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Review article

Sunflower Production in Blacksea Region: The Situation & Problems

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Abstract

Sunflower is one of the most important oil crops in the world. In addition to be the most preferable vegetable oil in the Eastern Europe, Balkans and Blacksea region, sunflower is the main crops in the rotation system in the agricultural production as well as the most planted oil crops in these areas. Both world sunflower planted areas (21.000 ha in 2007 to 26.000 ha in 2019) and also seed production (26.000 MT in 2007 to 51.000 MT in 2019) have raised in last ten years but Blacksea region contributed mainly for these increases. In the region, while sunflower production has tripled from 11800 MT (2007) to 35.000 MT (2019), sunflower planted areas has raised 60% more from 2007 to 2019 (10.000 to 16.000 ha) in last 12 years. The rate of region in sunflower production has increased from 45 to 68%, acreages from 49 to 64% in this period. Furthermore, the region plays key role and also dominated sunflower world trade as well as other oilseeds such as canola and soybean. As a spring crop, sunflower influence eventually from climatic conditions such as temperature, soil humidity, etc. in some critical stages which are determining seed and oil yield especially bud formation and the grain filling period. Biotic and abiotic stresses coincide in these two stages lead extremely reduce seed yield regularly in sunflower production areas in due to unregularly rainfalls and higher temperatures in spring and early summer seasons in Blacksea region which sunflower grows mostly in dryland. Therefore, it need to well understand these reducing factors and sunflower responses and mechanisms then it need to find accurate management solutions to cope with these factors efficiently such as early planting time and increasing plant density for obtaining better yields. Besides, biotic stresses mostly diseases such as downy mildew, *Phomopsis, Sclerotinia*, *Verticilium* wilt, *Macrophomina* and also broomrape parasite, weeds are the main factors reducing sunflower yield in the region. While there is only genetic resistance possible for disease control mentioned above ones, effective control of broomrape and weeds are possible Clearfield system with post emergence Imidazolinone (IMI) herbicide plus resistant varieties as well as sulfonyl Urea (SU) herbicide and resistant hybrids. Furthermore, combining these herbicide resistances together with new races of broomrape races and downy mildew and other diseases will lead higher yield results in sunflower production in the region in addition to other agronomical solutions.

Keywords: Sunflower, Blacksea, Seed production, Hybrid breeding, Stress conditions.

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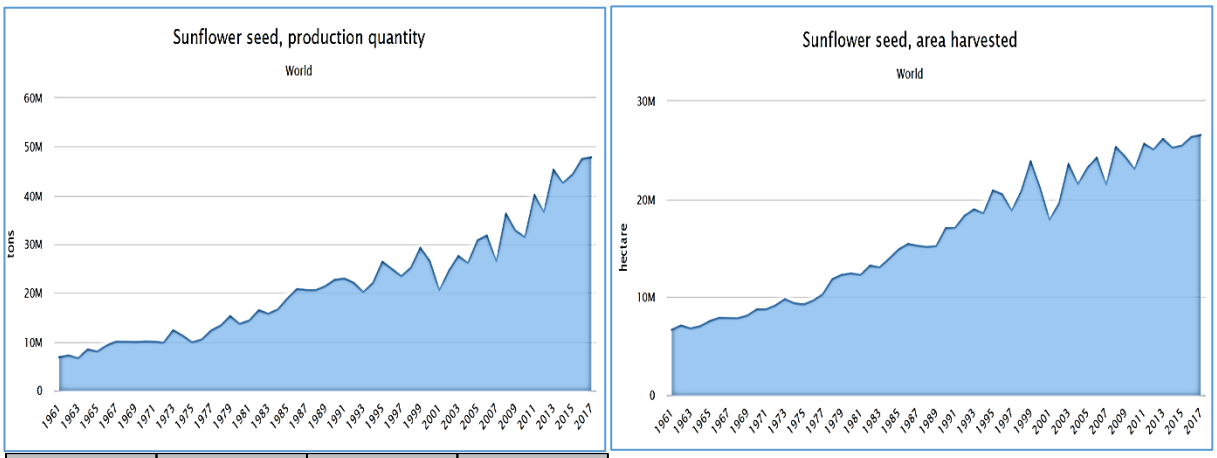
INTRODUCTION

