59th Croatian & 19th International Symposium on Agriculture
11th – 16th February 2024

Influence of conservation tillage and fertilization on weed infestation and soybean yield

Brozović Bojana, Irena Jug, Boris Đurđević, Marija Ravlić, Iva Rojnica, Danijel Jug, Marko Aragović
(bojana.brozovic@fazos.hr)

ACTIVEsoil

Assessment of conservation soil tillage as advanced methods for crop production and prevention of soil degradation

http://www.activesoil.eu/index.php/hr/

Josip Juraj Strossmayer University of Osijek
Faculty of Agrobiotechnical Sciences Osijek

Introduction

- adaptation
- mitigation

- one of the most effective ways to adapt crop production to the present shifting and seasonal changes in average temperatures and precipitation amount in various agroecological conditions, with conservation tillage as the main tool

- The sustainability of implementation and wide general integration of conservation tillage in agriculture production depend mainly on the extent of expected changes in the weed community, the use of herbicides, and the development of effective weed management

- Weeds - common and widely present segments of crop fields

- Presence - interactions of agricultural production measures and environmental and ecological elements

- Weed abundance - conditioned by different management strategies (soil tillage, crop rotation, liming and fertilization, herbicide use, site specific)

- Pronounced variation, simple and prompt alternation to new environmental and agricultural conditions

- Damage - up to 80% yield loss

Conservation tillage

- Different possibilities of changes in weed abundance
- Extensive dominance of perennial weed species, but also annuals
- Higher total weeds densities, biomass, coverage, greater weed species number

The impact of conservation soil tillage on weed occurrence also depends on specific agroecological conditions combined with weed management strategies, whereby increased weediness does not always lead to yield loss.

The aim of the research was to determine the impact of conservation tillage and fertilization on the weed status of soybean

- Čačinci (17.86336 E, Lat. 45.61316 N, Alt. 111 m)
- Stagnosol – limited physical, chemical and biological soil properties:

pH (KCl) = 4,09, pH (H_2O) = 5,65

OM = 2,8%

Al-K_2O = 15,63 mg$100g^{-1}$ soil

Al-P_2O_5 = 10,37 mg$100g^{-1}$ soil

- Split plot experimental design

Materials and methods

Main treatment

- Soil tillage
  - ST tillage - conventional, plowing (30 cm)
  - CTD tillage - conservation, loosening with a minimum of 30% of crop residues
  - CTS tillage - conservation, shallow tillage up to 10 cm with a minimum of 50% crop residues

Subtreatment

- Fertilization
  - FR (according to the recommendation)
  - FD (50% of the recommendation)
  - Recommended fertilization: NPK 40:150:94 + 40 kg N ha^{-1} KAN

Herbicide application

- Uniform for all treatments
- Pre-em: 960 gl^{-1} S-Metolachlor (1.2 l ha^{-1}), Metribuzin 70 % (0.6 kg ha^{-1})
- Post-em: 22.4 g l^{-1} Imazamox, 480 g l^{-1} Bentazon (1 l ha^{-1})

Weed assessment

Weed sampling – V3 (three trifoliate) and R7 (beginning maturity).

Weed density, above-ground biomass, number of weed species, weed coverage were determined on each treatment and subtreatment.

