RESPONSE OF TOLERANT SUNFLOWER HYBRID FROM SERBIA TO TRIBENURON-METHYL

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Growing crops tolerant to herbicides is part of IWM concept.

- Crops tolerant to herbicides
  - Genetically modified crops
  - Tolerant crops made by conventional breeding methods
Benefits

- Easier and cost-effective weed control
- More effective control of troublesome weeds
- More flexible weed control
- Weed control based on economic thresholds and CTWC
- Control of resistant and parasitic weeds
- Higher yield
- Using environmentally acceptable herbicides....
Risks with TC

“gene flow”

volunteers

expression stability of introduced genes

introduced genes toxicity

allergens for people and domestic/wild animals
Three technologies of weed control include crop tolerance to herbicides:

- Clearfield system
- ClearfieldPlus_system
- ExpresSun system
Growing area in RS: 180 000 ha
Why tolerant sunflower is too popular?

Due to......

A lack of effective herbicides for broadleaf weeds control after crop emergence

There is no new molecules of herbicides for weed control of this crop, due to high cost of herbicide registration.
Tolerant sunflower hybrids in Serbia (in 2003)

Tolerant to IMI herbicides (Clearfield) donor of genes for tolerance: wild H. annuus population collected at Rossville, Kansas, USA (Al-Khatib et al., 1998)

Tolerant to SU herbicides (ExpressSun)

Sources of genes for tolerance: genetic stocks SURES-1 and SURES-2 (Miller and Al-Khatib, 2004)
Helianthus annuus L.

- cultivated (hybrids) plants
- "off-type" crop plants
- volunteer plants
- wild sunflower
- weedy sunflower

Gene flow
First case of gene flow from tribenuron-methyl tolerant sunflower to weedy sunflower were confirmed.
**KNOWN**

- Donor of genes for tolerance
- **Way** of inheritance of tolerance
- Efficacy of tribenuron-methyl for control of weeds present in sunflower in Serbia

**UNKNOWN**

- Precise level of tolerance of tolerant sunflower hybrid (breeding in Serbia) to tribenuron-methyl
- Possibility of use chlorophyll fluorescence parameters for fast testing sunflower tolerance to tribenuron-methyl
Tolerant sunflower hybrid response to tribenuron-methyl based on:

A whole-plant response (in pots and in the field)

ALS enzyme activity \textit{in vitro}

Chlorophyll fluorescence \textit{in vivo} (Fluorimeter PAM-2100)
**Material & Methods**

A whole-plant response (in pots and in the field)

0, 22.5, 45, 67.5, 90, 135 g a.i.ha$^{-1}$; grown in pots
0, 11.25, 22.5, 33.75, 45, 67.5, 90, 112.5 g a.i.ha$^{-1}$; grown in field

ALS enzyme activity *in vitro*

0, 0.01, 0.1, 1, 10, 100 µM

Chlorophyll fluorescence *in vivo*

0X; 0.2X; 0.4X; 0.6X; 0.8X; 1.0X; 1.2X; 1.4X; 1.6X; 1.8X; 2.0X

X = 22.5 g a.i.ha$^{-1}$
A whole-plant response: pot experiment

\[ R^2: GR_{50} = 225 (26, 1972) \]
\[ S: GR_{50} = 4.0 (2.2, 7.2) \]

\[ R^2: GR_{50} = 196 (3, 12537) \]
\[ S: GR_{50} = 14 (9, 20) \]

\[ R^2: GR_{50} = 341 (3, 40625) \]
\[ S: GR_{50} = 7 (6, 9) \]
A whole-plant response: field experiment
ALS enzyme activity in vitro

$T$

$R_2: l_{50} = 63 (45.89)$

$S: l_{50} = 0.024 (0.017, 0.034)$

RI = 2618
## Chlorophyll fluorescence parameters

**FLUORIMETER PAM-2100** (Heinz Walz, Germany)

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<thead>
<tr>
<th>Measured parameters</th>
<th>Calculated parameters</th>
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<tr>
<td>Fm</td>
<td>IF (IF =Ft/Fo)</td>
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Chlorophyll fluorescence

- **Fo**

- **ΦPSII**

- **Fv/Fm**

- **Fv**

T1-0X; T2-0,2X; T3-0,4X; T4-0,6X; T5-0,8X; T6-1,0X; T7-1,2X; T8-1,4X; T9-1,6X; T10-1,8X; T11-2,0X
A major findings of this study

High level of tolerance of sunflower hybrid tolerant to tribenuron-methyl was confirmed based on whole-plant response (in pots and in the field)

High level of tolerance of sunflower hybrid tolerant to tribenuron-methyl was confirmed based on ALS enzyme activity

Tribenuron-methyl affected chlorophyll fluorescence, but plants recovery and photosynthesis stabilized
What to do in the future?

Risk assessment of gene flow from tolerant hybrid to weedy sunflower

Education and informing of farmers

Development of strategies for crop-weedy sunflower hybrids control
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