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UNIVERSITEIT STELLENBOSCH UNIVERSITY

A NEW NITROGEN FERTILISATION REGIME FOR MINIMUM-TILLAGE KIKUYU-RYEGRASS PASTURE IN THE SOUTHERN CAPE

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Supervisors:
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Background

Dairy production in southern Cape

- ✓ Planted pastures

High milk production per hactare

High stocking rate = grass pastures

- ✓ Kikuyu and Ryegrass

Nitrogen (N)

- ✓ Major and expensive inputs
- ✓ Irrigated pastures higher risk for leaching
- ✓ Nitrate: soluble and leach easily

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Problem statement

Current guidelines: 300 – 500 kg N ha^{-1} $year^{-1}$

- Developed on cultivated, cutting trials
- Might not be applicable
- Does not take into account nutrient inputs from grazing animals
- Pastures managed under minimum tillage practices

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Aim & Objectives

Aim

- ✓ Determine the effects of N fertilisation on soil and pasture characteristics

Objectives

- ✓ Use soil analyses to aid in preventing losses through leaching

- ✓ Determine N fertilisation rate to achieve optimum pasture quality and production

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Trial layout

Site
- ✓ Kikuyu over-sown with annual ryegrass (cv. Barmultra II)

5 Fertilisation treatments
- ✓ 5 fixed rates (0, 200, 400, 600, 800 kg N ha^{-1} $year^{-1}$)

Randomised block design
- ✓ 15 x 15 m plots
- ✓ Each treatment replicated 4 times
- ✓ Grazing cycle = 28 – 35 days depending on season

Treatments

Table 1: After grazing and annual nitrogen treatment (kg N ha^{-1})		
Treatment	After grazing ($kg\ N\ ha^{-1}\ grazing\ cycle^{-1}$)	Annual ($kg\ N\ ha^{-1}\ year^{-1}$)
N0	0	0
N20	20	200
N40	40	400
N60	60	600
N80	80	800

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Parameters & measurements

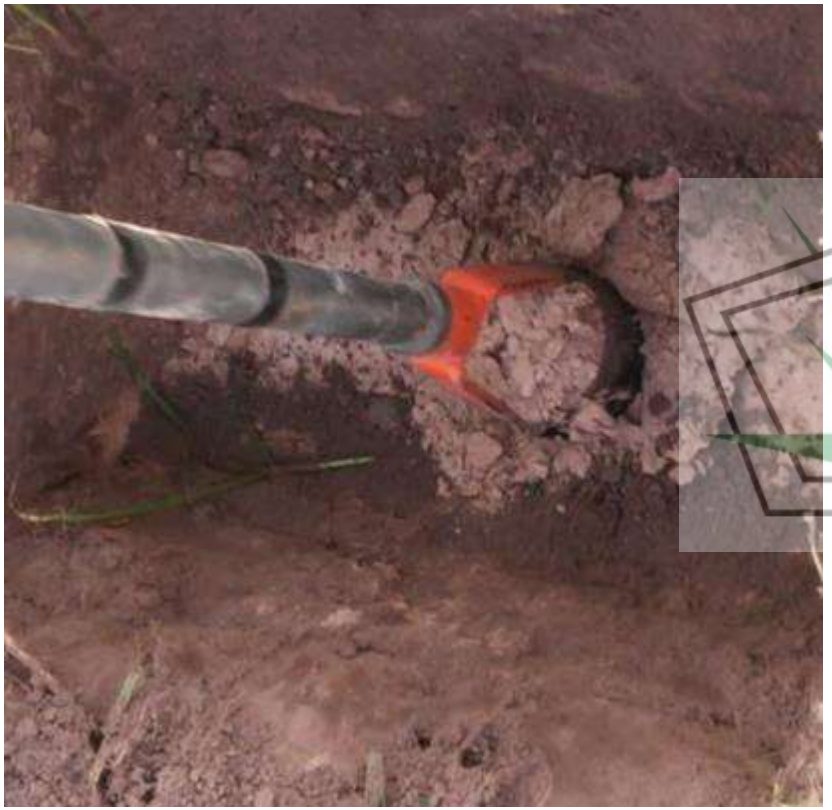
Soil

- ✓ Total mineral N
- ✓ Potential mineralisable N
- ✓ Total soil N
- ✓ Kjeldahl N
- ✓ Organic carbon
- ✓ Urease activity

