# RESEARCH ON THE CONTROL OF *SORGHIUM HALEPENSE* AT THE CORN CULTIVATED ON THE MEADOWS OF THE DANUBE AND IN THE BANAT AREA

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*The expansion of the Sorghum halepense species on the soils in Romania is owed, first of all, to the fact that the atrazin-based herbicides were used unilaterally but this herbicide is an extremely selective one for the Zea mais species and as selective for the Sorghum halepense. In Romania, as in Bulgaria, Hungary and the ex-Yugoslavia, various researches with the classical herbicides Mistral, Titus, etc. have been carried out. The present report presents the efficiency of the classical herbicides as well as that of the new herbicides, Terano, Mikado, Equip, Maister compared to the Mistral herbicides.*

*At the Baneasa-Giurgiu site, the land was infested with Sorghum halepense - the level of covering with the relative species was of over 75%. For instance, in the not hoeing variants, the corn production was small, as only 1800 kg /ha was obtained. On the other had, the variant treated with 3 herbicides: Guardian 4 litres/ha applied before the sowing, then on the vegetation with Dialen Super in a dose of 1 litre/ha + Mistral 2.5 litres/ha the corn production was of 12,200 kg/ha - of course, the corn culture was irrigated three times during the vegetation, having a wetting norm of 400 $m^3$ / ha. Among the "classical" herbicides, Mistral, Titus and Equip, the best results in fighting the Sorghum halepense species was obtained with Mistral applied in doses of 2.0 - 3.0 litres / ha - the fighting being of 95 - 100 % while the Titus 75 DF herbicide applied in a dose of 50 g / ha the fighting of the Sorghum halepense species was only of 47%. As regards the conditions in Banat, the experiments were carried out at the Didactic Site of the University of Agricultural Sciences and Veterinary Medicine in Timisoara. The land on which the relative experiment took place had a covering degree with Sorghum halepense of about 68%. The best results in fighting the Sorghum halepense species and the most important corn production were obtained in the variants treated with the Mistral herbicide, The Master herbicide was placed second.*

*In conclusion, the sorghum halepense is the species that causes the biggest damage in the corn culture. Under the conditions in the Danube Meadow, the losses in corn were over 9500 kg/ha (under irrigation conditions), and in Banat of over 4000 - 5000 kg/ha under non-irrigation conditions).*

***Keywords**: Sorghum halepense, Mistral, Equip, Terano, Maister, Danube Meadow.*

In Romania, *Sorghum halepense*, also called Johnsongrass, extended on a very large scale on the embanked Danube meadows, in Dobrogea, in the west part of the Banat region and on the river meadows in Moldova. The rapid expansion of *Sorghum halepense* is due to a complex of factors, among which the unilateral use of herbicides based on atrazin and the introduction of irrigation have mostly contributed the most to the infestation of different culture fields with cu *Sorghum halepense*.

Based on research undertaken in our country, it was established that *Sorghum halepense*, depending on the level of infestation, may produce damages of over 2.000 - 9.000 kg/ha at corn, 500-2.000 kg/ha la soy, 500-1.500 kg/ha at sun-flower, 20.000 - 30.000 kg/ha at sugar beet [6].

The synthesis of new herbicides able to control *Sorghum halepense* in corn fields represents an important achievement of world's chemistry, which allows to diversify the control strategies for *Sorghum halepense* - a species causing serious damage to farmers worldwide.

Maurere W. and coll. presents the new herbicide Tell 75 WG based on primisulfuron, which applied after the emergence in corn fields has considerably reduced the infestation with *Sorghum halepense* of seeds and root-stalks. The authors show that this herbicide is very effective, especially against *Elymus repens* (*Agropyrum repens*).

Beraud and coll. [1] have obtained very good results using the herbicide nicosulforan applied after the emergence when corn plants had 4-5 leaves. In Hungary, Berzseny and coll. (1995) have studied the influence of different herbicides against the species *Sorghum halepense* in corn fields.