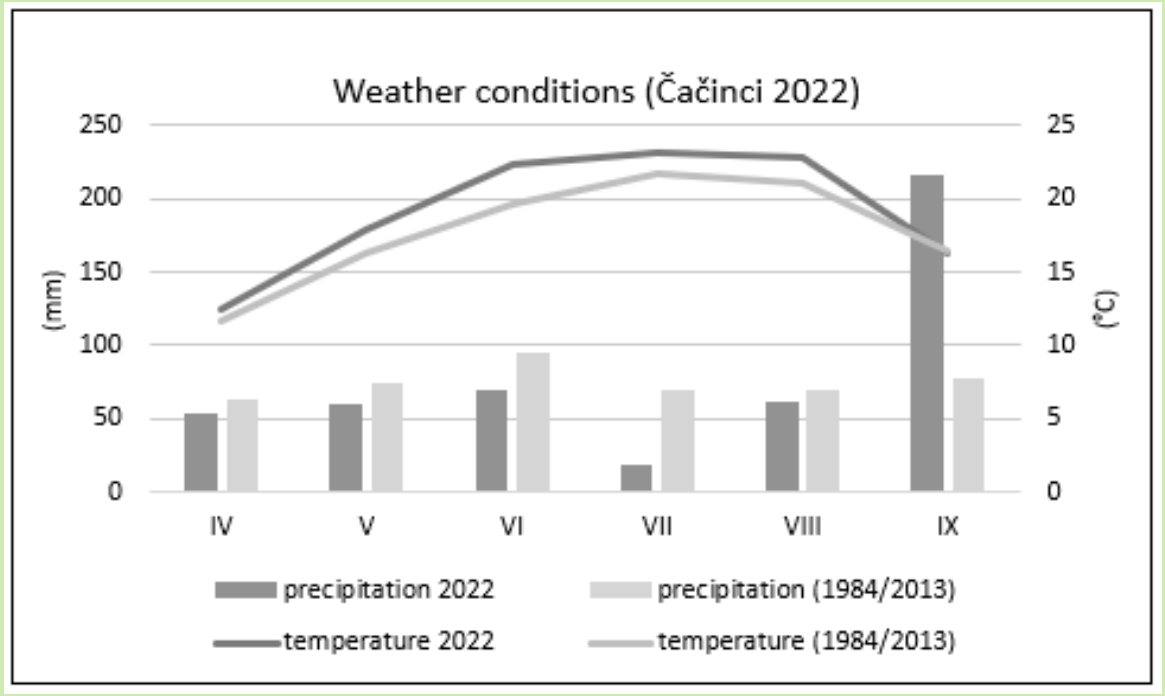
All classified weed species on the area of 0.25 m^2 in four repetitions were counted and cut off on the ground level, separated by different weed types and dried at 60 °C for 48 h.

Weed coverage was determined visually (*Vitta and Quintanilla, 1996*).

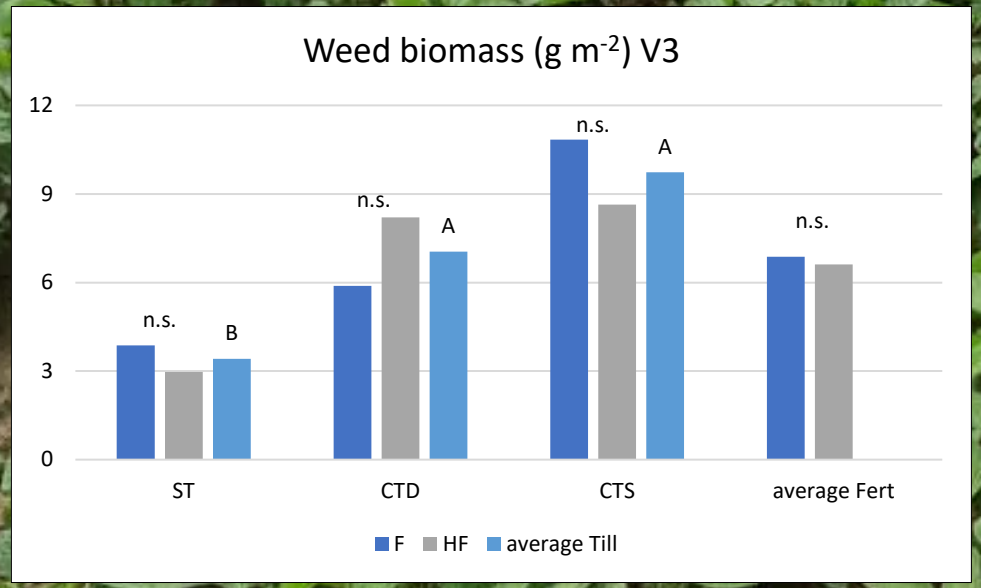
Determined weed species

- *Ambrosia artemissifolia* L.
- *Calystegia sepium* (L.) R. Br.
- *Cirsium arvense* (L.) Scop.
- *Convolvulus arvensis* L.
- *Lythrum salicaria* L.
- *Mentha spicata* L.
- *Setaria glauca* (L.) P. Beauv.
- *Setaria viridis* (L.) P. Beauv.
- *Panicum capilare* L.
- *Xanthium strumarium* L.

