

ECOBREED T6.2: Farmer Participatory Trials (FPT)

Farmer Participatory Trials (FPTs) of ECOBREED Soybean at NARDI Fundulea/Călărași RO *Bulletin 2022*

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The participatory trials of ECOBREED soybean/NARDI Fundulea were established in 3 organic agriculture units - Agroecological Research & Innovation Center of NARDI Fundulea / county Călărași, in ECOFRUCT and ECOVIAL farms of Ștefan cel Mare / county Călărași, and in one conventional farm - AGROTERRA Agigea /county Constanța. According to the "Map of ECOBREED Soybean DEMO Farms/NARDI Fundulea" (fig. 1) and information of Table 1, these organic soybean DEMO units were placed in Development regions South - Muntenia (3) and South – East (1), at different altitudes and geographical coordinates and on soils chernoziomic.

Fig. 1 "Map of Romanian ECOBREED Soybean Demo Farms"

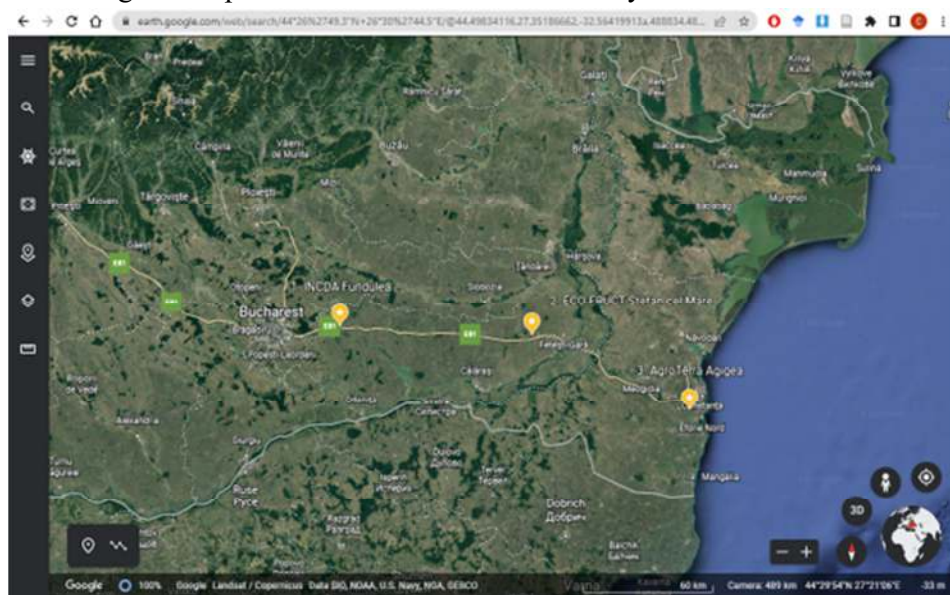


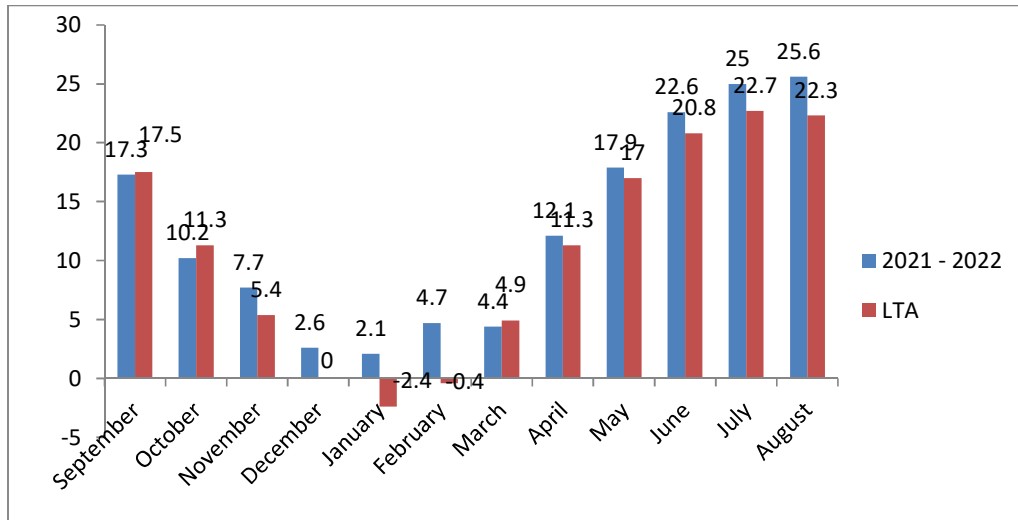
Table 1. Geographical settlement and soil types of the soybean FPTs 2022

