NEW SUNFLOWER GENOTYPES WITH RESISTANCE TO BROOMRAPE, CREATED AT NARDI FUNDULEA

Anton F.G.[1,2], Joiţa-Păcureanu M.[1], Rîşnoveanu L.[3,4], Stanciu D.[1], Dan M.[1]

[1]National Agricultural Research and Development Institute, Fundulea, 1 Nicolae Titulescu, Fundulea, Calarasi County, Romania

[2]Faculty of Biotehnology**,** University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, Bucharest, Romania

[3]Agricultural Research Development Station Braila, Viziru km. 9 street, Braila, Braila County, Romania

[4]„Dunarea de Jos" University of Galati, Engineering and Agronomy Faculty of Braila-Agronomy Center for Research and Consultancy and Environment „Lunca", 29 Calarasi, Braila, Braila County, Romania

Abstract

Parasite broomrape of sunflower become a very difficult problem, in south-east of Romania, because in a short period of time, new virulent races appear. When sunflower breeders from regions infested with Orobanche cumana Wallr. obtain resistant sunflower genotypes, to present races, in a short time became sensible. In this paper, we present results from two years, 2018 and 2019 when we tested sunflower genotypes in artificial condition, in green house, for resistance to broomrape collected from natural infested fields in Braila area, 2017 and 2018.

Keywords: *sunflower, broomrape, genotype, resistance, races*

1. INTRODUCTION

In last years, in South East of Romania, new races of broomrape of sunflower appear very quickly (Pacureanu, 2018). Around Black Sea region, are present the most virulent races of broomrape: in Romania are present races G, H and I (Pacureanu, 2018), in Bulgaria, races G and H (Encheva, 2018), in Ukraine, races G and H (Makliak et al., 2018), in Russia, races G and H (Guchetl S. et al, 2018), in Turkey, races G and H (Kaya et al, 2018).

2. MATERIALS AND METHODS

2.1. Materials

We tested for resistance to broomrape, 22 sunflower genotypes, derived from interspecific hybridization between maintainer lines (maintainer of CMS lines) and wild species of genus *Helianthus* and 12 sunflower genotypes, derived from interspecific hybridization between restorer lines and wild species of genus *Helianthus*. For interspecific hybridization, in year 2014, we use seven wild perenial species: *Helianthus maximiliani* (P3M, P14M), *Helianthus hirsutus (*P6H), *Helianthus strumosus (*P8St), *Helianthus mollis* (P9Mo), *Helianthus tuberosus* (P11T), *Helianthus divaricatus* (P12D), *Helianthus giganteus* (P15G) and five wild annuual species *Helianthus neglectus* (A1Ne), *Helianthus debilis* (A2De, A3De), *Helianthus petiolaris* (A8Pe), *Helianthus praecox* (A9Pr, A10Pr), *Helianthus argophyllus* (A13Arg).

There have been tested also, for resistance to broomrape, two sunflower lines derived from genotypes with free pollination (table 1), who was collected in year 2014 (wild sunflower plants open pollinated).

Table 1. Morphological characteristics of sunflower genotypes derived from genotypes with free pollination, in year 2017, in Fundulea

No.	**Sunflower line derived from genotypes with free pollination**	**Average of some morphological characteristics**	**Non-branching\ Branching**
1	ANT 21-1 FP	Height: 140 cm Head diameter: 12cm Seed yield\sunflower plant: 30g	Branching sunflower genotype
2	ANT 12-5FP	Height: 165 cm Head diameter: 24cm Seed yield\sunflower plant: 88g	Non-branching sunflower genotype

We tested for resistance to broomrape and three synthetic populations of sunflower (table 2), obtained from three different sunflower populations.

