Intercropping as a sustainable alternative to reduce late blight infestation in potato

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Our efforts so far ...

Chemical control

- Fungicide resistance
- Restrictions on use
- High costs involved
- Not compatible with organic farming

Resistant cultivars

- Resistance can be overcome
- Limited resistance genes available
- Market demand for 'traditional' cultivars

Our efforts so far ...

Chemical control

Resistant cultivars

Crop diversification

?

- Evidence for intercropping
- Relevance for late blight
- Discuss the application of intercropping

Crop diversification through intercropping

"Intercropping is the practice of growing two or more crops in the same field for a significant part of their growing period."

(Li et al., 2020)

Intercropping influenced the occurrence of stripe rust and powdery mildew in wheat

Shiqin Cao [a, c], Huisheng Luo [a], Ming'an Jin [a], Shelin Jin [a, *], Xiayu Duan [c, *], Yilin Zhou [c], Wanquan Chen [c], Taiguo Liu [c], Qiuzhen Jia [a], Bo Zhang [a], Jin Huang [a], Xiaoming Wang [a], Xunwu Shang [b], Zhenyu Sun [a]

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[c] Institute of Plant Protection, Chinese Academy of Agricultural Sciences, 2 Yuanmingyuan Xilu, Beijing, 100193, China

Evaluation of garlic intercropping for enhancing the biological control of *Ralstonia solanacearum* in flue-cured tobacco fields

Rongquan Lai , Minsheng You , Lincan Jiang , Bitian Lai , Shunhui Chen , Wenlong Zeng & Daibing Jiang

Effects of strip intercropping of potatoes with non-hosts on late blight severity and tuber yield in organic production

H. Bouws† and M. R. Finckh*

Department of Ecological Plant Protection, Faculty of Organic Agricultural S
Witzenhausen, Germany

Impact of intercropping on epidemics of groundnut leaf spots: defining constraints and opportunities through a 7-year field study

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Article

Maize/Soybean Relay Strip Intercropping Reduces the Occurrence of *Fusarium* Root Rot and Changes the Diversity of the Pathogenic *Fusarium* Species

Xiaoli Chang [1,2,†], Li Yan [2,†], Muhammd Naeem [2,†], Muhamm
Hao Zhang [1], Guoshu Gong [2], Min Zhang [2], Chun Song [2], We
Wanquan Chen [1,4,*]

Effect of intercropping cowpea with maize or cassava on cowpea bacterial blight and yield

Der Einfluß des Mischkulturanbaus von Augenbohne mit Mais oder Maniok auf den Bakterienbrand und den Ertrag

