PRELIMINARY RESULTS ABOUT EXPERIMENTAL SUNFLOWER HYBRIDS RESISTANT TO BOTH SULFONYLUREA AND IMIDAZOLINONE HERBICIDE

Florin Gabriel ANTON[1,2]

e-mail : gabi22mai@yahoo.com

Abstract

It is important to choose what herbicide we want to use depending on degree of weed infestation and what type of sunflower hybrid resistant at sulfonylurea or imidizalinone herbicide. Some farmers who cultivated sunflower in South-East of Romania where broomrape is present with the most virulent races, use IMI sunflower hybrids and spray with a IMI herbicide for a better control. Other farmers, prefers SU sunflower hybrids especially in field without broomrape. At NARDI Fundulea, we created sunflower hybrids resistant at sulfonylurea herbicide and sunflower hybrids resistant at imidazolinone herbicide but also we created experimental sunflower hybrids resistant to booth sulfonylurea and imidazolinone herbicide. In year 2018, at NARDI Fundulea, we tested, four experimental sunflower hybrids SU-IMI Plus, H1 SU-IMI Plus, H2 SU-IMI Plus, H3 SU-IMI Plus and H4 SU-IMI Plus, for resistance at sulfonylurea herbicide in Express Sun™ system and imidazolinone herbicide in Clearfield® system. These four experimental sunflower hybrids were full resistant in booth systems, in Express Sun™ and Clearfield®.

Key words: sunflower, herbicide, imidazolinone, sulfonylurea, hybrids

Sunflower is a very important culture in Romanian agriculture and in nowadays on the seed market is three types of sunflower hybrids: conventional hybrids, imidazolinone hybrids (IMI) and sulfonilureea hybrids (SU). The farmers who sowing IMI hybrids in Clearfield® system and SU hybrids in Express Sun™ system, have a good weed control, because, this specific herbicide for this types of hybrids, have a large specter of weed such as annual dicotyledonous weeds and some annual monocotyledons (Al-Khatib K. *et al*., 2010; Škorić D. *et al*, 2012; Santos G. *et al.*, 2012).

At NARDI Fundulea, in sunflower breeding program, one main objective, was to introduce genes *Imr1, Imr2,* for resistance to imidazolinone herbicide (Alonso L.C. *et al.*, 1998) gene *SU7 Express Sun* for resistance to sulfonylurea herbicide (tribenurol methyl), gene *CLHA-PLUS* for resistance to imidazolinone herbicide (Sala C.A. *et al*., 2008).

The degree of weed infestation in fields cultivated with sunflower in Romania is very high and because of that in nowadays is used the technology who integrated sunflower hybrids Clearfield IMI + herbicide imidazolinone Pulsar in dose of 1.2 l/ha or sunflower hybrids SU + herbicide sulfonilureea Expess in dose of 30g/ha (Bozic D. *et al.*, 2015).

The farmers from the region from south-east of Romania, infested with parasite broomrape use herbicide imidazolinone Pulsar (Alonso et al., 1998; Pfening M. *et al*., 2008; Fernandez-Martinez F.M. *et al*., 2015).

From 2018, on the Romanian seed market is sunflower hybrids IMI Clearfield Plus with herbicide Pulsar Plus who is less aggressive than herbicide Pulsar 40 (Sala C.A. *et al*, 2012, Bessai J. *et al*., 2018).

My idea, was to integrated both genes for resistance at herbicide SU and IMI Plus in the same genotype to create sunflower hybrids SU-IMI Plus and farmers to decide what herbicide to use depending on what weed infestation or presence/absence of parasite broomrape.

MATERIAL AND METHOD

At NARDI Fundulea, in year 2014, I started to introduce gene CLHA Plus from lines sources *BTI-bM1b* and *BTI - R1*, in two elite lines B, ANT 1B SU, ANT 2B and in two elite lines C, ANT1C SU, ANT 2C SU, who are resistant at SU herbicide, belonging to NARDI Fundulea (*figure 1*).

[1]National Agricultural Research and Development Institute, Fundulea
[2]University of Agronomic Sciences and Veterinary Medicine – Bucharest, Faculty of Biotechnology

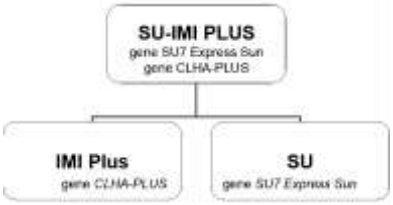

Figure 1 **Incorporate gene CLHA PLUS and gene SU7 Express Sun in a SU-IMI Plus sunflower genotype**

This two maintainer lines ANT 1B SU, ANT 2B and two restorer lines, ANT1C SU, ANT 2C SU, has already integrated gene for resistance to sulfonilureea herbicide from lines sources *Sures 1* and *Sures 2* (*figure 2*).