Table 2. Morphological characteristics of sunflower genotypes derived from synthetic populations, in year 2017, in Fundulea

No.	**Synthetic population of sunflower**	**Average of some morphological characteristics**	**Non-branching\ Branching**
1	ANT 17-1 SP	Height: 165 cm Head diameter: 15cm Seed yield\sunflower plant: 16 g	Branchging sunflower genotype
2	ANT 17-2SP	Height: 170 cm Head diameter: 22cm Seed yield\sunflower plant: 27g	Non-branchging sunflower genotype
3	ANT 17-3 SP	Height: 165 cm Head diameter: 28cm Seed yield\sunflower plant: 65g	Non-branchging sunflower genotype

2.2. Methods

All mentioned sunflower genotypes were tested for resistance to broomrape, in artificial condition in greenhouse, in year 2018, with broomrape collected from natural infested fields in Braila area, year 2017 and in year 2019, with broomrape collected from natural infested fields in Braila area, year 2018. We used buckets of 10 liters with 70% soil-30% sand and 2 grams of broomrape seeds with three buckets\sunflower\genotype and 5 plants of sunflower\bucket. We made notation about broomrape attack in flowering time of sunflower genotypes.

The attack degree (AD) of sunflower genotypes with broomrape was calculate after this formula:

$$AD = \frac{\text{Frequency x Intensity}}{100}$$

The frequency = the number of sunflower plants with broomrape

The intensity of infestation with broomrape: the average of broomrapes/one sunflower plant

3. RESULTS

After 60-70 days from sowing in green house, the sunflower genotypes studied, start phase of flowering and aerial shoots of broomrape development (Figure 1).



Figure 1. Aspects from green house, in year 2018, in Fundulea

In booth years, 2018 and 2019 when we tested in artificial condition with broomrape, we identified resistant plants to broomrape, 11 sunflower genotypes derived from interspecific hybridization between lines B (maintainer) and wild species of genus *Helianthus* and 4 sunflower genotypes, derived from interspecific hybridization between lines C (restorer) and wild species of genus *Helianthus* (Table 3).

Table 3. Sunflower genotypes tested in artificial conditions, in green house, for resistance to broomrape, in years 2018 and 2019, in Fundulea

No.	Sunflower genotypes derived from interspecific hybridization between maintainer lines (line B) and wild species of genus *Helianthus*	Number of broomrape\number of sunflower Tested in year 2018, in artificial conditions in Fundulea with broomrape from natural field Braila, 2017	Number of broomrape\number of sunflower Tested in year 2019, in artificial conditions in Fundulea with broomrape from natural field, Braila 2018
1	ANT 039B x P3M	14 broomrape \7 sunflower plants	8 broomrape\3 sunflower plants
2	ANT 96-3240Bx P3M	0 broomrape	0 broomrape
3	ANT 08B x P14M	15 broomrape\3 sunflower plants	16 broomrape\2 sunflower plants
4	ANT 015B x P14M	12 broomrape\11 sunflower plants	10 broomrape\3 sunflower plants
5	ANT 093B x P14M	8 broomrape\8 sunflower plants	28 broomrape\6 sunflower plants
6	ANT 84-19265Bx P14M	6 broomrape\5 sunflower plants	6 broomrape\3 sunflower plants
7	ANT 16479Bx P14M	6 broomrape\3 sunflower plants	9 broomrape\3 sunflower plants
8	ANT 001B x P6H	0 broomrape	0 broomrape
9	ANT 011B x P6H	6 broomrape\5 sunflower plants	7 broomrape\3 sunflower plants
10	ANT 050B x P8St	0 broomrape	0 broomrape
11	ANT 1633-1Bx P12D	7 broomrape\7 sunflower plants	4 broomrape\3 sunflower plants
12	ANT 79-16471Bx P15G	0 broomrape	0 broomrape
13	ANT 16438Bx P11T	0 broomrape	0 broomrape
14	ANT 029B x A2De	9 broomrape\8 sunflower plants	4 broomrape\2 sunflower plants
15	ANT 96-3249Bx A1Ne	0 broomrape	0 broomrape
16	ANT 23-602Bx A1Ne	0 broomrape	0 broomrape
17	ANT 010B x A2De	27 broomrape\12 sunflower plants	39 broomrape\ 15 sunflower plants
18	ANT 885-14Bx A3De	0 broomrape	0 broomrape
19	ANT 102-7869-1223Bx A8Pe	8 broomrape\6 sunflower plants	5 broomrape\3 sunflower plants
20	ANT 23-602Bx A9Pr	0 broomrape	0 broomrape
21	ANT 84-19669Bx A10Pr	0 broomrape	0 broomrape
22	ANT 16438Bx A13Arg	0 broomrape	0 broomrape

