Contribution to winter camelina carbon intensity from crops preceding or following winter camelina in the crop sequence

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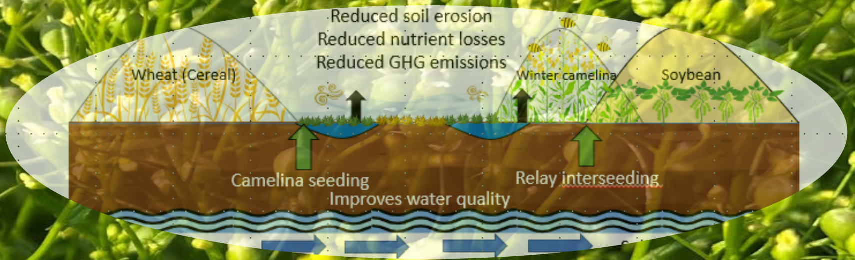

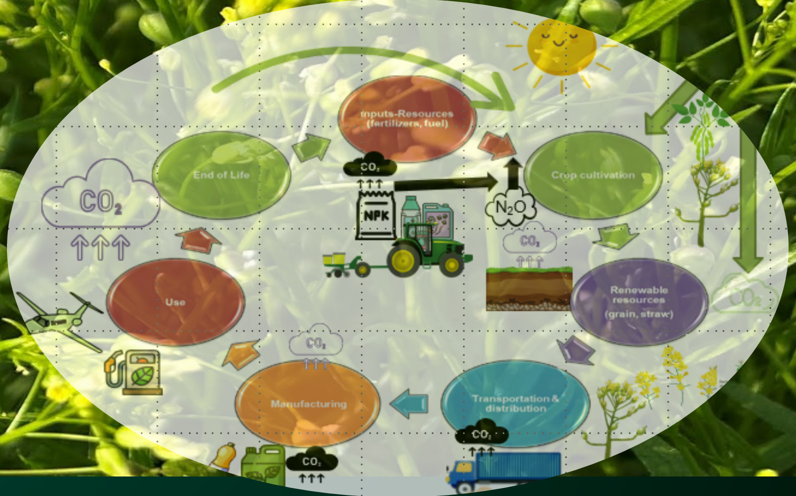

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Camelina

- ✓Novel vegetable oil (NVO) (32-38% oil)
  - ✓Spring and **winter biotypes**
- ✓ Intermediate oilseed crop (IOC) for SAF
  - ✓Winter camelina very winter hardy
  - ✓~5000 ha in North Central US (MN,ND,MT)
- ✓Provides soil cover and living roots
- ✓Increases biodiversity
- ✓Low ILUC, Low carbon intensity??
- ✓Can be grown in marginal land??
  - ✓**Marginal land=marginal yield**

IOC - Low ILUC

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Environmental impact assessment of double- and relay-cropping with winter camelina in the northern Great Plains, USA

Marisol Berti[a,*], Burton Johnson[a], David Ripplinger[b], Russ Gesch[c], Alfredo Aponte[a]

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Productivity and seasonal water use of double cropped dry bean, proso millet, and sunflower after early maturing winter camelina

R.W. Gesch[a,*], C.A. Eberle[a], M.T. Berti[b], M. Ott[c], J.V. Anderson[d]

