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Relay-cropping of soybean cultivars into wheat for ecological intensification of agriculture

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Background & Aims

As an example of ecological intensification, **relay-cropping (RC)** allows to harvest two crops within the same year thereby increasing land use efficiency (Lamichhane *et al.*, 2023). Compared to sequential double cropping, sowing **soybean (SB)** into standing **wheat (W)** allows for earlier SB establishment in the growing season thus escaping summer drought (Wallace *et al.*, 1992 ; Duncan *et al.*, 1997). The purpose of this study was to compare the response of a range of commercial SB cultivars in RC to identify and propose the ideotype of a soybean variety adapted for W-SB relay cropping.

Materials & Methods

Auzeville, SW France (43.53°N, 1.48°E)

21 soybean cultivars (MGs 000 to II) – 3 replicates

SB sowing into W
06/05/21

Winter W harvest
06/07/21

- SB biomass at R1 (W harvest), R5 and R8 stages
- Plant area index (PAI) measured with a LICOR 2000 from R3 to R5
- FCOVER (fraction of green vegetation cover) determined with a Phemobile from R3 to R5 (visible spectrum)



9	8	7	6	5	4	3	2	1	X
RGT SIGMA	RGT SPHINXA	RGT SULTANA	RGT SIGMA	RGT SPHINXA	RGT SULTANA	RGT SIGMA	RGT SPHINXA	RGT SULTANA	RGT SULTANA
RGT SANTANA	RGT SYMBALA	ES INVENTOR	RGT SANTANA	RGT SYMBALA	ES INVENTOR	RGT SANTANA	RGT SYMBALA	ES INVENTOR	ES INVENTOR
RGT SAKUSA	RGT STUMPA	ES MENTOR	RGT SAKUSA	RGT STUMPA	ES MENTOR	RGT SAKUSA	RGT STUMPA	ES MENTOR	ES MENTOR
ANGELICA	RGT SPEEDA	RGT STABELLA	ANGELICA	RGT SPEEDA	RGT STABELLA	ANGELICA	RGT SPEEDA	RGT STABELLA	RGT STABELLA
I R R I G A T I O N									
ANGELICA	RGT SPEEDA	RGT STABELLA	ANGELICA	RGT SPEEDA	RGT STABELLA	ANGELICA	RGT SPEEDA	RGT STABELLA	RGT STABELLA
ES TRIBOR	WENDY PZO	RGT SINEMA	ES TRIBOR	WENDY PZO	RGT SINEMA	ES TRIBOR	WENDY PZO	RGT SINEMA	ES TRIBOR
RGT SINOHIA	RGT STOCATA	RGT STRAVIATA	RGT SINOHIA	RGT STOCATA	RGT STRAVIATA	RGT SINOHIA	RGT STOCATA	RGT STRAVIATA	RGT STRAVIATA
ES MEDIATOR	ES ISIDOR	ES PALLADOR	ES PALLADOR	ES ISIDOR	ES MEDIATOR	ES PALLADOR	ES ISIDOR	ES MEDIATOR	ES MEDIATOR

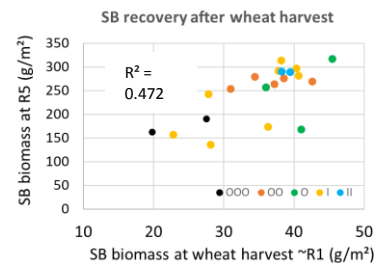
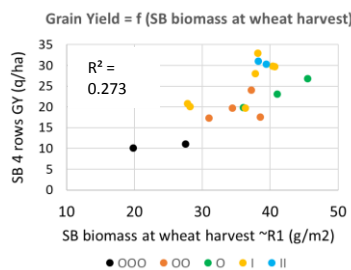
Number of rows 1SB: 2 WW (17 cm between rows)
+ 4 SB varieties grown as sole crops (reference)

SB irrigation (152 mm)

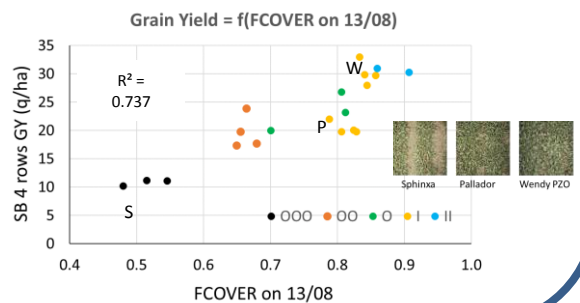
SB harvest : 29/09/21 (00-000) - 12/10/21 (0 to II)

Results

- Relay-cropping decreased biomass at R1 (-84 %) and R5 (-63 %), leaf area index at R1 (-74 %) and R5 (-49 %) and grain yield at R8 (-55 %).
- Grain yield of SB in RC ranged from 1.1 t/ha (MG 000) to 3.1 t/ha (MG II), consistently with the SB biomass at wheat harvest and R5.
- The best adapted cultivars to RC exhibited a faster recovery capacity, resulting in a higher shoot biomass and leaf area index at the end of vegetative growth.



PAI 3.1	PAI 3.4	PAI 3.7	PAI 3.8	PAI 4.0
RGT SPHINXA (000)	RGT STUMPA (00)	ES TRIBOR (0)	RGT STOCATA (I)	WENDY PZO (II)
GY 10.2 q/ha	17.7 q/ha	26.8 q/ha	29.9 q/ha	33.0 q/ha
Height 26 cm	35 cm	56 cm	57 cm	61 cm



Conclusion

- In SW France, late-maturing groups (0, I, II) are better adapted to relay-cropping (as in conventional sole crop)
- Relatively less time in competition with the cereal and higher recovery capacity
 - Longer cycle duration (an advantage with irrigation)
 - Pronounced indeterminate growth with larger canopy cover and higher radiation interception
 - Higher competitiveness with weeds



Centre Occitanie - Toulouse

References

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Lamichhane JR *et al.*, 2023. *Field Crops Res.* **291**: 108795
Wallace SU *et al.*, 1992. *Agron. J.* **84**: 968



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