https://doi.org/10.61308/WBPO2502

„Dalena CLP“ – Bulgarian Clearfield Plus hybrid sunflower with high adaptive potential

Nina Nenova
Dobrudzha Agricultural Institute – General Toshevo, Agricultural Academy – Sofia, Bulgaria
E-mail: *nina_n13@abv.bg*
Nina Nenova ORCID: 0009-0001-2115-731X

Citation: Nenova, N. (2025). “Dalena CLP” – Bulgarian Clearfield Plus hybrid sunflower with high adaptive potential. *Bulgarian Journal of Crop Science, 62*(1) 51-56.

Abstract: In recent years, the areas grown with sunflowers have increased, and for this reason, proper crop rotations are not always observed, and there has been an attack of economically important diseases. In addition, the changing climatic conditions to drought and high temperatures during the vegetative period of sunflower necessitate the creation of adaptive hybrids sunflower to biotic and abiotic stress conditions suitable for all areas per country. Hybrid “DALENA CLP” is a Bulgarian Clearfield Plus hybrid sunflower with high adaptive potential, created in DZI - General Toshevo. It has been tested in different regions in Bulgaria in years with extreme drought conditions – 2019 and 2020. It was officially registered with a certificate from the Patent Office of the Republic of Bulgaria. The hybrid is a medium early, linoleic type and resistant to downy mildew /race 731/ and the pathogen of Orobanche cumana /race G/, tolerant to the pathogens of *Phoma* and *Phomopsis.* It is resistant to lodging before harvest and the maximum yield from it is about 4000 kg/ha. The aim of this study is to present a detailed morphological, biological and economic characteristics of this adaptive Bulgarian Clearfield Plus hybrid sunflower “Dalena CLP”, with stable yield potential under limited dry-climatic conditions.

Keywords: sunflower; climate change; Clearfield Plus hybrid sunflower

INTRODUCTION

In the last years, farmers preferred to cultivate herbicide-resistant sunflower hybrids. This is necessary for the contaminated and weedy soils, as well as the limited effective herbicides for weed control in sunflower Additionally, measures are taken to control and protect against parasites broomrape. These technologies reducing the need for multiple treatments (Encheva et al., 2015; Kaya, 2015). This direction has been worked on since 2013 at the Dobrudzha Agricultural Institute – General Toshevo and many lines and experimental hybrids have been created and tested, and biotechnological methods have been used in most of them (Encheva et al., 2014; Nenova et al., 2014; Nenova et al., 2016). In recent years, the institute has been working mainly on the creation of sunflower hybrids suitable for cultivation using the Clearfield Plus technology. This technology allows good control over weeds (Pfenning et al., 2012; Sala et al., 2012, Weston et al., 2012). With this technology, the broomrape parasite, which is one of the biggest problems in sunflower cultivation, can also be controlled (Skoric & Pacureanu, 2010) The first Bulgarian Clearfield Plus sunflower hybrid “Enigma CLP” was selected at DZI – Gen Toshevo (Georgiev et al., 2021).

The aim of this study is to present detailed information and characteristics of the second created Bulgarian Clearfield Plus sunflower hybrid “Dalena CLP” at DZI - General Toshevo, which is already massively occupying large areas in Bulgaria, especially in the Northeastern regions

and meets the requirements of farmers by being high yielding and drought tolerant.

MATERIAL AND METHODS

Hybrid "Dalena CLP" is single cross hybrid, developed on the method of interlinear hybridization, suitable for growing using the Clearfield Plus technology The maternal component is line 1111A, cytoplasmic male sterility provided by BASF, but improved in DZI. The line characterized by a very good general and specific combinative ability, it is resistant to the parasite broomrape to race G, it is moderately resistant to *Phoma*, *Alternaria* and *Phomopsis*. In recent years, it has been very successfully participating as a mother component of the newest Clearfield Plus sunflower hybrids created at the Institute. The father paternal line N23R was obtained from experimental hybrid No 23 after self-pollination, followed by chemical treatment and selection and reproduction Three years of testing on the experimental fields of the institute followed. For the period from 2019 to 2020, it was submitted for official testing for DUS (Distinctness, Uniform, Stable Variety) and Values for cultivation and use (VCU) of hybrid in the field and laboratory 2-year testing within the structures of the Bulgarian Executive Agency of Variety Testing (BEAVT), Field Inspection and Seed Control, and was officially registered and approved with order No RD 12-5/10.04.2019 of the Ministry of Agriculture and Forestry structural units of BEAVT. In 2021, after two years of testing, it was submitted to the Expert Committee of EASAC with a proposal for official recognition and entry in the variety list of the Republic of Bulgaria Hybrid "Dalena CLP" was recognized and approved by Order of the Minister of Agriculture and Agriculture No RD 12-2 of 17. 02. 2021 Certificate of the hybrid with Reg. No 11276P2 from 18092023 was issued by the Patent Office of the Republic of Bulgaria (Figure 1).


