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# Yields of different crops in an agroforestry system

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# Yields of different crops in an agroforestry system

- Study objectives
- Methods
- Results – grain yields
- Results – product quality
- Discussion
- Conclusions

# Project structure

## LfL

- Effects of tree strips for fuelwood production on agricultural crops
- Soil physics, soil water dynamics and microclimate
- Soil fauna
- Organic carbon content
- Economics of an agroforestry system

## LWF

- Establishment and growth performance of fast-growing trees in organic agriculture
- Human resource management
- Economics (choice of tree species, establishment process)

## Field Trials

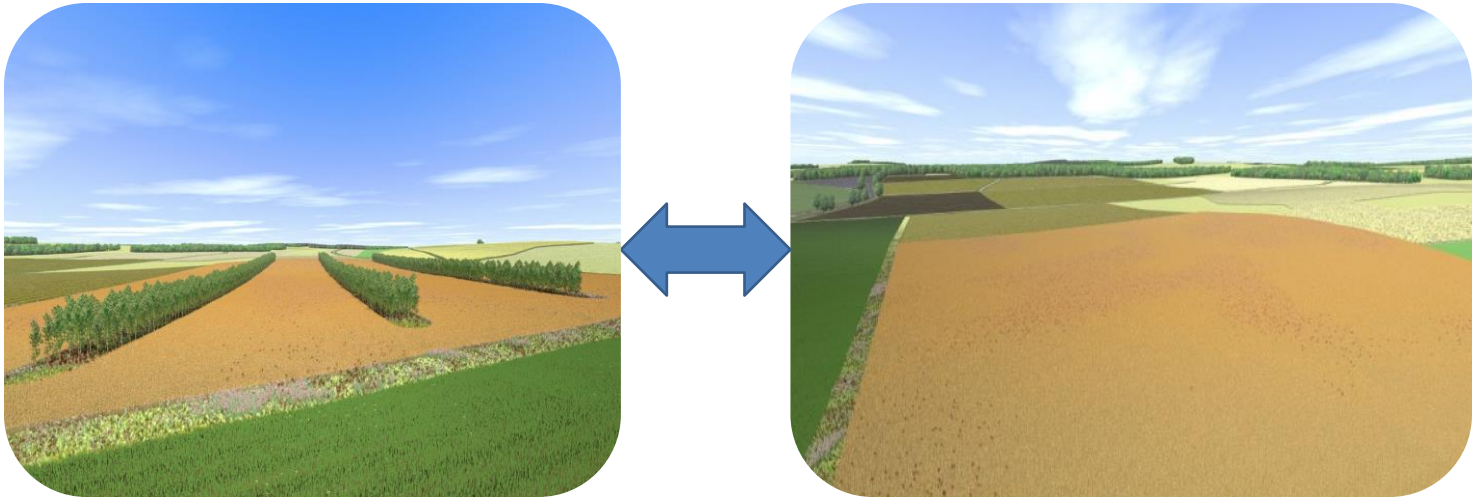
- Inspection of trees and weed control
- Wild garlic cultivation in agroforestry systems for fuelwood production
- Undersowing forest and forest-edge species in fuelwood strips

# Yields of different crops in an agroforestry system

## Study questions and objectives

Comparison of an agroforestry system with fast-growing trees with an arable system in terms of:

