International Rapeseed Congress - Berlin 2019

Kiel University
Christian-Albrechts-Universität zu Kiel

Strategies to optimize N fertilization of winter oilseed rape

Klaus Sieling & Henning Kage

Institute of Crop Science and Plant Breeding
Kiel University, Germany

Strategies to optimize N fertilization of winter oilseed rape (OSR)

Kiel University
Christian-Albrechts-Universität zu Kiel

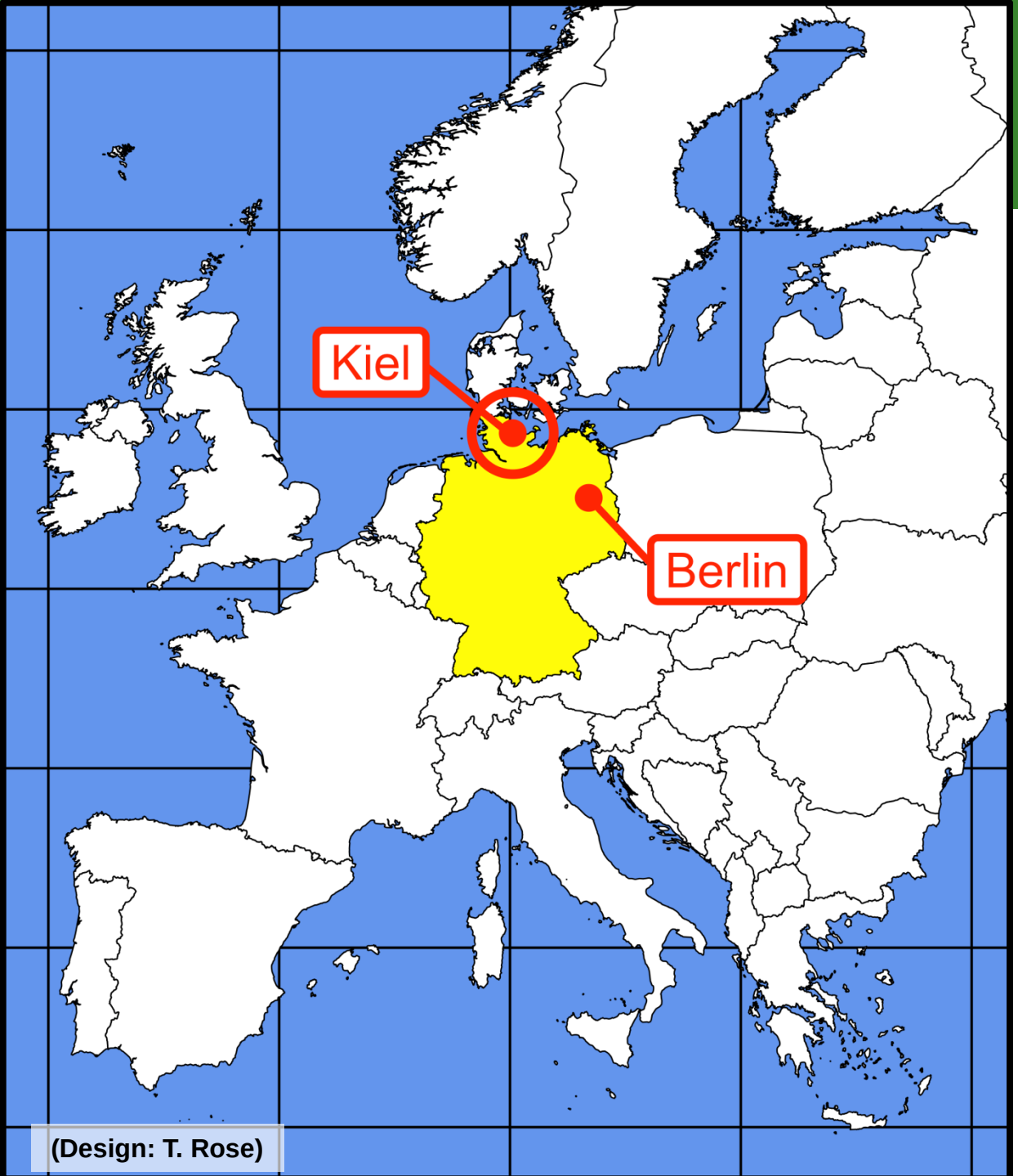
Introduction

Autumn N application of OSR

Spring N application of OSR

Cropping system

Summary



(Design: T. Rose)

Kiel University
Christian-Albrechts-Universität zu Kiel

Location

- sandy loam (Luvisol)
- average temperature: 8.3 °C
- annual rainfall: 750 mm

Introduction

Kiel University
Christian-Albrechts-Universität zu Kiel

Oilseed rape (OSR)

- low N offtake by the seeds → high N surpluses
- after harvest, enhanced N mineralization due to soil tillage

Winter wheat as subsequent crop

- low N uptake (~ 20 kg N ha^{-1}) in autumn

- ➢ increasing soil nitrate pool at the beginning of the percolation period
- ➢ increasing the risk of N losses via N leaching or denitrification

Autumn N application

Autumn N application

Kiel University
Christian-Albrechts-Universität zu Kiel

Aim:

- **Support of autumn growth in order**
  - **to ensure winter survival**
  - **to increase seed yield**

Autumn N often applied with

- **minimum tillage (straw mulch at the soil surface)**
- **delayed sowing (e.g. after winter wheat)**

Autumn N effects on yield and N surplus

Kiel University
Christian-Albrechts-Universität zu Kiel

Harvest years	Autumn N [kg N ha^{-1}]	Yield increase [t ha^{-1}]	N remaining in the system [kg N ha^{-1}]
2003-2005	40	0.22^{ns}	33 (83%)
2006-2007#	40	0.08^{ns}	37 (93%)
2008-2009#	80	0.59***	61 (76%)
2010, 2011, 2013‡	45	0.52***	30 (67%)
2016-2018	40	0.17^{ns}	36 (90%)