Sunflower Production in The World

Sunflower is one of the most important oil crops in the world. As having 40-50 % higher oil content, growing possibility in different climatic conditions and higher adaptation capability, higher mechanization use, easier production without marketing problem and as well as being the most preferable vegetable oil in the Eastern Europe, Balkans and Blacksea region make sunflower is the top oil crop in these regions. Therefore, sunflower is the main crops in the rotation system in the agricultural production as well as the most planted oil crops in these areas. While from oilseeds, soybean and palm gradually increased in related to human population increases, both world sunflower planted areas (21.000 ha in 2007 to 26.000 ha in 2019) and also seed production (26.000 MT in 2007 to 51.000 MT in 2019) have raised in last ten years but mostly due to increases in the Blacksea sunflower production (Figure 1).



Year	Crop	Change	Change %
2014/15	19.1	-2.0	-10%
2015/16	21.3	2.1	11%
2016/17	26.3	5.0	24%
2017/18	24.4	-1.9	-7%
2018/19	28.0	3.6	15%
2019/20	27.5	-0.5	-2%

Figure 1. Black Sea Countries

Sunflower Production in Black Sea Region

In Blacksea region, while sunflower production has tripled from 11800 MT (2007) to 35.000 MT (2019), sunflower planted areas has raised 60% more from 2007 to 2019 (10.000 to 16.000 ha) in last 12 years (FAOSTAT, 2018). The rate of region in sunflower production has increased from 45 to 68%, acreages from 49 to 64% in this period (Table 1). Furthermore, the region plays key role and also dominated sunflower world trade as well as other oilseeds such as canola and soybean. Sunflower is vital crop in Balkans and Blacksea region as having over half of the world harvesting area and production

(Figure 2). However, as a spring crop, climatic conditions during its vegetation period play important roles on determining sunflower yield, then unstable changes could observe based on years depending on summer rainfall and temperatures (Figure 3) (Abakumov, 2012; Kaya et al., 2008 and 2015; Goncharov et al. 2018; Popescu, 2018; Vinnichek et al. 2019).

Figure 2. Black Sea Countries

UKR	Crop	Change	Change %
2017/18	13.6	-1.6	-10%
2018/19	15.5	1.9	14%
2019/20	14.9	-0.6	-4%

RUS	Crop	Change	Change %
2017/18	10.8	-0.3	-3%
2018/19	12.6	1.7	16%
2019/20	12.6	0.1	1%

EU	Crop	Change	Change %
2017/18	9.8	1.3	16%
2018/19	9.5	-0.3	-3%
2019/20	10.0	0.5	5%

TUR	Crop	Change	Change %
2017/18	1.32	0.35	-25%
2018/19	1.60	0.28	17,5%
2019/20	1.75	0.15	8,5%

Figure 3. Recent changes on sunflower production in major Black Sea Countries and EU.

Table 1. Sunflower harvested area and production by season in Black sea countries[1,2]

	Harvesting Area (1000 Ha)					Seed Production (1000 MT)				
Countries	**2019**	**2016**	**2013**	**2010**	**2007**	**2019**	**2016**	**2013**	**2010**	**2007**
Ukraine	5849	6087	5090	4526	3411	14900	13627	11051	6772	4174
Russia	8100	7294	6795	5575	5003	13000	11011	9842	5345	5671
Romania	1010	1038	1095	810	830	2400	2032	2196	1285	570
Bulgaria	789	818	860	692	520	1944	1874	1937	1380	525
Turkey	695	718	630	500	475	1750	1671	1450	1020	690
Moldova	330	361	275	252	230	924	677	505	382	170
BSR Tot.	16773	16316	14745	12355	10469	34918	30892	26981	16184	11800
World T.	26260	26341	25892	23923	21305	51380	47516	40190	33605	26430
%	63.9	61.9	56.9	51.6	49.1	68.0	65.0	67.1	48.2	44.6

[1]USDA Oilseeds Annual, [2]Index Mundi.