- Crop yields
- Crop quality



# Experimental sites


**LfL experimental station Neuhof, Donau-Ries 2009 conversion of part of the station to organic farming**

**Braun organic farm, Pulling, Freising**

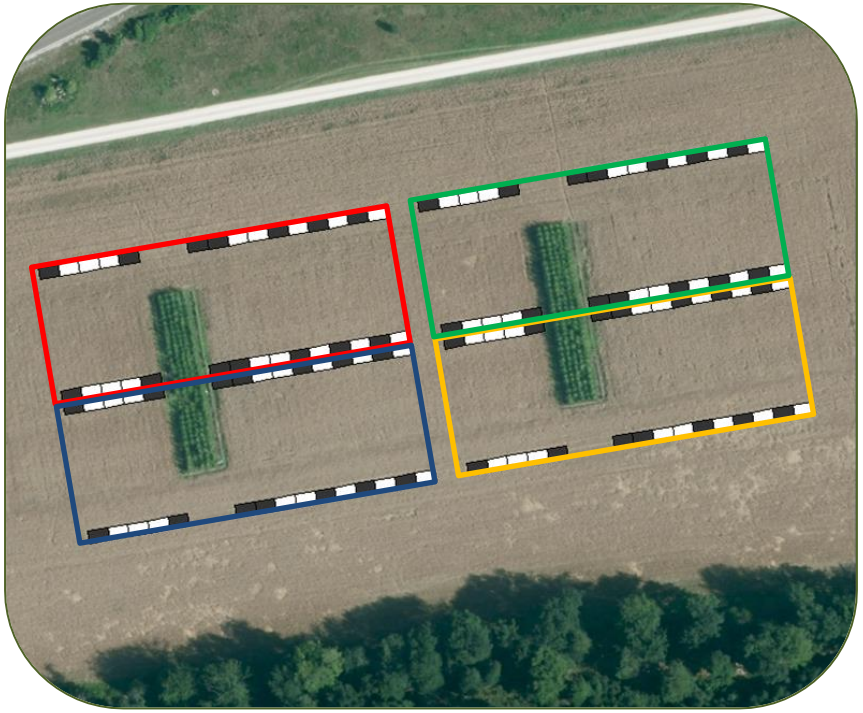
# Methods

| Site | Pulling | Neuhof |
|---|---|---|
| **Mean annual precipitation** | 820 mm | 674 mm |
| **Mean annual temperature** | 8.5 °C | 8.8 °C |
| **Soil texture** | Silt loam | Silt loam/clay loam |
| **Soil type** | Pararendzina from river marl over gravel | Cambisol/Stagnosol from loess or loam |
| **Water table** | high | low |
| **pH** | 7.4 | 6.7 |

# Methods

## Trial design

- Split plot with 2 factors and 3 (Pulling) or 4 replicates (Neuhof)
- Measurement of the effect of tree strips every 5 m (starting at a distance of 25 m from one side of the tree strips and ending at a distance of 50 (Neuhof) or 60 m (Pulling) from the other side of the tree strips, harvest plots 15 m²)
- Crops analysed:
  wheat, oats, clover-grass ley



**Field trial at the Neuhof site**

## Tree strips for fuelwood production

- Planted in April 2009, 5 rows, distance between trees 1.50 m x 1.25 m
- Hybrid poplar 'Max 1' and 'Max 3',
  7 year rotation

# Methods

## Measurements

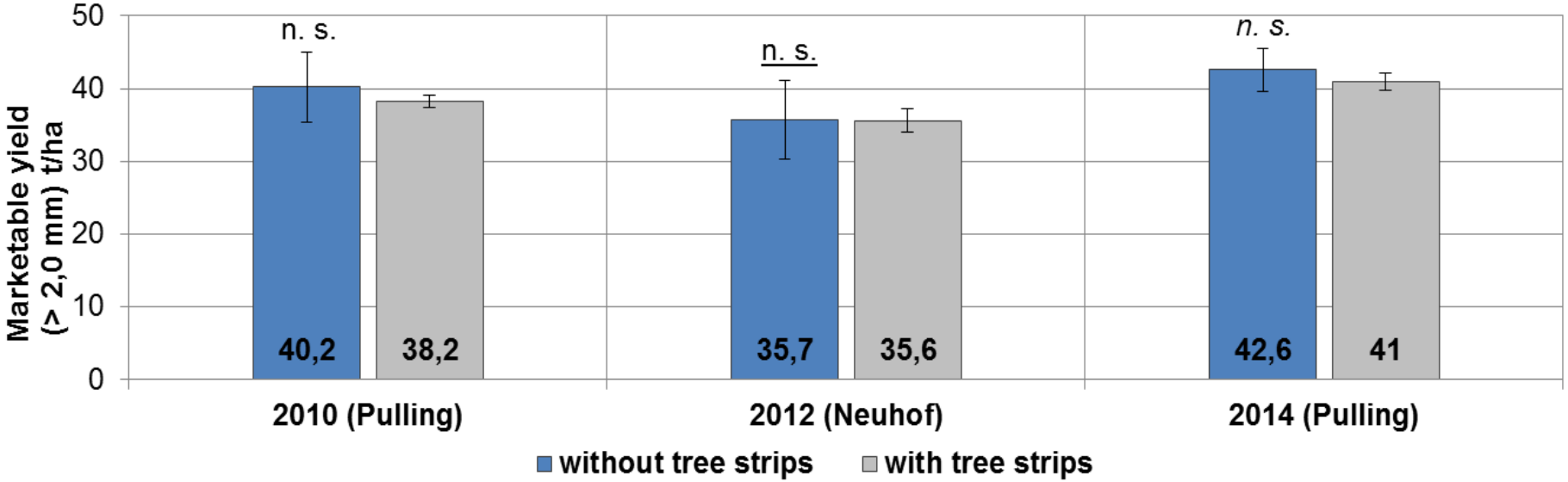
- Crops: agronomic properties in accordance with guidelines from the Bundessortenamt (Federal Office of Plant Varieties, BSA 2000), yield and quality