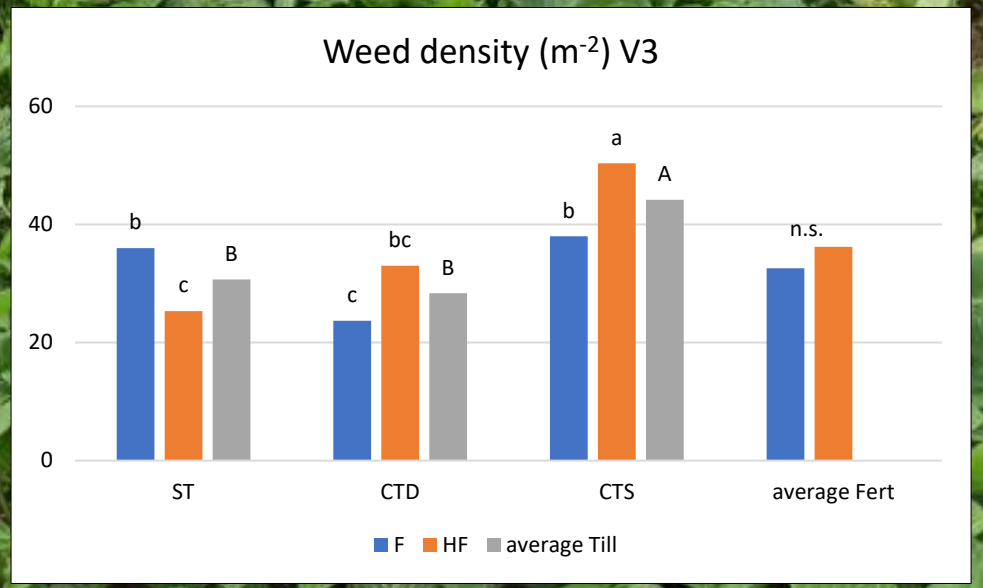
Weather conditions



Results – first weed sampling in critical weed free period of soybean V3



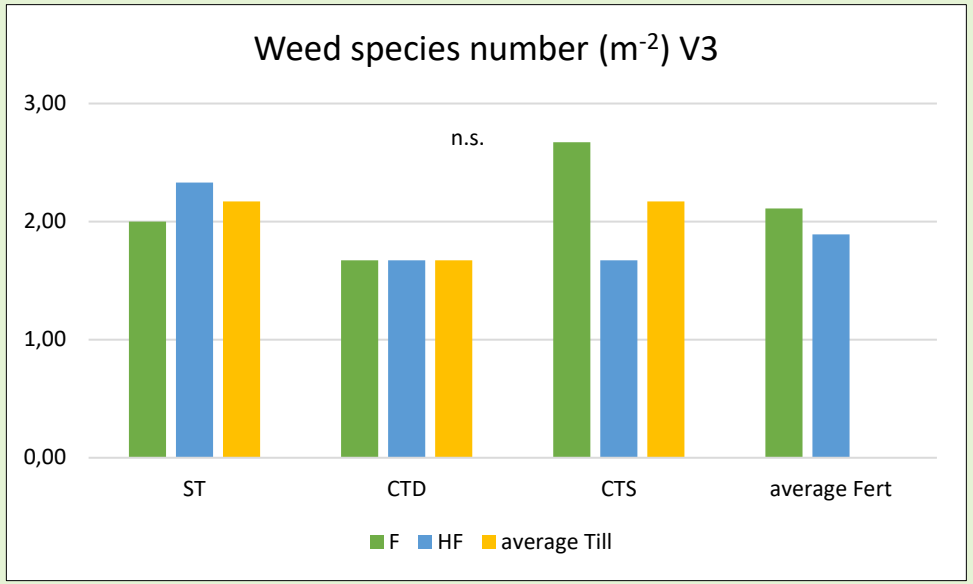
Graph 1. Weed biomass – V3



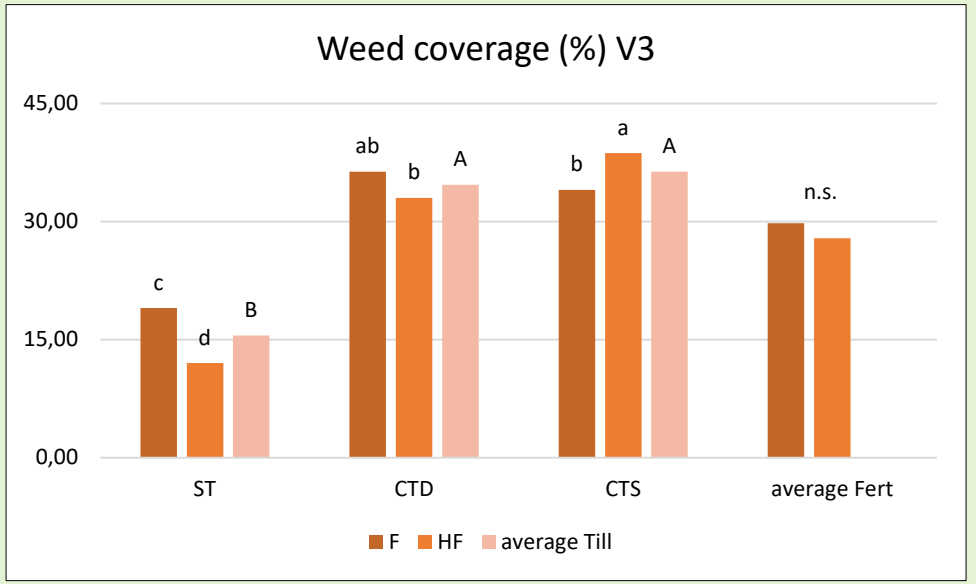
Graph 2. Weed density – V3

- columns marked with the same upper or lower case letter are not statistically significantly different ($p<0.05$)
- ST tillage - conventional, plowing (30 cm)
- CTD tillage - conservation, loosening, 30% crop residues
- CTS tillage - conservation, shalow tillage, 50% crop residues
- F (according to the recommendation)
- HF (50% of the recommendation)

