IMPROVING SUNFLOWER FOR RESISTANCE TO 
Orobanche AND TRIBENURON METHYL 
HERBICIDES - SUNFLOWER HYBRID PF100

Dicu, G.*, Dumitrescu, N., Radu, M., State, D., Fuia, S., Diaconescu, O.

Procera Agrochemicals Romania Ltd., no. 11, Muncii Street, 915200, Fundulea, 
Calarasi County, Romania

Received: July 15, 2009
Accepted: November 10, 2009

SUMMARY

Procera Agrochemicals Romania is a company that has developed a program for sunflower breeding in 2004. One of the main goals of this improvement program was to obtain sunflower hybrids resistant to broomrape, in consequence of the fact that Romania has a constantly increasing incidence of soil-areas infested with this parasite.

Sunflower hybrid PF100 is a semi-late hybrid that has genetic resistance to broomrape and it has also been genetically improved for resistance to sulfonylurea herbicides SURES-1 and SURES-2, for both male and female lines. PF100 has been tested in the Romanian official network of the State Institute for Variety Testing and Registration during last four years (2005-2008). The results recorded showed that the seed production varied from 2348 kg/ha (Timis County, 2005) to 4604 (Vaslui County, 2006) and the oil content in seeds was between 47 and 51%. In 2008, the highest seed yield of this hybrid (3700 kg/ha) was obtained in the demonstration plots established in Viziru, Braila County (a most heavily infested county in the country).

Key words: broomrape, tribenuron methyl, sunflower breeding, resistance genes, PF 100

INTRODUCTION

Sunflower is considered one of the most important oleaginous plants cultured both worldwide and in Romania. The annual cultivated area in Romania is 700,000 - 900,000 hectares. Unfortunately, although there are valuable sunflower hybrids on the market, the average production is quite low. For example, official data show that the average seed production was only 650 kg/ha in 2007.

The major reasons for the low productivity of the sunflower crop were, on the one hand, the highly fluctuating pedoclimatic conditions that were becoming more
and more severe in the recent years, and on the other, the negative influence of the parasitic weed *Orobanche cumana* and the dicotyledonous weeds present in sunflower fields. The broomrape grows as a parasite in the sunflower crop, causing substantial crop losses and sometimes even compromising the entire harvest, usually when the recommended crop rotation is not properly followed or when hybrids with genetic resistance to the parasite are not used.

In recent years, broomrape has been increasingly aggressive, because new and more virulent races occurred. For this reason, the sunflower breeding should have the same dynamics and new parent lines and hybrids resistant to the new races must be developed in order to reduce the negative effects caused by this parasitic weed.

In Romania, the broomrape-infested area is over 200,000 ha, mainly in the south-east of the country, namely in the counties Constanta, Tulcea, Ialomita, Braila and Buzau, showing a spreading trend to surrounding areas.

The sunflower breeding program developed by Procera Agrochemicals since 2004 has a general goal to develop sunflower hybrids with high productive potential, genetic resistance to broomrape, genetically improved with resistance genes to the tribenuron-methyl herbicides that control the dicotyledonous weeds specific to sunflower crops (weeds that previously could only be partially controlled through harrow or hoeing) and also obtaining high-oleic sunflower hybrids.

The present paper presents the performance of the sunflower hybrid PF 100 in the official tests in the Romanian SIVTR network (The State Institute for Variety Testing and Registration). This hybrid - developed within a research project conducted by Procera - will be registered by Procera Agrochemicals Romania in 2008 and it will enter the market the next year. PF 100 has genetic resistance to broomrape, E-race inclusive, and is genetically improved with resistance genes for tribenuron methyl herbicides. Characteristics of PF 100 hybrid exhibited in experimental crop management plots are also shown, namely the reaction to the sowing date and sunflower vegetation stage when the herbicide treatment was applied, 4-6 and 6-8 leaves stages.