ПАТЕНТНО ВЕДОМСТВО
на Република България

СЕРТИФИКАТ
ЗА
НОВ СОРТ РАСТЕНИЯ

Рег. № 11276 Р2

Заявка № 1178
Дата на заявяване: 04/04/2022
Приоритет:
Срок на действие: 18/09/2048
Публ. на заявката: 08.1/15.08.2022 г.
Наименование:
Слънчоглед сорт „ДАЛЕНА CLP"
Наименование лат.:
Helianthus annuus L. „DALENA CLP"

Притежател:
Добруджански земеделски институт,
9520 гр. Генерал Тошево, [BG]
Автори:
Нина Иванова Ненова;
Галин Георгиев Георгиев;
Даниела Вълкова Янева;
Валентина Гергиева Енчева;
Георги Петров Георгиев

ПРОФ. Д-Р ВЛАДЯ БОРИСОВА
ПРЕДСЕДАТЕЛ

Figure 1. Certificate of sunflower hybrid "Dalena CLP", issued by the Patent Office

RESULT AND DISCUSSION

Morphological test of the "Dalena CLP" hybrid

Hybrid "Dalena CLP" past the test for DUS in 2019 and 2020 in the Experimental Brashlen station at BEAVT and with a final report with absolutely no remarks. The morphological description of the hybrid (Table 1) was made according to the methodology of UPOV (2002).

Values for cultivation and use (VCU)

Hybrid "Dalena CLP" is suitable for cultivation using Clearfield Plus technology. Clearfield Plus is a technology used in sunflower cultivation that offers several advantages. According to farmers, this technology provides better resistance to annual cereal and broadleaves weeds, and also, in the absence of resistance to the parasite broomrape also exercises control over this parasite. Hybrid "Dalena CLP" is medium early, with a vegetation period of 110 – 120 days. The high of the plants is about 150 to 170 cm. The diameter of the head is 20-22 cm. The hybrid is oil, linoleic

Table 1. Morphological characteristics of sunflower hybrid "Dalena CLP"

№	Traits	Expression	Degree
1.	Hypocotyl:anthocyanin coloration	Present	9
2.	Hypocotyl:intense anthocyanin coloration	Medium	5
3.	Leaf: size	Large	7
4.	Leaf: green color	Dark	7
5.	Leaf: blistering	Strong	7
6.	Leaf: serration	Very coarse	9
7.	Leaf: shape of cross section	Weakly concave	2
8.	Leaf: shape of distal part	Broad triangular	7
9.	Leaf: auricles	Large	7
10.	Leaf: wings	Weakly expressed	2
11.	Leaf: angle of lowest lateral veins	Right angle or nearly right angle	2
12.	Leaf: height of the tip of the blade compared to insertion of petiole (at 2/3 height of plant)	Medium	5
13.	Stem: intensity of hairiness at the top	Medium	5
14.	Time of flowering	Medium	5
15.	Ray flower: density	Very density	7
16.	Ray flower: shape	Ovate	2
17.	Ray flower: disposition	Flat	1
18.	Ray flower: length	Long	7
19.	Ray flower: color	Medium yellow	3
20.	Disk flower color	Yellow	1
21.	Disk flower: anthocyanin coloration of stigma	Present	9
22.	Disk flower: intensity of anthocyanin coloration of stigma	Medium	5
23.	Disk flower: presence of pollen	Present	9
24.	Bract shape	No elongated, no rounded	2
25.	Bract: length of the tip	Medium	6
26.	Bract: green color of the external part	Medium to dark	5
27.	Bract: attitude in relation to head	Strongly embracing	3
28.	Plant: natural height	Tall	7
29.	Plant: branching	Absent	1
30.	Plant: type of branching	-	-
31.	Plant: natural position of closest lateral head to the central head	-	-
32.	Head: attitude	Turned down with strongly curved stem	8
33.	Head: size	Medium to large	6
34.	Head: shape of grain side	Weakly convex	4
35.	Seed: size	Medium	5
36.	Seed: shape	Ovoid	3
37.	Seed: thickness relative to width	Medium to thick	6
38.	Seed: main color	Black	7
39.	Seed: stripes on margin	Weakly expressed	2
40.	Seed: stripes between margin	Absent or weakly expressed	1
41.	Seed: color of stripes	Grey	2