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[2] Present address: Institut National des Recherches Agricoles du Bénin/LDC, 01 B.P. 128 Porto-Novo, Republic of Benin
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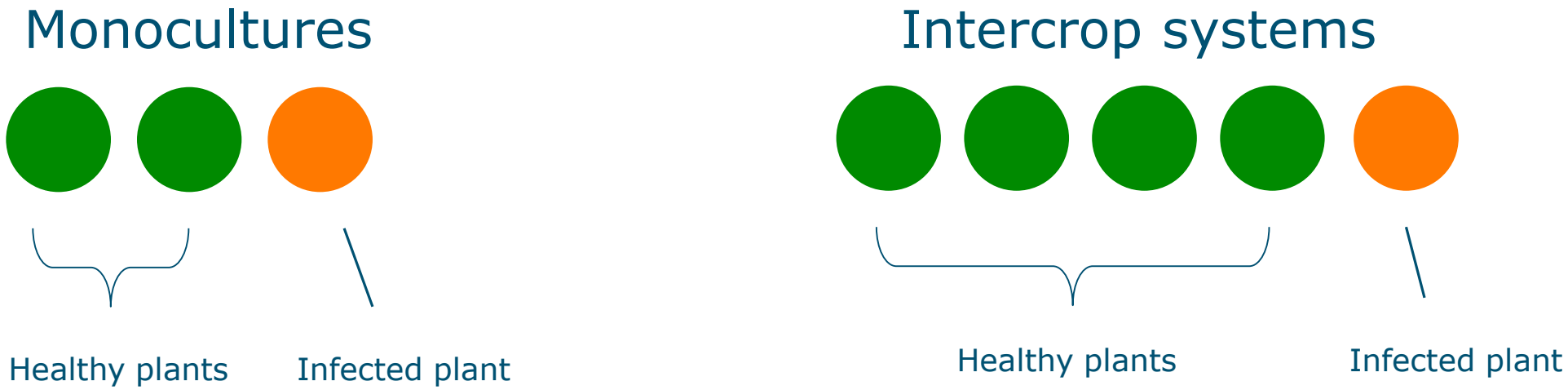
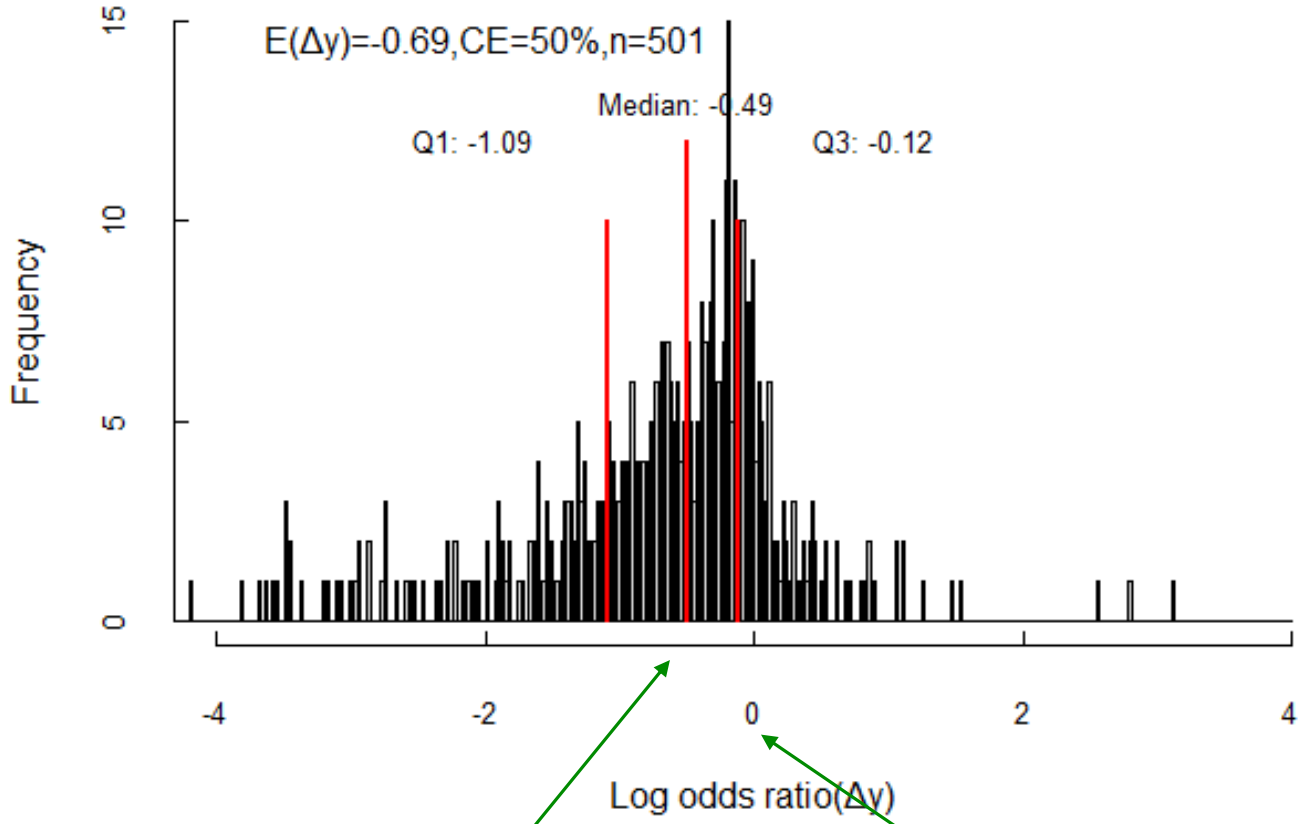
Disease incidence lower in intercropping compared to sole cropping