**Yield measurements using a plot combine**

LfL Agrarökologie

# Results - Yields

## Wheat marketable yield (2010, 2012, 2014)



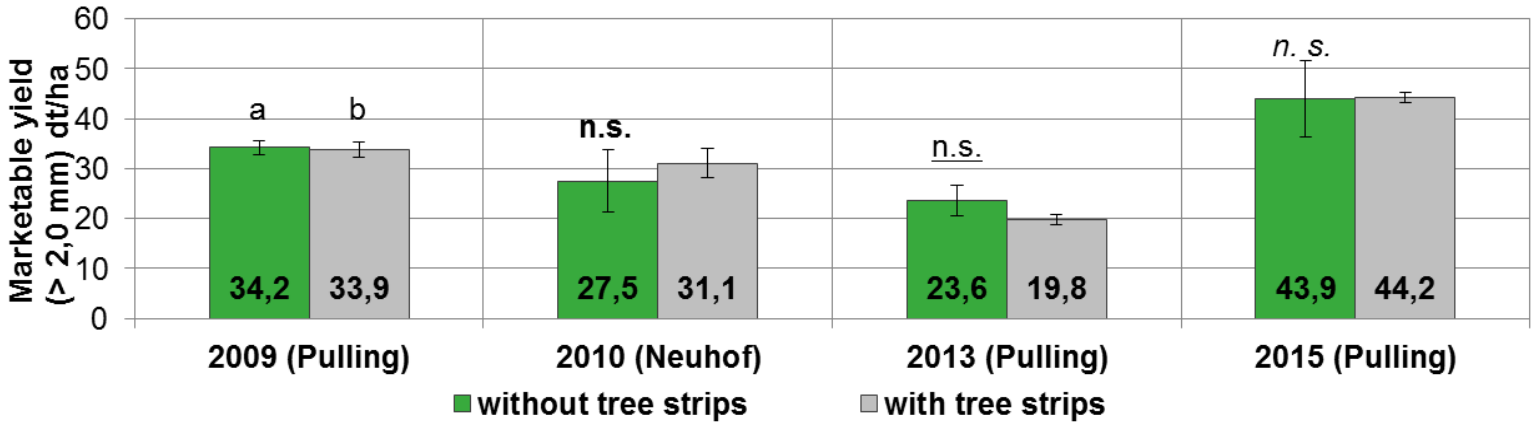

**Mean for all distances to tree strips, n. s. = not significant (SNK Test, p < 0.05), error bars = mean ± standard deviation**