type, the content of oil in the seeds is 43-45%. The seeds are gray and there are no stripes along the edge and middle of the seeds. It is resistant to downy mildew up to race 731, which comes from both parental forms, tolerant to *Phoma* and *Phomopsis.* To the parasite, broomrape is tolerance to race G. The plants are resistant to lodging and do not break during harvesting. Cultivation technology – traditional for Clearfield Plus hybrids, with a recommended density of 60000 to 63000 plants per hectare.

Hybrid „Dalena CLP“ has been tested in two consecutive years in the BEAVT system in three places- Selanovtsi, Brashlyan and Radnevo. In 2019, the NK Meldimi and NK Neoma hybrids were used as standards, in 2020 the standard was changed to the ES Anthemis CLP hybrid. The two years of testing were characterised by very little precipitation (Table 2). „Dalena CLP“ hybrid in 2019, exceeded the standard by 2.7% with an average yield of 398 kg/da from the three test places. In 2020, the average yield was 332 kg/da

Table 2. Climatic characteristics for 2019 and 2020 for the period March - September

Month	Year	Place	Precipitation, mm/m²
March-September	2019	Selanovci	233.4
		Brashljn	279.2
		Radnevo	281.6
Average			264.7
March-September	2020	Selanovci	319.6
		Brashljn	263.2
		Radnevo	209.3
Average			264.0

Table 3. Results from varietal testing for biological and economic properties of sunflower hybrid „Dalena CLP“ seed yield, kg/da -2019.

Hybrid	Selanovci		Brashljn		Radnevo		Average	
	kg/da	%	kg/da	%	kg/da	%	kg/da	%
NK Meldimi	**383**	**100,0**	**402**	**100,0**	**377**	**100,0**	**387**	**100,0**
NK Neoma	478+++	124,8	503+++	125,1	387	102,7	**456**	117,7
Dalena CLP	384	100,1	437	108,6	374	99,1	**398**	102,7
GD 5%	14,44	3,77	49,06	12,20	45,65	12,12		
GD 1%	19,18	5,01	65,15	16,20	60,62	16,09		
GD 0.1%	24,88	6,49	84,52	21,01	78,64	20,87		

Table 4. Results from varietal testing for biological and economic properties of sunflower hybrid „Dalena CLP“ seed yield, kg/da -2020.

Hybrid	Selanovci		Brashljn		Radnevo		Average	
	kg/da	%	kg/da	%	kg/da	%	kg/da	%
ES Anthemis CLP	**358**	**100**	**338**	**100**	**325**	**100**	353	100,0
Dalena CLP	**380+++**	**105.9**	**355**	**105**	**261**	**80,3**	**332**	**97.5**
GD 5%	6,43	3,77	49,06	12,20	27,35	8,43		
GD 1%	8,56	5,01	65,15	16,20	36,43	11,23		
GD 0.1 %	11,15	6,49	84,52	21,01	47,48	14,63		

or 2.5% lower than the standard (Tables 3 and 4). These data show that even in drought the hybrid has given stable yields close to the standarts.

Biochemical and phytopathological characteristics of hybrid "Dalena CLP"

The oil content in the seeds of the „Dalena CLP" hybrid is not affected by drought conditions. This is shown in Tables 5 and 6. For both years the oil content in the seeds is 42.9% and 45.3%.According to the standards, during the two years of testing, the oil content is about 3-6% lower than that of the standards. In addition to productive indicators, breeders must also create disease- and parasite-resistant varieties and hybrids. Climate change also affects the race composition of pathogens. Plant pathologists have always considered environmental influences in their studies of plant diseases: the classic disease triangle emphasizes on the interactions between plant hosts, pathogens and the environment. The „Dalena CLP" hybrid is resistant to the Orobanche - race G. This hybrid resistant to this race and can grow to areas that are highly infected with the Orobanche pathogen. Radnevo is a region in Bulgaria where the soils are most infected with the most aggressive races Orobanche. These data show that even in drought the hybrid has given stable yields close to the using standarts.