**MATERIAL AND METHODS**

Official tests were performed by the State Institute for Variety Testing and Registration ISTIS network in the last four years (2005-2008) in 8 testing centers located in areas favorable for sunflower culture without irrigation. The control hybrids used for comparison against PF 100 were Select, Performer and Favorit (the last one was used in all test years). Three of the eight test locations (Cogealac, Ramnicu Sarat and Mircea Voda) are located in the areas most heavily infested with *Orobanche cumana*. The production results were calculated and interpreted with ANOVA program.
Figure 1: PF 100 production results compared with the control hybrids Select and Favorit in the official SITVR network, 2006

Figure 2: PF 100 production results compared with the control hybrids Performer and Favorit in the official SITVR network, 2007

Figure 3: PF 100 production results compared with the control hybrids Performer and Favorit in the official SITVR network, 2008
In order to assess the stability of the resistance genes to tribenuron methyl herbicides, several crop management experiments were performed in 2008 within the Procera's breeding field in Fundulea, which included two sowing dates, with three treatment variants in each: without herbicide, herbicide applied at 4-6 leaves stage and herbicide applied at 6-8 leaves stage.

The experiments were organized in blocks with three randomized replications. Each experimental plot was 7.5 m\(^2\), with two 5-meter rows. 0.75 m between the rows. A Hege 95 seeding machine was used for sowing and the harvest was performed with a Delta plot combine. All production results were statistically calculated and interpreted through ANOVA program.

**RESULTS AND DISCUSSIONS**

The official data from the State Institute for Variety Testing and Registration network showed that the sunflower hybrid PF 100 had an average seed production of 3,307 kg/ha in 2006, 238 kg more than the control hybrid Favorit and 112 kg/ha more than Select, unfortunately without statistical significance (DL 5%=766.11). The yield of PF 100 varied from the minimum level of 2,642 kg/ha registered in the location Peciou Nou, Timis County, to the maximum level of 4,604 kg/ha registered in the location Negresti, Vaslui County (Figure 1).

In 2007, PF 100 productivity was slightly smaller, ranging between 1,616 kg/ha (Troian location, Teleorman County) to 3,961 kg/ha (Arad location, Arad County). The average production increases were 297 kg compared with the control hybrid Favorit and 38 kg compared with the control hybrid Performer, without statistical significance (DL 5%=912.92), (Figure 2).

In 2008, the productivity of PF 100 varied from 2,295 kg/ha (Troian location, Teleorman County) to 3,897 kg/ha (Negresti location, Vaslui County). The average production increases were 192 kg compared with Favorit and 103 kg compared with Performer, without statistical significance (DL 5%=708.48).

In addition to high productivity, the main agronomic features of the sunflower hybrid PF 100 were genetic resistance to broomrape and genetic resistance to tribenuron methyl herbicides. To illustrate the genetic resistance to broomrape, production results of PF 100 are shown from three SIVTR testing centers, Cogalac, Mircea Voda and Ramnicu Sarat, located in the most heavily infested areas. Seed productions of PF 100 ranged between 2,329 kg/ha in Ramnicu Sarat location, Buzau County and 3,811 kg/ha in Mircea Voda location, Braila County. These values very close to the control Favorit - a hybrid resistant to broomrape (Figure 4).

The sunflower hybrid PF 100 is resistant to the tribenuron methyl herbicides. Several crop management experiments were established in 2008 in Procera's experiment field at Fundulea. The main purpose was to assess the hybrid's reaction to two sowing dates, correlated with the moment when a tribenuron methyl herbicide (Primstar) was applied.

The sowing dates were April 10 and April 30, and the treatment variants were: no herbicide, herbicide applied at 4-6 leaves stage and herbicide applied at 6-8 leaves stage.
Figure 5 shows the productivity of PF 100. In the first sowing date, the production varied between 3.1 t/ha, without tribenuron methyl treatment, and 4.0 t/ha, when the herbicide treatment was applied at 6-8 leaves stage. In the same sowing date, The yield increase was 0.9 t/ha, statistically very highly significant, in favour of the variant with herbicide treatment at 6-8 leaves stage compared with the variant of herbicide treatment at 4-6 leaves stage. The yield increase between the two sowing dates was 0.4 t/ha registered only for the treatment applied at 6-8 leaves, in favour of the first sowing date.