No.	Sunflower genotypes derived from interspecific hybridization between restorer lines (line C) and wild species of genus *Helianthus*	Number of broomrape\number of sunflower Tested in year 2018, in artificial conditions in Fundulea with broomrape from natural field, Braila 2017	Number of broomrape\number of sunflower Tested in year 2019, in artificial conditions in Fundulea with broomrape from natural field, Braila 2018
1	ANT 925 C x A2De	0 broomrape	0 broomrape
2	ANT 103 C x P3M	19 broomrape\8 sunflower plants	24 broomrape\3 sunflower plants
3	ANT 064C x P3M	7 broomrape\5 sunflower plants	10 broomrape\6 sunflower plants
4	ANT 066C x P14M	0 broomrape	0 broomrape
5	ANT 068C x P14M	0 broomrape	0 broomrape
6	ANT 088 C x P14M	39 broomrape\15 sunflower plants	32 broomrape\6 sunflower plants
7	ANT 095C x P14M	30 broomrape\11 sunflower plants	18 broomrape\6 sunflower plants
8	ANT 101 C x P14M	21broomrape\6 sunflower plants	23 broomrape\3 sunflower plants
9	ANT 053 C x P14M	20 broomrape\15 sunflower plants	25 broomrape\15 sunflower plants
10	ANT 305 C x P9 Mo	0 broomrape	0 broomrape
11	ANT 064C x P9Mo	9 broomrape\3 sunflower plants	40 broomrape\12 sunflower plants
12	ANT 001 C x P12D	27 broomrape\9 sunflower plants	41broomrape\3 sunflower plants
No.	**Sunflower genotypes derived from sunflower with free pollination**	**Number of broomrape\number of sunflower** **Tested in year 2018, in artificial conditions in Fundulea with broomrape from natural field, Braila 2017**	**Number of broomrape\number of sunflower** **Tested in year 2019, in artificial conditions in Fundulea, with broomrape from natural field Braila, 2018**
1	ANT 21-1 FP	14 broomrape\ 6 sunflower plants	30 broomrape\15sunflower plants
2	ANT 12-5FP	7 broomrape\7 sunflower plants	2 broomrape\2 sunflower plants
No.	**Sunflower genotypes derived from synthetic populations of sunflower**	**Number of broomrape\number of sunflower** **Tested in year 2018, in artificial conditions in Fundulea with broomrape from natural field, Braila 2017**	**Number of broomrape\number of sunflower** **Tested in year 2019, in artificial conditions in Fundulea with broomrape from natural field, Braila 2018**
1	ANT 17-1 SP	44 broomrape\9 sunflower plants	20 broomrape\4 sunflower plants
2	ANT 17-2SP	50 broomrape\12 sunflower plants	32 broomrape\4 sunflower plants
3	ANT 17-3 SP	23 broomrape\10 sunflower plants	14 broomrape\2 sunflower plants

4. DISCUSSION

The average of broomrapes/sunflower plants was bigger in year 2019, with broomrape from natural field Braila 2018, then in year 2018, with broomrape from natural field Braila 2017.