Figure 2. Hybrid „Dalena CLP"

CONCLUSION

Hybrid "Dalena CLP" (Figure 2) is a CLP hybrid and middle early hybrid. It has a stable yield during the dry years and the content the oil in the seeds is about 44%. The hybrid is resistant to downy mildew /race 731/ and broomrape /race G/ and middle resistant to *Phoma* and *Phomopsis*. Cultivation technology – traditional for Clearfield Plus hybrids, with a recommended sowing density of 60000 to 63000 plants per hectare.

Acknowledgements

The present research was reported at an jubilee scientific conference with international participation "Sustainable and competitive agriculture un-

Table 5. Results from varietal testing for biological and economic properties of sunflower hybrid „Dalena CLP", Oil content, % - 2019

Hybrid	Selanovci		Brashljn		Radnevo		Average	
	%	St %	%	St %	%	St %	%	St %
NK Meldimi	44,30	100,0	43,95	100,0	48,60	100,0	45,62	100,0
NK Neoma	49,10	110,8	45,90	104,4	50,10	103,1	48,37	106,0
Dalena CLP	39,50	89,2	42,00	95,6	47,10	96,9	42,87	94,0

Table 6. Results from varietal testing for biological and economic properties of sunflower hybrid „Dalena CLP", Oil content, % - 2020

Hybrid	Selanovci		Brashljn		Radnevo		Average	
	%	St %	%	St %	%	St %	%	St %
ES Anthemis CLP	48,60	100,0	45,50	100,0	46,00	100,0	46,70	100,0
Dalena CLP	46,80	96,3	45,40	99,8	43,60	94,8	45,27	96,9

der the conditions of global climate change", held in September, 03-04 2024, in Maize Research Institute, Knezha, Bulgaria.

REFERENCES

Encheva J., Georgiev, G., Nenova, N., Valkova, D., Georgiev, G. & Christov, M. (2014). Developing sunflower lines and hybrids resistant to herbicides. Field Crops Studies, vol. IX-1, pp. 57-68 (Bg).

Encheva, J., Georgiev, G., Nenova, N., Valkova, D., Georgiev, G., & Christov, M. (2015). Developing sunflower lines and hybrids resistant to herbicides. *Plant breeding sciences,* LII (4), pp. 3-11 (Bg).

Georgiev, G., Karapira, S., & Ilchenko, S. (2021). „Enigma CLP" – the first Bulgarian Clearfield Plus sunflower hybrid. *Field Crop Studies, 14*(1), pp. 9-22. http://fcs.dai-gt.org/bg/pdf/fulltext_XIV_1_1.pdf

Kaya, Y. (2015). Herbicide Resistance Breeding in Sunflower, Current Situation and Future Direction. *Journal of ASM. Life Sciences, 2*(326), 101-105.

Nenova, N, Valkova, D., Encheva, J., & Taxin, N. (2014). Promising lines as a results from interspecific hybridization between cultivated sunflower (*H. annuus* L.) and the perennial. *Turkish Journal of Agricultural and Natural Sciences. 2*, pp. 1654-1659.

Nenova, N., Valkova, D., Encheva, V., & Georgiev, G. (2016). Comparative investigation of immature embryos growing of interspecific hybrids. 19th International Sunfower Conference, Congress book – Association of Thrace universities, Edirne, Turkey, 460– 464.

Pfenning, M., Tan, S., & Perez-Brea, J. (2012). Weed control in Clearfiel-Plus sunflowers with superior herbicide solutions. In: Proc. XVIII Sunflower Conf., Mar del Plata-Balcarce, Argentina, pp. 535-538.

Sala, C. A., Bulos, M., Altieri, E., & Ramos, M. L. (2012). Genetics and breeding of herbicide tolerance in sunflower. HELIA, 35(57), pp. 57-70.

Skoric, D., & Pacureanu, M. (2010). Sunflower breeding for resistance to broomrape (Orobanche cumana Wallr). In: Proc. Inter. Symp. "*Sunflower Breeding for Resistance to Disease*", Krasnodar, Russia, pp. 19-29.

UPOV. (2002). Protocol for distinctness uniformity and stability tests (*Helianthus annuus* L.). *European Union Community plant variety office*, 10-28.

Weston B., Pfenning, M., Perz-Brea, J., Tan, S., McNevin, G., Carlson, D., de Romano, A., Romano, C., Bulos, M., & Sala, C. A. (2012). Yield and oil improvements in Clearfiel-Plus sunflowers. In: Proc. XVIII Sunflower Conf., Mar del Plata-Balcarce, Argentina, pp. 557-562.

Received: October, 28, 2024*; Approved:* December, 11, 2024*; Published:* February, 2025