Unravelling the success of weed control by relay intercropping with legumes in low-input cereal-based Mediterranean cropping systems

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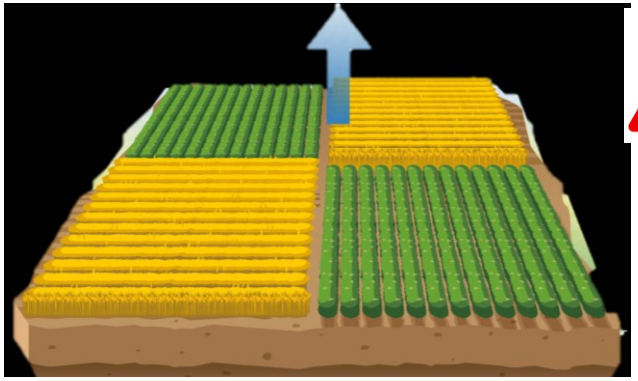
5 June 2024

Highly specialized and simplified agricultural



Weed control strategy based on **Herbicides**

Weed species are increasingly difficult to be controlled

Health and environmental impacts of herbicides residues

- Weed resistance
- High specialization of weeds for simplified agro-ecosystems
- Progressive reduction of chemical products
- Increasing restriction to the use of herbicide

IWM

Integrated **W**eed **M**anagement

Many tools and tactics are combined to manage weeds

Reliance on herbicides

Weed control

Maintain crop productivity

IWM

Integrated Weed Management

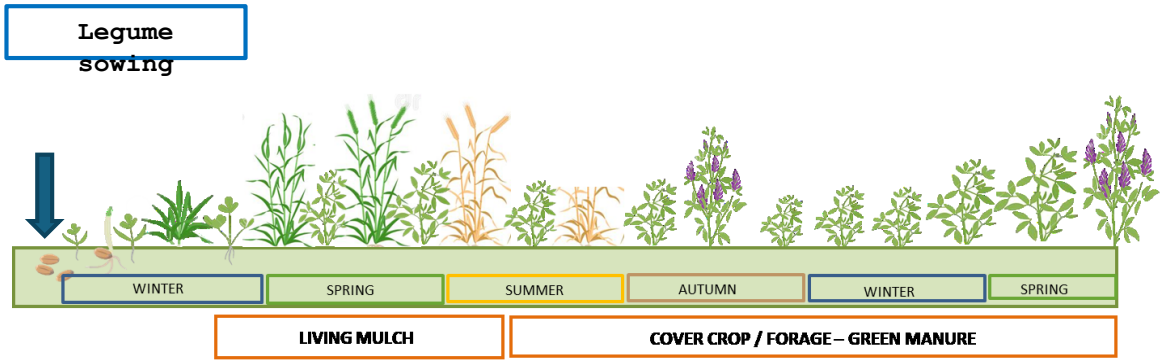
Diverse cropping systems

Intercropping

Intercropping is a farming practice involving two or more crop species, or genotypes, growing together and coexisting for a time. *

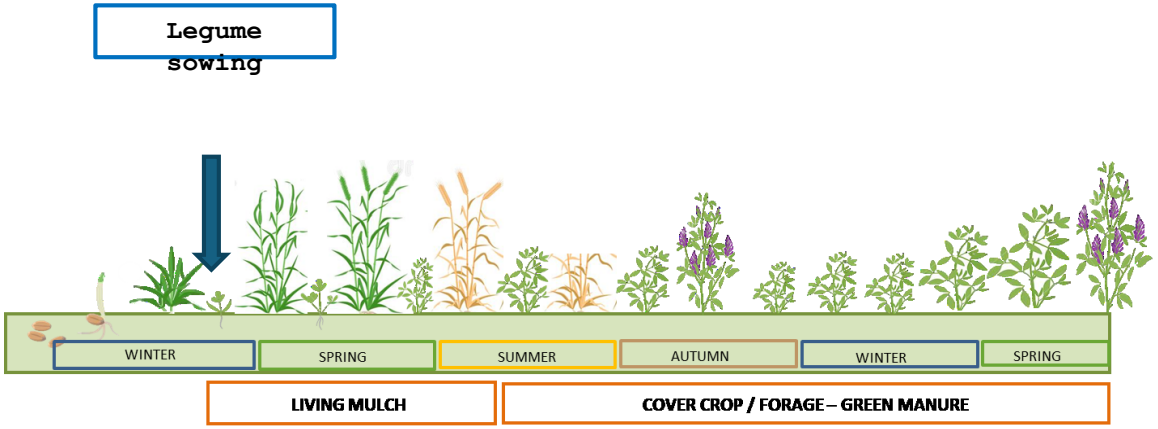
*Brooker, R.W., Bennett, A.E., Cong, W.-F., Daniell, T.J., George, T.S., Hallett, P.D., Hawes, C., Iannetta, P.P.M., Jones, H.G., Karley, A.J., Li, L., McKenzie, B.M., Pakeman, R.J., Paterson, E., Schöb, C., Shen, J., Squire, G., Watson, C.A., Zhang, C., Zhang, F., Zhang, J. and White, P.J. (2015), Improving intercropping: a synthesis of research in agronomy, plant physiology and ecology. New Phytol, 206: 107-117. https://doi.org/10.1111/nph.13132