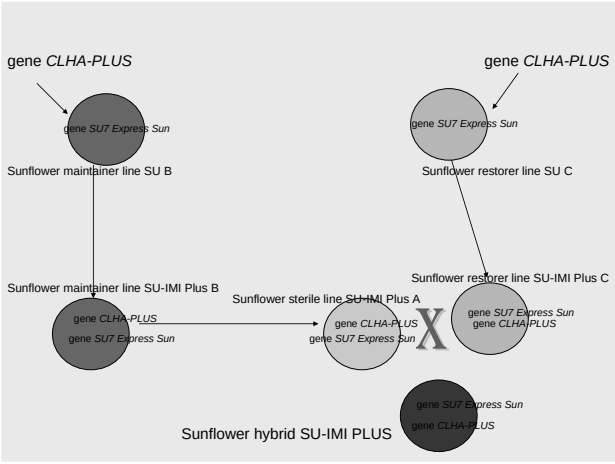

Figure 2 **Scheme of obtaining a sunflower hybrid SU-IMI Plus**

I make selection from F2 generation of resistant\tolerant\sensible genotype after I sprayed the same genotype with Pulsar 40 in dose of 1.2 l/ha in field IMI in stage of four true leaves and the same genotype with Express 50 in dose of 30 g/ha in field SU at stage of four true leaves.

RESULTS AND DISCUSSIONS

I crossing pollen from two restorer line, ANT 1C SU-IMI Plus and ANT 2C SU-IMI Plus to two female lines, ANT 1A SU-IMI (analog sterile of maintainer fertile line ANT 1B SU-IMI Plus) and ANT 2A SU-IMI (analog sterile of maintainer fertile line ANT 2B SU-IMI Plus) in year 2017 and we obtain in year 2018, four experimental hybrids SU-IMI Plus (*figure 3*).

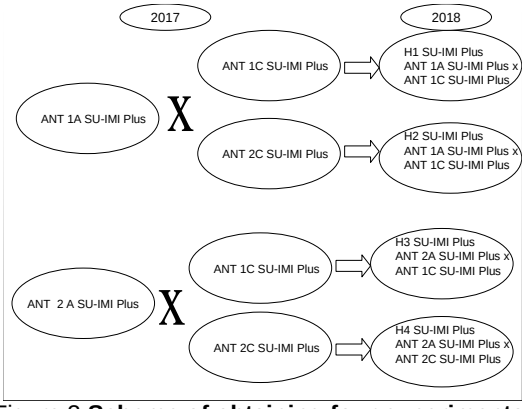

Figure 3 **Scheme of obtaining four experimental sunflower hybrids SU-IMI Plus**

In year 2018, I make notation about four SU-IMI Plus experimental hybrids tested in SU field and IMI fields for resistance at herbicides *(table 1, 2*). The four SU-IMI Plus sunflower hybrids was sowing in micro lots of 4 rows and was sprayed with IMI herbicide Pulsar 40 in dose of 1.2 l/ha, who has active substance 40 g/l imazamox, instead Pulsar Plus in dose of 1.6 l/ha, who has active substance 25 g/l imazamox, in IMI field, in Clearfield® system (Bessai J. *et al.*, 2018) and with SU herbicide Express 50 in dose of 30 g/ha who has active substance 50 g/kg tribenurol methyl, in SU field, in Express Sun™ system .

Table 1

Resistance at herbicide PULSAR 40, of four SU-IMI Plus sunflower hybrids, in IMI field, in Clearfield® system, in year 2018, at NARDI Fundulea

Hybrid combination	Date of sowing	Date of treatment in stage of four true leaves	Observation regarding resistance\sensitivity after 14 days after treatment, in field IMI/2018
H1 SU-IMI Plus ANT 1A SU-IMI Plus x ANT 1C SU-IMI Plus	14.05.2018	5.06.2018	All plants resistant
H2 SU-IMI Plus ANT 1A SU-IMI Plus x ANT 2C SU-IMI Plus	14.05.2018	5.06.2018	All plants resistant
H3 SU-IMI Plus ANT 2A SU-IMI Plus x ANT 1C SU-IMI Plus	14.05.2018	5.06.2018	All plants resistant
H4 SU-IMI Plus ANT 2A SU-IMI Plus x ANT 2C SU-IMI Plus	14.05.2018	5.06.2018	All plants resistant

Table 2

Resistance at herbicide EXPRESS 50, of four SU-IMI Plus sunflower hybrids, in SU field, in Express Sun™ system , in year 2018, at NARDI Fundulea

Hybrid combination	Date of sowing	Date of treatment in stage of four true leaves	Observation regarding resistance\sensitivity after 14 days after treatment, in field SU/2018
H1 SU-IMI Plus ANT 1A SU-IMI Plus x ANT 1C SU-IMI Plus	25.04.2018	23.05.2018	All plants resistant
H2 SU-IMI Plus ANT 1A SU-IMI Plus x ANT 2C SU-IMI Plus	25.04.2018	23.05.2018	All plants resistant
H3 SU-IMI Plus ANT 2A SU-IMI Plus x ANT 1C SU-IMI Plus	25.04.2018	23.05.2018	All plants resistant
H4 SU-IMI Plus ANT 2A SU-IMI Plus x ANT 2C SU-IMI Plus	25.04.2018	23.05.2018	All plants resistant

Plant height of SU-IMI Plus sunflower hybrids, was in Fundulea, in year 2018, in IMI field, in Clearfield® system, in Fundulea, between 158 and 165 cm and in SU field, in Express Sun™ system, was between 135 and154 cm.