Results – first weed sampling in critical weed free period of soybean V3

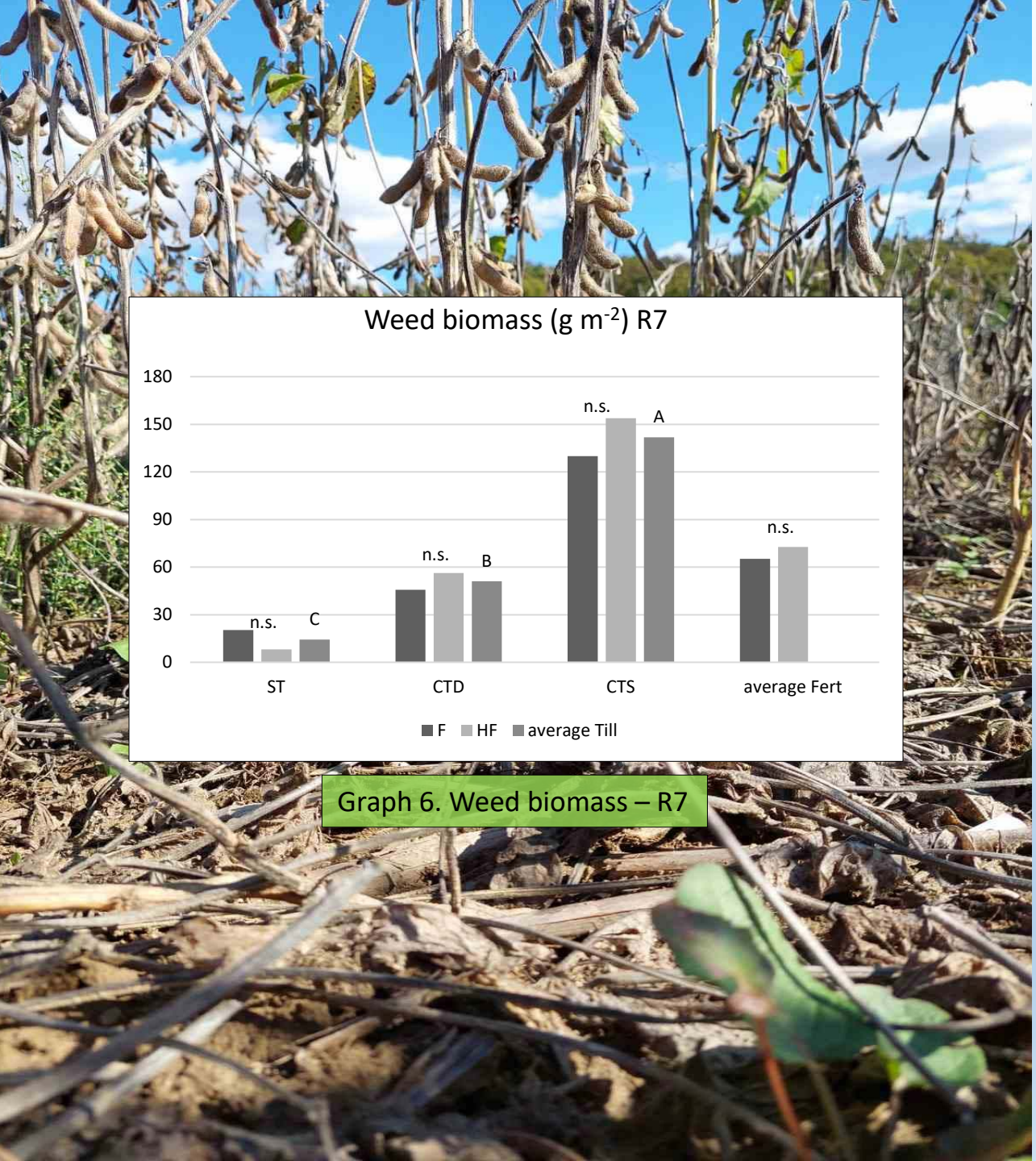


Graph 3. Weed species number – V3



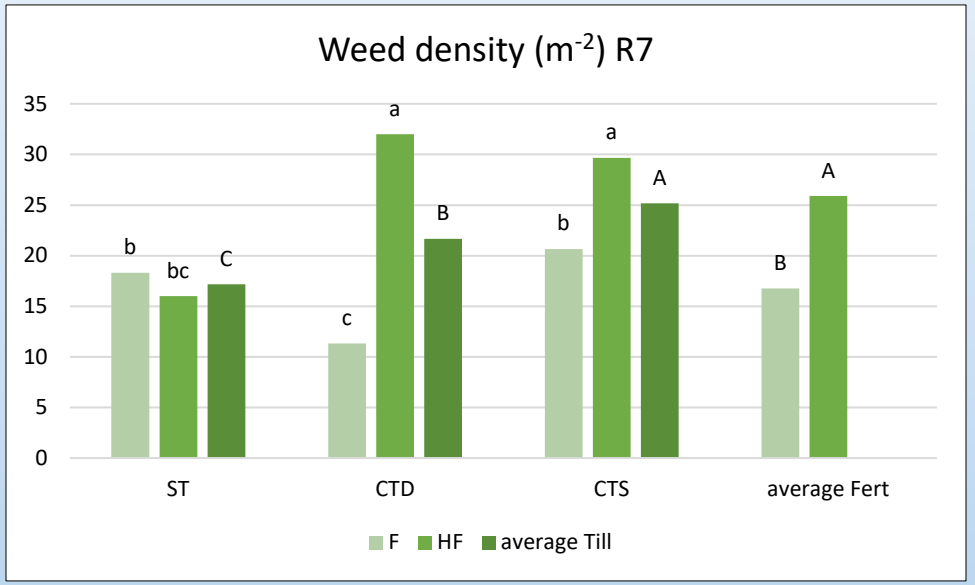
Graph 4. Weed coverage – V3

- columns marked with the same upper or lower case letter are not statistically significantly different ($p<0.05$)
- ST tillage - conventional, plowing (30 cm)
- CTD tillage - conservation, loosening, 30% crop residues
- CTS tillage - conservation, shalow tillage, 50% crop residues
- F (according to the recommendation)
- HF (50% of the recommendation)



