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THE EFFECT OF SPECIAL FOLIAR FERTILISATION APPLIED ON INBRED SUNFLOWER LINES IN HYBRID SUNFLOWER SEED PRODUCTION

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Abstract

The paper presents some aspects concerning the influence of special foliar fertilisation on yield and concentration of nutrients in hybrid sunflower seed. This way is useful in seed production, in order to obtain seeds enriched in nutrients, especially in Mo, which caused nutritional disorders in commercial lands. According to the results, the special foliar fertilisers have significantly increased the yields and the Mo concentration in hybrid sunflower seed and have generally positive effect on N, P, K, Zn and Cu concentrations. At the same time, the use of these fertilizers has contributed to Romania's leading position in the production of sunflower seeds, as evidenced by the materials processed on the Eurostat, MADR and NIS websites.

Key words**:** *concentration of nutrients, foliar fertilisation, hybrid sunflower seed*

INTRODUCTION

Cultivated for its non saturated fatty acids, sunflower is one of the most important oilseeds crops used in human and animal feed [5]. In 2016, 68.96% of the sunflower worldwide surface was cultivated in Europe, while Romania ranked 5th among the world's top sunflower seeds producers, with 2,032,340 tonnes [6]. According to data from Eurostat, Romania is the largest cultivator and producer in the European Union, reaching in 2018 - 1,139.75 thousand ha of sunflower [7].
Developed first from the need to control the nutritional deficiencies of Mo and B in sunflower, the special foliar fertilisation method has also become a means of increasing the production of hybrid seed.
The possibility of intervention with such means is based both on international [3], [4] and national research [2], which show that besides soil conditions, climate, technology, hybrid genetic features, an important role in the control of nutritional disorders they also have the nutrient content of the seed.

MATERIALS AND METHODS

For the realization of the following paper, field experiments were carried out, documentary materials were studied and statistical data was used on the following sites: Eurostat, NIS and MADR. The production of sunflower seeds in Romania during the period 1970-2017 was analyzed and also, the total and average production of sunflower seeds by Macroregions and development regions in 2017, area cultivated with sunflower in Romania 2007-2017.
The field experiments were carried out in the pedo-climatic conditions at Iasi (SC Moldova-Tiganasi SA, SCDA Podul Iloaiei) and the plant test used were inbred sunflower lines in hybrid sunflower seed production (HS Rapid, HS PR 475). The treatments used were: CFF 624, CFF 624a and Folplant 231 and all the

treatments were applied three times at 1% concentrations.

The special foliar fertilisers consisting in complex compositions of mineral nutrients (N, P, K, Zn, Mo, Cu, B) and of organic substances (PAH-protein acid hydrolysate) and aimed at optimizing the mineral composition of hybrid sunflower seed in the micronutrient Mo (Table 1).

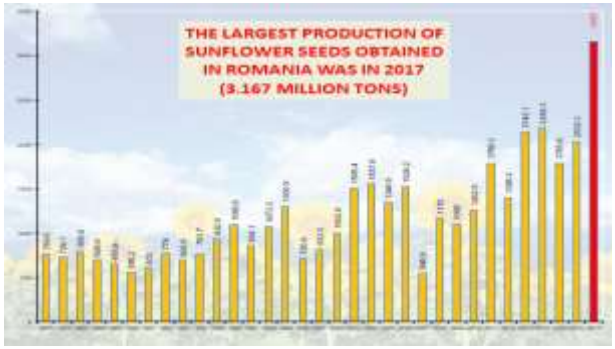
Table 1. The chemical composition of special foliar fertilisers

Specification g elements or substances/ kg of fertiliser	CFF 624	CFF 624a
N	183	217
P	62	73
K	114	96
S	21	21
Fe	0.4	0.4
Mn	0.5	0.5
Zn	0.35	0.35
Cu	0.25	0.25
Co	0.01	-
B	0.80	1.50
Mo	0.15	0.66
PAH (cm^3)	88.0	102.0
pH of solution (1% concentration)	7.15	7.20
PAH-protein acid hydrolysate made from bone glue and H_2SO_4 4.5 n		

Source: [1]

RESULTS AND DISCUSSIONS

Romania is the top producer and exporter of sunflower seeds in the E.U., and the demand from the European countries is rising. The production of sunflower seeds in Romania is expected to grow at the rate of 5% for the next three years.



