

SUNFLOWER CULTIVATION IN DIFFERENT SYSTEMS, IN ROMANIA

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Abstract

Sunflower is cultivated in Romania, in five cultivation system, Clearfield, Clearfield Plus, Express Sun, conventional and organic. Clearfield system use sunflower genotypes with resistance at imidazolinone herbicides with active substance imazamox 40g/l. Clearfield Plus system use sunflower genotypes with resistance at imidazolinone herbicides with active substance imazamox 25g/l. Express Sun system use sunflower genotypes with resistance at sulfonyleurea herbicides with active substance tribenuril metil 500g/l. Conventional system use classic sunflower genotypes with resistance at selective graminicides herbicides with active substances quizalofop-p-etil 50 g/l, quizalofop-p-tefuril 40 g/l, cletodim 120 g/l. Organic system don't use any herbicides, insecticides and fungicides. There are differences between these systems regarding weed infestation. Sunflower hybrid FD15E27 has in year 2024, in Fundulea, a seed yield of 1010 Kg/ha, in system Express Sun, a seed yield of 1624 Kg/ha, in conventional system and a seed yield of 635 Kg/ha, in organic system. Insufficient precipitation and high temperatures affected seed yield of sunflower, in year 2024, in Fundulea, with a total rainfalls of 237.3 mm during period of vegetation from April to September and with a maximum temperature of 40.7°C in July.

Key words: cultivation system, drought, high temperature, sunflower genotypes

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is an important culture from oleaginous plant over the world and is cultivated in many countries such as Ukraine, Russian Federation, Argentina, China, Romania, Turkey, Bulgaria, France, Hungary, Tanzania, Kazakhstan, Moldova, United States of America, Spain, South Africa, Serbia, Italy, Uganda, India and others (source: Atlasbig). Romania is an important producer on the international sunflower market (Chiurciu et al., 2023).

In year 2021, Romania ranked fifth in the world after Ukraine, Russian Federation, Argentina and China in terms of total production of sunflower seeds, which was 2843530 tons (fig. 1).

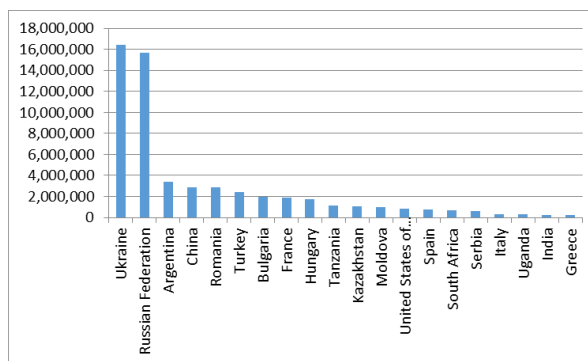


Figure 1. Total production (tons) of sunflower seeds in year 2021, in world (source: Atlasbig)

In year 2021, Romania ranked first place in the European Union, in terms of the area cultivated with sunflowers in organic condition with 46461 hectares (Bruma et al., 2021).

In year 2023, Romania ranked first place in the European Union, in terms of the area cultivated with sunflowers, which was 1089000 hectares (fig. 2).

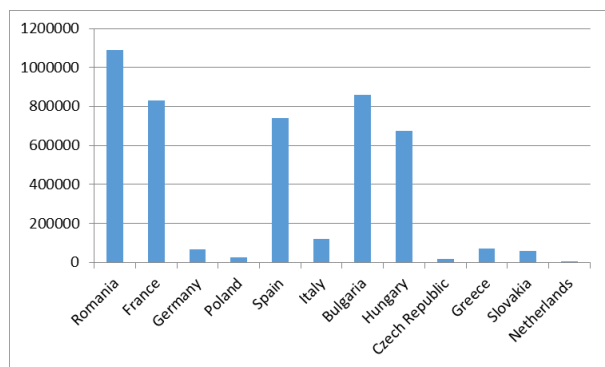


Figure 2. Area cultivated (hectares) with sunflower in year 2023, in European Union (source: INSE, 2024)

In year 2023, Romania ranked second place in the European Union, in terms of total production of sunflower seeds, which was 2028000 tons (fig. 3).