Some accessions of perennial wild species such as *Helianthus maximiliani* (P3M, P14M), *Helianthus hirsutus (*P6H), *Helianthus strumosus (*P8St), *Helianthus mollis* (P9Mo), *Helianthus tuberosus* (P11T), *Helianthus giganteus* (P15G) and some accessions of annual wild species such as *Helianthus neglectus* (A1Ne), *Helianthus debilis* (A2De, A3De), *Helianthus praecox* (A9Pr, A10Pr), *Helianthus argophyllus* (A13Arg), give total resistance of genotypes derived from interspecific hybridization with them.

Four sunflower genotypes, ANT 96-3240Bx P3M, ANT 001B x P6H, ANT 050B x P8St, ANT 16438Bx P11T, derived from interspecific hybridization between lines B, ANT 96-3240B, ANT 001B, ANT 050B, ANT 16438B, and four perennial wild sunflower species, *Helianthus maximiliani* (P3M), *Helianthus hirsutus (*P6H), *Helianthus strumosus (*P8St), *Helianthus tuberosus* (P11T), were resistant at broomrape in booth years, 2018 and 2019, tested in artificial condition, in Fundulea (Fig. 2).

Seven sunflower genotypes, ANT 96-3249Bx A1Ne, ANT 23-602Bx A1Ne, ANT 885-14Bx A3De, ANT 23-602Bx A9Pr, ANT 84-19669Bx A10Pr, ANT 16438Bx A13Arg, derived from interspecific hybridization between lines B, ANT 96-3249B, ANT 23-602B, ANT 885-14B, ANT 23-602B, ANT 84-19669B, ANT 16438B and four annual wild sunflower species, *Helianthus neglectus* (A1Ne), *Helianthus debilis* (A3De), *Helianthus praecox* (A9Pr, A10Pr), *Helianthus argophyllus* (A13Arg), were resistant at broomrape in booth years, 2018 and 2019, tested in artificial condition, in Fundulea (Fig. 2)

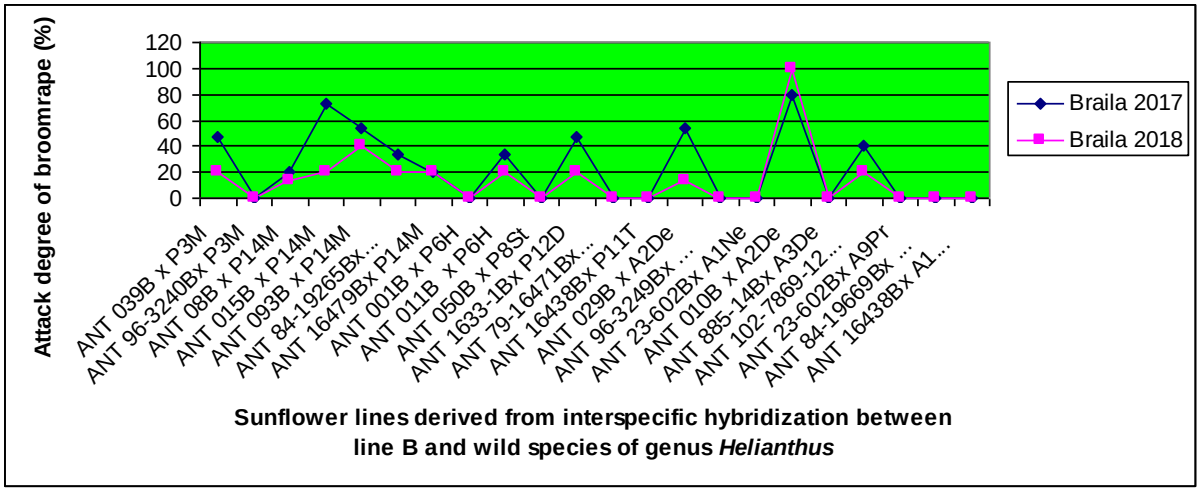


Figure 2. Attack degree of broomrape in artificial condition, in Fundulea, in years 2018 and 2019, of sunflower lines derived from interspecific hybridization between lines B and wild species of genus *Helianthus*

Three sunflower lines, ANT 066C x P14M, ANT 068C x P14M, ANT 305 C x P9 Mo, derived from interspecific hybridization between lines C, ANT 066C, ANT 068C, ANT 305 C and two perennial wild sunflower species, *Helianthus maximiliani* (P14M), *Helianthus mollis* (P9Mo), were resistant at broomrape in booth years, 2018 and 2019, tested in artificial condition (Figure 3).

