization of used fertilizers

To fulfil the objectives, for study was chosen two inputs accepted for organic agriculture: CODAMIX (coded F1) and ECOAMINOALGA (coded F2). The inputs' full chemical characterization is presented in Table 3.

Table 3. Foliar organic fertilizers characterization

CODAMIX (F1)			**ECOAMINOALGA (F2)**	
Guaranteed analysis	%w/w	%w/v	Parameter	Content, %
Iron (Fe) complexed and water soluble	4.00	5.12	Organic nitrogen	3
Manganese (Mn) complexed and water soluble	2.00	2.56	Organic matter	46
Zinc (Zn) complexed and water soluble	0.50	0.64	Potassium (K_2O)	6
Copper (Cu) complexed and water soluble	0.12	0.15		
Boron (B) water soluble	0.30	0.38		
Molibdenum (Mo) water soluble	0.08	0.10		
Complexing agent: lignosulfonates				

Fertilization scheme

In Table 4 are depicted treatments for each experimental crop. The foliar treatments with F1 and F2 inputs were applied twice, excepting autumn wheat crop, in the case of which was applied one treatment only.

Table 4. Fertilization scheme

Experimental crop	Autumn wheat	Sunflower	Maize	Soybean
Preceding crop	Sunflower	Wheat	Maize	Wheat
Basal application	Bio Enne* 250 kg/ha	Bio Enne* 250 kg/ha	Bio Enne* 250 kg/ha	$N_{30}P_{30}$ + $CaCO_3$ 1.5 t/ha
First treatment application (phenophase)#	25.05.2020 (grain filling)	25.05.2020 (6-7 leaves)	25.05.2020 (7-8 leaves)	25.05.2020 (3rd trifoliate leaf)
Second treatment application (phenophase) #	-	19.06.2020 (12 leaves)	09.06.2020 (8 leaves)	09.06.2020 (4th trifoliate leaf)

*Bio Enne contains: 12% organic nitrogen, 23% water soluble sulphuric anhydride, 35% organic carbon
#Foliar application; 2.5 L solution 0.5%/ha/treatment; applied volume 150 L.

Biomass determinations

The biomass determinations were performed at maturity stage and are expressed as dry matter. For all cultures, the sampling was performed for 1 square meter as it follows: for wheat was used quadrat shape (1m x 1m), for sunflower and maize were collected 5 plants (corresponding to 50000 plants/ha) and for soybean were collected plants from 2 rows of 1 m long and 0.50 m spacing between rows. After weighting whole plant, it was weighted

spikes, calatidium, cobs, siliques, seeds and the results were expressed as kg/ha of dry matter.

RESULTS AND DISCUSSIONS

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

The experimental results (Table 5) indicated for wheat crop that all investigated yield parameters increased after foliar fertilization in comparison with control variant. It was noticed a significant increase of total biomass and spikes biomass after F2 treatment, precisely with 47.45% and 47.71% respectively, as against control variant and with 28.77% and 34.40% respectively, as against F1 treatment. Also, all subjected parameters present superior values after F2 treatment than after F1 treatment and in both cases, higher than unfertilized (control) variant. Moreover, after F2 treatment, seeds biomass presented an increase with53.78% as against control and with 20.89% in comparison with F1 treatment.

Table 5. The efficiency of foliar fertilization on **autumn wheat** yield parameters

Experimental variant (dose; number of treatments)	**Total biomass, kg/ha**	**Spikes biomass, kg/ha**	**Seeds biomass, kg/ha**	**TKW, g**
Control	4413	2293	1095	30.0
F1(2.5L/ha; 1)	5053	2520	1393	30.8
F2(2.5L/ha; 1)	6507*	3387*	1684	32.2
DL 5% =	1958	1013	678	5.1
DL 1 % =	3247	1681	1124	8.5
DL 0.1% =	6072	3144	2101	15.8