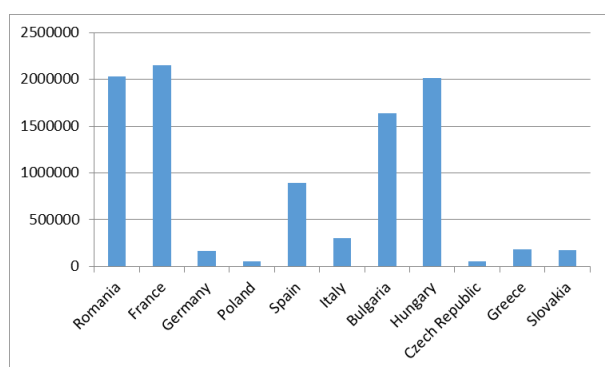


Figure 3. Total production (tons) of sunflower in year 2023, in European Union (source: INSE, 2024)

From period 2015 - 2023, the highest area cultivated with sunflower in Romania was in year 2019 with 1282697 hectares (fig. 4).

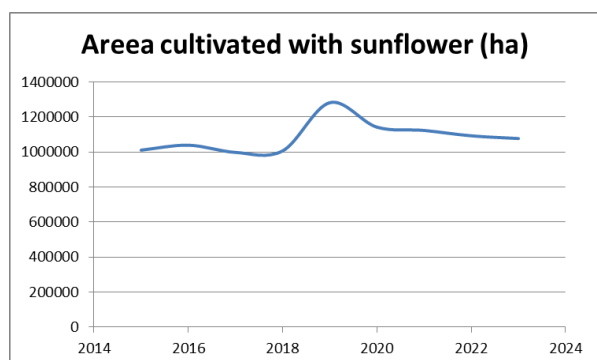


Figure 4. Area cultivated (hectares) with sunflower in period 2015-2023, in Romania (source: MADR, 2024)

From period 2015 - 2023, the highest average seed yield (kg/ha) in Romania was in year 2018 with 3041 kg/ha (fig. 5).

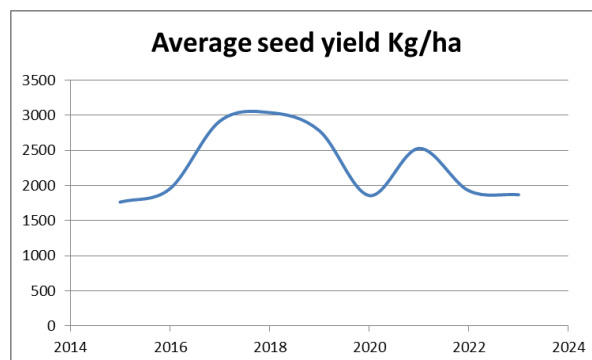


Figure 5. Average seed yield (kg/ha) registered in period 2015-2023, in Romania (source: MADR, 2024)

From period 2015 - 2023, the highest total production (tons) in Romania was in year 2019 with 3569150 tonnes (fig. 6).

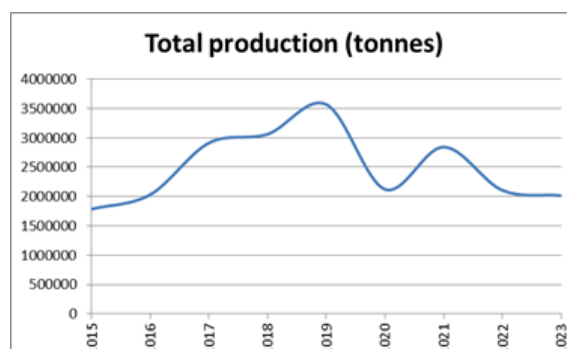
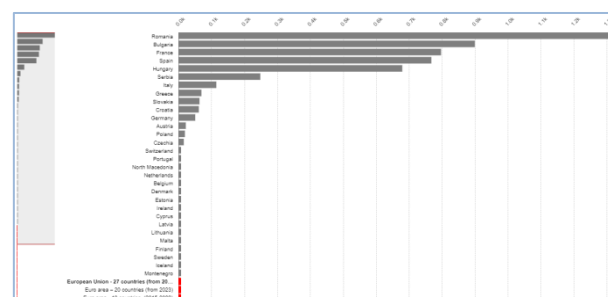


Figure 6. Total production (tons) registered in period 2015-2023, in Romania (source: MADR, 2024)

In year 2024, Romania ranked first place in the European Union, in terms of the area cultivated with sunflowers, which was 13326000 hectares (fig. 7).