Pasture

- ✓ Herbage production (t DM ha^{-1})
- ✓ Botanical composition
- ✓ Crude protein (CP)
- ✓ Agronomic nitrogen use efficiency

Results: Soil



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Total mineral N

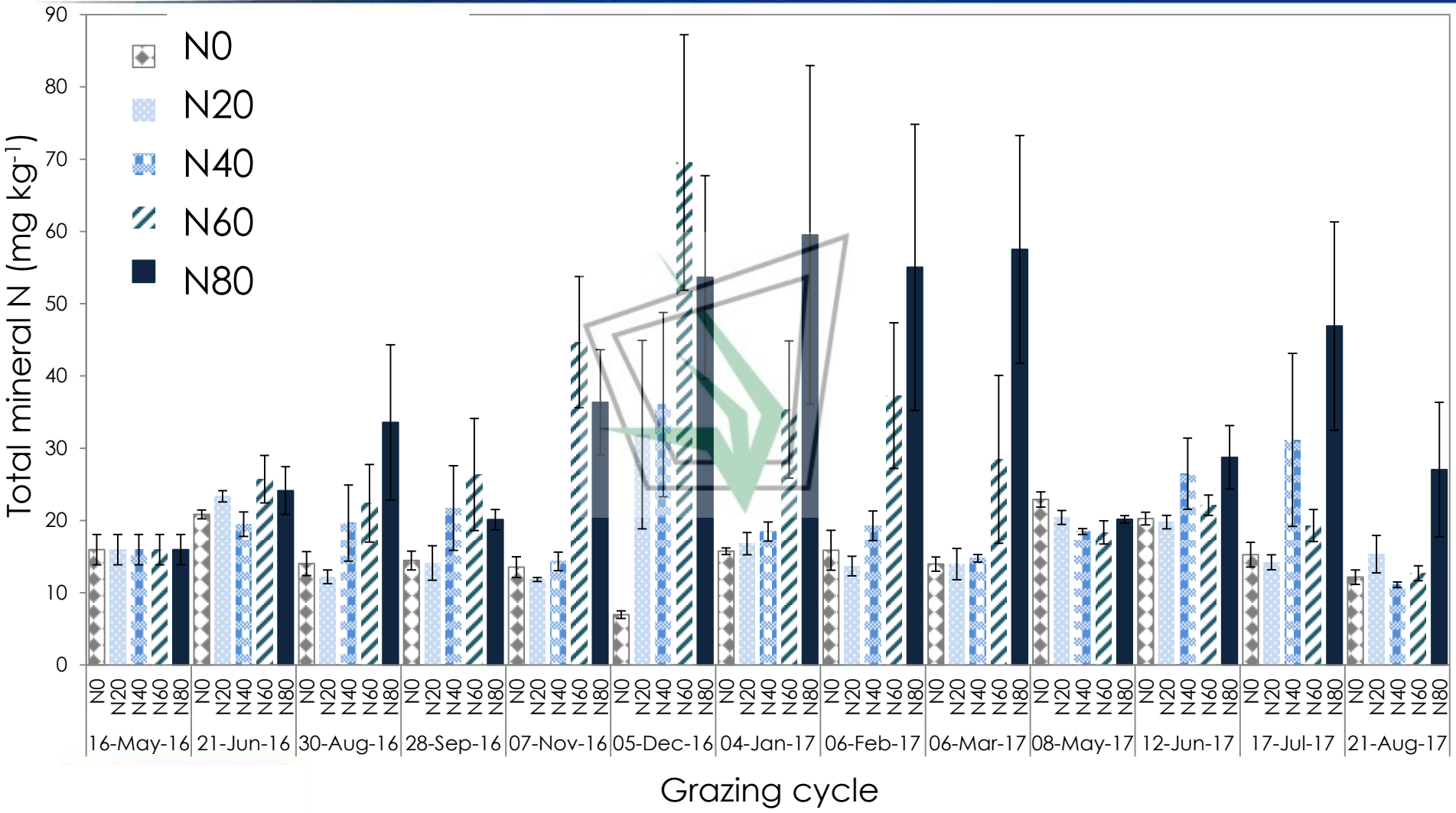