- Henke et al. 2009
‡ - Sieling et al. 2017

Autumn N effects on yield and N surplus

Kiel University
Christian-Albrechts-Universität zu Kiel

Harvest years	Autumn N [kg N ha^{-1}]	Yield increase [t ha^{-1}]	N remaining in the system [kg N ha^{-1}]
2003-2005	40	0.22^{ns}	33 (83%)
2006-2007#	40	0.08^{ns}	37 (93%)
2008-2009#	80	0.59***	61 (76%)
2010, 2011, 2013‡	45	0.52***	30 (67%)
2016-2018	40	0.17^{ns}	36 (90%)

- inconsistent results (sometimes profitable)

- Henke et al. 2009
‡ - Sieling et al. 2017

Autumn N effects on yield and N surplus

Kiel University
Christian-Albrechts-Universität zu Kiel

Harvest years	Autumn N [kg N ha^{-1}]	Yield increase [t ha^{-1}]	N remaining in the system [kg N ha^{-1}]
2003-2005	40	0.22^{ns}	33 (83%)
2006-2007#	40	0.08^{ns}	37 (93%)
2008-2009#	80	0.59***	61 (76%)
2010, 2011, 2013‡	45	0.52***	30 (67%)
2016-2018	40	0.17^{ns}	36 (90%)

- inconsistent results (sometimes profitable)
- cannot be recommended from the environmental point of view

- Henke et al. 2009
‡ - Sieling et al. 2017

Autumn N effects on yield and N surplus

Kiel University
Christian-Albrechts-Universität zu Kiel

Harvest years	Autumn N [kg N ha^{-1}]	Yield increase [t ha^{-1}]	N remaining in the system [kg N ha^{-1}]
2003-2005	40	0.22^{ns}	33 (83%)
2006-2007#	40	0.08^{ns}	37 (93%)
2008-2009#	80	0.59***	61 (76%)
2010, 2011, 2013‡	45	0.52***	30 (67%)
2016-2018	40	0.17^{ns}	36 (90%)

- inconsistent results (sometimes profitable)
- cannot be recommended from the environmental point of view
- no pathway(s) identified

- Henke et al. 2009
‡ - Sieling et al. 2017

Spring N application

Spring N fertilization

Kiel University
Christian-Albrechts-Universität zu Kiel

Amount of spring N:

depending on yield level (last 3 year average)
e.g. 4 t ha^{-1} → 170 kg N ha^{-1}

N application dates:

1. at the beginning of spring growth
2. at stem elongation

- distribution pattern less important than in e.g. wheat
- taking autumn canopy N uptake into account when calculating spring N fertilization

Spring N fertilization

Kiel University
Christian-Albrechts-Universität zu Kiel

Amount of spring N:

depending on yield level (last 3 year average)

e.g. 4 t ha^{-1} → 170 kg N ha^{-1}

Assessing autumn canopy N uptake:

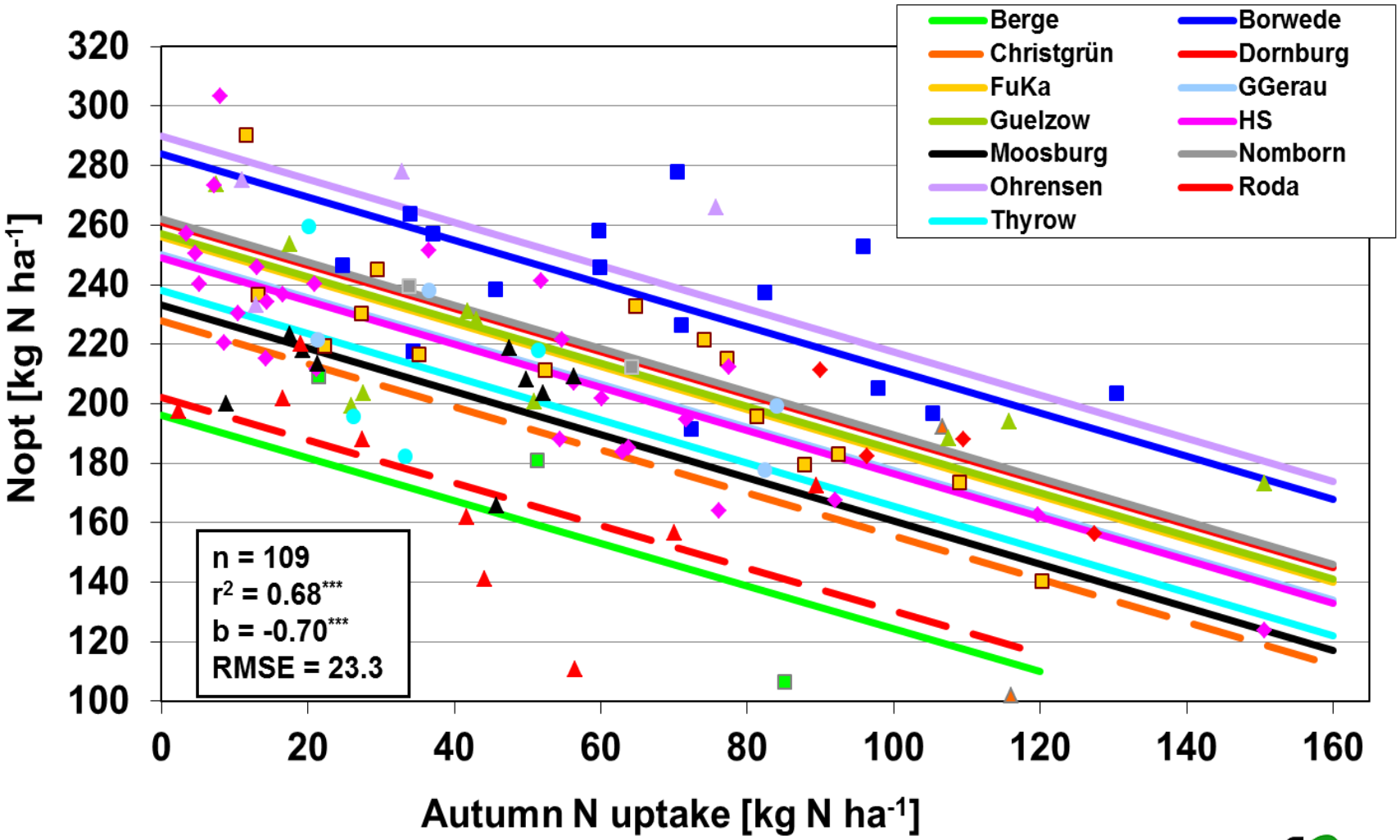
Josephine Bukowiecki: Drone-based assessment of autumnal winter oilseed rape growth