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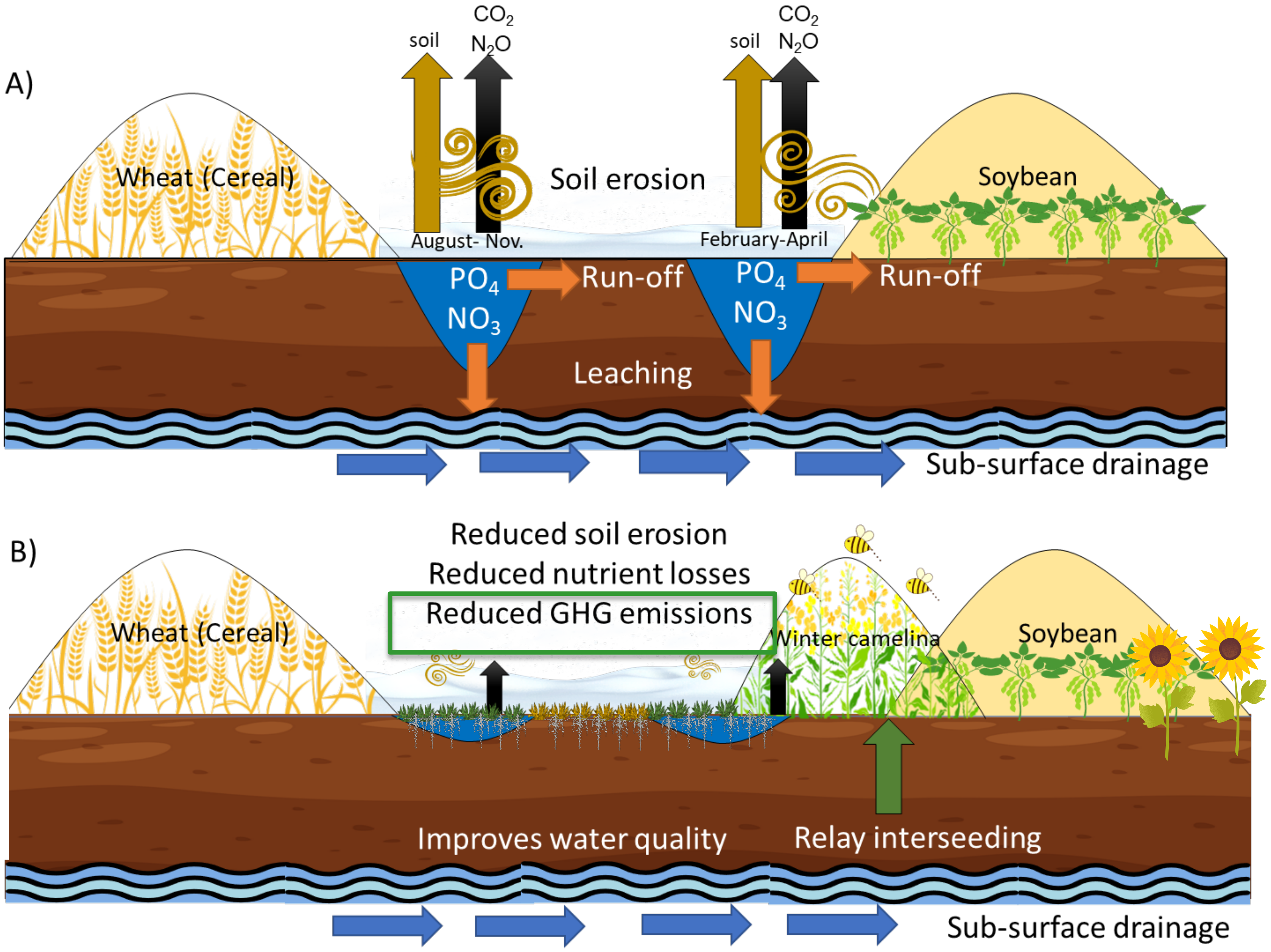
Agronomy Journal

SPECIAL SECTION: ADVANCING RESILIENT AGRICULTURAL SYSTEMS: ADAPTING TO AND MITIGATING CLIMATE CHANGE

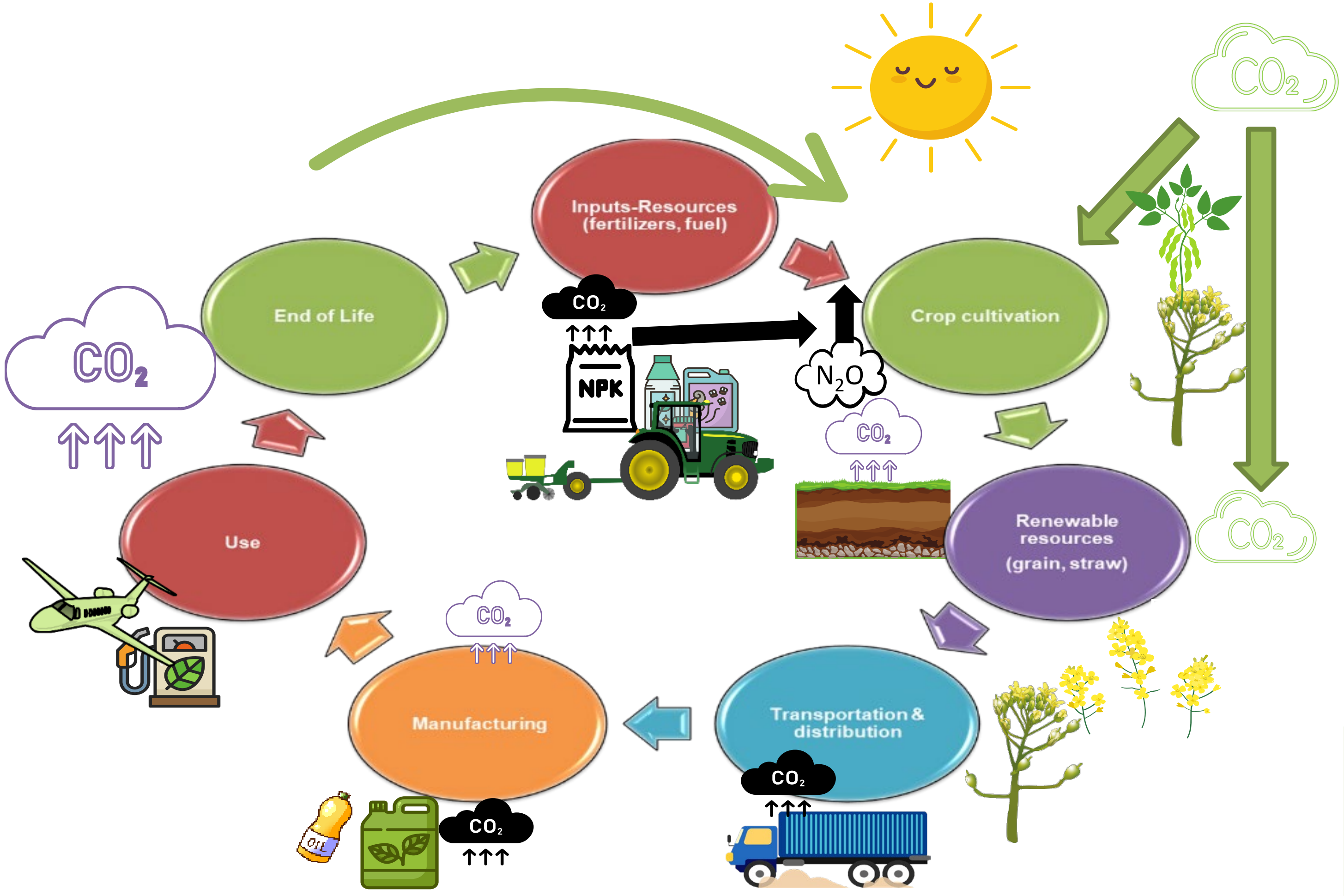
Relay cropping as an adaptive strategy to cope with climate change