Contemporary intercropping



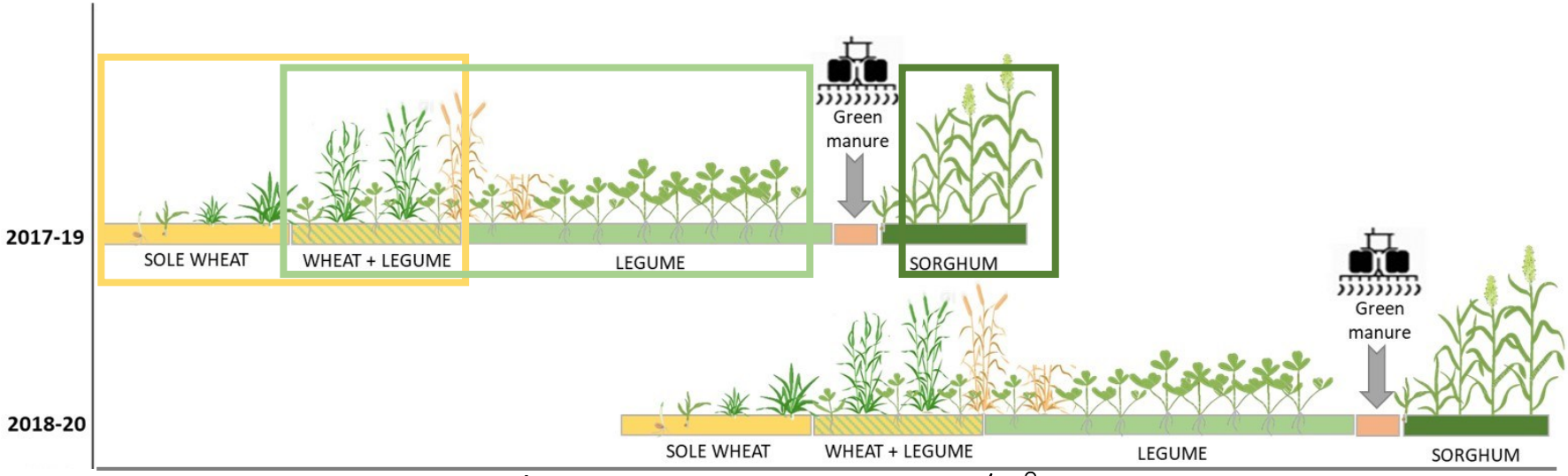
Two crops are sown at the same time

Relay intercropping



Sowing of crop 2 is delayed compared with crop 1

CONCEPTUAL DIAGRAM AND TREATMENTS



- Durum wheat cv. Minosse: 350 plants/m^2 (≃ 200 kg/ha)

- Subsidiary legumes:
  - *Medicago sativa* (cv Gamma, 40 kg/ha)
  - *Trifolium repens* (cv Companion, 15 kg/ha)
  - *Hedysarum coronarium* (cv Carmen, 30 kg/ha)
  - *Medicago lupulina* (40 kg/ha)
  - *Medicago polymorpha* (cv Scimitar, 40 kg/ha)
  - *Trifolium subterraneum* (cv Mont Barker, 15 kg/ha)
  - *Trifolium incarnatum* (cv Kardinal, 40 kg/ha)