(Wednesday, 11:30 at room A03/A04)

- distribution pattern less important than in e.g. wheat
- taking autumn canopy N uptake into account when calculating spring N fertilization

Autumn N uptake and optimum N fertilization (Nopt)

Kiel University
Christian-Albrechts-Universität zu Kiel

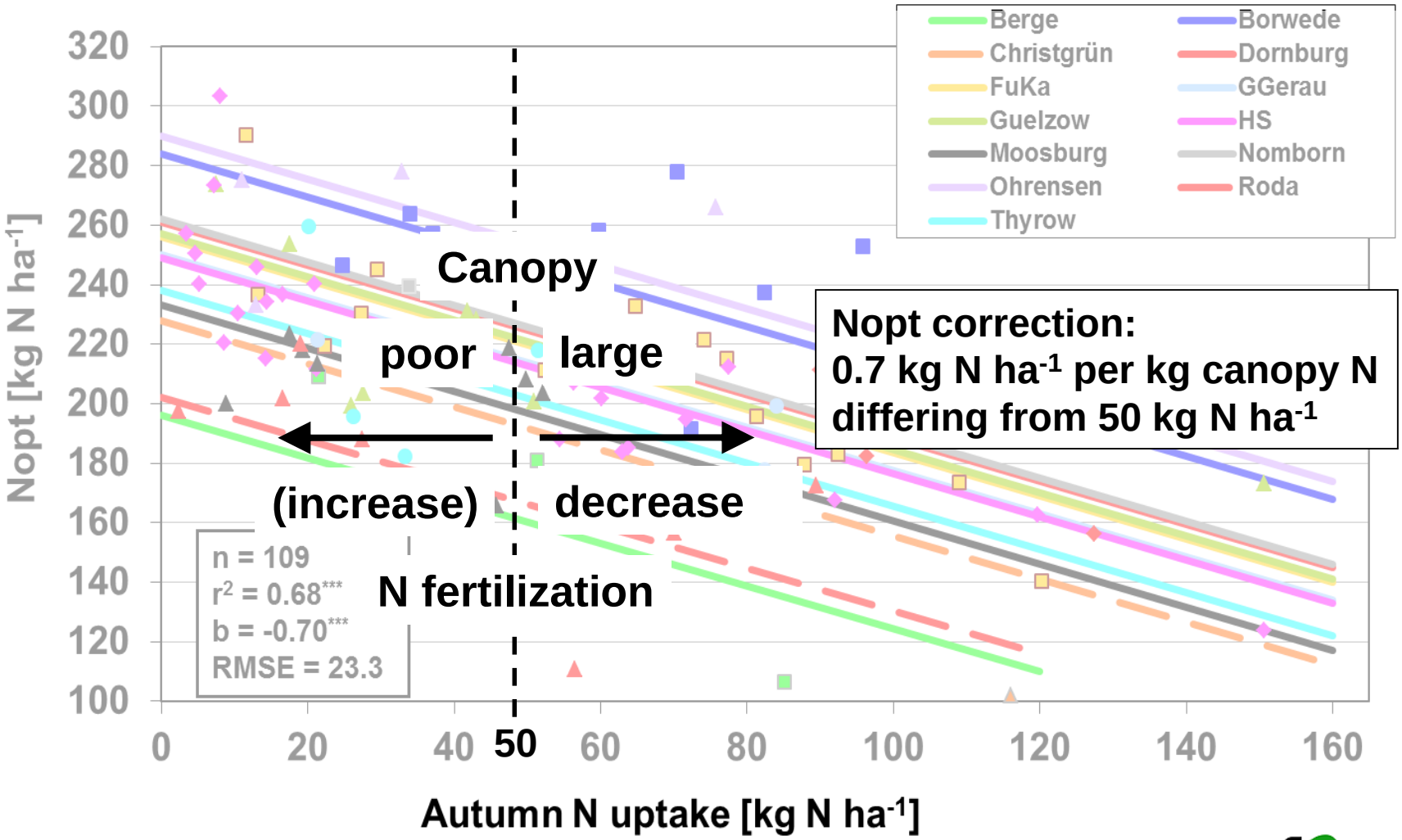


(Henke et al., 2009)

Project supported by: ufop

Autumn N uptake and optimum N fertilization (Nopt)