Russ W. Gesch[1] | Marisol T. Berti[2] | Carrie A. Eberle[1] | Sharon L. Weyers[1]

NDSU



What does carbon intensity mean and what factors affect it?



Life cycle assessment (LCA)

Functional units and system boundary

Area: kg CO_2 eq. /ha (cradle-farm gate)

Weight: g CO_2 eq./kg of seed (cradle-farm gate)

Energy: g CO_2 eq./ MJ of biofuel (cradle-grave)

Carbon intensity	**Energy g CO_2 eq./ MJ**
Canola oil-jet fuel	47-73
Soybean oil-renewable diesel	54-63
Soybean oil-jet fuel	40-70
Camelina oil-jet fuel	**22-87**
Corn ethanol-jet fuel	65-100

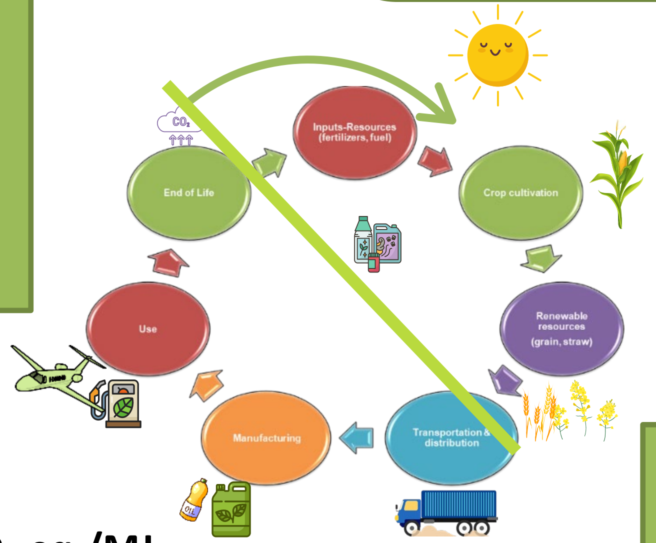
Can we achieve a low CI in the feedstock production?

Jet fuel 90-94 g CO_{2eq}/MJ

50%

Renewable diesel
Sustainable aviation fuel
45-47 g CO_2eq/MJ
Cradle to grave

59-75% of CO_2 equivalent emissions are produced by farm gate
25-41% CO_2 equivalent emissions happen during transportation, extraction , conversion