Perennial

Annual self-seeding

Annual

- Forage-Sorghum cv. Sugar Graze 2: 150 plants/m^2 (≃ 35 kg/ha)

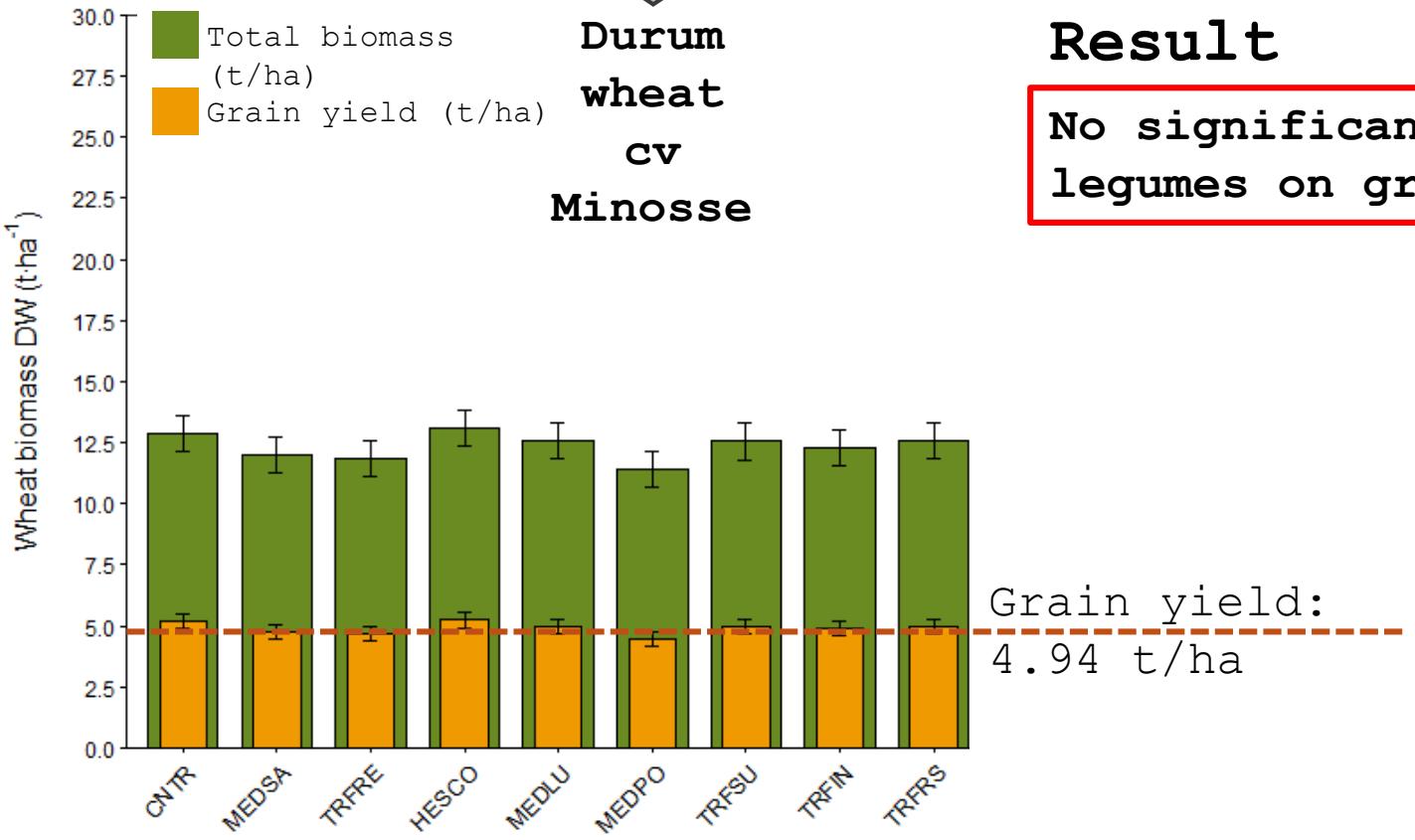
Experimental design

- Low – input management
- 2 year wheat – sorghum rotation
- 4 replication (blocks)