Nr.	Farm Demo (FPTs) Name	Altitude	Position	Development regions	Soil types
1	Agroecological Research & Innovation Center / NARDI Fundulea	63	N44.44702, E26.51237	South -Muntenia	Phaeozem
2	ECO-VIAL Ștefan cel Mare	33	N44.41903, E27.63793	South -Muntenia	Chernozem
3	ECO-FRUCT Ștefan cel Mare	30	N44.4127, E27.63995	South -Muntenia	Chernozem
4	AGROTERRA Agigea	63	N44.0895, E28.56077	South – East	Chernozem

Climatic data recorded in the period September 2021 – August 2022 at NARDI Fundulea shows that the monthly air temperature (Fig. 2) was highest than the multiannual average

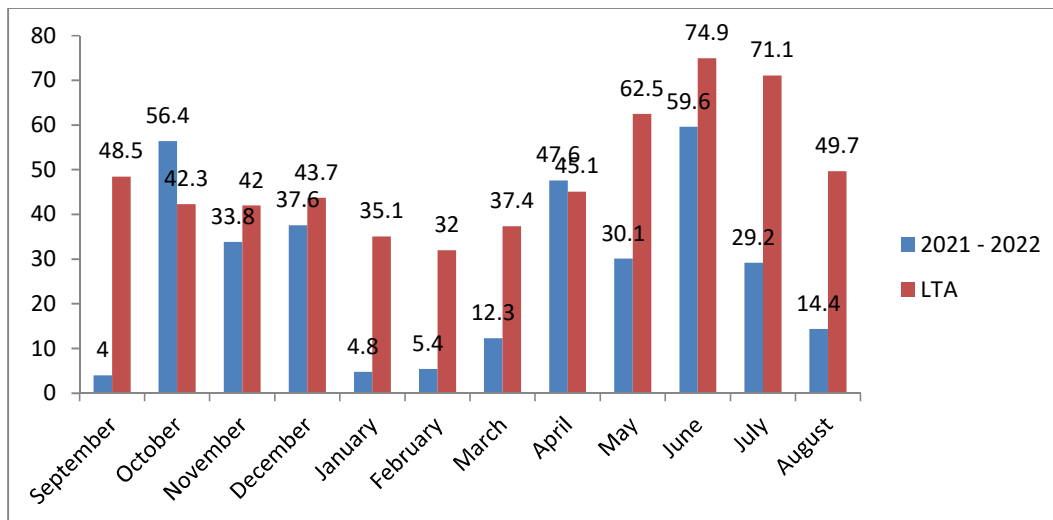
values (LTA), excepting in September and October 2021 when the air temperature was similar with LTA, the agriculture year 2021 - 2022 being second warmest year of the last 60 years.

Fig. 2. Average monthly air temperatures recorded at NARDI Fundulea, in the period September 2021 – August 2022 compared to Long Term Average (LTA)



Regarding precipitation (Fig. 3), in the period considered, only in one month - October 2021, the precipitations were higher than LTA. In the rest of months, the sum of precipitations in the agriculture year 2021 - 2022 were below of the multiannual average (LTA), the monthly precipitation deficit varying between 2,5 – 44,5 mm, the year precipitation deficit - 249,1 mm being the biggest in the last 60 years.

Fig. 3 The amount of monthly precipitation from September 2021 – August 2022 and the multi-year monthly averages (LTA) recorded at NARDI Fundulea



Also, the Fundulea climatic scenario 2021 – 2022 was, more or less, similar in all DEMO centers, but ECOFRUCT and ECOVIAL Ștefan cel Mare and AGROTERRA Agigea solved these climate problems by irrigation.