Kiel University
Christian-Albrechts-Universität zu Kiel

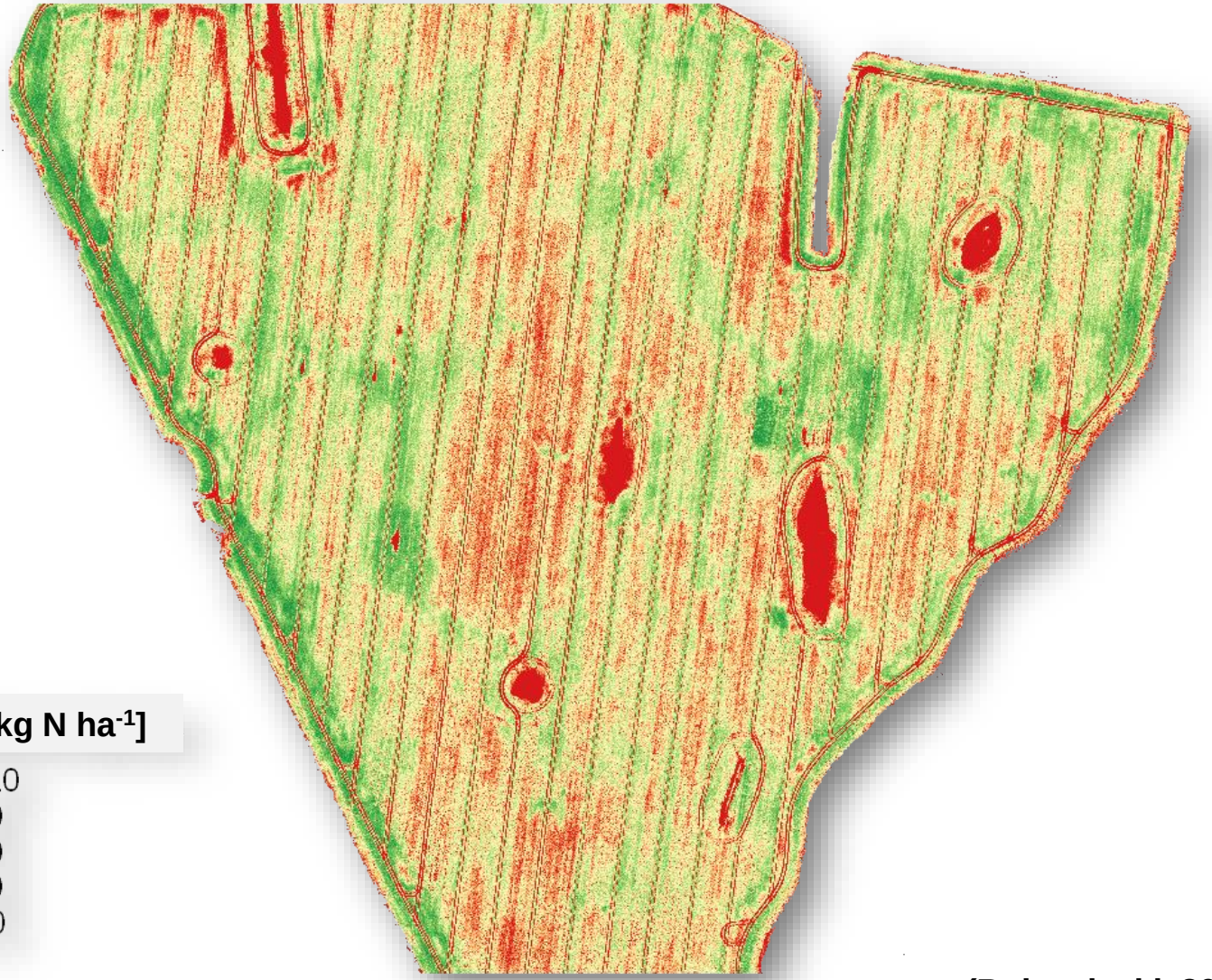


(Henke et al., 2009)

Project supported by: ufop

Variability of N uptake in autumn 2018

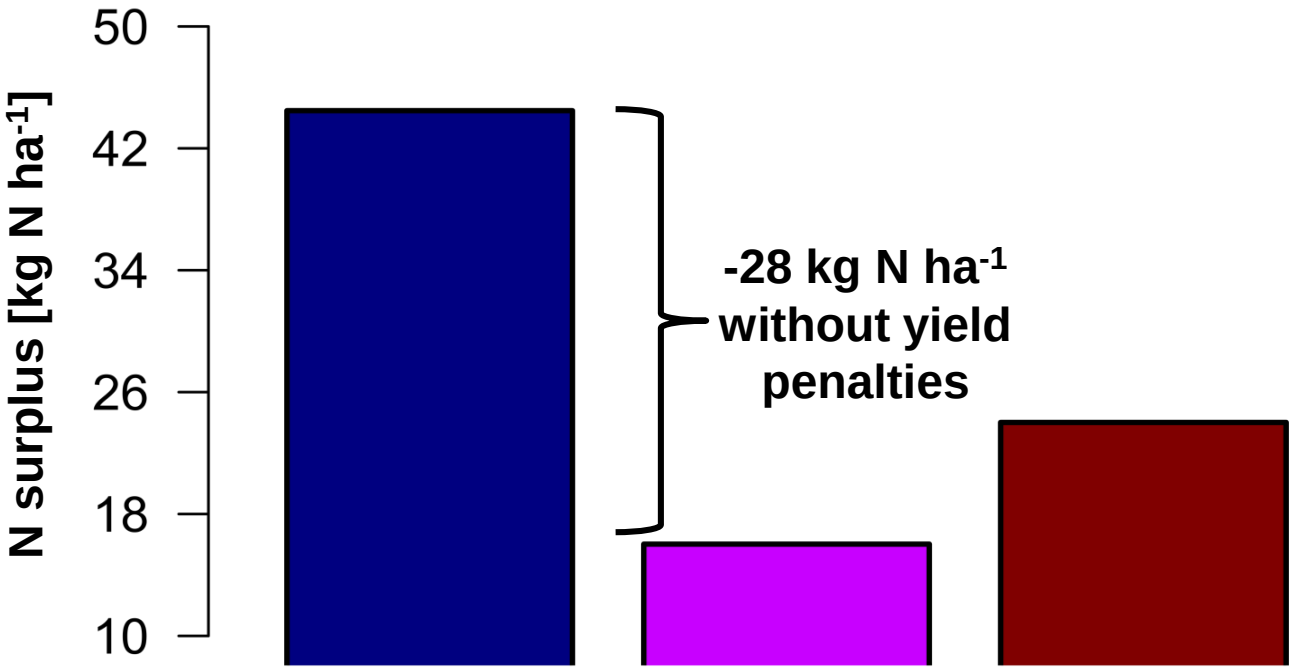
Kiel University
Christian-Albrechts-Universität zu Kiel



(Bukowiecki, 2019)