Clode and Everaere [2] in France have studied the herbicide DPXE 9636 applied in very small doses to corn fields infested with *Sorghum halepense*. Also in France, Keyzer and coll. [3] have studied the effectiveness of Foe 5043 herbicides associated with metosulam and obtained very good results for the control of different species monocotyledons in corn farming.

An interesting experiment was realized in Poland by Rola Henrika (1997) studying the selectiveness of different corn hybrids, with whom the use of herbicides for the control of the *Sorghum halepense* species proved successful. In Italy, Villani and Palmier [4] have successfully used the nicosulfuron herbicide for a corn culture very severely infested with *Sorghum halepense*. Also, in Slovenia, Simonicica [5] has obtained remarkable results with the nicosulfuron herbicide against infestation with *Sorghum halepense*.

## MATERIAL AND METHOD

During 1999-2003, N. Sarpe, Mihalcea and Ramona Chirita have studied new herbicides for the control of *Sorghum halepense*.

The experiments took place in two localities:

At Baneasa - Giurgiu Station, in the embanked Danube meadows, on alluvial soil containing 3,50% humus and 27% clay.

At the Didactic Station of the University of Agricultural Studies and Veterinary Medical Studies - Timisoara, on chernozem soil containing 3,4% humus and 32% clay.

In both stations, experiments were placed following the method of random blocks, in 4 repetitions, each lot having a surface of 25 $m^2$.

At the Baneasa - Giurgiu Station and the Didactic Station Timisoara the following herbicides were used:

1.GUARDIAN containing 840 g/l acetochlore;

2. TITUS 25 DF containing 25% rimsulfuron;

3.MISTRAL containing 40 g/l nicosulfuron;

4.ICETIN SUPER containing 100 g/l dicamba + 300 g/l / 2,4 - D

5.MAISTER containing 300 g/l foramsulfuron + 10 g/kg iodosulfuron - methylsodium + 300 g/kg iodosulfuron - diethyl (safener);

6.EQUIP containing 22,5 g/l formasulfuron + 22,5 g/l isoxadifen - ethyl (saferen);

7.MIKADO care contine 300 g/l sulcotrione;

8.TERANO containing 25 g/kg metosulam + 600 g/kg flufenacet.

## RESULTS AND DISCUSSION

Table1 presents the results obtained at Baneasa Station.

Table 1

**Effectiveness of different herbicides against *Sorghum halepense* for corn cultures, with irrigation Baneasa - Giurgiu 1999-2001**

| **Species of dominant weed** | |
|---|---|
| *1. Sorghum halepense 70-80%* | *5. Setaria verticillata* |
| *2. Abutilon theophrasti* | *6. Solanum nigrum* |
| *3. Chenopodium album* | *7. Polygonum convulvulus* |
| *4. Echinochloa crus-galli* | 8. *Polygonum persicaria* |

| Herbicides | Rate l/ha | Time of applic. | Weed control % | | |
|---|---|---|---|---|---|
| | | | After 30 days | After 60 days | Before harvesting |
| 1.Control I - 3 hoeings | - | - | 97 | 90 | 80 |
| 2.Control II - not hoed | - | - | 0 | 0 | 0 |
| 1.Guardian + | 2,5 | ppi 5 cm | 55 | 40 | 35 |
| Icedin Super | 1,0 | postem I | | | |
| 2.Guardian + | 2,5 | ppi 5 cm | 70 | 60 | 52 |
| Titus 25 DF | 25 g | postem I | | | |
| 3.Guardian + | 2,5 | ppi 5 cm | 74 | 68 | 65 |
| Titus 25 DF | 50 g | postem I | | | |
| 4.Guardian + | 2,5 | ppi 5 cm | 78 | 75 | 72 |
| Mistral | 1,0 | postem I | | | |
| 5.Guardian + | 2,5 | ppi 5 cm | 83 | 80 | 78 |
| Mistral | 2,0 | postem I | | | |
| 6.Guardian + | 2,5 | ppi 5 cm | 90 | 80 | 75 |
| Icedin Super + | 1,0 | postem I | | | |
| | 50 g | postem II | | | |
| 7.Guardian + | 2,5 | ppi 5 cm | 100 | 100 | 96 |
| Icedin Super + | 1,0 | postem I | | | |
| Mistral | 2,0 | postem II | | | |
| 8.Titus 25 DF | 50 g | postem II | 40 | 30 | 26 |
| 9.Mistral | 1,0 | postem II | 60 | 60 | 60 |
| 10.Mistral | 2,0 | postem II | 70 | 60 | 60 |