Materials and Methods

In all DEMO FPTs seven (7) soybean varieties belonging to different genetics were tested - Serbian (Favorit and NS Mercury), Romanian (Ovidiu F and Fabiana F) and USD (STK 01, STK 02 and STK 03) and 3 mixtures of soybean varieties: NS Mercury + Fabiana F, Favorit + Ovidiu F and STK 01 + Ovidiu F (Tab. 2).

Table 2. The name and MG of soybean varieties cultivated in 4 FPTs

Variety name	Maturity Group (MG)	NARDI Fundulea	ECOFRACT* Ștefan cel Mare	ECOVIAL* Ștefan cel Mare	AGROTERRA* Agigea
NS Mercury	I	x	x	-	x
Fabiana F	I	x	x	x	x
NS Mercury + Fabiana F	?	x	x	x	x
Favorit	00	x	x	-	x
Ovidiu F	0	x	x	x	x
Favorit + Ovidiu F	?	x	x	x	x
STK 02	I.1	x	x	x	x
STK 01 + Ovidiu F	?	x	x	x	x
STK 03	I.3	x	x	-	x
STK 01	0.6	x	x	-	x

*irrigated

The soybean varieties were sown on different dates: 27.04.22 at NARDI Fundulea, 06.05.22 at AGROTERRA Agigea, 09.05.22 at ECOFRUCT and 19.07.22 at ECOVIAL Ștefan cel Mare. Also, each variety were placed in 3 rows strips at the distance between rows of about 50 cm at NARDI Fundulea and ECOFRUCT and ECOVIAL Ștefan cel Mare and at 70 cm at AGROTERRA and sowed along the entire length of the plot and with different types of sowers: HEGE for experimental plots at NARDI Fundulea, MATERMACC at ECOFRUCT and ECOVIAL Ștefan cel Mare and SFOGGIA at AGROTERRA Agigea.



Photo 1. Sowing soybean at FPTs "NARDI Fundulea" and "ECOFRACT Ștefan cel Mare"

According to the 2021-2022 Agricultural Journal, each Soybean Demo had a specific soybean cultivation technology:

- NARDI Fundulea DEMO technology consisted in: chopping vegetal remains from previous crop (maize), especially weeds; land scarification with Knocke; fertilizing with BIO-FER NATURE (375 kg/ha); disking 2 times and plowing in autumn 2021 and seedbed preparing by working of the land with Angeloni POKER 300 complex combiner and other combiner (2 times); bacterization of seeds with POLIRIZ S - a mixture of six *Bradyrhizobium* strains; sowing on 27 April 2022; weeding - mechanically (1 time) and by hand (2 times) and harvesting mechanically in September 2022;
- ECOFRUCT technology consisted in: soil till with Tiger equipment; fertilization with chicken manure fermented (12 t/ha); seedbed preparing with combiner and sowed of canola in autumn 2021 and, because rape was compromised, soybean seedbed preparing with combiner;

bacterization of soybean seeds with POLIRIZ S, a mixture of six *Bradyrhizobium* strains and sowing on 09.05.2022; manually weeding (1 time); irrigation (4 times x 30 l/m²), as well as mechanically harvesting in September 2022;

- ECOVIAL technology was specific of the second crop: seedbed preparing with the combiner and sowing on 19.07.2022;

- AGROTERRA Agigea technology was specific of the organic soybean on a conventional land cultivated previous with conventional maize full infested with *Xanthium strumarium*: seedbed preparing with the combiner; bacterization of soybean seeds POLIRIZ S, a mixture of six *Bradyrhizobium* strains and sowing on 05.05.2022; hand weeded (1 time), irrigation (3 times x 40 l/m²), as well as harvesting mechanically in September 2022.



Photo 2. Mechanical weeding of soybean at FPT "NARDI Fundulea"/26.05.2022

During soybean seedling and growing seasons, were made all observations and measurements that are provided in FPT assessments 2022 of WP 6.2: monitoring *Agriotes* sp. with pheromone traps (photo 3), estimation of the degree of weeds infestation (%) and pigeon attack at NARDI Fundulea, as well as Number of nodosities per plant, Number of plants/m², Yield (dt/ha) and TGW (g) at harvesting at all FPTs.