CROP PRODUCTION

Durum wheat

Durum wheat cv Minosse



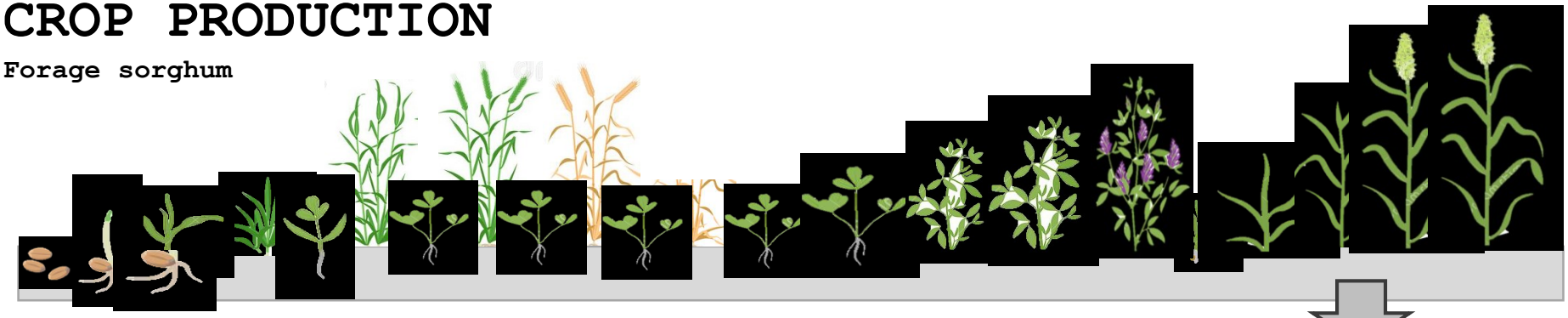
Result

No significant effect of legumes on grain yield

CNTR: control plot (wheat as sole crop) ; **MEDSA**: *M. sativa*; **TRFRE**: *T. repens*; **HESCO**: *H. coronarium*; **MEDLU**: *M. lupulina*; **MEDPO**: *M. polymorpha*; **TRFSU**: *T. subterraneum* ; **TRFIN**: *T. incarnatum*; **TRFRS**: *T. resupinatum*