- Disease incidence reduced from 34% in sole cropping to 21% in intercropping
- An ongoing meta-analysis based on 108 experiments conducted worldwide

Li et al., unpublished

- The reduction in the odds was estimated at 50% on average

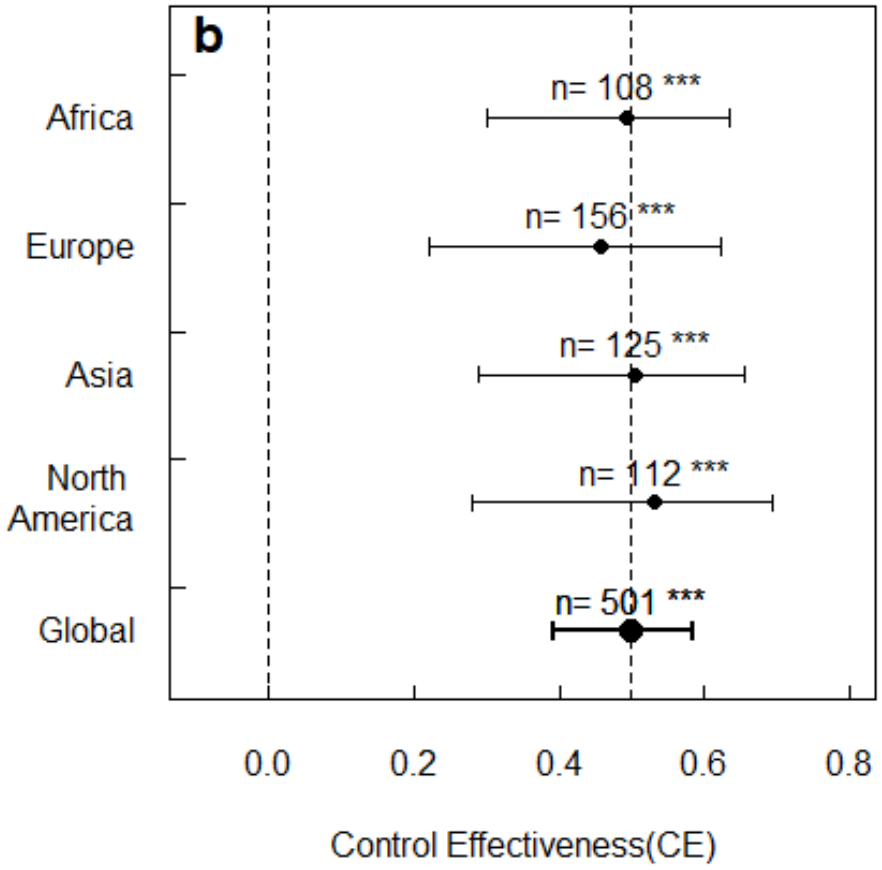


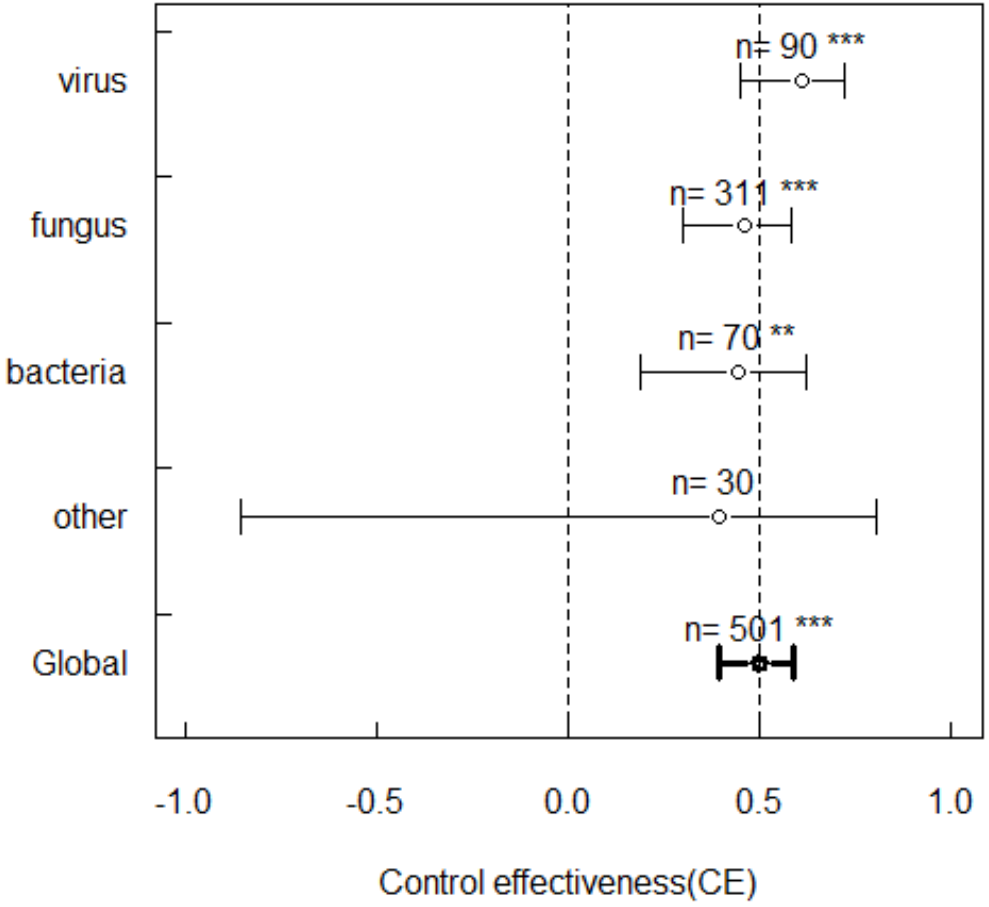
50% reduction in log odds in intercrop compared to sole crop

No difference between intercrop and sole crop

Li et al., unpublished

- Disease control effectiveness of intercropping was not sensitive to the region or pathogen taxonomic group





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Li et al., unpublished

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Redefining the field to mobilize three-dimensional diversity and ecosystem services on the arable farm