In Romania, sunflower culture was affected by severe drought that decrease seed yield very much (Romania-Insider, 2024).

Seed yield of sunflower crop is reduced by limiting factors such as pest attacks, climatic condition through high temperatures and drought (Anton et al., 2023 b; Cojocaru et al., 2023; Dincă et al., 2024; Ion et al., 2015).

Among the biotic factors that limit sunflower production, the most important are diseases, pests and weeds (Anton et al., 2023 a; Georgescu et al., 2022; Prodan et al., 2021).

MATERIALS AND METHODS

In year 2024, we sow on date 5th April, five sunflower genotypes in different systems in non-irrigated fields. Sunflower hybrid FD15E27 was cultivated in three systems: Express, conventional and organic.

Sunflower hybrid FD15CL44 was cultivated in three systems: Clearfield CL, Conventional C and Organic O.

Sunflower hybrid FD22CLP64 was cultivated in three systems: Clearfield Plus CLP, Conventional C and Organic O.

Varieties Record and Neagra de Cluj were cultivated in two systems, Conventional C and Organic O.

All seeds of sunflower genotypes were treated with fungicides with active substance cyantraniliprole and insecticides with active substance oxathiapiprolin 200 g/l in four systems, Clearfield Plus CLP, Clearfield CL, Express E and Conventional C, excepting system Organic O.

All genotypes were treated with herbicides pre-emergence with active substance 455 g/l pendimetalin in four systems, Clearfield Plus CLP, Clearfield CL, Express E and Conventional C, excepting Organic system O.

Sunflower hybrid FD15E27 cultivated in system Express E, was treated with herbicides with active substance 500 g/kg tribenuron-metil.

Sunflower hybrid FD15CL44 cultivated in system Clearfield CL, was treated with

herbicides with active substance imazamox 40g/l.

Sunflower hybrid FD22CLP64 cultivated in system Clearfield Plus CLP, was treated with herbicides with active substance imazamox 25g/l.

All genotypes were treated with herbicides post-emergence with active substance cletodim 120 g/L in four systems, Clearfield Plus CLP, Clearfield CL, Express E and Conventional C, excepting system Organic O.

RESULTS AND DISCUSSIONS

Rainfalls registered in Fundulea, in year 2024, in growing season of sunflower, from months April to September, 237.3 mm, was lower than multi annual average of 60 years, 351.8 mm (tab. 1). Excepting month April with 62.4 mm rainfalls, other months was under multi annual average of 60 years. The soil water reserve from January to March was in year 2024 only 57.6 mm and multi annual average of 60 years was 104.5 mm.

Table 1. Average monthly rainfalls (mm) registered in Fundulea location, in year 2024

Month	Rainfalls (mm)	Multi annual average of 60 years
January	17.6	35.1
February	1.4	32.0
March	38.6	37.4
April	62.4	45.1
May	34.2	62.5
June	15.6	74.9
July	45.4	71.1
August	18.0	49.7
September	61.7	48.5

In growing season of sunflower, from April to September, temperatures registered were higher than multiannual average of 60

years, excepting month May with 16.4⁰C (tab. 2).

Table 2. Average monthly temperatures (°C) registered in Fundulea location, in year 2024

Month	Temperature (°C)	Multi annual average of 60 years
January	1	-2.4
February	7.6	-0.4
March	8.5	4.9
April	15	11.3
May	16.4	17.0
June	26.1	20.8
July	27.7	22.7
August	26.3	22.3
September	20	17.5

In month July, in Fundulea, were registered in four days temperatures up to 40°C (tab. 3). The very high temperatures during the flowering and grain filling period led to a significant reduction in the seed yield of sunflower.