Site-specific N application

Kiel University
Christian-Albrechts-Universität zu Kiel

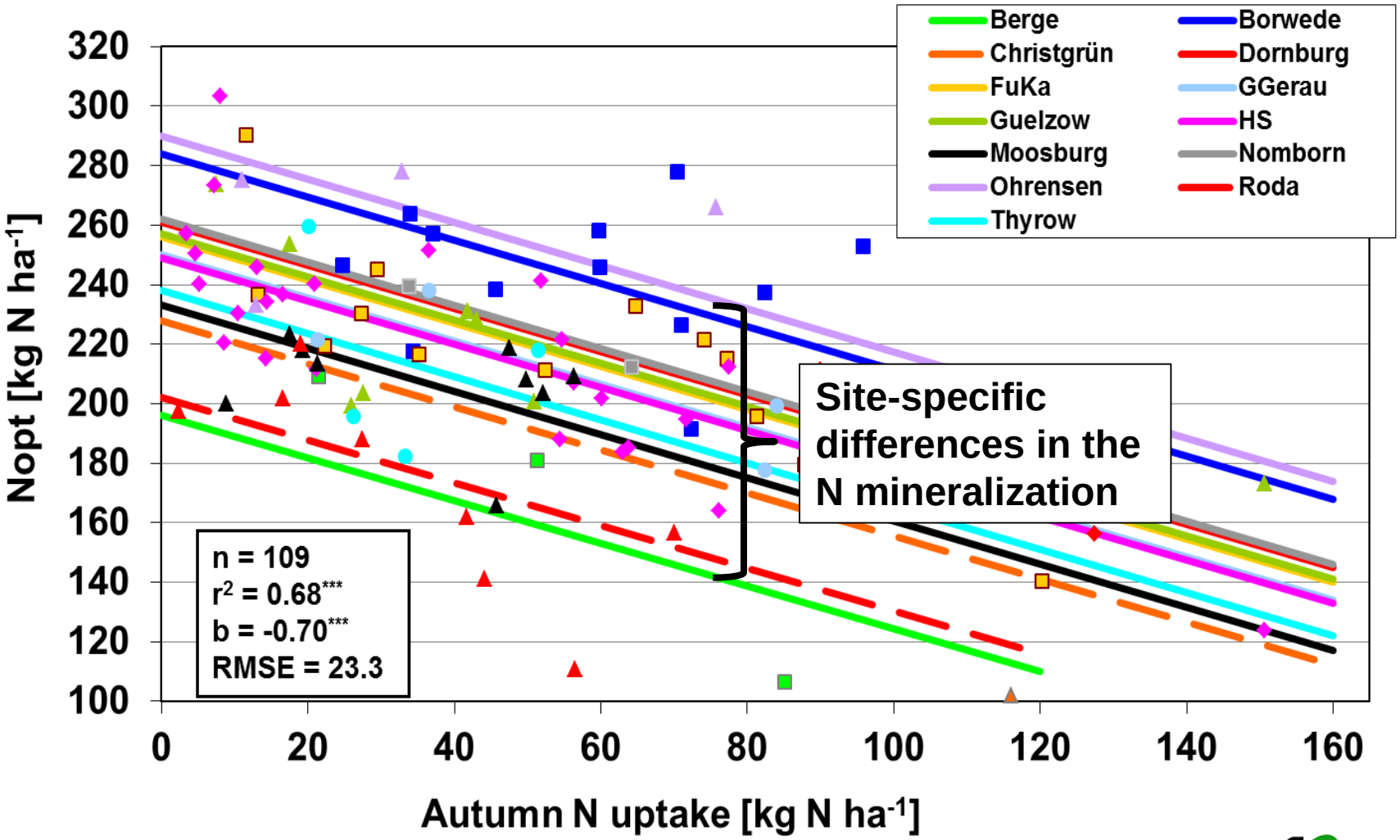


N amount [kg N ha^{-1}]	218	188	188

(Pahlmann et al., 2017)

Autumn N uptake and optimum N fertilization (Nopt)

Kiel University
Christian-Albrechts-Universität zu Kiel



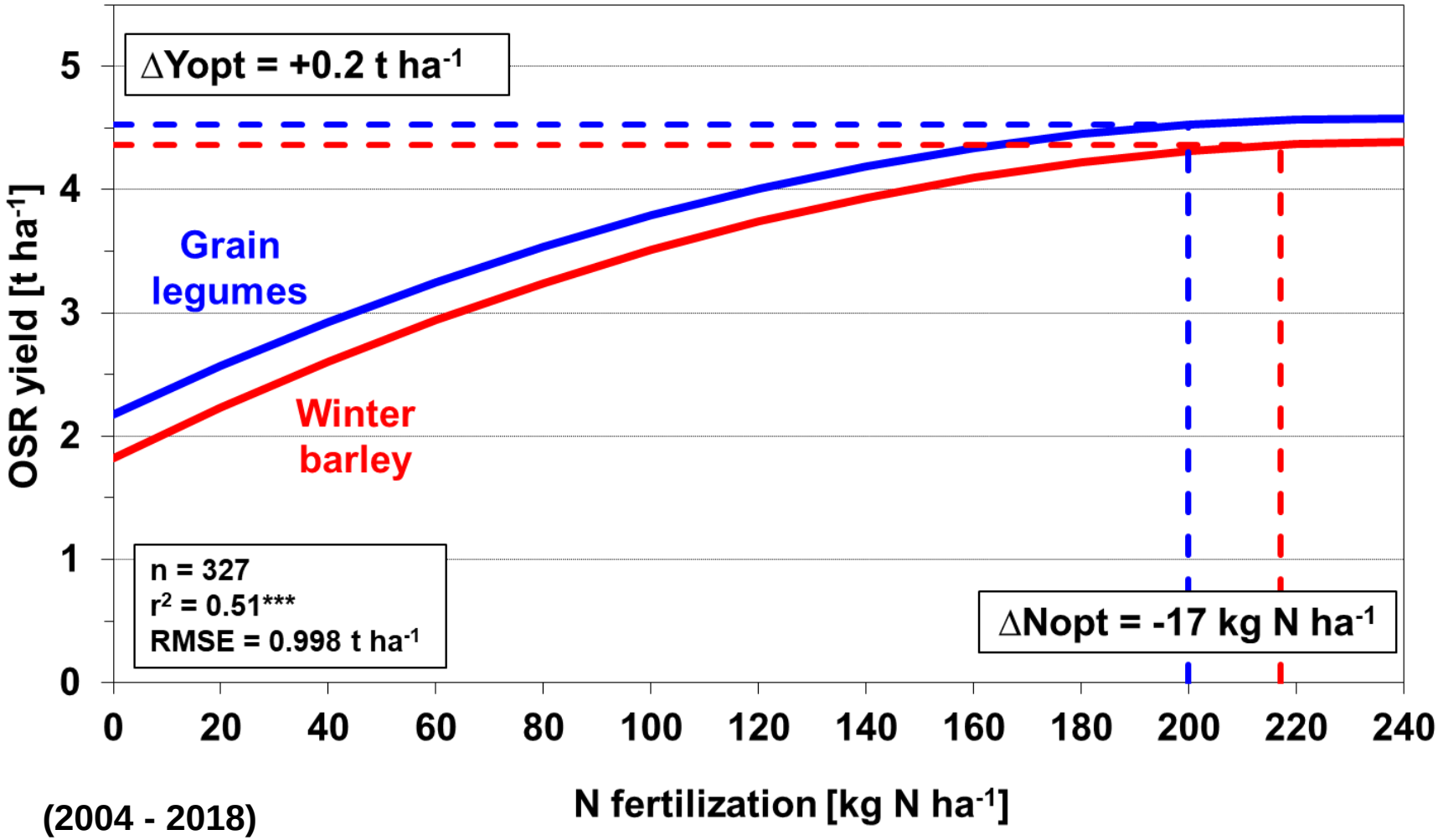
(Henke et al., 2009)