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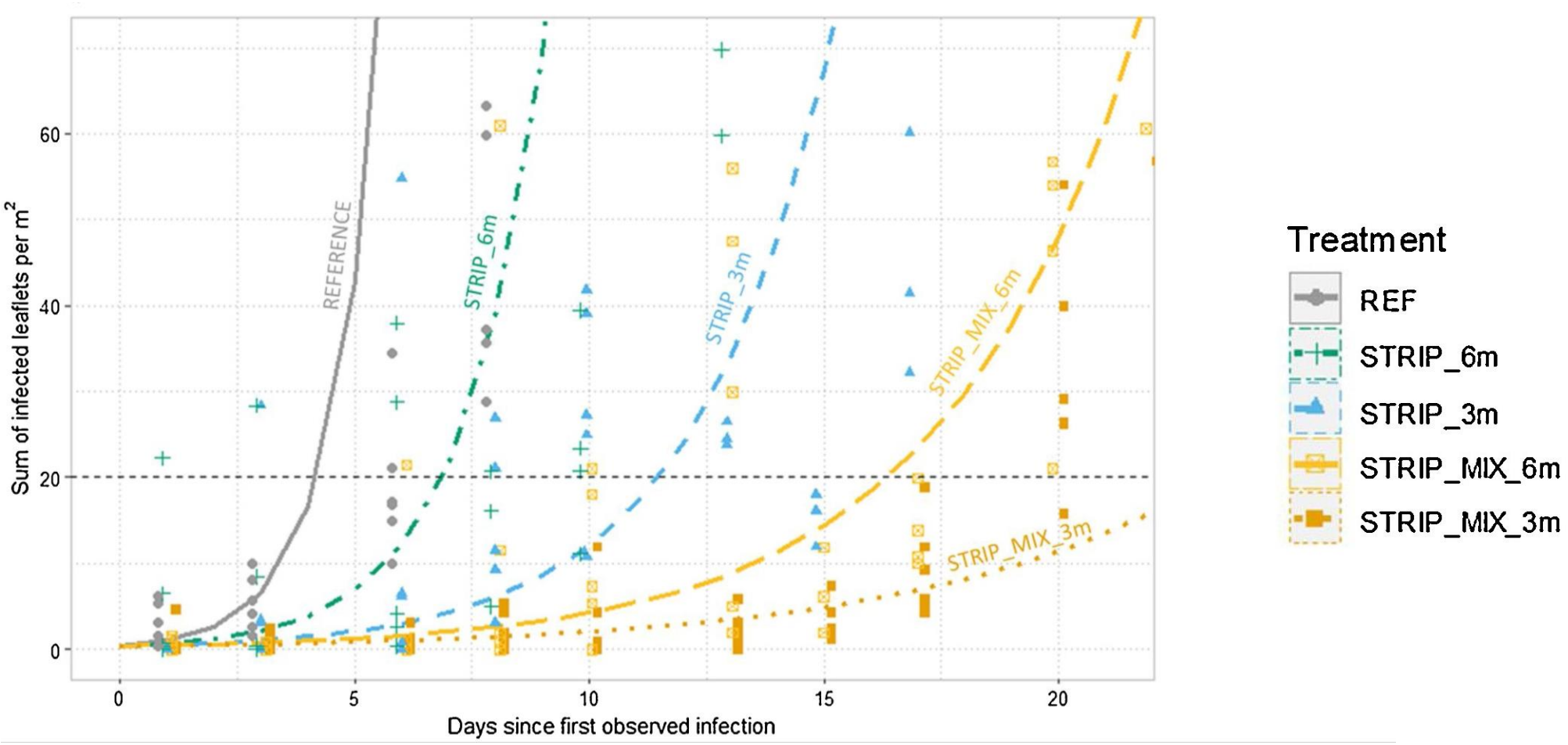
ABSTRACT

In this article we explore the concept and implications of three-dimensional (spatial, temporal, and genetic) in-field crop diversification to inform systems redesign towards ecological intensification. We first present a conceptual framework for classifying diversity in arable contexts. We then apply the framework to analyse two long-term systems experiments in The Netherlands where spatial and genetic diversity measures were implemented via strip and mixed intercropping with the aim to increase ecosystem service delivery: incidence and spreading