Table 3. Maximum daily temperatures (°C) recorded in July, in Fundulea location, in year 2024

Day	Average daily temperature (°C)	Maximum daily temperature (°C)	Minimum daily temperature (°C)
10 th July	30.2	38.4	20.9
11 th July	30.7	39.3	20.7
12 th July	30.4	40.5	19.3
13 th July	31.0	38.6	20.1
14 th July	31.4	39.3	20.7
15 th July	31.0	39.8	18.2
16 th July	31.0	40.6	23.3
17 th July	32.0	40.6	21.7
18 th July	31.7	40.7	24.3

Pre-emergence herbicides with active substance 455 g/l pendimetalin in dose 2-4 l/ha, must be applied immediately after sowing sunflower genotypes in all four systems, Clearfield Plus CLP, Clearfield CL, Express E and Conventional C.

In system Clearfield Plus CLP, herbicides with active substance imazamox 25g/l in dose of 1.6 – 2 l/ha and must be applied only one time in stage of vegetation BBCH12-18, only for sunflower genotypes

with resistance at this herbicides (FD22CLP66).

In system Clearfield CL, herbicides with active substance imazamox 40g/l in dose of 1.0 – 1.2 l/ha and must be applied only one time in stage of vegetation BBCH 12-18, only for sunflower genotypes with resistance at this herbicides (FD15CL44).

In system Express E, herbicides with active substance tribenuron-metil 500 g/kg in dose of 35g/ha and must be applied only one time in stage of vegetation BBCH 12-18, only for sunflower genotypes with resistance at this herbicides (FD15E27).

For a better control of weed infestation is recommended to use a post-emergence graminicidal herbicides with active substance 120 g/L cletodim in dose of 0.6-2.0 l/ha until stage of vegetation BBCH 32, in all four systems, Clearfield Plus CLP, Clearfield CL, Express E and Conventional C.

If sunflower field is infested with weds such *Amaranthus spp.*, *Chenopodium album*, *Digitaria sanguinalis*, *Echinochloa crus-galli*, *Setaria sp.*, *Sorghum halepense* and *Solanum nigrum* is recommended to use all four system Clearfield Plus CLP, Clearfield CL, Express E and Conventional C together with an pre-emergence herbicide and with an post-emergence graminicidal herbicides (tab. 4).

If sunflower field is infested with weds such *Cirsium arvense* and *Xanthium spp* is recommended to use systems Clearfield Plus CLP, Clearfield CL or Express E, together with a pre-emergence herbicide and with a post-emergence graminicidal herbicides.

If sunflower field is infested with weds such *Agropyron repens* and *Ambrosia elatior* is recommended to use only systems Clearfield CL, together with a pre-emergence herbicide and with a post-emergence graminicidal herbicides.

If sunflower field is infested with parasitic plant *Orobanche Cumana* Wallr and weed *Ambrosia artemisiifolia* is recommended to use only systems Clearfield Plus CLP, together with a pre-emergence herbicide

and with an post-emergence graminicidal herbicides.