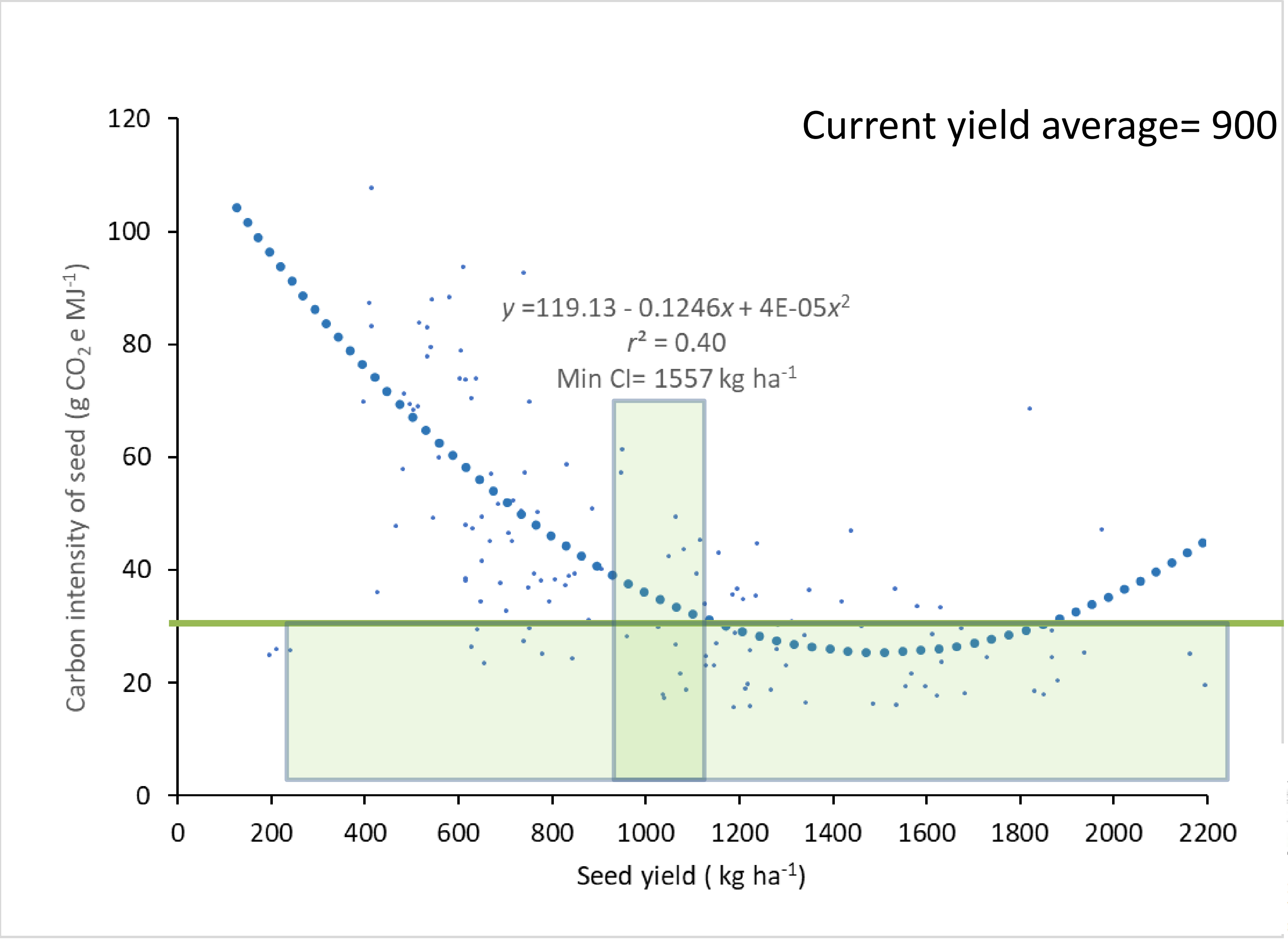


27-32 g CO_2 eq./MJ

Nitrogen fertilizers
Field emissions
50-60%

15-18 g CO_2 eq./MJ

Camelina seed yield vs carbon intensity



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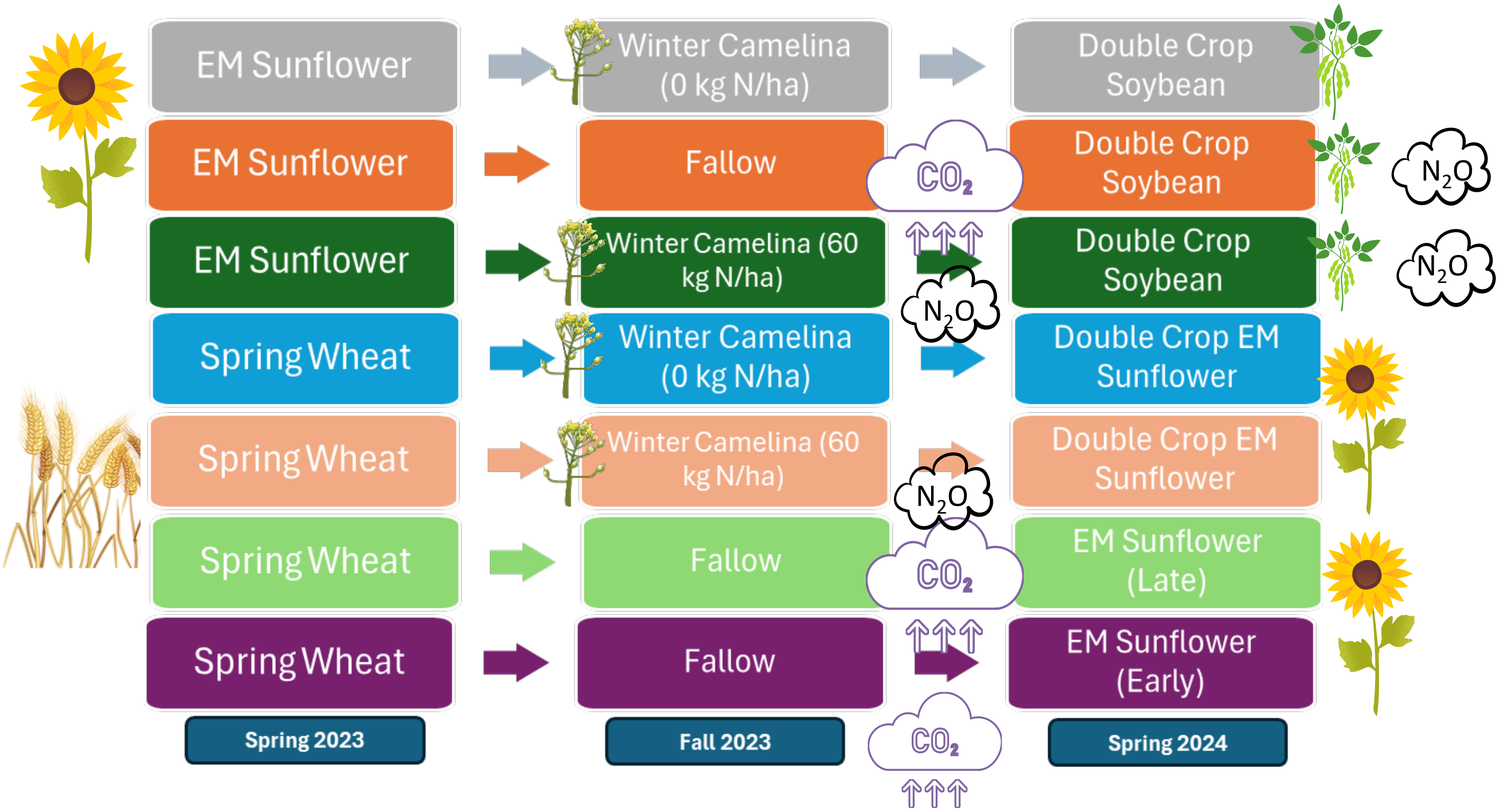
Nitrogen rates affect seed yield and carbon intensity in spring and winter camelina