Graph 6. Weed biomass – R7

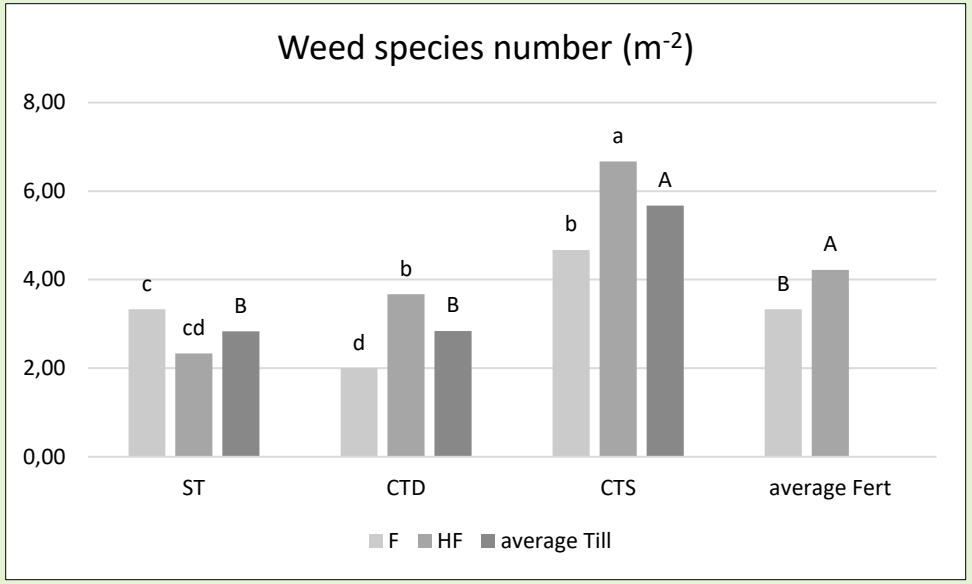
Results – second weed sampling (residual weed flora) – R7 growth stage of soybean



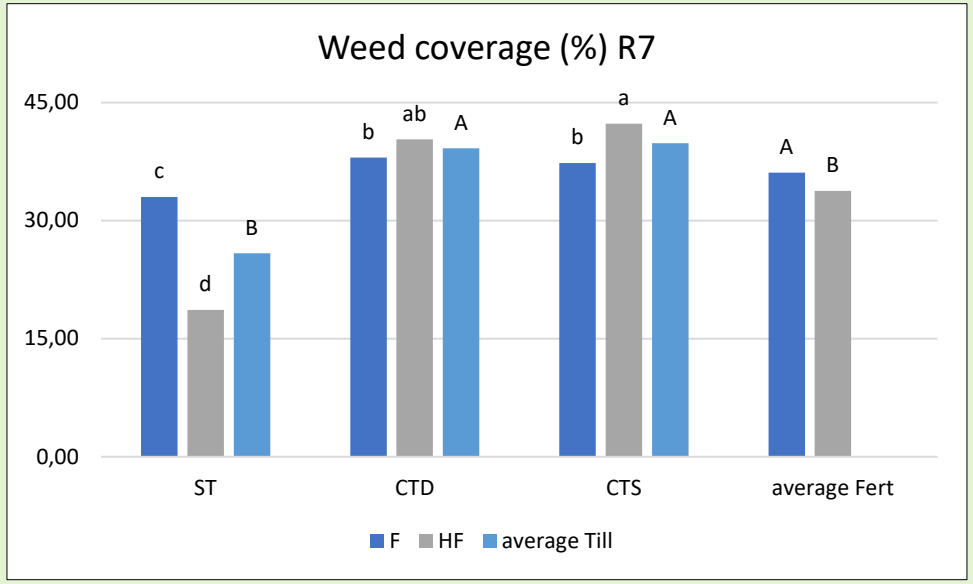
Graph 7. Weed density – R7

- columns marked with the same upper or lower case letter are not statistically significantly different($p<0.05$)
- ST tillage - conventional, plowing (30 cm)
- CTD tillage - conservation, loosening, 30% crop residues
- CTS tillage - conservation, shalow tillage, 50% crop residues
- F (according to the recommendation)
- HF (50% of the recommendation)

Results – second weed sampling (residual weed flora) – R7 growth stage of soybean



