Dealing with crop rotation in agroforestry

Impact of shade on crops growth and yield
Hybrid walnut phenology

shade layers installation

13/05
21/05
29/05
12/06
07/07

...
66 days on 292 days
132 days on 192 days
Global radiation measurement

Pyramometer, *CS300, Campbell*
**Agronomic measurements**

**During growing season**
- Leaf area index
- Biomass dry matter

**Straw & spike**
- Leaves+stems & roots

**At harvest**
- Final grain yield
- Grain number m²
- Grain weight
- Protein content
- Sugar yield
Shade dynamic on wheat

Relative cumulated global radiation

CS : -25%
PS : -18%

before LAlmax
211 days
LAlmax-Flo
24 days
Flo-harvest
55 days

-16%
-22%
-46%
-65%
Aboveground biomass

Impact on growth

Straw Spike

Cumulated global radiation MJ/m²

ANOVA + Tukey
Impact on final grain yield

ANOVA + Tukey

Cumulated global radiation MJ/m²

CS : - 45 % grain yield
PS : - 25 %

Final grain yield

CS : - 25 % GRc
PS : - 18 %

ANOVA + Tukey
Impact on yield components

Grain number per m²

CS : - 18 %
PS : - 13 %

Grain size proportion

2.8 mm
2.5 mm
2.2 mm
< 2.2 mm

ANOVA + Tukey
Grain yield vs Protein yield

ANOVA + Tukey

CS : - 45 % grain yield
PS : - 25 %

CS : - 25 % GRc
PS : - 18 %

CS : - 19 % protein yield
PS : - 8.5 %

Cumulated Global radiation MJ/m²

Final grain yield

Final protein yield
Shade dynamic on sugar beet

Cumulated global radiation

Relative cumulated global radiation:

- NS: Yellow
- PS: Green
- CS: Blue

Cumulated global radiation (%):

- Before 60 days: -29%
- Vegetative 54 days: -59%
- Roots 74 days: -71%

Vegetative: -59%
PS: -24%
CS: -40%
Sugar beet height

Aboveground height

ANOVA + Tukey
Roots & total aboveground biomass

ANOVA + Tukey

CS → - 71 % yield
PS → - 35 % yield
Impact on Sugar yield

CS → - 70 % yield
PS → - 38 % yield

Cumulated global radiation MJ/m²

ANOVA + Tukey
Winter wheat

66 days of shade on 292 days

- LAI\text{max} & Straw biomass
- Final grain & protein yield

Sugar Beet

132 days of shade on 292 days

- LAI\text{max} & aboveground biomass
- Morphology
- Sugar yield and roots biomass
Artificial shade treatment

- Heterogeneous & spatio-temporal pattern of light
- Difficult to associate to a specific light environment
- CS treatment: worst case scenario
Artificial shade treatment

North-South orientation

20 years old

50 years old

Light availability (%)

35 m

7 m

Hi-sAFe & SamsaraLight model
Thank you