Postem I = the herbicides were used when the corn plant had 4-5 leaves, and the dicotyledons weed had 4-6 leaves;

Postem II = the herbicides were used when the corn plant had 7-8 leaves, and the Johnsongrass weed had 10-30 cm height.

Information in table 1 show that the herbicides effectiveness registered extremely high variations. For example, at the variant treated with Guardian + Icedin Super, 100% of the annual monocotyledons *Echinochloa crus-galli* and *Setaria verticillata* were removed. Also, a percent of 90-95% was realized when using this herbicide combination against *Sorghium halepense* appeared on seeds (due to the Guardian herbicide). Icedin applied after the emergence had a very good effect against dicotyledons resistant to acetochlore, such as the species from the *Abutilon*, *Chenopodium*, *Solanum* and *Polygonum* gender. Due to the severe infestation with *Sorghum halepense* appeared on root-stalks, the level of total control of the 3rd variant (Guardian + Icedin Super) was only 35% before the corn harvesting.

At the variants treated with (Guardian + Titus), the control level was 70-74% at 30 days from use and reduced to 52-65% before the corn harvesting At these two herbicides Guardian + Titus, no control was obtained for the species from the genre Abutilon, Chenopodium, Solanum, Polygonum and Sorghum halepense which regenerated from the plants grown from root-stalks.

The effectiveness of the herbicides Guardian + Mistral in a dose of 1,0 liters per hectare ( l/ha ) was also unsatisfactory because the control level for all weeds was only 72-78% before the corn harvesting and the weed belonging to the genre *Abutilon*, *Chenopodium*, *Solanum*, *Polygonum* remained uncontrolled. It should be noted that in case of Mistral, used in a dose of 1 l/ha, the level of regeneration of *Sorghum halepense* was very high, about 70%.

The best results against *Sorghum halepense* and other species of weed were obtained at the variant treated with 3 herbicides: Guardian 2,5 l/ha + Icedin Super 1 l/ha + Mistral 2 l/ha. The level of control for this variant was 100% after 30 days and 60 days and 96% before the corn harvesting.

Results somehow satisfactory were obtained for the variant treated with Guardian + Icedin Super + Titus, that shown a control level of 90% after 30 days but before the corn harvesting reduced to 75% due to regeneration of *Sorghum halepense* plants grown from root-stalks.

Table 2 presents the results obtained at the corn kernel production.

Table 2

**Production of kernel of corn treated with different herbicides used against *Sorghum halepense*, with irrigation Baneasa - Giurgiu 1999-2001**

| Herbicides | Rate l/ha | Time of applic. | YIELD | | Production increase compared to Guardian + Icedin |
|---|---|---|---|---|---|
| | | | Kg/ha | % | |
| 1.Control I - 3 hoeings | - | - | 12730 | 100 | - |
| 2.Control II - not hoed | - | - | 2927 | 23 | - |
| 3.Guardian + Icedin Super | 2,5 1,0 | ppi 5 cm postem I | 4710 | 37 | - |
| 4.Guardian + Titus 25 DF | 2,5 25 g | ppi 5 cm postem I | 7001 | 55 | +2291 |
| 5.Guardian + Titus 25 DF | 2,5 50 g | ppi 5 cm postem I | 8147 | 64 | +3437 |
| 6.Guardian + Mistral | 2,5 1,0 | ppi 5 cm postem I | 9038 | 71 | +5092 |