Fig, 1. Evolution of sunflower seeds production in Romania (1970-2017)
Source: MADR [8]

As shown in Fig. 1 the production of sunflower seeds has grown exponentially from 1970 when the sunflower seeds production was 769.6 thousand tons to 3,167 million tons in 2017, the growth was 415%, compared with the previous year 2016 the growth was by 55 percents. The growth of this sector was determined by the demand expressed by the industrial sector especially by the beauty and healthcare sector.

Also the production per Macroregions and Development Regions is shown in the table below.

Table 2. Production of sunflower seeds per Macroregions and Development Regions in 2017

Macroregions/ Development Regions	Production		Differences (±) year 2017, compared to 2016	
	Total	Average	Total production	Average production
	- tons -	- kg/ha -	- tons -	- kg/ha -
TOTAL	3,167,743	2,917	+880,403	+962
MACROREGION ONE	169,557	2,890	+37,526	+818
NORTHWEST	138,582	2,929	+26,218	+886
CENTRE	30,975	2,725	+11,308	+465
MACROREGION TWO	1,336,609	2,987	+492,548	+1,201
NORTHEAST	385,177	2,956	+189,821	+1,482
SOUTHEAST	951,432	2,999	+302,727	+1,091
MACROREGION THREE	649,091	2,887	+172,478	+720
BUCHAREST-ILFOV	28,596	2,482	+6,816	+563
SOUTH-MUNTENIA	620,495	2,909	+165,662	+728
MACROREGION FOUR	757,486	2,833	+177,851	+790
SOUTHWEST-OLTENIA	466,272	3,155	+165,700	+1,538
WEST	291,214	2,436	+12,151	-416

Source: NIS [9]

The highest amount of sunflower seeds is produced in Macroregion two respectively in the Southeast Development Region where the quantity almost reached one million tons, followed by South-Muntenia Development Region with 620 thousand tons.

In 2017 Romanian farmers cultivated 1,030 thousand hectares with sunflower (Table 1).

Table 3. Evolution of the area cultivated with sunflower in Romania 2007-2017

Specification	UM	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Area	1,000 ha	835.9	813.9	766.1	790.8	995	1,067	1,074.6	1,001	1,000	1,016	1,030

Source: MADR [8]

The area cultivated with sunflower as shown in table 3 has seen an increase since 2007 when in Romania was cultivated 835.9 thousand ha to 1,030 thousand hectares in 2017, the increase was by 23.22 percents.

On the field, the following experiments were carried out:

- *Soil agrochemical characterisation*

The soil from experimental fields was cambic chernozem soil. Table 4 shows the main agrochemical properties of soil. From this it may be observed a high fertility level of this soil, except the IMo index which prognoses the appearance of Mo deficiency.

Table 4. Main agrochemical properties of soil, from SC Moldova-Tiganasi SA and SCDA Podul Iloaiei experimental fields

Agrochemical property	SC Moldova Tiganasi SA	SCDA Podul Iloaiei
pH	6.60	6.97
Humus,%	3.61	3.36
P_{AL}, ppm	47.85	151
K_{AL}, ppm	239.4	257.5
Zn,ppm	1.08	1.79
Fe, ppm	16.83	17.48
Cu, ppm	1.20	1.08
Mn, ppm	78.80	70.30
Mo, ppm	0.15	0.18
IMo	0.99	1.25

Source: [1]

- *The effect of special foliar fertilisation on yield in hybrid sunflower seed*

The experimental data concerning the effect of special foliar fertilisation on yield increases are presented in Table 5, 6 and 7.

Table 5. The agronomical effect of special foliar fertilisation on inbred sunflower lines in hybrid sunflower seed production for HS Rapid at SC Moldova-Tiganasi SA experimental field

Treatments	Yield increases		
	kg/ha	%	kg/ kg of fertiliser
Check	-	-	-
Folplant 231	339	27	22.6
CFF 624	612	48	40.8
CFF 624a	765	60	51.0
DL 5%	431		
DL 1 %	754		

Source: [1]

Thus, for HS Rapid sunflower hybrid variety the yield increases were between 10-765 kg seed/ha (2-60%) and for HS PR 475 sunflower hybrid variety the yield increases were between 246-410 kg seed/ha (21-35%).
The best special foliar fertiliser was CFF 624a, which assured the yield increases for all the experimental fields (average data during three years). The obtained yield increases were generally significantly in comparison with the check sprayed with water.