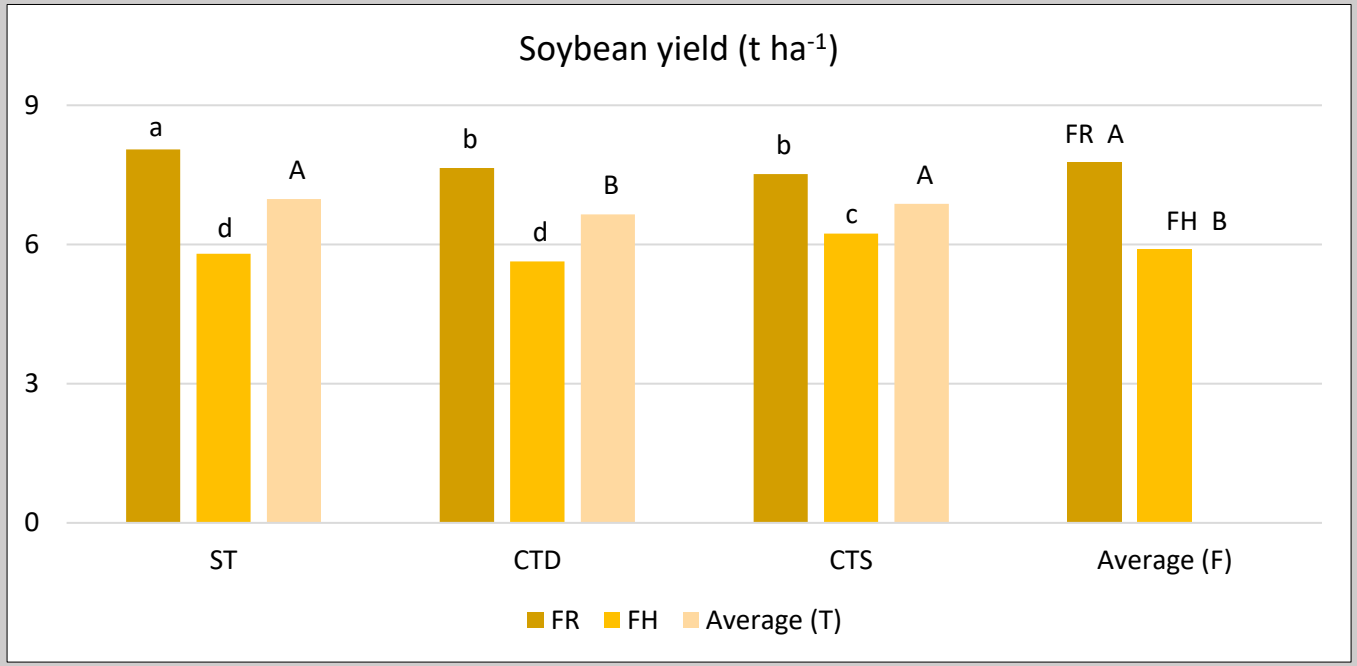
Graph 8. Weed species number – R7



Graph 9. Weed coverage – R7

- columns marked with the same upper or lower case letter are not statistically significantly different ($p<0.05$)
- ST tillage - conventional, plowing (30 cm)
- CTD tillage - conservation, loosening, 30% crop residues
- CTS tillage - conservation, shalow tillage, 50% crop residues
- F (according to the recommendation)
- HF (50% of the recommendation)

Results - Soybean yield on different tillage and fertilization treatments



Graph 10. Soybean yield

- columns marked with the same upper or lower case letter are not statistically significantly different ($p<0.05$)
- ST tillage - conventional, plowing (30 cm)
- CTD tillage - conservation, loosening, 30% crop residues
- CTS tillage - conservation, shalow tillage, 50% crop residues
- F (according to the recommendation)
- HF (50% of the recommendation)

Conclusion

- Conservation tillage systems had the effect of increasing the level of soybean weediness.
- The average influence of fertilization on weediness was less expressed compared to soil tillage.
- Tillage and fertilization significantly affected soybean yield.
- The highest soybean yields were achieved on the conventional (ST) and shallow conservation tillage systems (CTS) despite the fact that this treatment had the highest weediness.
- Reduced fertilization led to a decrease in soybean yield on average, but not on the CTS tillage system, which can be recommended as supstitution for plowing with the need for further research.

Thank you for attention

Acknowledgement

This work has been fully supported by **Croatian Science Foundation** under the project "Assessment of conservation soil tillage as advanced methods for crop production and prevention of soil degradation – **ACTIVEsoil**" (IP-2020-02-2647)