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

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

The results concerning the sunflower crop, except those for TKW (Table 6) indicated significant and distinct significant differences between treatments and control variant. The values related to calatidium biomass, seeds biomass and TKW are higher after F1 treatment than after F2 treatment. Hence, after F1 treatment in comparison with control variant, these yield parameters increased with 9.38%, 10.80% and 12.00%, respectively. After F2, in comparison with control, the values for calatidium biomass and seeds biomass increased with 5.26% and 3.22%, respectively meanwhile TKW decreased with 4.65%. Concerning total biomass, the treatment F2 produced an increase with 23.75% and 8.92% as against control and F1, respectively. Nevertheless, application of F1 and F2 evidenced positive influence on all yield parameters.

Table 6. 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	10533	5700	3100	40.8
F1 (2.5L/ha; 2)	11967**	6235***	3435***	45.7
F2 (2.5L/ha; 2)	13035***	6000**	3200**	38.9
DL 5% =	475	104	57	12.5
DL 1 % =	787	172	94	20.7
DL 0.1% =	1473	322	177	38.7

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

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

For maize crop, the results (excepting TKW parameter) indicated significant and distinct significant differences between treatments and control variant (Table 7). Concerning the efficiency of applied inputs, the experimental results evidenced that in all cases, application of F2 generated upper values for all yield parameters than F1. The most important increase (71.38%) after F2 treatment in

comparison with control variant was recorded for total biomass parameter. After F2 treatment, cobs biomass increased with 29.50% and 22.87% in comparison with control and F1, respectively, meanwhile seeds biomass presented similar increases: with 30% and 22.78%as against control and F1, respectively. TKW values after F2 treatment were with 10.81% and 3.14% higher in comparison with F1 and control variant, respectively.

Table 7. 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	12370	7467	5667	318
F1 (2.5L/ha; 2)	17669***	7870**	6000**	296
F2 (2.5L/ha; 2)	21200***	9670***	7367***	328
DL 5% =	901	228	198	35
DL 1 % =	1495	378	328	59
DL 0.1% =	2796	706	613	110

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

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

Even if all yield parameters for soybean crop are higher after treatments with F1 and F2, respectively in comparison with control variant, the differences between them are very small. In the case of siliques biomass and TKW parameters, it was found significant differences between treatments. For these two parameters in comparison with control were found increases as it follows: after F1with 3.50% and 12.08%, respectively and after F2 with 4.28% and 15.38%, respectively.

Table 8. 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	4930	2570	1230	91
F1 (2.5L/ha; 2)	5110	2660*	1280	102*
F2 (2.5L/ha; 2)	5120	2680*	1290	105*
DL 5% =	104	85	76	9.5
DL 1 % =	154	126	112	14.0
DL 0.1% =	238	195	173	21.6

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

CONCLUSIONS

The investigation of the efficiency of CODAMIX (F1) and ECOAMINOALGA (F2) (inputs accepted for organic agriculture) on different field crops (wheat, sunflower, maize, and soybean) evidenced positive effects on yield parameters in comparison with control variant.

For autumn wheat and maize, the values of all yield parameters evidenced the higher efficiency of F2 input in comparison with F1.

Concerning sunflower crop, all yield parameters, excepting total biomass were higher after F1 treatment in comparison with F2. Also, excepting TKW after F2 treatment, all parameters were higher after using both inputs in comparison with control variant.

For soybean, the effects of F1 and F2 inputs on yield parameters were similar, the results being close between F1 and F2 and slightly higher than those recorded for unfertilized variant.

ACKNOWLEDGEMENTS

This paper was financed by the Faculty of Agriculture, University of Agronomic Sciences and Veterinary Medicine of Bucharest.

This work is consistent with research directions and guidelines specified by Ministry of Agriculture and Rural Development in the project ADER 1.4.4. *Identification, evaluation,*

testing, development and validation of analysis methods of nutrients and contaminants from inputs usable in organic agriculture.

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