Table 4. Weeds controlled in systems Clearfield, Express and Conventional

Clearfield Plus system (Imazamox 25g/l) +Pre-emergence herbicides (pendimetalin 455 g/l) + Post-emergence graminicidal herbicides (Cletodim 120 g/L)	Clearfield system (Imazamox 40g/l) +Pre-emergence herbicides (pendimetalin 455 g/l) + Post-emergence graminicidal herbicides (Cletodim120 g/L)	Express system (tribenuron-metil500 g/kg) +Pre-emergence herbicides (455 g/l pendimetalin) + Post-emergence graminicidal herbicides (Cletodim120 g/L)	Conventional system Pre-emergence herbicides (455 g/l pendimetalin) + Post-emergence graminicidal herbicides (Cletodim120 g/L)
<p>Orbanche spp. <i>Abutilon theophrasti</i>, Ambrosia artemisiifolia <i>Alopecurus myosuroides</i>, <i>Apera spica-venti</i>, <i>Anagallis arvensis</i>, Amaranthus spp., <i>Atriplex spp.</i>, Chenopodium hybridum, <i>Capsella bursa-pastoris</i>, <i>Cardamine hirsuta</i>, <i>Cerastium arvense</i>, Chenopodium album Cirsium arvense, Convolvulus arvensis, Digitaria sanguinalis, Echinochloa crus-galli, <i>Euphorbia helioscopia</i> <i>Fumaria officinalis</i>, <i>Heliotropium europaeum</i>, <i>Lamium spp.</i>, <i>Mercurialis annua</i>, <i>Myosotis arvensis</i>, <i>Panicum dicotomiflorum</i>, <i>Papaver rhoeas</i> <i>Poa annua</i>, <i>Polygonum persicaria</i>, <i>Portulaca oleracea</i>, <i>Ranunculus repens</i>, <i>Stellaria media</i>, Setaria sp., Sorghum halepense, Solanum nigrum, <i>Sonchus arvensis</i>, <i>Spergula arvensis</i>, <i>Stachys annua</i>, <i>Thlaspi arvense</i>, <i>Urtica urens</i>, <i>Veronica spp.</i>, <i>Viola spp.</i> Xanthium spp.</p>	<p><i>Abutilon theophrasti</i> Agropyron repens, <i>Alopecurus myosuroides</i>, <i>Apera spica-venti</i> <i>Anagallis arvensis</i>, <i>Atriplex spp</i> Amaranthus spp., Ambrosia elatior <i>Capsella bursa-pastoris</i>, <i>Cardamine hirsuta</i>, <i>Cerastium arvense</i>, Chenopodium album, Cirsium arvense Convolvulus arvensis, Datura stramonium, Digitaria sanguinalis, Echinochloa crus-galli <i>Euphorbia helioscopia</i>, <i>Fumaria officinalis</i> <i>Heliotropium europaeum</i>, <i>Lamium spp.</i>, <i>Mercurialis annua</i>, <i>Myosotis arvensis</i> Panicum milliaceum, <i>Panicum dicotomiflorum</i>, <i>Poa annua</i>, <i>Papaver rhoeas</i>, <i>Polygonum persicaria</i>, <i>Portulaca oleracea</i>, <i>Ranunculus repens</i>, Setaria viridis, Solanum nigrum Sorghum halepense <i>Sonchus arvensis</i>, <i>Spergula arvensis</i>, <i>Stachys annua</i>, <i>Stellaria media</i>, <i>Thlaspi arvense</i>, <i>Urtica urens</i>, <i>Veronica spp.</i>, <i>Viola spp.</i>, Xanthium strumarium</p>	<p><i>Anagallis arvensis</i>, <i>Atriplex spp</i> <i>Alopecurus myosuroides</i>, <i>Apera spica-venti</i>, <i>Abutilon theophrasti</i>, Amaranthus retroflexus, <i>Agrostemma githago</i>, <i>Anagallis arvensis</i>, <i>Anthemis spp.</i>, <i>Aphanes arvensis</i>, <i>Atriplex spp.</i>, <i>Brassica nigra</i>, <i>Brassica oleifera</i>, <i>Capsella bursa-pastoris</i>, <i>Cardamine hirsuta</i>, <i>Cerastium arvense</i>, <i>Centaurea cyanus</i>, Chenopodium spp., <i>Chrysanthemum segetum</i>, Cirsium arvense, Digitaria sanguinalis, Datura stramonium, Echinochloa crus-galli, <i>Euphorbia helioscopia</i>, <i>Fumaria officinalis</i>, <i>Galeopsis tetrahit</i>, <i>Galinsoga parviflora</i>, <i>Galium aparine</i>, <i>Geranium spp.</i>, <i>Heliotropium europaeum</i> <i>Lactuca serriola</i>, <i>Lamium spp.</i>, <i>Lithospermum arvense</i>, <i>Matricaria spp.</i>, <i>Medicago sativa</i>, <i>Mercurialis annua</i>, <i>Myosotis arvensis</i>, <i>Panicum dicotomiflorum</i>, <i>Poa annua</i> <i>Polygonum persicaria</i>, <i>Portulaca oleracea</i> <i>Papaver rhoeas</i>, <i>Ranunculus repens</i>, <i>Raphanus raphanistrum</i>, <i>Senecio vulgaris</i> Setaria viridis, <i>Silene conica</i>, <i>Sinapis arvensis</i>, <i>Sinapis nigra</i>, Solanum nigrum, Sorghum halepense <i>Sonchus arvensis</i>, <i>Sonchus oleraceus</i>, <i>Spergula arvensis</i>, <i>Stachys annu</i>, <i>Stellaria media</i>, <i>Taraxacum officinalis</i>, <i>Thlaspi arvense</i>, <i>Veronica spp.</i>, <i>Vicia spp.</i>, <i>Viola spp.</i>, Xanthium spp., <i>Urtica urens</i>,</p>	<p><i>Alopecurus myosuroides</i>, <i>Apera spica-venti</i>, <i>Anagallis arvensis</i>, Amaranthus spp., <i>Atriplex spp.</i>, <i>Capsella bursa-pastoris</i>, <i>Cardamine hirsuta</i>, <i>Cerastium arvense</i>, Chenopodium album, Digitaria sanguinalis, Echinochloa crus-galli, <i>Euphorbia helioscopia</i>, <i>Fumaria officinalis</i>, <i>Heliotropium europaeum</i>, <i>Lamium spp.</i>, <i>Mercurialis annua</i>, <i>Myosotis arvensis</i>, <i>Panicum dicotomiflorum</i>, <i>Papaver rhoeas</i> <i>Poa annua</i>, <i>Polygonum persicaria</i>, <i>Portulaca oleracea</i>, <i>Ranunculus repens</i>, <i>Stellaria media</i>, Setaria sp., Sorghum halepense, Solanum nigrum, <i>Sonchus arvensis</i>, <i>Spergula arvensis</i>, <i>Stachys annua</i>, <i>Thlaspi arvense</i>, <i>Urtica urens</i>, <i>Veronica spp.</i>, <i>Viola spp.</i></p>

