Increased nitrogen availability and biodiversity in organic winter oilseed rape by intercropping annual legume companion crops

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Winter oilseed rape (OSR) is an important constituent in organic production

On farm oilpressing

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RESEARCH ARTICLE – DOSSIER OPEN ACCESS

RAPESEED: SOME EXAMPLES OF CURRENT FRENCH RESEARCH
COLZA : QUELQUES EXEMPLES DE RECHERCHE EN FRANCE

Intercropping frost-sensitive legume crops with winter oilseed rape reduces weed competition, insect damage, and improves nitrogen use efficiency

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Abstract – Mixing plant species in agroecosystems is highlighted as an agroecological solution to reduce pesticides

"Mixing plant species in agroecosystems is highlighted as an agroecological solution to reduce pesticides and fertilizers while maintaining profitability"

Intercropping at high latitudes

Project period: 2020-2023. The project was financed by the Fund for Organic Research at the Swedish Agricultural University (SLU)

Project group

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Insect specialist: Dr. Ola Lundin, Dept. Ecology, SLU, Uppsala

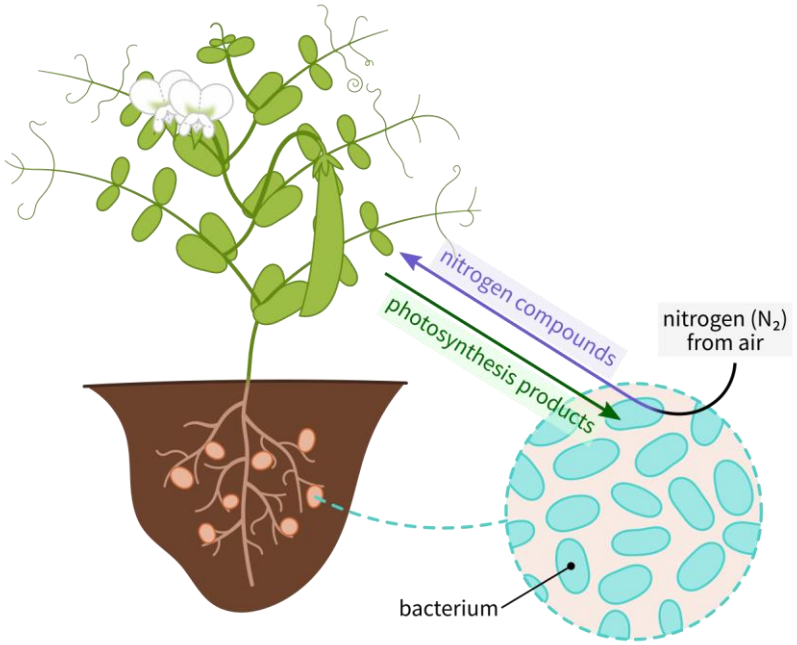
Plant Pathologist: Dr. Eva Edin, Rural Economy and Agricultural Society, Västerås

Background

- ✓Plant available nitrogen in early spring is important for crop development and high yield
- ✓Organic amendments can be difficult to spread early in the season depending on soil type
- ✓Organic WOSR is subject to a pressure of insect pests as the cabbage stem flea beetle (CSFB)

Hypothesis

- ✓ Legume species that provide biological nitrogen fixation and freeze during the winter can contribute site-specific nitrogen in early spring
- ✓ Increased biodiversity will affect the prevalence of CSFB



Wikipedia

www.fgsorganics.co.uk/

Objectives

To develop a concept to improve the nitrogen supply in WOSR with intercropping of annual legume species

To investigate whether intercrops on can affect damage from the cabbage stem flea beetle (CSFB)

To present solutions for seeding techniques of legumes applicable for different regions of Sweden

Location of field experiments - soil mineral nitrogen at seeding

Sampled soil layer, cm	Örebro Pre-crop: rye	Linköping Pre-crop: fallow	Kristianstad Pre-crop: barley
	59°17'N 15°04'E	58°29'N 15°30'E	56°01'N 14°03'E
	(kg ha^{-1})	(kg ha^{-1})	(kg ha^{-1})
0-30	16	82	33
30-60	11	50	41
60-90	7	35	17
Total N content	**34**	**167**	**91**
Date of seeding	25 August	25 August	1 Sep