Photo 3. Pheromone traps for *Agriotes* sp. at soybean FPT "NARDI Fundulea 2022

RESULTS

In this part it is presented and discussed the most important parameters for soybean growing in organic system in 2022, chronologically:

1. Dynamic of the infestation of *Agriotes* sp. in soybean at NARDI Fundulea 2022

This information is from ECOBREED soybean T4.1 and T4.2 which are in the same land with FPT Fundulea, but separated by a windbreak, and it is presented in bulletin because we observed many dry plants early at each variety because of the *Agriotes* sp. In this study it was monitored *Agriotes obscurus* and *Agriotes ustulatus* and monitoring started when we got the traps, on 20.06.2022, with at least one, maybe two months late of when flying of *Agriotes* sp. started and it was stopped in the beginning of August. In ECOBREED Fundulea the *Agriotes*

obscurus seems to be dominant and more abundant than *Agriotes ustulatus*, mainly in the first period of monitoring.

Table 3. Monitoring of *Agriotes* sp. at NARDI Fundulea FPT 2022

Date	<i>Agriotes obscurus</i>	<i>Agriotes ustulatus</i>	Date	<i>Agriotes obscurus</i>	<i>Agriotes ustulatus</i>
20.06.2022	381	99	15.07.2022	4	19
24.06.2022	609	72	19.07.2022	12	45
27.06.2022	526	97	22.07.2022	31	23
30.06.2022	79	67	26.07.2022	4	17
04.07.2022	112	198	29.07.2022	12	12
07.07.2022	52	8	03.08.2022	1	7
12.07.2022	18	36			

2. Weeds infestation in Romanian ECOBREED soy FPTs in 2022

The crops infestation with weeds is another specific and serious problem in organic farming, weeds being main competitor for the soil water and nutrients, mainly for soybean. In our ECOBREED soybean FPTs, the weeds infestation of soybean in 2022 was characteristics of each FPT- at NARDI Fundulea with *Echinochloa crus-galli* (ECHCG), *Setaria viridis* (SETVI) and *Ambrosia* sp. (AMBEL), at ECOFRUCT Ștefan cel Mare with *Chenopodium album* (CHEAL), *Amaranthus retroflexus* (AMRE) and *Datura stramonium* (DATST) and at ECOVIAL Ștefan cel Mare with *Raphanus raphanistrum* (RAPRA), *Amaranthus retroflexus* (AMARE) and *Chenopodium album* (CHEAL), and at AGROTERRA Agigea with *Sorghum halepense* (SORHA), *Setaria viridis* (SETVI) and *Xanthium strumarium* (XANTST). In these FPTs, we studied only the weeds on the soy rows because these cannot be controlled by mechanical weeding, as it is showed in photo 4, with STK 02 soybean variety in FPT Fundulea infested with weeds on row because of lowest soybean seeds number at sowing.

Table 4. The spectrum of weeds on the row in 4 soybean Romanian FPTs in 2022

NARDI Fundulea (STK 02)		ECOFRUCT Ștefan cel Mare		ECOVIAL Ștefan cel Mare		AGROTERRA Agigea	
Weeds	%	Weeds	%	Weed	%	Weed	%
<i>Echinochloa crus-galli</i>	73,00	<i>Chenopodium album</i>	48,00	<i>Raphanus raphanistrum</i>	35,00	<i>Sorghum halepense</i>	60,00
<i>Setaria viridis</i>	23,00	<i>Amaranthus retroflexus</i>	47,00	<i>Amaranthus retroflexus</i>	33,00	<i>Setaria viridis</i>	38,00
<i>Ambrosia</i> sp.	4,00	<i>Datura stramonium</i>	5,00	<i>Chenopodium album</i>	32,00	<i>Xanthium strumarium</i>	2,00



Photo 4. Soybean- STK 02 at FPT "NARDI Fundulea"/04.07.2022

3. Harvested soybean plants number in Romanian FPTs

The harvested soy plants number in all ECOBREED FPTs of 2022 (Tab. 5) was less than number of seeds sowed with about 38,7% at NARDI Fundulea, 44,2% at ECOFRUCT Ștefan cel Mare and 40,9% at AGROTERRA Agigea since, at least, of the attack of wild pigeons at Fundulea, domestic pigeons at ECOFRUCT Ștefan cel Mare and of European hares at Agrotterra Agigea.