Intercropping and potato late blight



Ditlzer et al. 2021

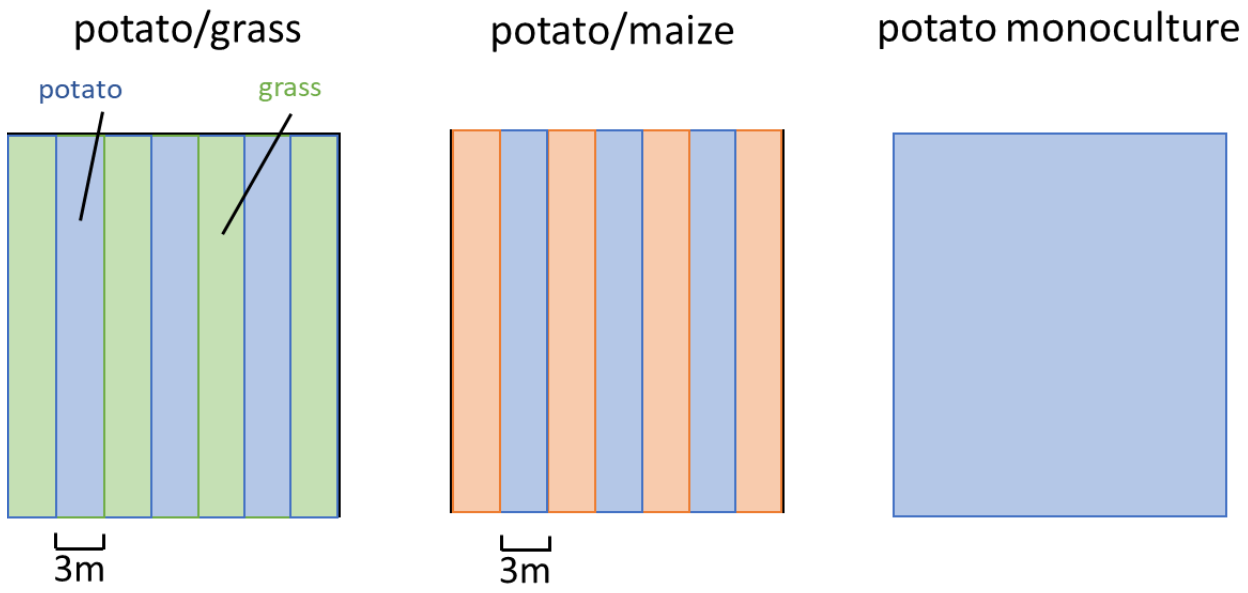
How could intercropping suppress disease?

Potential mechanisms

- Host dilution
- Barrier for incoming spores
- Altered microclimate
- Morphological or physiological changes of the host plant