Marisol T. Berti[a,*], Marisol Morocho-Lema[a], James V. Anderson[b], Clara Lizarazo-Torres[c]

Objective: Assess the changes in productivity and carbon intensity of winter camelina into wheat-sunflower-soybean rotation.

Crop sequences

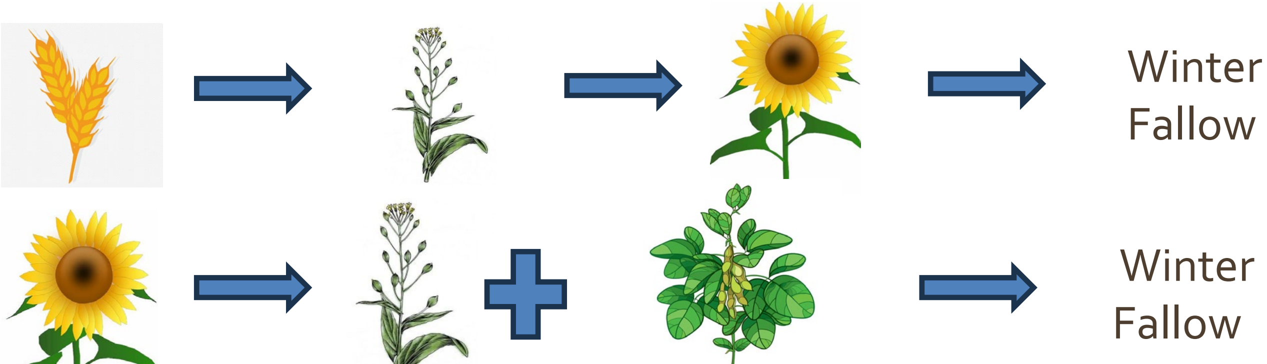


- ✓ Life cycle assessment- cradle to gate, two functional units
- ✓ g CO_2 eq./ha g CO_2 eq./MJ energy

Houston Lindell, MS student

Effect of preceding crop on camelina yield and oil content

Crop rotation	Seed yield wheat or sunflower	Seed yield winter camelina	Camelina oil content
	kg/ha	kg/ha	%
Wheat-WC-sunflower	8450	760	35.5
Wheat-WC +N-sunflower	9580	1360	36.9
Sunflower-WC- DC soybean	3979	1675	36.7
Sunflower-WC +N-DC soybean	3020	1501	35.2
LSD (0.05)	-	527	NS



Total GHG emissions per hectare from crop sequences

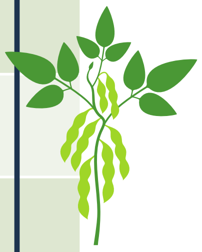
Sequence	May-Sept. 2023	Sept. 2023- July 2024 (WC or F)	May- Sept. 2024	Total cropping sequence
		kg CO_{2eq} ha^{-1}		
Sunflower-WC-DC soybean	1377	685	1406	3468
Sunflower-F-soybean	1378	293	1406	3077
Sunflower-WC +N-DC soybean	1377	1064	1406	3847
Wheat-WC-sunflower	1423	685	1379	3847
Wheat-WC +N-sunflower	1473	1064	798	3335
Wheat-F- sunflower (late)	1517	293	1381	3191
Wheat-F sunflower (early)	1474	293	1376	3143