After 2001, applying sunflower seed export taxes, Ukraine and Russia mostly export sunflower oil with adding new crushing oilseeds almost every year (Table 2). Similarly, Bulgaria and Romania increased crushing capacity in recent years and focused to sell only sunflower crude oil. Turkey has over 5 million MT sunflower crushing capacity but uses only 50% of them (Konyali, 2017; Popescu, 2018). Turkey is currently the biggest sunflower seed importer country in the region as well as one of the biggest ones in the world (Table 3 and 4).

Table 2. Sunflower crushing and sunflower oil production by seasons in Eastern Europe[1, 2]

	Sunflower Crushing, 1000 MT				Sunflower Oil Production, 1000 MT			
	2018	**2015**	**2012**	**2010**	**2018**	**2015**	**2012**	**2010**
Russia	11750	8600	8.467	6.211	4853	3552	3.632	2.616
Ukraine	14800	11650	9.125	7.332	6364	5010	3.937	3.125
Romania	1300	1150	790	752	650	600	329	314
Bulgaria	1300	830	475	360	550	300	199	152
Turkey	2150	1350	1.625	1.497	935	587	329	324
Moldova	210	200	216	197	87	83	91	83
BSR Total	33.528	25.795	22.710	18.359	15.457	12.147	8.743	6.829
World Total	47.010	36.667	35.314	30.464	20.290	15.390	14.800	12.536
%	71.3	70.3	64.3	60.3	76.2	78.9	59.1	54.5

[1]USDA Oilseeds Annual, [2]Index Mundi.

Table 3. Sunflower trade and their proportions in the world (%) by seasons in Black Sea[1,2]

	Sunflower Seed Exports, 1000 MT				**Sunflower Seed Imports, 1000 MT**			
	2018	**2015**	**2012**	**2010**	**2018**	**2015**	**2012**	**2010**
Russia	231	107	326	15	52	121	28	34
Ukraine	105	83	282	410	23	22	18	7
Romania	1000	800	650	560	230	190	130	210
Bulgaria	600	546	150	166	125	50	6	11
Turkey	60	42	-	-	600	396	754	649
Moldova	370	316	113	108	5	6	1	4
BSR Total	2366	1894	1521	1259	1035	785	937	915
World Total	2520	2001	1632	1508	2200	1870	1730	2151
%	93.9	94.6	93.2	83.5	47.0	42.0	54.1	42.5

[1]USDA Oilseeds Annual, [2]Index Mundi.

Table 4. Sunflower oil trade and their proportions in the world (%) by seasons in Black Sea[1,2]

	Sunflower Oil Exports, 1000 MT				**Sunflower Oil Imports, 1000 MT**			
	2018	**2015**	**2012**	**2010**	**2018**	**2015**	**2012**	**2010**
Russia	2646	1540	1387	393	10	3	17	101
Ukraine	6064	4500	3614	2703	-	1	2	1
Romania	3	5	2	3	16	14	17	15
Bulgaria	381	236	37	36	18	13	3	5
Turkey	400	583	553	149	525	686	744	225
Moldova	60	35	66	42	10	6	4	1
BSR Total	9554	6899	5659	3326	579	723	787	348
World Total	10300	8110	7256	4771	9350	7020	7232	4834
%	92.8	85.1	78.0	69.7	0.61	0.10	0.10	0.07

[1]USDA Oilseeds Annual, [2]Index Mundi.

Currently, over 90% of world seed and oil of sunflower come from Black Sea region and Ukraine is the biggest sunflower oil exporter country of the world (60%) and following by Russia (25%). Turkey is the major buyer country in the region mostly import sunflower seed from Bulgaria and Romania and sunflower crude oil from Ukraine and Russia and from other countries from the region.