| Herbicides | Rate l/ha | Time of applic. | YIELD | | Production increase compared to Guardian + Icedin |
|---|---|---|---|---|---|
| | | | Kg/ha | % | |
| 7.Guardian +<br>Mistral | 2,5<br>2,0 | ppi 5 cm<br>postem I | 10056 | 79 | +5346 |
| 8.Guardian +<br>Icedin Super +<br>Titus 25 DF | 2,5<br>1,0<br>50 g | ppi 5 cm<br>postem I<br>postem II | 9802 | 7 | +5092 |
| 9.Guardian +<br>Icedin Super +<br>Mistral | 2,5<br>1,0<br>2,0 | ppi 5 cm<br>postem I<br>postem II | 13239 | 104 | +8529 |
| 10.Titus 25 DF | 50 g | postem II | 3691 | 29 | -1019 |
| 11.Mistral | 1,0 | postem II | 4073 | 32 | -637 |
| 12.Mistral | 2,0 | postem II | 4740 | 37 | -30 |
| Postem I = The herbicides were used then the corn plant had 4-5 leaves, and the dicotyledons weed had 4-6 leaves<br>Postem II = The herbicides were used when the corn plant had 7-8 leaves, and the Johnsongrass weed had 10-30cm height | | | | | |

At the analysis of information in table 2, it is evident that kernel productions in the experiments' variants registered extreme variations because of the great differences in weed control, due to the strong connection between the control level and the kernel corn production.

The highest kernel corn productions of 13239 kg/ha were obtained at the variant 9, treated with Guardian + Icedin Super + Titus or Mistral, the kernel production was 9802 kg/ha -a lot inferior to the variant treated with Guardian + Icedin Super + Mistral.

The lowest kernel productions were registered at the variants treated after the emergence with Titus or Mistral. At this variants, compared to the hoed control sample, over 8.000 - 9.000 kg kernel corn per hectare were lost.

The results obtained at the Didactic Station of the University of Agricultural Studies and Veterinary Medical Studies in Timisoara are presented in table 3.

At the analysis of data presented in table 3, it results that the effectiveness of the chemical methods against *Sorghum halepense* depended on a large extent on the active substance of each herbicide and on the dose used per hectare.

The most efficient herbicide, ranked on the first place, is Mistral. Still, even for this herbicide, the effectiveness depended on the dose that was used. For example, at a dose of 1 liter and 2 liters per hectare, the control level evaluated before the corn harvesting was 60-80%, while for the doses of 3 liters and 5 liters per hectare, the control level against *Sorghum halepense* before the corn harvesting was 100%. For the doses of 1 and 2 liters of Mistral per hectare, the regeneration level was zero, meaning that the *Sorghum halepense* in root-stalks was removed at 100%.

The herbicide Mistral was ranked on second place, the control level against *Sorghum halepense* before the corn harvesting being only 20 respectively 25%, and even for maximum doses of 200 and 300 g /ha the control level before the corn harvesting was 80-90%. The regeneration phenomenon of *Sorghum halepense* in root-stalks was more intense in the case of the Maister herbicide compared to the

Mistral herbicide. From the data of table 3 and at maximum doses (200-300 g/ha) of Maister, the regeneration level was 10-20%.

Table 3

**Effectiveness of the herbicides used for corn infested with *Sorghum halepense*, without irrigation University of Agricultural studies, Timisoara - 2003-2005**