**Mean tree height at time of wheat harvest**:

Pulling (2010): 3.6 m, Neuhof (2012): 4.4 m, Pulling (2014): 10.1 m

# Results - Yields

## Oat marketable yield (2009, 2010, 2013, 2015)



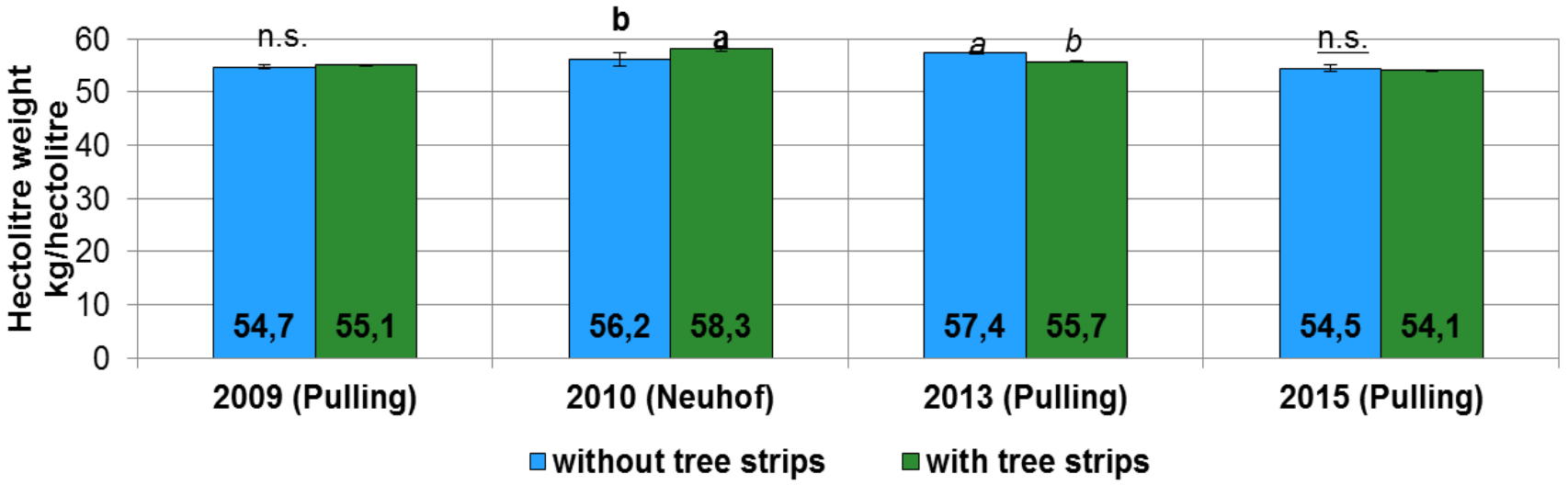

**Mean for all distances to tree strips, different letters = significant differences, n. s. = not significant (SNK Test, p < 0.05), error bars = mean ± standard deviation**

**Mean tree height at time of oat harvest**:

2009 (Pulling): 0.7 m, 2010 (Neuhof): 1.6 m, 2013 (Pulling): 8.5 m, 2015 (Pulling): 11.4 m

# Results – Product quality

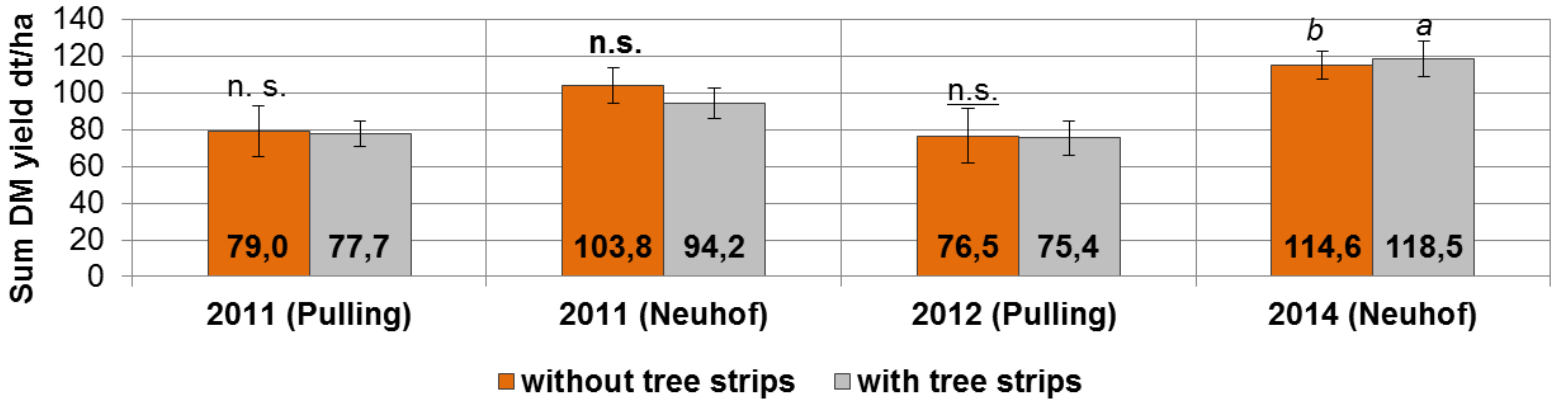
## Oat quality (2009, 2010, 2013, 2015): hectolitre mass