- Volatile compounds
- Other mechanisms?

Example from own field experiment

- Two contrasting companion crops: maize or grass
- Strips of 3 m width



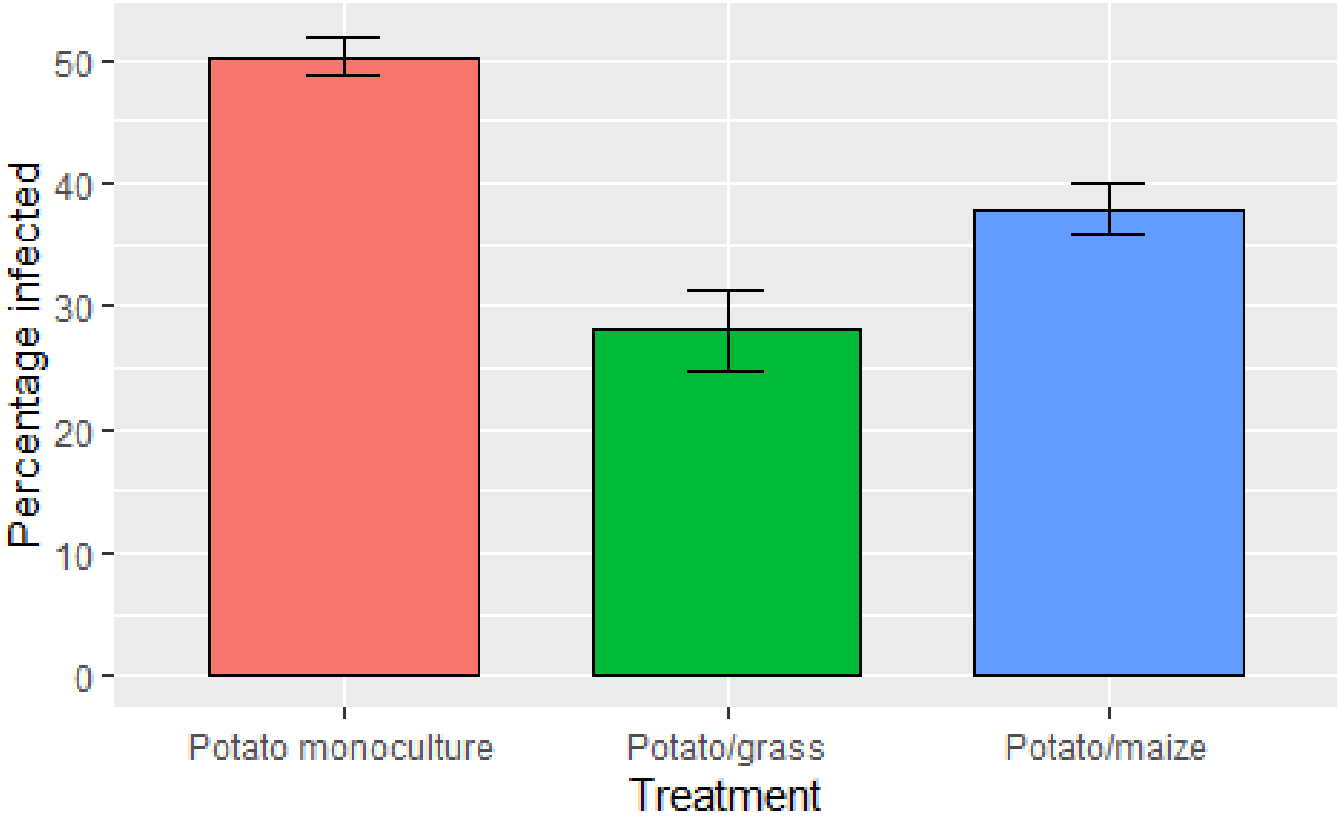
Example from field experiment - measurements