| Species of dominant weed | | | | | |
|---|---|---|---|---|---|
| *1. Sorghum halepense 70-80%*<br>*2. Echinochloa crus-galli*<br>*3. Setaria verticillata*<br>*4. Amaranthus retroflexus* | | | *5. Chenopodium album*<br>*6. Hibiscus trionum*<br>*7. Polygonum convulvulus*<br>*8. Cirsium arvense* | | |
| **Herbicides** | **Rate l/ha** | **Time of applic.** | **Weed control %** | | **Regeneration of Sorghum halepense** |
| | | | **After 30 days** | **After 60 days** | |
| 1.Control I - 3 hoeings | - | - | 100 | 93 | 10 |
| 2.Control II - not hoed | - | - | 0 | 0 | 100 |
| 3. Mistral | 1,0 | postem | 80 | 60 | 50 |
| 4. Mistral | 2,5 | postem | 94 | 80 | 20 |
| 5. Mistral | 3,0 | postem | 100 | 100 | 0 |
| 6. Mistral | 5,0 | postem | 100 | 100 | 0 |
| 7. Maister | 0,100 | postem | 60 | 20 | 80 |
| 8. Maister | 0,150 | postem | 90 | 25 | 75 |
| 9. Maister | 0,200 | postem | 95 | 80 | 20 |
| 10. Maister | 0,300 | postem | 100 | 90 | 10 |
| 11. Equip | 1,0 | postem | 50 | 17 | 83 |
| 12. Equip | 2,0 | postem | 60 | 37 | 63 |
| 13. Equip | 3,0 | postem | 65 | 45 | 55 |
| 14. Equip | 5,0 | postem | 80 | 60 | 40 |
| 15. Mikado | 1,0 | postem | 30 | 5 | 95 |
| 16. Mikado | 1,5 | postem | 50 | 5 | 95 |
| 17. Mikado | 3,0 | postem | 55 | 10 | 90 |
| 18. Mikado | 5,0 | postem | 60 | 12 | 88 |
| 19. Terano | 1,0 | postem | 32 | 5 | 95 |
| 20. Terano | 2,0 | postem | 53 | 5 | 95 |
| 21. Terano | 3,0 | postem | 56 | 5 | 95 |
| 22. Terano | 5,0 | postem | 65 | 8 | 82 |
| Note: in fighting against *Sorghum halepense* in seeds and other monocotyledon species, the Guardian herbicide was used before the corn sowing in a dose of 2.5 l/ha and the Icedin Super 1.0 l/ha was used against dicotyledons post-emergence. | | | | | |

The lowest effectiveness against *Sorghum halepense* in root-stalks was registered at the herbicide Mikado and Terano. The control level of these two herbicides before the corn harvesting was only 5% at minimum doses of 1 l/ha and 8-12%, at maximum doses of 5 l/ha. In case of these herbicides, a strong regeneration of *Sorghum halepense* plants on root-stalks was registered after 60 days from use - the respective plants grew mature seeds and viable root-stalks, which is the most dangerous phenomenon.

As it is shown in table 3, the regeneration level in case of the 3 herbicides was very high, of 78-88% in case of doses of 5 l/ha, and reached over 90-95% in case of minimum doses of 1.0-1.5 l/ha.

Table 4 presents the results on kernel production.

Table 4

**Kernel production of corn treated with different herbicides, University of Agricultural studies - Timisoara, 2003-2005**

| Herbicides | Rate l/ha | Time of applic. | YIELD | |
|---|---|---|---|---|
| | | | Kg/ha | % |
| 1.Control I - 3 hoeings | - | - | 6500 | 100 |
| 2.Control II - not hoed | - | - | 6700 | 10 |
| 3. Mistral | 1,0 | postem | 4710 | 72 |
| 4. Mistral | 2,5 | postem | 5050 | 77 |
| 5. Mistral | 3,0 | postem | 6510 | 100 |
| 6. Mistral | 5,0 | postem | 5925 | 106 |
| 7. Maister | 0,100 | postem | 3438 | 52 |
| 8. Maister | 0,150 | postem | 5240 | 80 |
| 9. Maister | 0,200 | postem | 5820 | 89 |
| 10. Maister | 0,300 | postem | 6050 | 93 |
| 11. Equip | 1,0 | postem | 1950 | 30 |
| 12. Equip | 2,0 | postem | 2600 | 40 |
| 13. Equip | 3,0 | postem | 3705 | 57 |
| 14. Equip | 5,0 | postem | 4875 | 75 |
| 15. Mikado | 1,0 | postem | 780 | 12 |
| 16. Mikado | 1,5 | postem | 1170 | 18 |
| 17. Mikado | 3,0 | postem | 1690 | 26 |
| 18. Mikado | 5,0 | postem | 1755 | 27 |
| 19. Terano | 1,0 | postem | 910 | 14 |
| 20. Terano | 2,0 | postem | 1300 | 20 |
| 21. Terano | 3,0 | postem | 1690 | 26 |
| 22. Terano | 5,0 | postem | 2015 | 31 |