Project supported by: ufop

From the single crop to the crop rotation

Preceding crop effect on seed yield and optimum N fertilization of oilseed rape

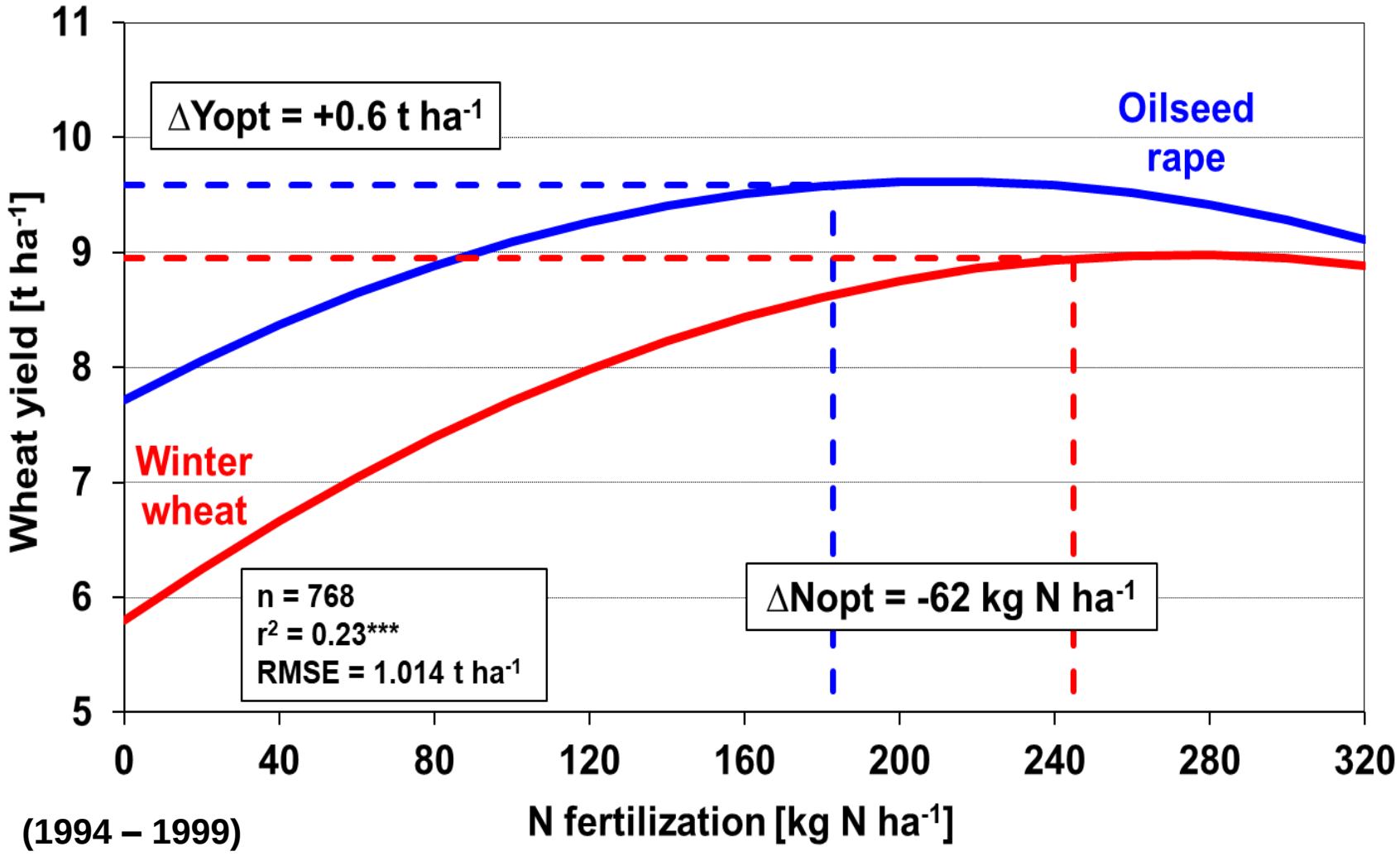
Kiel University
Christian-Albrechts-Universität zu Kiel



(2004 - 2018)