Legume species and seed density

Legume species	Cultivar (species of clover)	Seed density (kg ha^{-1})	Rate of normal seed rate
2. *Vicia faba*, faba bean	Tiffany	139	50%
3. *Lupinus angustifolius* blue lupine	Boregine	100	50%
4. *Vicia sativa*, common vetch	Tempy	50	50%
5. Clover mixture *Trifolium resupinatum* *Trifolium alexandrinum* *Trifolium squarrosum*	Persian clover 33 % Berseem clover 33% Squarrose clover 33%	6	

Experimental design 2021

Treatment	Row space cm	Seeding technique
A1. Winter OSR	12.5	
A2-4. Blue lupin, faba bean, Fodder vetch	12.5	Simultaneous seeding of WOSR and legumes with the fertilizer coulter
A5. Clover mixture	12.5	Clover seeds mixed with rapeseed
B1. Winter OSR	50	
B2-4. as A2- A4	50	Simultaneous seeding between the rows
B5. Clover mixture*	50	Simultaneous seeding of WOSR and legumes between rows

- Clover mixture was seeded simultaneously as the WOR in the same row but seeding of legumes occurred simultaneously as row hoeing at the field trial in south Sweden.

Pre-crop requirements: soils low in nitrogen; cereal crop or grass swards

OSR cultivar: Explicit 45 seeds per m

Fertiliser: 50 kg N per ha as a pelleted product Ekoväx 8-3-5-3 spread before seeding and at the start of growth in spring. Row spacing as large plot and legumes randomised within large plot. Three replicates.

WOSR at 50 row spacing intercropped with blue lupin, faba bean, fodder vetch and clover mixture 4 October 2021. Seeded at 9 August, Linköping.

Blue lupin

Faba bean

Fodder vetch

Clover mixture

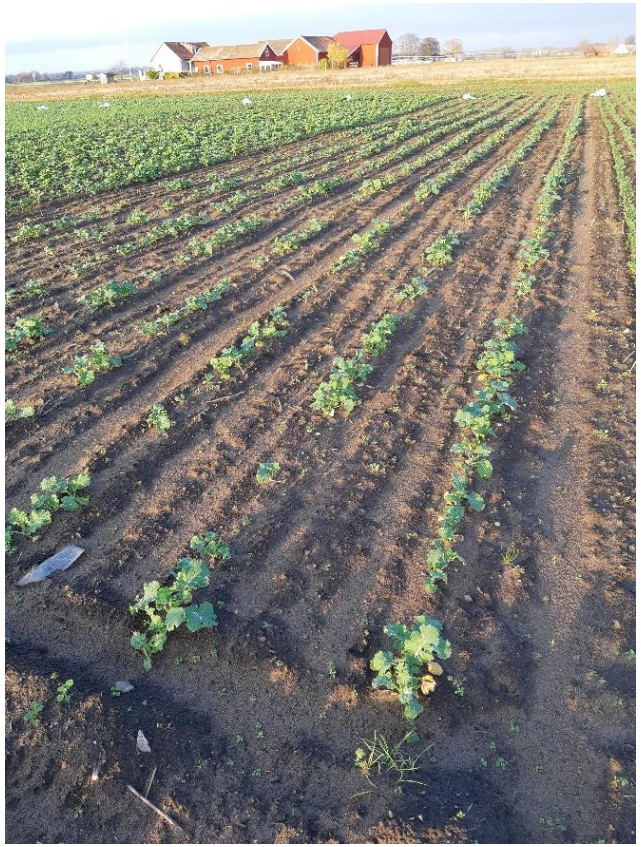
Analyses and assessments

- N-uptake and C-uptake in above ground biomass in 2 m^2 cutouts in each plot
  - ✓Before first frost, Nov/Dec
  - ✓Early budding at the end of April
  - ✓End of flowering BBCH 69