Mean for all distances to tree strips, different letters = significant differences, n. s. = not significant (SNK Test, $p < 0.05$), error bars = mean ± standard deviation

# Results - Yields

## Clover-grass ley dry matter yield (2011, 2012, 2014)



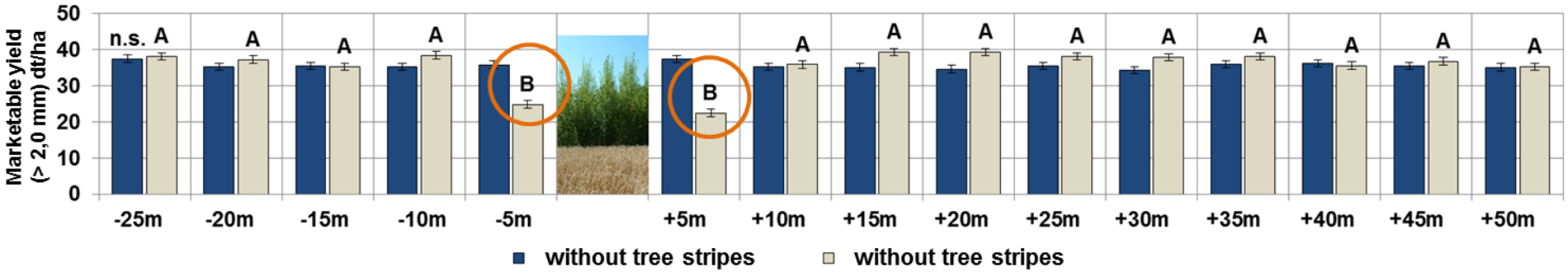

**Mean for all distances to tree strips, different letters = significant differences, n. s. = not significant (SNK Test, p < 0.05), error bars = mean ± standard deviation**

**Mean tree height at time of clover-grass ley**:

2011 (Pulling): 3.6 m, 2011 (Neuhof): 2.9 m, 2012 (Pulling): 6.2m, 2014 (Neuhof): 6.8 m

# Results

## Wheat marketable yield (Neuhof site, 2012) at various distances to the tree strips




**Different letters = significant differences (treatment with tree strips), n. s. = not significant (SNK Test, p < 0.05), error bars = mean ± standard deviation (left upwind, right downwind)**

- Mean tree height at time of wheat harvest: 4.4 m
- Yields were significantly lower in close proximity to the tree strips in the treatment with tree strips
- Yields were higher in the other plots compared to the treatment without tree strips

# Discussion

- Bruckhaus & Buchner (1995) and Pretzschel et al (1991) reported positive effects of hedgerows/windbreaks on yields of agricultural crops
  – we could not confirm this for an agroforestry system under southern Bavarian conditions

- Our findings were in line with the findings of Ochsenbauer et al (2013), who also report lower biomass for winter wheat in close proximity to short rotation coppice strips (SRC) and higher biomass at distances > 5 meters from SRC

- Reasons for lower yields close to tree strips:
  Shade? Competition for water? Competition between roots?

# Conclusions

- Tree strips do not affect total yield but do affect spatial yield distribution:
  → negatively in close proximity to trees
  → positively in areas further away from trees

- Lower yields were limited to an area of approx. 5-8 metres either side of the trees

- These lower yields are offset by higher yields in areas further away from the tree strips (trees act as a windbreak)

- Tree strips for fuelwood production do not affect the quality of wheat, oat or clover-grass leys

# Thank you for listening!

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