CROP PRODUCTION

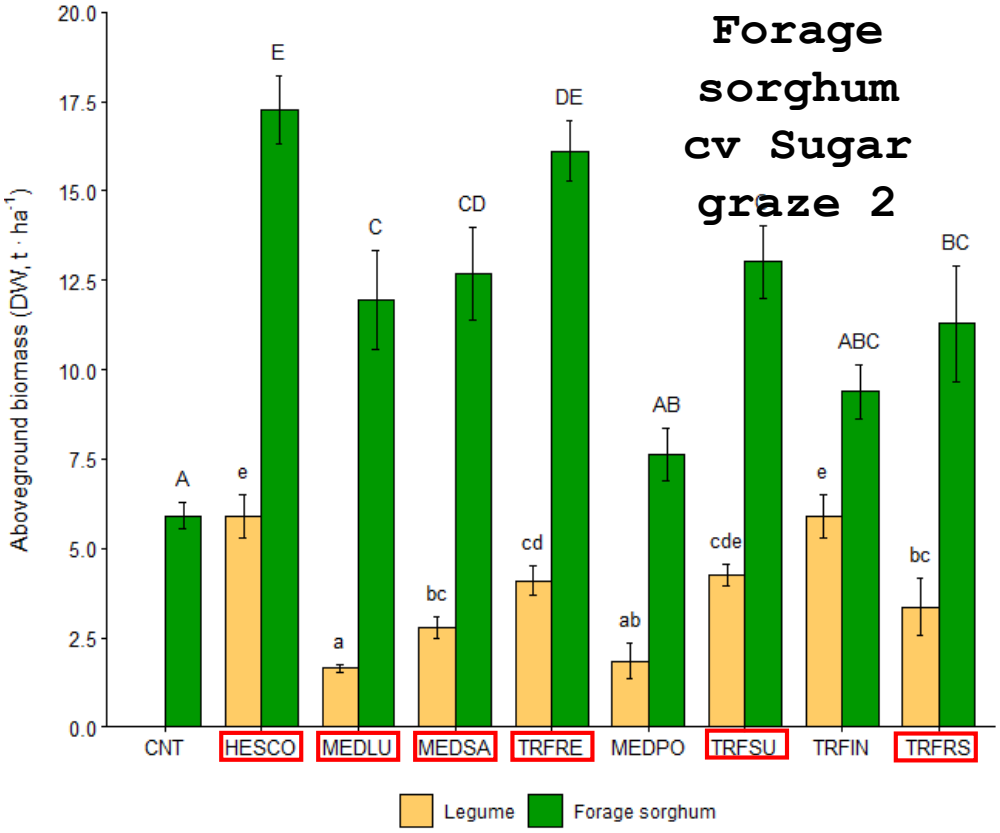
Forage sorghum



Results

- **Beneficial effect of legumes on sorghum biomass production**
- **Sorghum preceded by *Hedysarum coronarium*, *Medicago lupolina*, *Medicago sativa*, *Trifolium repens*, *Trifolium subterraneum* had a production level of 11.88 (DW, t/ha)**

Forage sorghum cv Sugar graze 2



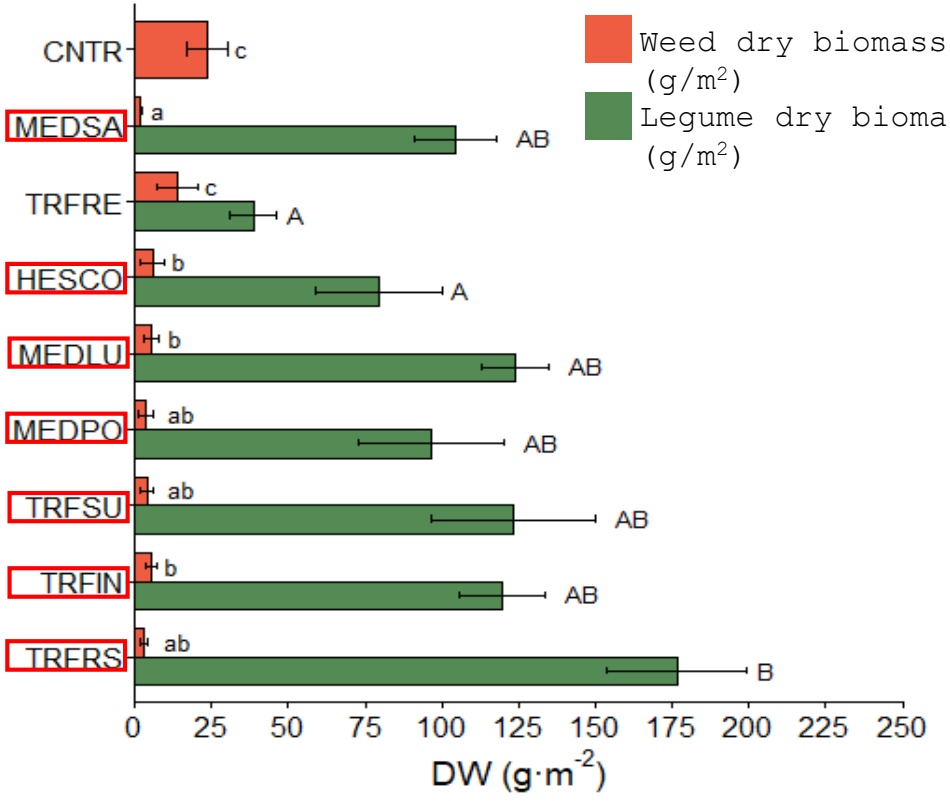
Production level of the same sorghum type grown under conventional condition range **from 13.5 to 15.4 DW t/ha** (Pannacci and Bartolini 2016).