  - ✓Injuries of cabbage stem flea beetle assessed in autumn and early spring as plants were dug out

Results

Winter oilseed rape and legume crops in 2021



Winter OSR 50 cm row spacing Kristianstad, 3 November

Winter OSR and fodder vetch, 12,5 cm row spacing, Linköping, 18 November

Winter oilseed rape and legume crops in 2021

Faba bean (left) and blue lupin (right) seeded 24 August simultaneously with WOSR

Frozen faba bean

Örebro 28 november 2021

Nitrogen uptake in winter oilseed rape

Treatment	Örebro (kg N ha^{-1})	Linköping (kg N ha^{-1})	Kristianstad (kg N ha^{-1})
Spring assessment			
Row space 12.5 cm	-	22 a	21 a
Row space 50 cm	-	23 a	18 a
1. No legume intercrop	-	25 a	21 a
2. Faba bean	-	20 b	19 a
3. Blue lupine	-	20 b	20 a
4. Common vetch	-	25 a	19 a
5. Clover mixture	-	23 ab	19 a
Summer, BBCH69			
Row space 12.5 cm	13 a	48 b	35 a
Row space 50 cm	16 a	84 a	30 b
1. No legume intercrop	15 a	67 ab	33 a
2. Faba bean	13 a	58 b	31 a
3. Blue lupine	15 a	66 ab	35 a
4. Common vetch	17 a	68 ab	33 a
5. Clover mixture	12 a	71 a	32 a

* The same letters are not significantly different, Tukey´s HSD-test, $p < 0.05$

Seed yield

Seed yield of WOR kilograms per hectare, 9% wc. Average for 12.5 cm and 50 cm row spacing

	Örebro (kg ha^{-1})	Linköping (kg ha^{-1})	Kristianstad (kg ha^{-1})
1. No legume intercrop	468	2485 a*	1464
2. Faba bean	508	2097 b	1340
3. Blue lupine	625	2141 b	1350
4. Common vetch	710	2500 a	1364
5. Clover mixture	591	2556 a	1276
p-value	*ns*	*0.0003*	*ns*

* The same letters are not significantly different, Tukey´s HSD-test, $p < 0.05$

Seed yield of WOR kilograms per hectare 9% wc Average for all treatments at 12.5 and 50 cm row spacings

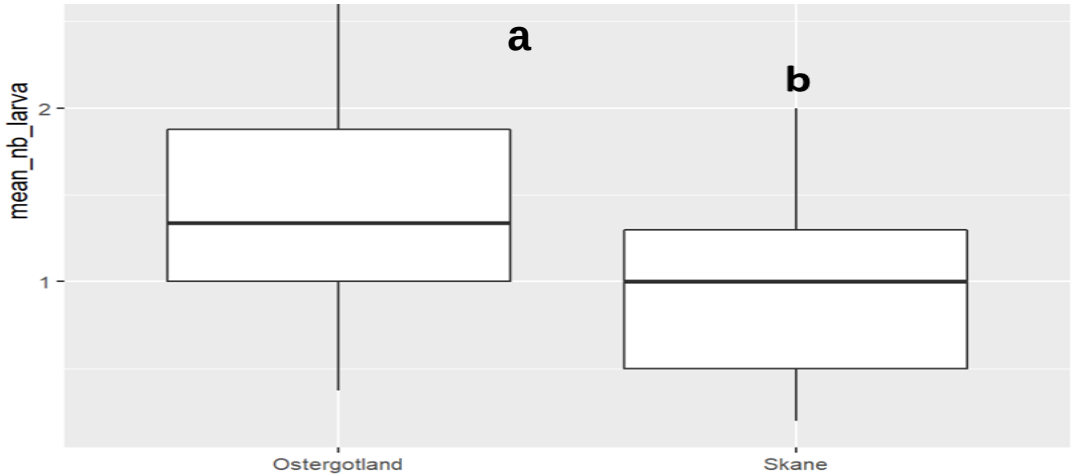
Row space cm	Örebro (kg ha^{-1})	Linköping (kg ha^{-1})	Kristianstad (kg ha^{-1})
12,5	548	2047 b*	1461 a
50	613	2665 a	1256 b
p-value	*ns*	*0.0117*	*0.0022*