Preceding crop effect on grain yield and optimum N fertilization of winter wheat

Kiel University
Christian-Albrechts-Universität zu Kiel

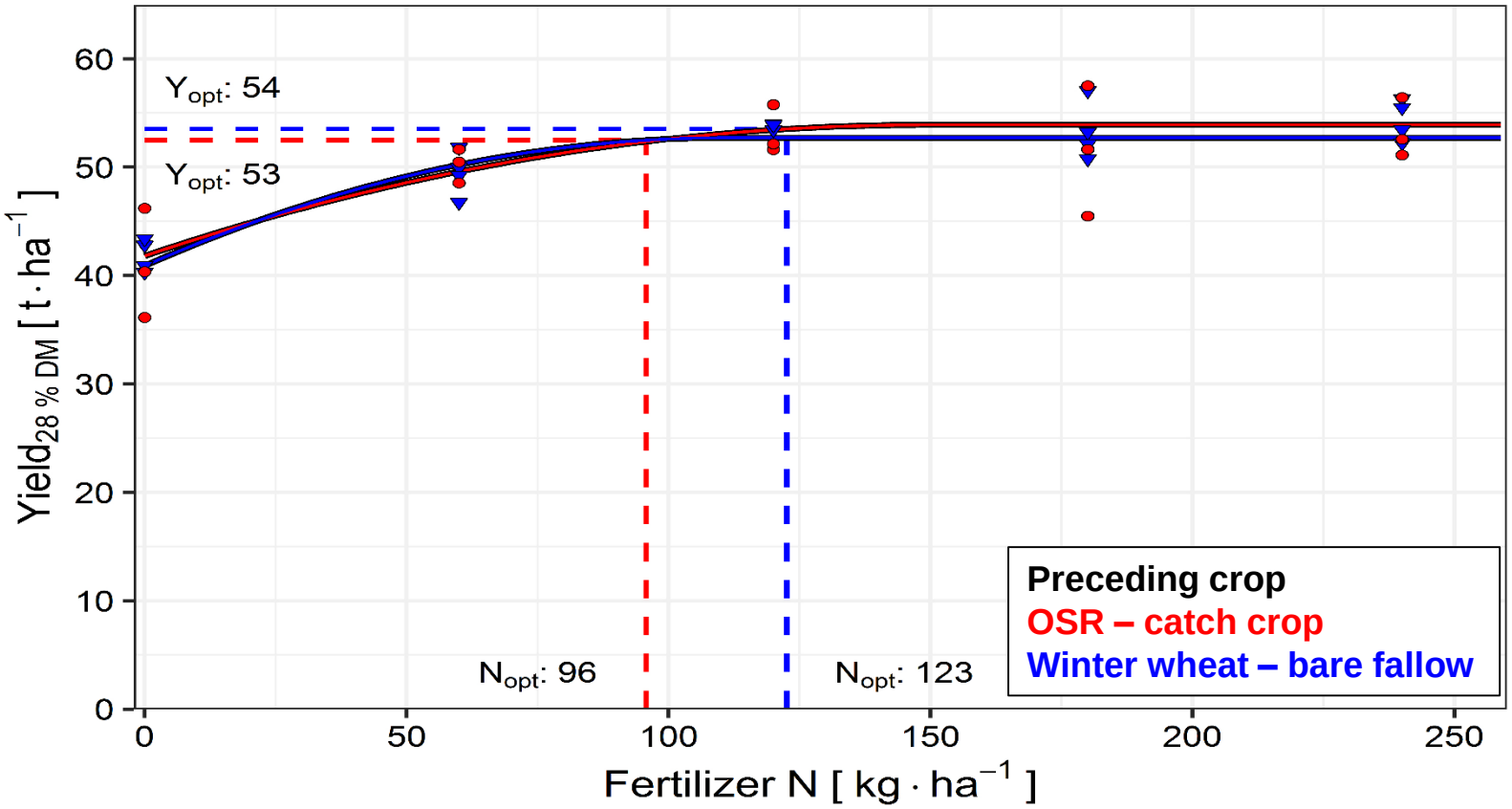


(1994 – 1999)

(Sieling et al., 2005)

Catch crop effects on yield and optimum N fertilization of silage maize (2016/17)