At the analysis of data in table 4, a strong connection between the control level and the corn production is noted.

At the variants treated with the Mistral herbicide, in dose of 3 and 5 l/ha, the highest production of kernel was registered: 6510-6925 kg/ha. These productions were possible because at the doses of 3 and 5 l/ha, *Sorghum halepense* in root-stalks as well as other weed species were removed at the level of 100% on variants treated with Mistral in doses below the optimal ones, meaning 1 and 2 l/ha, the kernel production diminished with approx. 1750 respectively 1450+kg/ha representing a decrease of 30-40% statistically ensured.

For the Maister herbicide, only at the maximum dose of 300 g/ha a production of 6050 kg kernel /ha was obtained, representing 93% of the production of the control sample, hoed 3 times.

For the Equip herbicide, because of the low level of control against *Sorghum halepens*, the corn production was very much lower than in the case of the Mistral herbicide used in equal doses per hectare. As you may note, even in the case of the maximum dose of 5 l/ha, the kernel production was of only 4875 kg/ha, representing 75% of the production obtained at variant 3 with 3 hoes.

The lowest production of kernel corn was obtained at the variants treated with Mikado and Terano. In case of these herbicides, at minimum doses, an extremely low, derisory production of 780-1309 kg/ha was obtained.

For the Mikado and Terano herbicides used, even for maximum doses of 5 l/ha, the kernel production represented only 27-37% of the production of the 3 hoeings variant. These extremely low kernel productions are undoubtfuly caused by the inefficiency of these herbicides against *Sorghum halepense* in root-stalks.

## CONCLUSIONS

1. In the existent conditions in Romania, *Sorghum halepense* produces damages reaching almost 40-80% depending on the infestation level. In the Danube meadows, with the use of irrigation, the damages on corn culture exceed 8.000-10.000 kg/ha.

2. At the Baneasa - Giurgiu Station, with the use of irrigation, a 100% removal of the species *Sorghum halepense* and the highest corn productions were obtained at the variants treated ppi with Guardian 2,5 l/ha and then after the emergence with Mistral in dose of 2,0 l/ha.

3. At the Didactic Station of the University of Agricultural Studies and Veterinary Medical Studies Timisoara, the best results against the species *Sorghum halepense* were obtained for the use of the Mistral herbicide at a dose of 3 l/ha and of Maister herbicide at a dose of 300 g/ha.

### BIBLIOGRAPHY

1. Beraud M., Lopeze P., 1992 - *Nicosulfuron new herbicideto control perennial weeds maize*, Brighton Crop Protection, Conference Weeds, p. 157-162.
2. Clode and Everaere M., 1992 - *DPXE 9636 new herbicide to control Johnsongrass in corn,* Brighton Crop Protection, Conference Weeds, p. 237- 243.
3. Keyzer J. and coll., 1998 - *The effect of herbicide Foe 5043 in maize*, Brighton Crop Protection, Conference Weeds, p. 901- 909.
4. Villani M., Palmier E., 1995 - *Nicosulfuron herbicide for the post - emergence control Johnsongrass in corn*, Brighton Crop Protection, Conference Weeds, p. 984-1002
5. Simonicica P., 1997 - *Use of new herbicides nicosulfuron*, Brighton Crop Protection, Conference Weeds, p. 1009-1017.
6. Şarpe N., 1987 - *Combaterea integrată a buruienilor din culturile agricole*, Editura Ceres, Bucureşti, p. 486.