CNTR: control plot; **MEDSA**: *M. sativa*; **TRFRE**: *T. repens*; **HESCO**: *H. coronarium*; **MEDLU**: *M. lupulina*; **MEDPO**: *M. polymorpha*; **TRFSU**: *T.*

Pannacci, E., Bartolini, S., 2016. Evaluation of sorghum hybrids for biomass production in Central Italy. Biomass Bioenergy, 88,135-141. https://doi.org/10.1016/j.biombioe.2016.03.024

WEED CONTROL

At wheat harvest time



CNTR: control plot (sole wheat); **MEDSA**: *M. sativa*; **TRFRE**: *T. repens*; **HESCO**: *H. coronarium*; **MEDLU**: *M. lupulina*; **MEDPO**: *M. polymorpha*; **TRFSU**: *T. subterraneum* ; **TRFIN**: *T.*

Results

- **Relay intercropping of legumes improve the weed control**

Weed biomass (DW, g/m²)

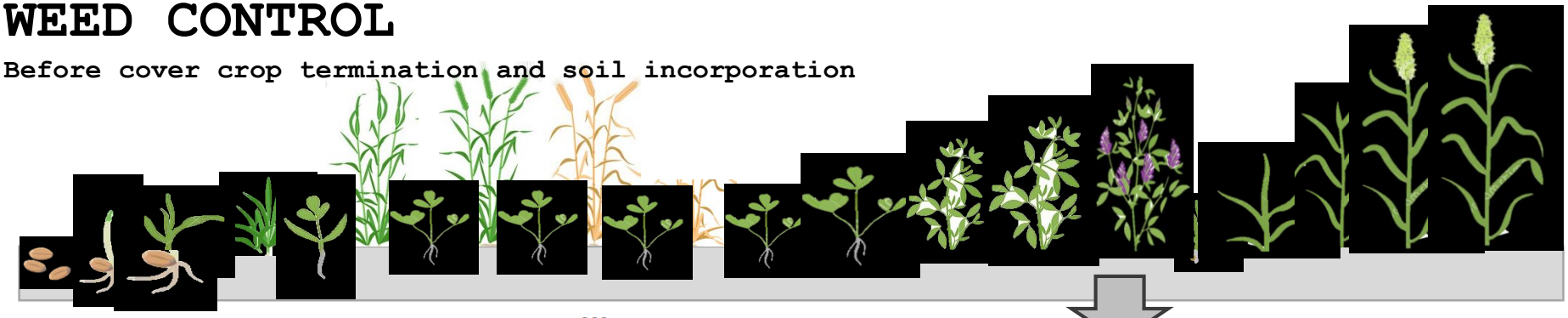
- Control (sole wheat stand) -> **23,47 DW, g/m²**
- *Medicago sativa* (MEDSA)
- *Hedysarum coronarium* (HESCO)
- *Medicago lupolina* (MEDLU) **3,62 DW, g/m²**
- *Medicago polymorpha* (MEDPO)
- *Trifolium subterraneum* (TRFSU)
- *Trifolium incarnatum* (TRFIN)
- *Trifolium resupinatum* (TRFRS)

Weed control: -85%

Leoni, F., Lazzaro, M., Ruggeri, M., Carlesi, S., Meriggi, P., Moonen, A-C., 2022 Relay intercropping can efficiently support weed management in cereal-based cropping system when appropriate legume species are chosen. Agron Sustain Dev,42, 75.