- Microclimate within the potato canopy
  - Temperature
  - Relative humidity
  - Leaf wetness duration
- Morphological aspects of the potato plants
  - Height
  - Stem diameter
  - Light interception
- Detached leaf assay
- Late blight infections in the field

Number of infected leaves at the beginning of the epidemic (8 July 2021)

Percentage infected at the end of the epidemic

(17 July 2021)



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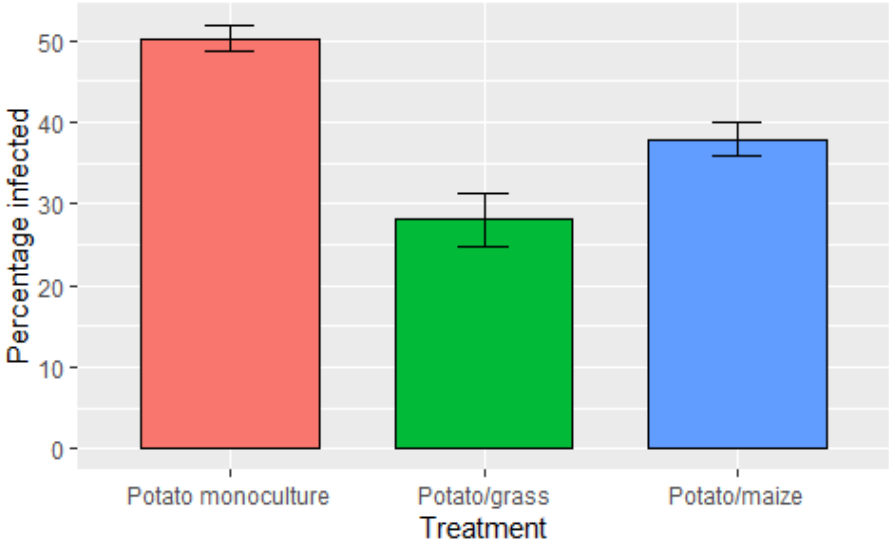
Percentage infected at the end of the epidemic

(17 July 2021)



- Intercropping can reduce disease levels, but won't complete suppress diseases
- Effects might only been seen later in the epidemic
- What makes grass a better companion crop?

From mechanisms to application

- Can lower disease levels be achieved by designing our intercrop systems smarter?
- What would be the **requirements** to implement intercropping?
    - Which **level of reduction** would be necessary in order for intercropping to be considered by farmers?
    - What will be the impact of intercropping at the **beginning of the epidemic**?
    - How can intercropping be **combined** with other disease control practices?

Take home messages

- Intercropping can reduce disease levels, but won't complete suppress diseases
- Intercrop systems might be able to suppress disease more optimally with better designs
- And we need to find ways to combine intercropping with other disease control practices

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