Curent Stiuation and Threads in Sunflower Blacksea Region

As a spring crop, sunflower influence eventually from climatic conditions such as temperature, soil humidity, etc. in some critical stages which are determining seed and oil yield especially bud formation and the grain filling period although sunflower has deep roots. Biotic and abiotic stresses coincide in these two stages lead extremely reduce seed yield regularly in sunflower production areas in due to unregularly rainfalls and higher temperatures in spring and early summer seasons in Blacksea region which sunflower grows mostly in dryland. Sunflower–wheat is the main rotation system in the

region with higher mechanization use then with lower input use, sunflower increase production areas higher comparing with other part of the world (Kaya et al., 2008 and 2015).

For a profitable sunflower production, it needs to well understand these reducing factors and sunflower responses and mechanisms then it need to find accurate management solutions to cope with these factors efficiently such as early planting time and increasing plant density for obtaining better yields. Besides, biotic stresses mostly diseases such as downy mildew, *Phomopsis, Sclerotinia, Verticilium* wilt, *Macrophomina,* other soil-borne fungal diseases and also broomrape parasite, weeds are the main factors reducing sunflower yield in the region. These factors restrict profitable sunflower production especially recent increases sunflower in the crop rotation, because most of farmers have limit to access to fungicides and disease-resistant hybrids due to financial problems and also expensive chemical inputs and being less applicable after planting. While there is only genetic resistance possible for disease control mentioned above ones, effective control of broomrape and weeds are possible Clearfield system with post emergence Imidazolinone (IMI) herbicide plus resistant varieties as well as sulfonyl Urea (SU) herbicide and resistant hybrids. Furthermore, combining these herbicide resistances together with new races of broomrape races and downy mildew and other diseases will lead higher yield results in sunflower production in the region in addition to other agronomical solutions (Kaya, 2016 and 2017).

There is no cultivar problem currently both in Turkey and also other Balkan countries but Ukraine and Russia have so large areas in different climatic zones and soils. Totally hybrid seeds are in the market they are resistant cultivars against to broomrape, and downy Mildew and also IMI herbicides controlling broad-leaf weeds and broomrape as well as SU herbicide resistant hybrids are in the market. International Seed Companies such as Limagrain, Syngenta, Pioneer, etc.. have large market share, but national seed companies increase their share in recent years. The most preferred hybrids by farmers and also future promising ones calling triangle resistant as Genetically resistant to broomrape and to downy mildew, IMI or SU herbicide resistant are increasing market shares year by year. On the other hand, higher oleic acid type hybrids which supply healthy oil to consumers are also in market. Commonly these hybrids are in the market: Orobanche & Downy Mildew resistant, also other disease resistant, IMI Herbicide Resistant, SURE Herbicide Resistant, Orobanche + Downy Mildew + IMI resistant, Linoleic Type, High Oleic, Mid Oleic ones. However, future hybrid composition should be like this: IMI + SURE Herbicide Resistant + Orobanche + Downy Mildew + High Oleic + Drought Tolerance (Kaya, 2016 and 2017).

Lower price did not satisfy producers so lower areas expected in recent years in both in Turkey & Balkans and also other countries. Therefore, due to higher price in wheat in competing crop in rotation, farmers prefer planting wheat or other alternative crops mostly canola in drylands and corn in irrigated areas or northern parts of region as getting more rainfall during the sunflower growing seasons.

The current threats are in sunflower production are; Increasing imports and lower world sunflower price than domestic market, lower fuel prices due to lower biodisel demand, increasing palm and soybean production recently, seasonal droughts effects due to growing summer. Due to these limitations, sunflower production pushed to marginal planted areas in the world then it will be felt more stress in the future, so it need urgent solutions for stress management (Kaya, 2016 and 2017).