Table 5. Number of soybean seeds sowed and of the harvested plants in Romanian FPTs

Soybean variety	Agro-ecological Research & Innovation Center NARDI Fundulea		ECOFRUCT* Ștefan cel Mare		AGROTERRA* Agigea	
	Sowing seeds (N0/m ²)	Harvesting plants (N0/m ²)	Sowing seeds (N0/m ²)	Harvesting plants (N0/m ²)	Sowing seeds (N0/m ²)	Harvesting plants (N0/m ²)
Mercury	56	28	56	31	41	28
Fabiana F	60	37	60	33	44	38
Mercury + Fabiana F	59	40	59	32	43	34
Favorit	45	28	45	25	33	20
Ovidiu F	54	28	54	20	39	18
Favorit + Ovidiu F	51	31	51	28	37	14
STK 02	41	32	41	26	30	8
STK 01 + Ovidiu F	44	22	44	27	32	12
STK 03	31	27	31	21	23	14
STK 01	27	14	27	18	20	16
<i>Average</i>	<i>47</i>	<i>27</i>	<i>47</i>	<i>26</i>	<i>34</i>	<i>20</i>

4. Effect of soybean bacterization in FPTs ECOBREED

According to table 6, except ECOFRUCT Ștefan cel Mare where the effect of bacterization was zero, in others ECOBREED FPTs, the bacterization was more (e.g., Fundulea FPT) or less (e.g., AGROTERRA Agigea) efficient, and the causes of these negative phenomena must be searched in fertilization system in case of ECOFRUCT and in previous conventional technologies at AGROTERRA. Also, the number of nodosities per plant seems to be specific of each soybean variety.

Table 6. Number of nodosities per plant at harvesting soy varieties in 3 FPTs ECOBREED

Soybean variety	NARDI Fundulea	ECOFRUCT* Ștefan cel Mare	AGROTERRA* Agigea
Mercury	67	0	18
Fabiana F	73	0	17
Mercury + Fabiana F	68	0	27
Favorit	112	0	26
Ovidiu F	70	0	14
Favorit + Ovidiu F	78	0	15
STK 02	64	0	17
STK 01 + Ovidiu F	52	0	12
STK 03	40	0	11
STK 01	26	0	16
<i>Average</i>	<i>65</i>	<i>0</i>	<i>17</i>

5. The soybean grain yield (dt/ha) and TGW in 4 FPTs ECOBREED

In 2022, the soybean grain yield and thousand grain weight (TGW) are according to natural characteristics of DEMO sites, soybean varieties features and DEMO technologies. So, the highest yields (2118 - 3654 kg/ha) and TGW (142,5 – 180,7g) was recorded at ECOFRUCT Ștefan cel Mare, in irrigation conditions and the long organic farming practices, and the lowest yield and TGW, at NARDI Fundulea 455 - 792 kg/ha, respectively 71,6 – 105,5 g at NARDI Fundulea, under rainfed conditions. Also, the yields and TGW at AGROTERRA Agigea would have been similar with those of ECOFRUCT, as it is the case of Mercury variety, if the soybean vegetation would not have been affected by conventional technology, except irrigation, and of the incredible attack of hares.