Fallow N_2O

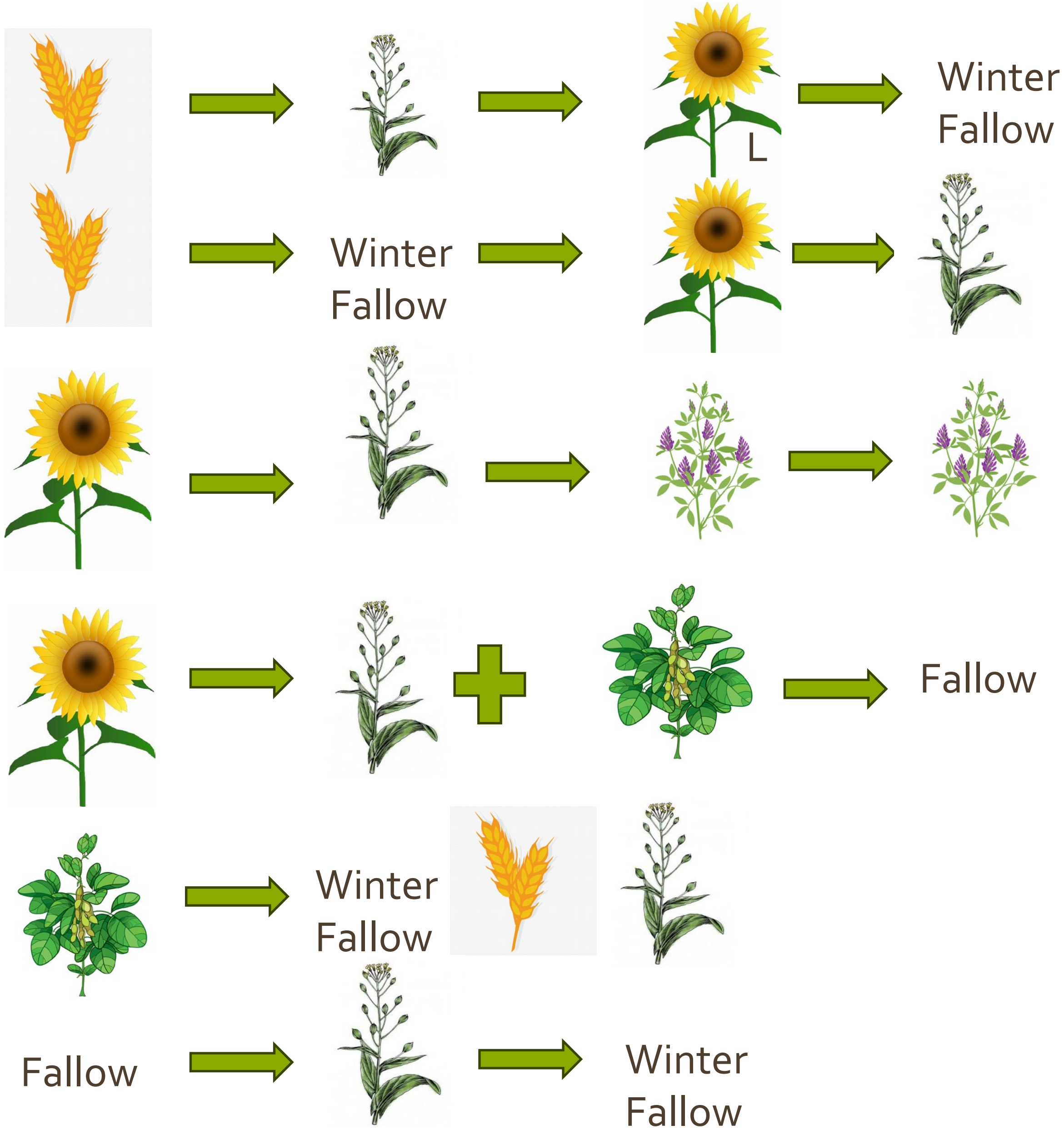
WC=winter camelina; F= winter fallow; DC=double cropping; N = nitrogen fertilizer (60 kg N/ha

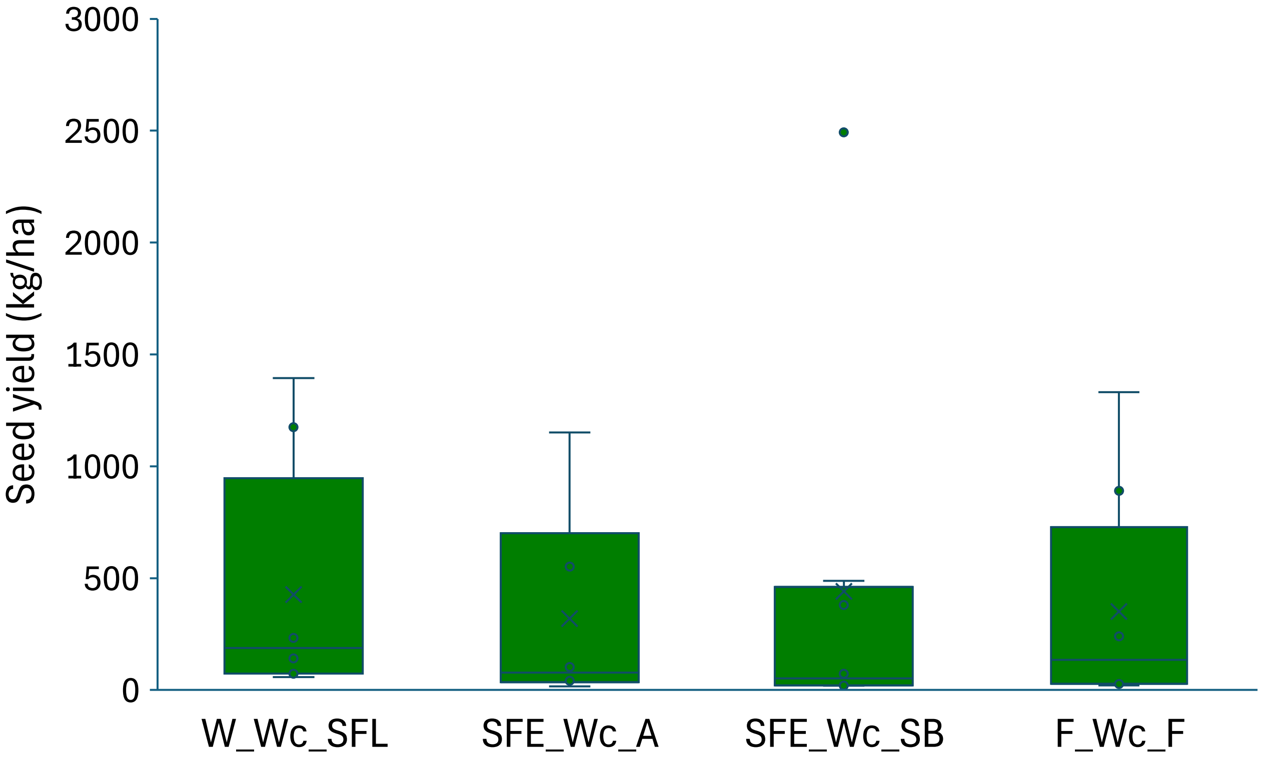
Carbon intensity of crops in the sequence g CO_{2eq} MJ^{-1}