Biotic stress threats in sunflower production are in the region; downy mildew (*Plasmora helianthi*), brown stem canker (*Phomopsis helianthi*), charcoal rot (*Macrophomina spps*.), *Alternaria* leaf blight, *Phoma* black stem, *Sclerotinia* basal stalk rot and wilt, *Rhizopus* head rot

Verticillium wilt. These are the most important limiting diseases for seed & oil yield in sunflower in the region as well as other part of the world. Due to humidity especially in northern part of region in some seasons, sunflower plants are infected by fungi limited by precipitation shortage and high evaporation. For instance, Phomopsis stem canker (*Phomopsis/Diaporthe helianthi*) develops leaf lesions if relative moisture exceeds 90 % during 36 hours (within canopy). While downy mildew *(Plasmopara halstedii)* requires about 50 mm of free water during the 10 days surrounding planting date, *Sclerotinia* head rot (*Sclerotinia sclerotiorum*) needs 42 hours of free water for infecting florets. On the other hand, *Phoma* black stem (*Phoma macdonaldii*) need free water at the trough level for significant stem infection and premature ripening are accelerating due to Phoma especially in dry conditions after flowering (Kaya, 2016 and 2017).

Broomrape (*Orobanche cumana* Wallr) and weeds are the most important limiting factors for seed & oil yield in sunflower in the world. Especially broadleaf weeds are not controlled pre planting applied herbicides such as *Xanthium strumarium, Sinapis arvensis, Cirsium arvense, Chenopodium album, Amaranthus spp., Avena spp. Convolvulus arvensis,, Datura stramonium,* CLEARFIELD control both broomrape and also key weeds is sunflower; CL hybrids are in the market. However hybrids should have CL+Br+DM resistant. If CL hybrids have CL+Br+DM Resistant; no need to wait 6-8 leaf stage for CL application. Because the weeds could be more at fields then apply CL herbicide as soon as possible for efficient weed control. If the hybrid is resistant to SU herbicide, you have to apply herbicide after weeds appear in the field too(Kaya, 2013, 2016 and 2017).

Downy mildew (*Plasmora helianthi*) disease affect yield up to 100% with reducing plant height and leaf number. Especially new races of downy mildew appeared in recently in Turkey and Balkans, Therefore, seed treatment (metalaxyl) do not control the new races of disease *Pl6* and *Pl8* genes is enough to control. The sunflower hybrids should have at least PlArg or Pl13 resistant genes or more (Kaya, 2016 and 2017).

As abiotic stress are other major restricting factors on sunflower production. The main ones are drought, high temperatures during growing season and nutrient deficiencies, as well as other soil issues

such as salt, higher and lower pH in the soil, etc. Bird and herbicide damage and hail, flood are other nature disasters influence sunflower yields negatively in the region (Kaya, 2016 and 2017).

Based on these limiting factors; for getting higher seed yield, the logical suggestion is as much as earlier planting. After March, whenever soil is ready for planting, it needs prepare seed bed urgently then needs start to plant to escape from higher heat stress. If sunflower plants in first week of April, sunflower flowering will start in first week of June then seed filling period will complete in June and until the July with escaping from hot summer conditions in July & August. The 2nd logical proposal is at least 50.000 plants seed density per ha. Sunflower needs to prepare good seed bed in soil then need to check emergence % of sunflower seeds because in planting, seeds should catch the soil to get water & fertilizers after emergence started. Sunflower seeds stay in empty air in soil bed if soil is not well prepared or much stalk wheat stems around seeds; or spongier soil in some fields. In these conditions; there is need to apply roller to soil surface to keep connected soil & seed (Kaya, 2016, 2017, 2019).

As conclusions, sunflower is the essential oil crop and also main crop in the rotation system in the region. It does not seem that there is no any other oil or other crop would replace sunflower in the near future. Therefore, growers should have to choose right hybrids both for better adaptation and also related to considering major problems in their areas and apply suitable agronomical solutions for getting better sunflower yield.

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