Kiel University
Christian-Albrechts-Universität zu Kiel

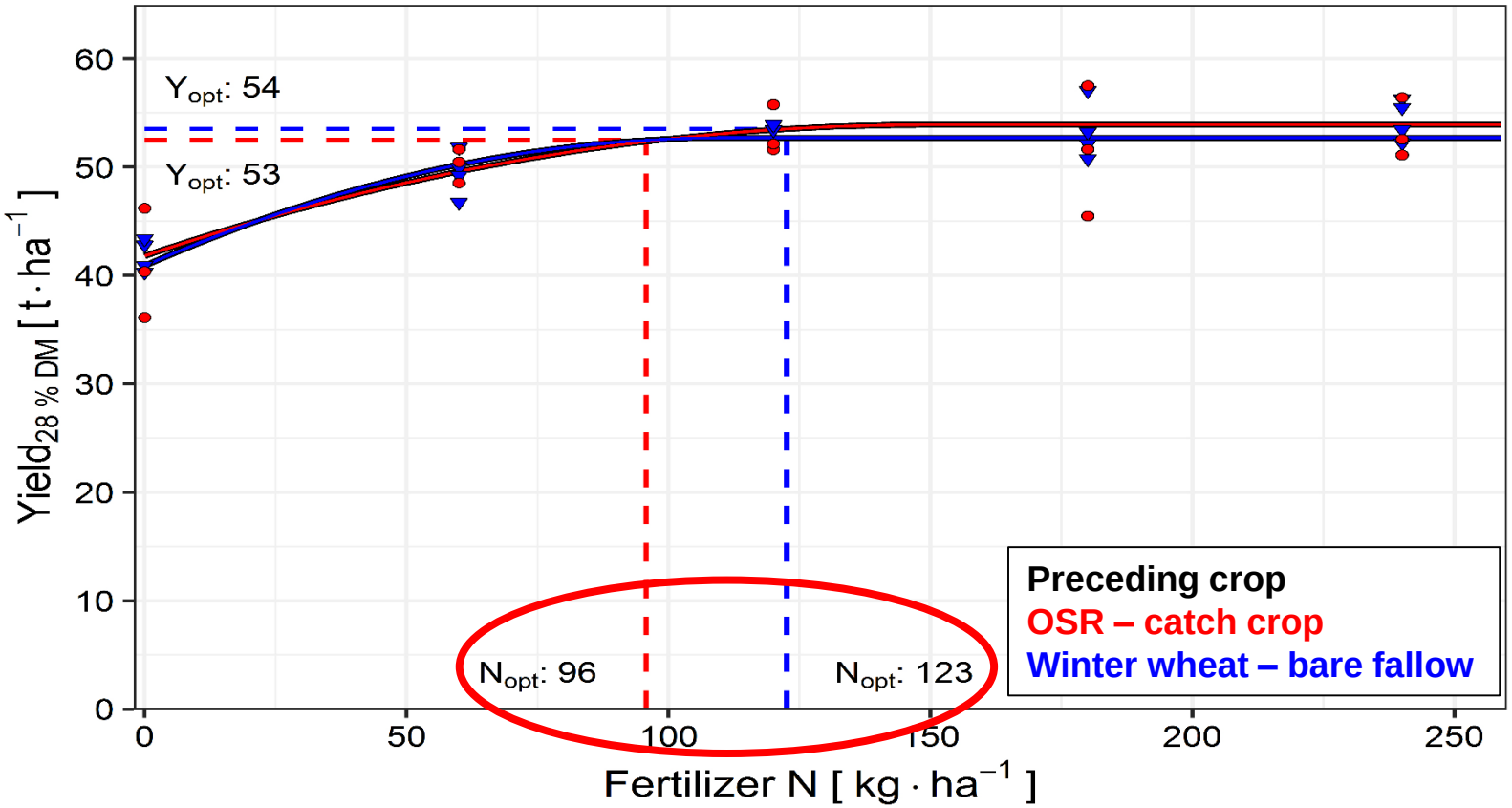


N uptake of the catch crop (*Avena strigosa*): 75 kg N ha^{-1}

(M. Rose, personal communication)

Catch crop effects on yield and optimum N fertilization of silage maize (2016/17)

Kiel University
Christian-Albrechts-Universität zu Kiel



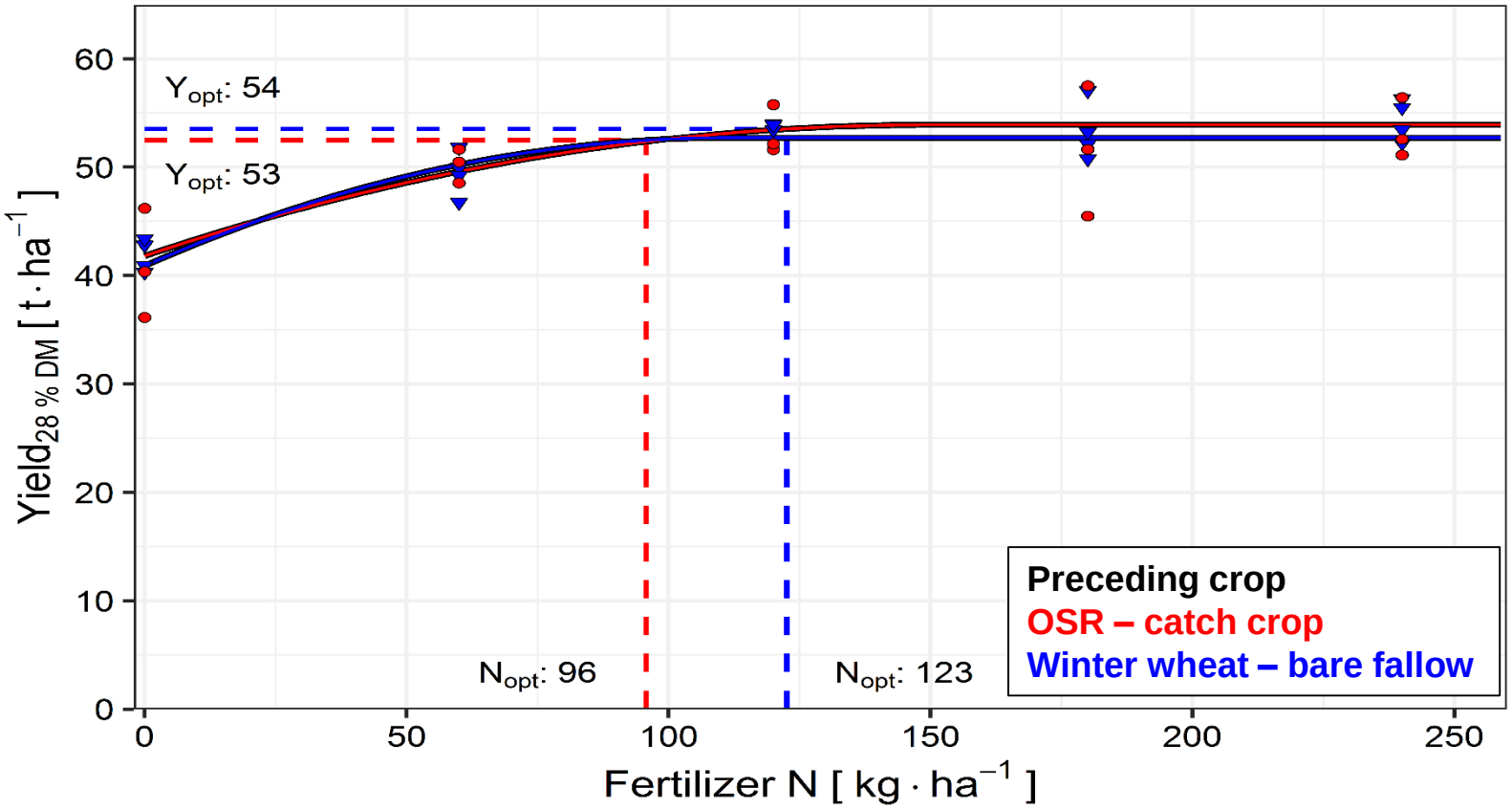
N uptake of the catch crop (*Avena strigosa*): 75 kg N ha^{-1}

reduction in optimum N fertilization: -27 kg N ha^{-1}

(M. Rose, personal communication)

Catch crop effects on yield and optimum N fertilization of silage maize (2016/17)

Kiel University
Christian-Albrechts-Universität zu Kiel



N uptake of the catch crop (*Avena strigosa*): 75 kg N ha^{-1}
reduction in optimum N fertilization: -27 kg N ha^{-1}

48 kg N ha^{-1} remain in the system

(M. Rose, personal communication)

Summary

Kiel University
Christian-Albrechts-Universität zu Kiel

- **Autumn N**
  - only as an exception
- **Spring N**
  - taking autumn canopy N into account
  - estimation of the N mineralization ?
- **Considering the whole cropping system (preceding crop, catch crops, …)**

Challenge:

- **Improving N transfer into the subsequent crop(s)**

Thank you for your attention !