One sunflower line, ANT 925 C x A2De, derived from interspecific hybridization between line C, ANT 925 C and annual wild sunflower specie, *Helianthus debilis* (A2De), were resistant at broomrape in booth years, 2018 and 2019, tested in artificial condition (Figure 3).

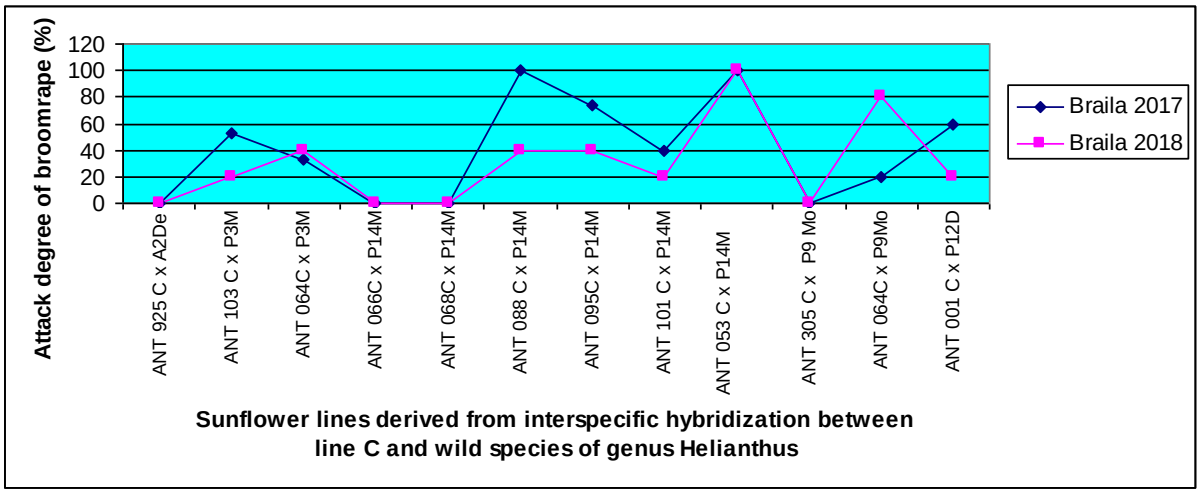


Figure 3. Attack degree of broomrape in artificial condition, in Fundulea, in years 2018 and 2019, of sunflower lines derived from interspecific hybridization between line C and wild species of genus *Helianthus*

5. CONCLUSIONS

Interspecific hybridization represent a breeding method for defense against broomrape. Sunflower annual and perennial wild species represent a gene pool for resistance to broomrape and some sunflower genotypes derived from interspecific hybridization poses resistance\tolerance to races present in Braila area.

Sunflower genotypes derived from genotypes with free pollination and sunflower genotypes derived from synthetic populations, don't have resistance to broomrape attack in booth years, 2018 and 2019 tested.

Fourteen sunflower genotypes, ANT 96-3240Bx P3M, ANT 001B x P6H, ANT 050B x P8St, ANT 16438Bx P11T, ANT 96-3249Bx A1Ne, ANT 23-602Bx A1Ne, ANT 885-14Bx A3De, ANT 23-602Bx A9Pr, ANT 84-19669Bx A10Pr, ANT 16438Bx A13Arg, ANT 066C x P14M, ANT 068C x P14M, ANT 305 C x P9 Mo, from 39 sunflower genotypes analyzed, can be a material for sunflower lines resistant to broomrape present in area Braila.

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