One thousand seed weight (TSW) of SU-IMI Plus sunflower hybrids, was in Fundulea, in year 2018, in IMI field, in, Clearfield® system and in SU field, in Express Sun™ system, between 48g and 68g.

Hectolitre weight (kg/hl) was in Fundulea, in year 2018, in IMI field, in, Clearfield® system, between 39.1 and 39.9 kg/hl and in SU field, in Express Sun™ system, was between 32.2 and 34.8 kg/hl.

Regarding oil content, H2 SU-IMI Plus have a bigger content then other three hybrids, in field SU, in Express Sun™ system (*figure 4*).

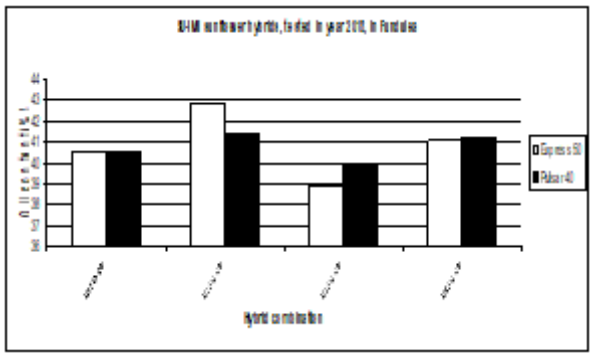

Figure 4 **Oil content of SU-IMI Plus sunflower hybrids, in year 2018, in Fundulea**

Seed yield (kg/ha) was in Fundulea, in year 2018, in micro lots of four rows, of 7 m long, in IMI field, in, Clearfield® system, between 3472 and 4316 kg/ha, when H4 SU-IMI Plus have the best production of seed and in SU field, in Express Sun™ system, was between 3851 and 4960 kg/ha, when H1 SU-IMI Plus have the best production of seed (*figure 5*).

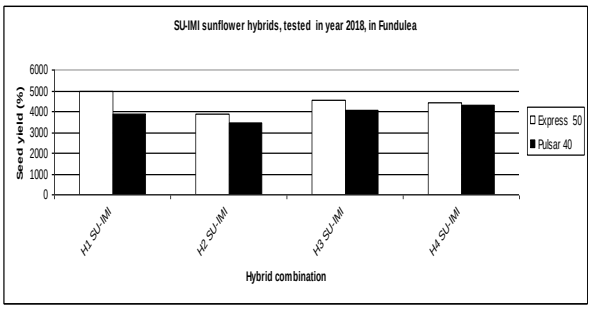

Figure 5 **Seed yield of SU-IMI Plus sunflower hybrids, in year 2018, in Fundulea**

Protein content (%) was in Fundulea, in year 2018, in IMI field, in Clearfield® system, between 18 and 19.1% and in SU field, in Express Sun™ system, was between 17.2 and 17.7% (*figure 6*).

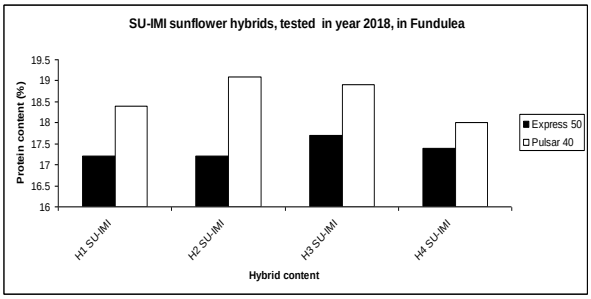

Figure 6 **Protein content of SU-IMI Plus sunflower hybrids, in year 2018, in Fundulea**

CONCLUSIONS

SU-IMI Plus hybryds, are a new generation of experimental sunflower hybrids who have integrated gene *CLHA-PLUS* for resistance to imidazolinone herbicide and gene *SU7 Express Sun* for resistance to sulfonylurea herbicide.

Farmers who sowing this new type of sunflower hybrids, decide what herbicide to use, depending on what weed infestation have or if broomrape is present/absent.

This very early preliminary result, show us the productive potential of this new experimental SU-IMI sunflower hybrids in a micro lots at density of 50.000 plants/ha, with a maximum seed yield of 4960 kg/ha (H1 SU-IMI Plus) in a technology with SU herbicides, in Express Sun™ system and of 4316 kg/ha (H4 SU-IMI Plus) in a technology with IMI herbicides, in Clearfield® system.

Oil content of 42.8% of H3 SU-IMI Plus in a technology with SU herbicides, in Express Sun™ system and of 41.4 % of H3 SU-IMI Plus in a technology with IMI herbicides, in Clearfield® system, show us, a good oil content of this new experimental sunflower hybrids.

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