Table 7. Soybean grain yield (t/ha) and TGW (g) at 11% moisture content in 4 FPT ECOBREED

Soybean variety	Maturity Group (MG)	Agroecological Research & Innovation Center NARDI Fundulea		ECOFRUCT* Ștefan cel Mare		AGROTERRA* Agigea		ECOVIAL* Ștefan cel Mare	
		Yield (dt/ha)	TGW (g)	Yield (dt/ha)	TGW (g)	Yield (dt/ha)	TGW (g)	Yield (dt/ha)	TGW (g)
Mercury	I	7,52	105,5	32,48	168,6	23,61	150,7	-	
Fabiana F	I	4,85	90,8	30,66	144,5	1,07 ^{xxx}	136,2	0,00 ^{xx}	0,00
Mercury + Fabiana F	?	4,55	91,4	28,63	144,8	0,00 ^{xxx}		0,00 ^{xx}	0,00
Favorit	00	7,92	98,7	21,18	145,8	0,00 ^{xxx}		-	-
Ovidiu F	0	6,97	97,0	33,67	170,6	1,48 ^{xxx}	169,0	0,00 ^{xx}	0,00
Favorit + Ovidiu F	?	6,55	96,8	28,57	142,5	0,00 ^{xxx}		0,00 ^{xx}	0,00
STK 02	I.1	0	71,6	34,9	143,1	0,00 ^{xxx}		0,00 ^{xx}	0,00
STK 01 + Ovidiu F	?	5,98	95,3	36,54	147,2	0,00 ^{xxx}		0,00 ^{xx}	0,00
STK 03	I.3	6,23	93,1	30,45	180,7	0,00 ^{xxx}			
STK 01	0.6	7,07	96,4	31,8	179,1	0,00 ^{xxx}			

*irrigated; ^{xx}infestation with AMRE, CHEAL and RAPRA; ^{xxx}hares attack;

These parameters were certainly influenced by the low sowing density of soybean plants, due, first by the small seeds quantity which increased distance between seeds at >5 cm and, mainly of the loss of many plants by mechanical weeding in especially with rotary hoe at ECOFRUCT, the strong attack of pigeons in germination phase at NARDI Fundulea, and of the soybean sowing on conventional land at AGROTERRA Agigea, as well as the ECOVIAL decision to abolish soybeans second crop area (23 ha) because of weak and uneven emergence of soybeans plants and of the infestation with a large number of broadleaf weeds (AMARE, CHEAL, RAPRA etc.).



Photo 6. Soybean FPT "NARDI Fundulea"/05.08.2022 and 05.08.2021

Conclusions

1. Agriculture year 2021 – 2022 was the second warmest and alone the driest of the last 60 years for all FPTs ECOBREED;
2. The agriculture technologies, excepting soybean varieties, are specific for each FPT, depending on endowment with equipment, soil characteristics and experience in organic farming.
3. The soybean tested varieties belong to three genetics - Serbian (Favorit and NS Mercury), Romanian (Ovidiu F and Fabiana F) and USD (STK 01, STK 02 and STK 03). Also, in all Demos it was studied also the effect of variety mixture: Mercury + Fabiana F; Favorit + Ovidiu F and STK 01 + Ovidiu F;
4. The soy bacterization with mixture of Bradyrhizobium strains is very efficient, except in the case of organic fertilization or chimization in excess, when this effect is zero.
5. The sowing density has to be higher with about 40 % than in conventional agriculture for avoiding infestation with weeds on the rows. and to cover plant losses during and after emergence.
6. The weeds are the main competitor of soybean for water and all other soil nutrients;
7. The dominant weeds in FPTs ECOBREED were: ECHCG, SETVI and AMBEL at NARDI Fundulea, CHEAL, AMARE and DATST at ECOFRUCT and RAPRA, AMARE and CHEAL in soy as second crop at ECOVIAL Ștefan cel Mare, as well as SORHA, SETVI and XANTST at AGROTERRA Agigea.
8. In FPTs ECOBREED, the soybean has many other enemies from sowing to harvesting – wild and domestic pigeons, hares, Agriotes sp., Tetranychus urticae, Etiella zinckenella, Septoria glycines etc.
9. Soybean production and MMB is in accordance with the genetic potential of the variety, but depends, in particular, on the water supply of the soil and the infestation of the crop with weeds throughout the growing season. In the ecological system, soybean production and quality are also significantly diminished by birds and wild animals, insect pests and pathogens.
10. The mixture of soy varieties seems to be efficient only at mixtures with good affinity between varieties (e.g., STK 01 + Ovidiu F).