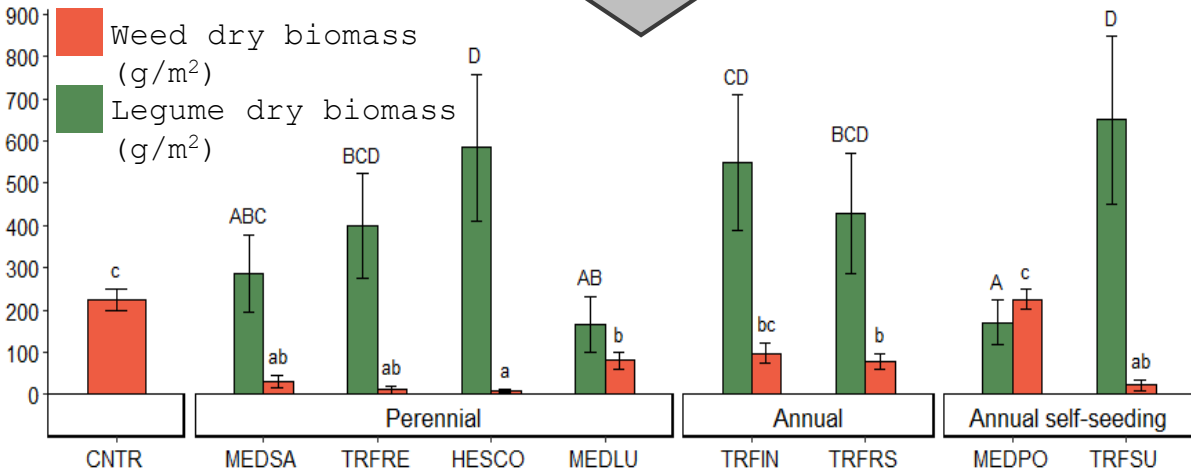
WEED CONTROL

Before cover crop termination and soil incorporation



Results

- **Relay intercropping of legumes improve the weed control in the subsequent spring**



CNTR: control plot (sole sorghum); **MEDSA:** *M. sativa*; **TRFRE:** *T. repens*; **HESCO:** *H. coronarium*; **MEDLU:** *M. lupulina*; **MEDPO:** *M. polymorpha*; **TRFSU:** *T. subterraneum* ; **TRFIN:** *T. incarnatum*; **TRFRS:** *T. resupinatum*.

Weed biomass (DW, g/m²)

- Control (sole wheat stand) -> **225,37 DW, g/m²**
- *Medicago sativa* (MEDSA)
- *Trifolium repens* (TRFRE)
- *Hedysarum coronarium* (HESCO)
- *Medicago lupolina* (MEDLU)
- *Trifolium subterraneum* (TRFSU)
- *Trifolium resupinatum* (TRFRS)