Sequence	May-Sept. 2023	Sept. 2023- July 2024 (WC)	May- Sept. 2024
Sunflower-WC-DC soybean	17.98	45.40	49.42
Sunflower-F-soybean	16.98	-	25.45
Sunflower-WC +N-DC soybean	16.02	38.42	40.71
Wheat-WC-sunflower	42.36	17.36	12.35
Wheat-WC +N-sunflower	34.86	33.09	9.71
Wheat-F- sunflower (late)	34.81	-	163.2
Wheat-F sunflower (early)	37.86	-	172.3



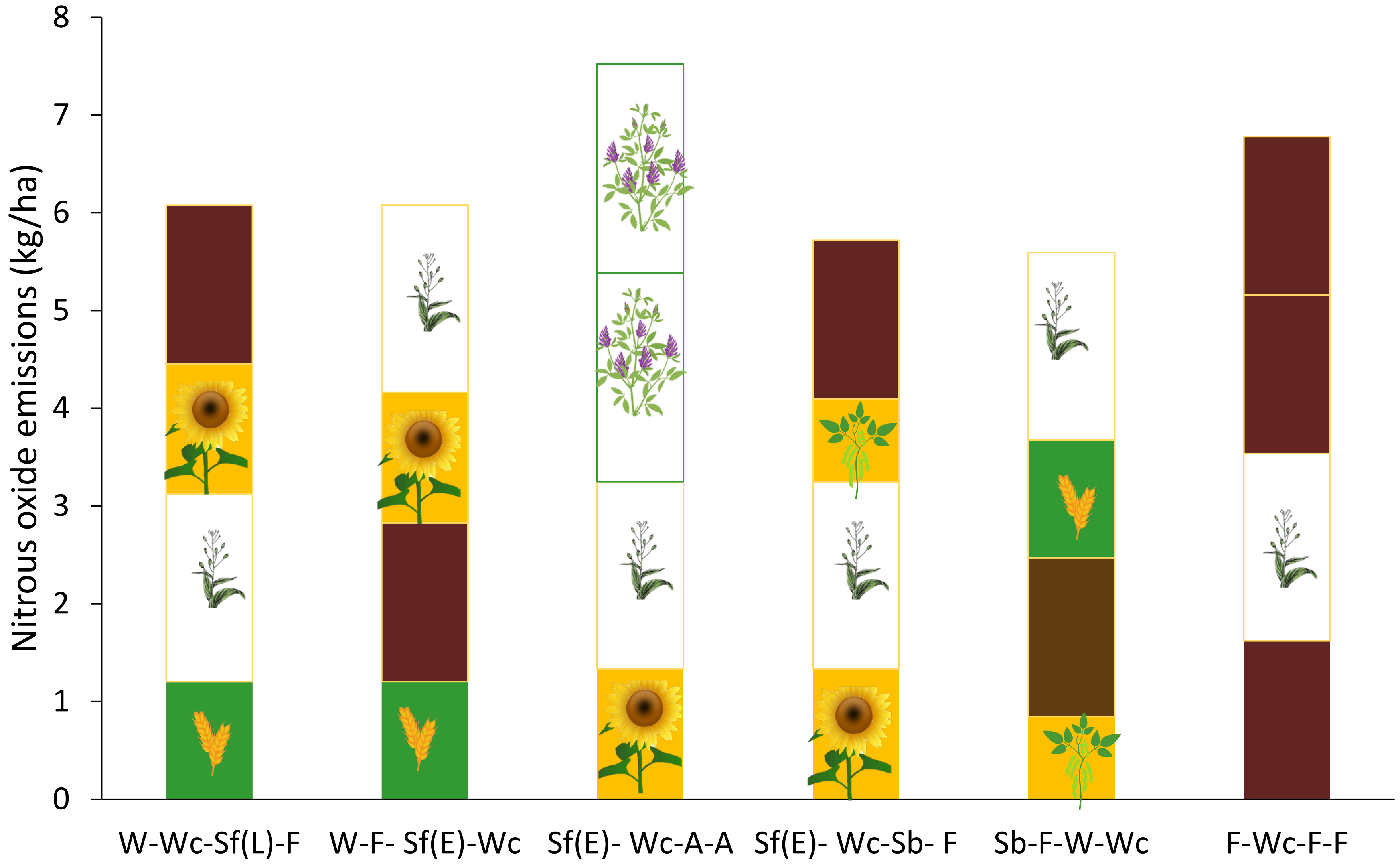
Effect of preceding crop in camelina seed yield