* The same letters are not significantly different, Tukey´s HSD-test, $p < 0.05$

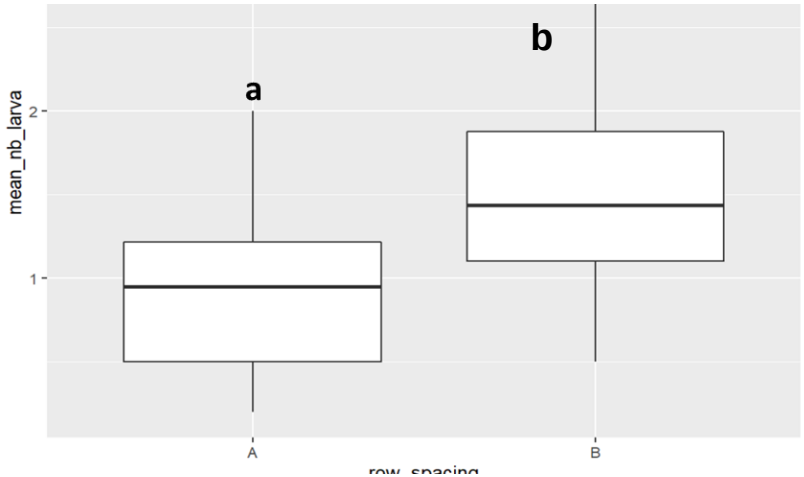
Results CSFB

- Generally low incidence of CSFB
- No significant differences in leaf damage between treatments
- At one site too few larvare for statistical processing

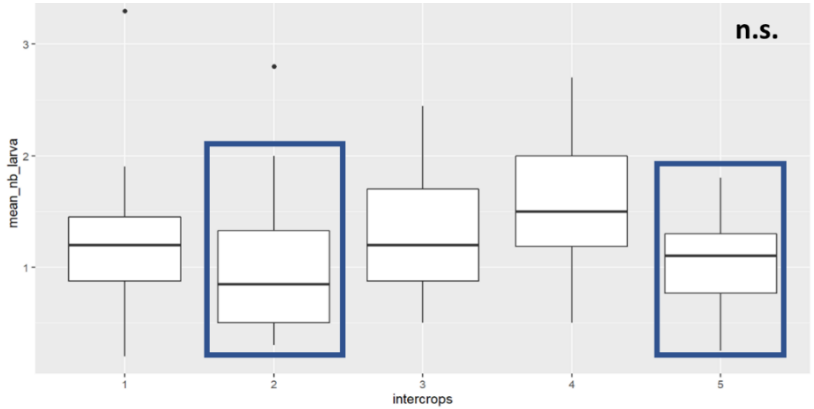
Larval damage of cabbage stem flea beetle. Mars 2022, Linköping and Kristianstad. Average number of larvae per plant



Avergage number of larvae per plant for the trial sites at Linköping and Kristianstad.



Average number of larvare per plant for each row distance. . A= 12,5 cm and B: 50 cm



1: Sole WOSR; 2: WOSR and faba bean; 3: WOSR and blue lupin; 4:WOSR and fodder vetch; 5: WOSR and clover mix (persian clover, Egyptian clover och squarrose clover.

The grading was carried out by by Mamadou B Traore, scholar from Mali, under supervision of Ola Lundin

Summary

Sowing time and establishment

Sowing timing and growth in the autumn crucial: 15-20 August optimal

Difficult to get growth on legume when sowing after hoeing in September

Growing place and interspecific competition

The benefit of legume species is pronounced in soils low in nitrogen.

Interspecific competition affects OSR growth. Advantage for low-growing clover species.

Recommendation

- The low-growing clover mix is a first choice that can be mixed directly with the rapeseed in the seed box at both row spacings

Thank you for your attention!

Clover mixture: squarrose clover, berseem clover and persian clover