} **25,57 DW, g/m²**

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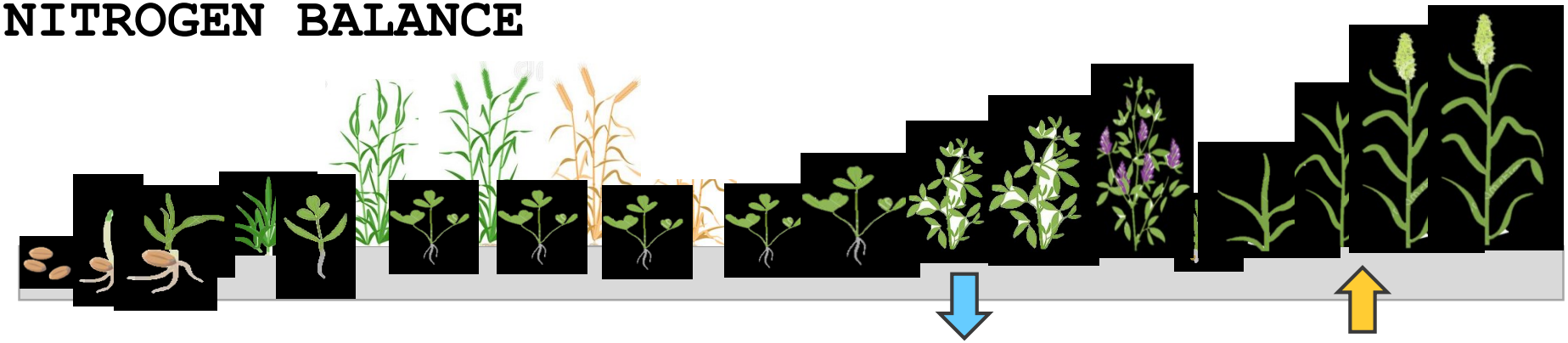
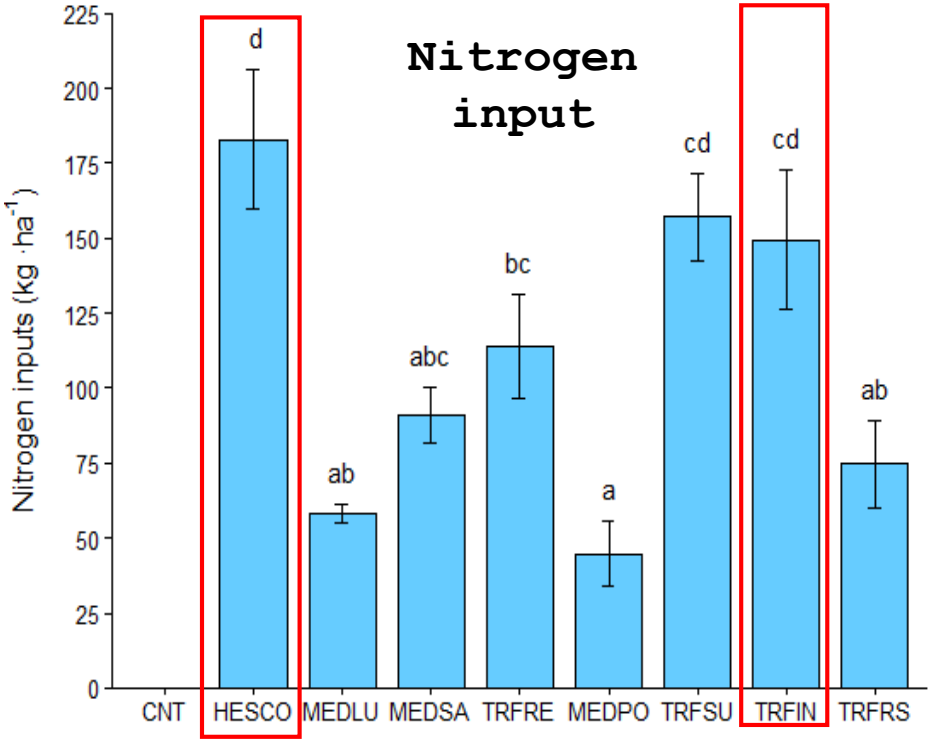
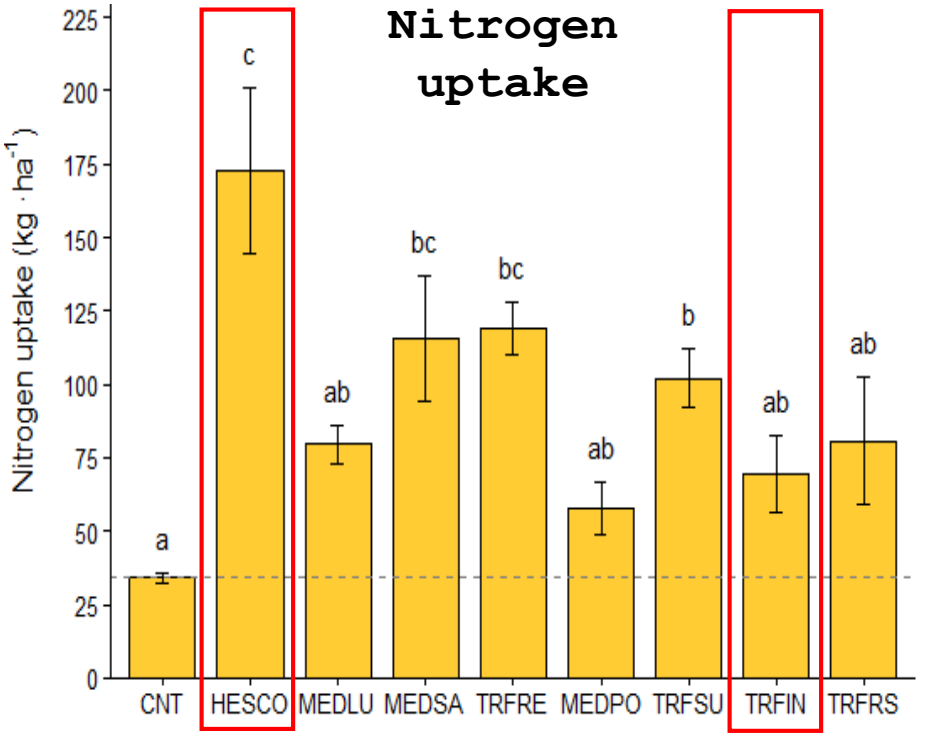
NITROGEN BALANCE







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Further information

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Screening suitable legumes for living mulches to support nitrogen dynamics and weed control in a durum wheat-forage sorghum crop sequence

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