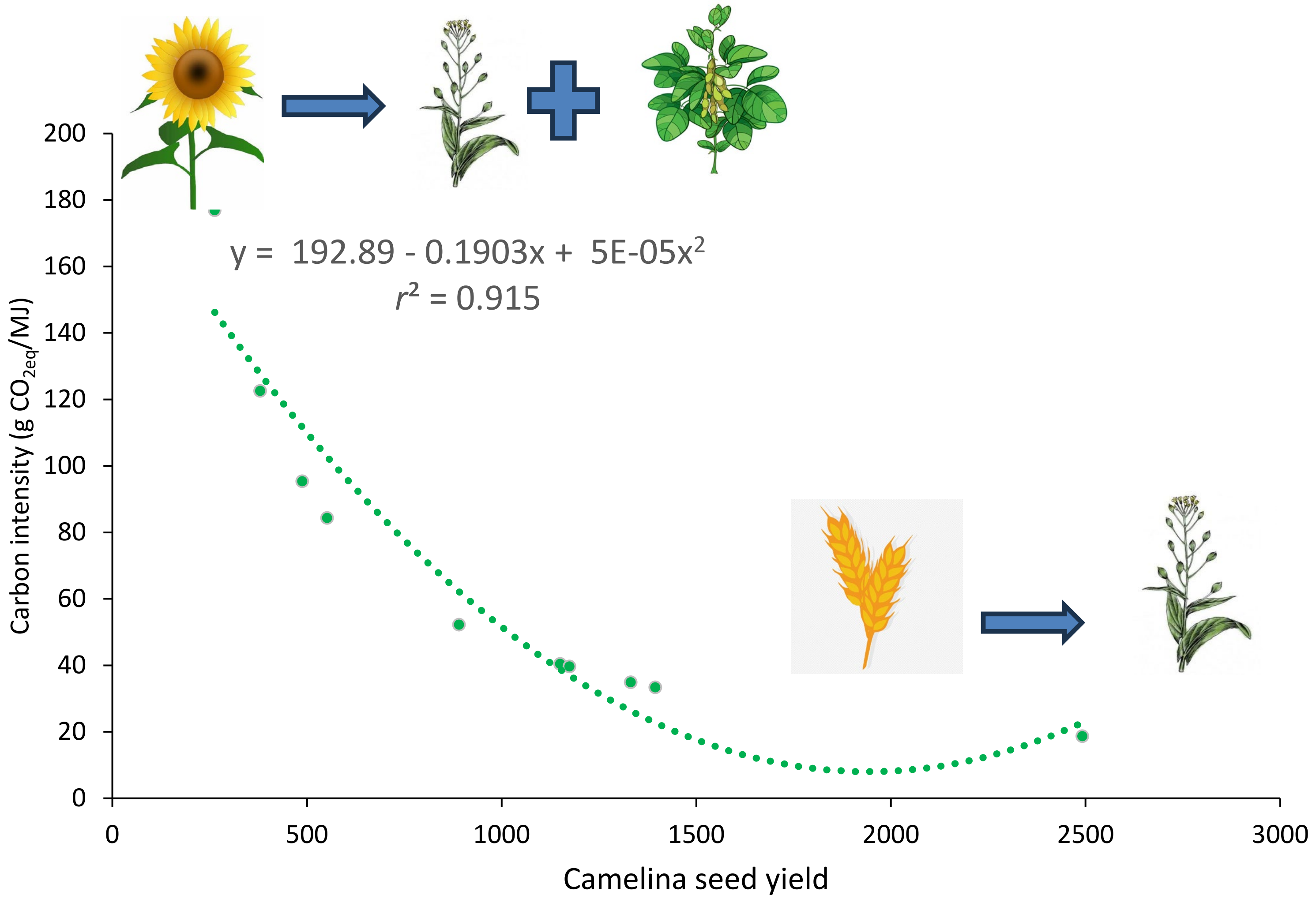
Anastasia Kurth, MS student

Nitrous oxide emissions in cropping sequences with camelina



Carbon intensity of camelina vs yield

- Lowest CI with camelina following wheat or fallow
- Highest CI camelina in relay with soybean



Take aways

✓CI of camelina production depends mainly on **seed yield**

✓WC seed yield was higher after wheat compared with sunflower and CI was the lowest.

✓Camelina after wheat requires more nitrogen than after sunflower.

✓Camelina in relay with soybean had lower yields than in other rotations.

✓winter camelina carbon intensity evaluation should be based on the entire crop rotation, not only on the period camelina is grown in the field.

✓**More data needed to fine tune models for CI accounting**

Thank you to sponsors and my team!

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https://www.berti-lab.com

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