Table 6. The agronomical effect of special foliar fertilisation on inbred sunflower lines in hybrid sunflower seed production for HS Rapid at SCDA Podul Iloaiei experimental field

Treatments	Yield increases		
	kg/ha	%	kg/ kg of fertiliser
Check	-	-	-
Folplant 231	10	2	1.0
CFF 624	16	3	1.6
CFF 624a	25	4	2.5
DL 5%	41		
DL 1 %	59		

Source: [1]

Table 7. The effect of special foliar fertilisation on yield increases in hybrid sunflower seed for HS PR 475 at SC Moldova-Tiganasi SA experimental field

Treatments	Yield increases		
	kg/ha	%	kg/ kg of fertiliser
Check	-	-	-
Folplant 231	246	21	16.4
CFF 624	367	31	24.4
CFF 624a	410	35	27.3
DL 5%	84		
DL 1 %	128		

Source: [1]

- *The effect of special foliar fertilisation on mineral composition in hybrid sunflower seed*

Table 8 and 9 presents the mineral composition of seed for HS Rapid sunflower hybrid variety.

Table 8. The effect of special foliar fertilisation on the content of macronutrients in hybrid sunflower seed, HS Rapid, SCDA Podul Iloaiei

Treatments	The content of macronutrients		
	N, %	P, %	K, %
Check	2.44	0.72	0.98
Folplant 231	2.48	0.82	0.93
CFF 624	2.80	0.85	0.98
CFF 624a	2.74	0.88	1.02

Source: [1]

Table 9. The effect of special foliar fertilisation on the content of micronutrients in hybrid sunflower seed, HS Rapid, SCDA Podul Iloaiei

Treatments	The content of micronutrients		
	Zn, ppm	Mo, ppm	B, ppm
Check	60.50	0.11	13.5
Folplant 231	78.80	0.22	17.5
CFF 624	79.30	0.16	12.5
CFF 624a	72.50	0.22	14.3

Source: [1]

The results showing positive increases for macronutrients (N, P and K) and for micronutrients (Zn, Mo and B) concentrations in seeds under the influence of special foliar fertilisation.

In Table 10 and 11 are presented the mineral composition of seed for HS PR 475 sunflower hybrid variety (average data during three years). The data emphasized that the special foliar fertilisation (CFF 624 and CFF 624a) assured in comparison with the check high increases of macronutrients (N, P and K) and of micronutrients (Zn, Mo and Cu) contents in seed. The CFF 624a treatment has assured a significantly increases of Zn, Mo and Cu concentrations in seed.

Table 10. The effect of special foliar fertilisation on the content of macronutrients in hybrid sunflower seed, HS PR 475, SC Moldova-Tiganasi SA

Treatments	The content of macronutrients		
	N, %	P, %	K, %
Check	2.37	0.54	1.00
Folplant 231	2.62	0.57	1.09
CFF 624	2.57	0.58	1.05
CFF 624a	2.60	0.56	1.04

Source: [1]

The mineral compositions of hybrid sunflower seed from experimental fields have been influenced by the specific climate conditions from Iasi (high temperature and low rainfall in summer), by the genetic potential of sunflower hybrids and by the applied foliar treatments.

Table 11. The effect of special foliar fertilisation on the content of micronutrients in hybrid sunflower seed, HS PR 475, SC Moldova-Tiganasi SA

Treatments	The content of micronutrients		
	Zn, ppm	Mo, ppm	Cu, ppm
Check	35.93 c	0.15 c	16.08 b
Folplant 231	40.37 bc	0.21 c	16.70 ab
CFF 624	43.67 ab	0.29 b	16.62 ab
CFF 624a	48.31 a	0.37 a	17.41 a

Source: [1]

CONCLUSIONS

Romania ranked 5th among the world's top sunflower seeds producers, in 2016. The highest amount of sunflower seeds is produced in the Southeast, followed by South-Muntenia Development Region.

The field experiments carried out under pedoclimatic conditions in Iasi, have revealed:

- The special foliar fertilization method have been achieved significantly yield increases for HS Rapid and for HS PR 475 sunflower hybrids.
- This method can be recommended for soils with micronutrients deficiencies, especially with Mo, B and Cu.

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