Source: BASF, FMCAGRO, GLISSANDO

Average of hectoliter weight (kg/hl) in year 2024 was between 31 kg/hl at variety Neagra de Cluj in system Conventional C, and 45 kg/hl at sunflower hybrid FD22CLP64 in system Clearfield Plus CLP (tab. 5).

Table 5. Hectoliter weight (kg/hl) of experimental sunflower hybrids in Fundulea location, in year 2024

Sunflower genotype	Hectoliter weight (kg/hl)					Average
	CLP	CL	E	C	O	
FD22CLP64	45	-	-	38	33	39
FD15E27	-	-	38	43	44	42
FD15CL44	-	39	-	38	37	38
Record	-	-	-	43	42	43
Neagra de Cluj	-	-	-	31	32	32

Average of seed yield (kg/ha) in year 2024 was between 635 kg/ha at sunflower hybrid FD15E27 in system Organic O and 1723 kg/ha at sunflower hybrid FD22CLP64 in system Clearfield Plus CLP (tab. 6).

Table 6. Seed yield of sunflower genotypes, in Fundulea location, in year 2024

Sunflower genotype	Seed yield (kg/ha)				
	CLP	CL	E	C	O
FD22CLP64	1723	-	-	1633	1523
FD15E27	-	-	1010	1624	635
FD15CL44	-	1663	-	1403	1327
Record	-	-	-	1222	1012
Neagra de Cluj	-	-	-	813	975

Sunflower hybrid FD15E27 has a low seed yield of 1010 kg/ha in system Express E

and of 635 kg/ha in system Organic O, do to bird attack in the phase of ripening. Variety Neagra de Cluj recorded a low seed yield in Systems Conventional C and Organic O, due to sensitivity to stem lodging when more than 50% of sunflower plants were falling.

CONCLUSIONS

Agricultural year 2024 was very difficult for sunflower culture because of severe drought and extreme heat registered in stage of flowering and seed filling which led to a significant reduction of seed yield.

Systems Clearfield CL and Clearfield Plus CLP is recommended to be use in sunflower culture if is presence of weed *Ambrosia sp.* and parasitic plant *Orobanche cumana*.

In all systems Clearfield CL, Clearfield Plus CLP, Express E and Conventional C is recommended to be use a pre-emergence herbicide for monocotyledonous and dicotyledonous weeds from seeds and a post-emergence graminicidal herbicide for a better control of a monocotyledonous weeds.

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