**CONCLUSIONS**

The sunflower hybrid PF 100 is a semi-late hybrid, with resistance to the broomrape and resistance genes to the tribenuron methyl herbicides.

This hybrid was tested in the period 2005-2008 within the SIVTR network, under different pedo-climatical conditions and without irrigation.
The seed production varied between 1,616 kg/ha (2006) in Troian location, Teleorman County, and 4,604 kg/ha (2006) in Negresti location, Vaslui County.

The maximum production increase was 297 kg/ha in 2007, compared with the control hybrid Favorit.

The data from Procera's experiment field proved the stability of the resistance genes; no phytotoxic effect occurred to negatively affect the commercial production.

Based on the data recorded and no yield reduction observed, we recommend extending the optimum herbicide application period until the vegetative phase of 6-8 leaves.

The main agronomical features of the sunflower hybrid PF 100 are high production capacity, genetic resistance to broomrape and resistance to the tribenuron methyl herbicides, giving it a major advantage over normal sunflower hybrids because it can be cultivated on the soils most heavily infested with dicotyledonous weeds.

REFERENCES


MEJORAMIENTO DEL GIRASOL POR RESISTENCIA A Orobanche Y A LOS HERBICIDAS METIL TRIBENURON – HÍBRIDO DE GIRASOL PF 100

La Agroquímica Procera de Rumania lleva a cabo, desde 2004, un programa de mejoramiento de girasol. Uno de los principales objetivos de este programa de mejora es obtener girasol híbridos resistentes al jopo, dado el hecho bien conocido de que Rumania tiene un constante incremento de suelo infestado con este parásito. El girasol PF100 es un híbrido semi-tardío, con resistencia genética al jopo así como con genes de resistencia –en las líneas progenitoras macho y hembra- a los herbicidas Sulfonilureas SURES-1 y SURES-2. El híbrido PF100 ha sido probado en la red oficial rumana de girasol en los últimos cuatro años (2005-2008). Los resultados mostraron que la producción de granos varió desde 2348 (Timis, 2005) a 4604 kg/ha (Vaslui, 2006) y el contenido graso fluctuó entre 47-51%. En 2008, el rinde más alto de este híbrido (3700 kg/ha) se obtuvo en las parcelas de los ensayos demostrativos ubicados en Viziru, Brasilia (uno de los condados más infestados con jopo).

L’AMÉLIORATION DU TOURNESOL POUR LA RÉSISTANCE À l’Orobanche ET AUX SULFONYLURÉES (TRIBENURON METHYL) - HYBRIDE PF100 DE TOURNESOL

RÉSUMÉ

Procera Agrochemicals Romania est une entreprise qui a développé un programme de sélection tournesol depuis 2004. Un des objectifs principaux de ce programme d’amélioration est d’obtenir des hybrides de tournesol résistants à l’Orobanche, pour pallier l’augmentation régulière des sols infestés par ce parasite en Roumanie, qui ont une grande incidence sur le rendement des cultures.

Le tournesol PF100 est un hybride demi-tardif résistant à l’Orobanche et génétiquement modifié pour la tolérance aux herbicides sulfonymuréés (gènes SURES-1 et SURES-2), à la fois pour les lignées mâles et femelles.

PF100 a été testé dans le réseau officiel roumain d’essais et inscription au catalogue (State Institute for Variety Testing and Registration) durant ces quatre dernières années (2005-2008).

Les résultats obtenus ont montré que le rendement grain variait de 2348 kg/ha (comté de Timis, 2005) à 4604 kg/ha (comté de Vaslui, 2006) et la richesse en huile entre 47 et 51%.

En 2008, la productivité grainière la plus élevée de cet hybride (3700 kg/ha) a été atteinte dans les parcelles de démonstration des essais à Viziru, comité de Brasilia (l’un des plus infestés par l’Orobanche).