Figure 1: Total mineral soil N (mg kg^{-1}) in soil depth 0 - 100 mm

Total mineral N

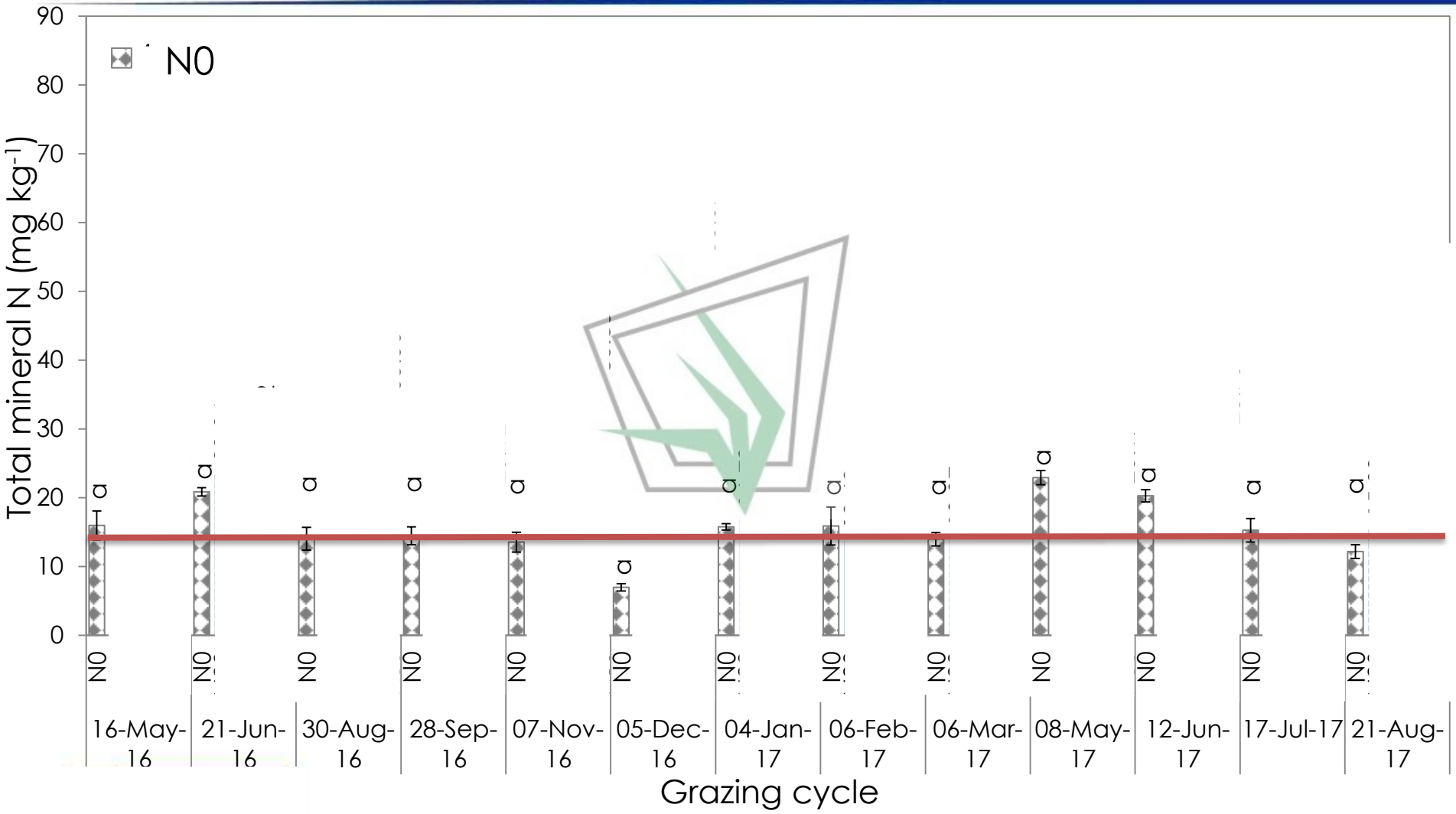

Figure 1: Total mineral soil N (mg kg^{-1}) in soil depth <u>0 - 100 mm</u>

Red line: Average of N0 = 15.5 mg kg^{-1}

Total mineral N

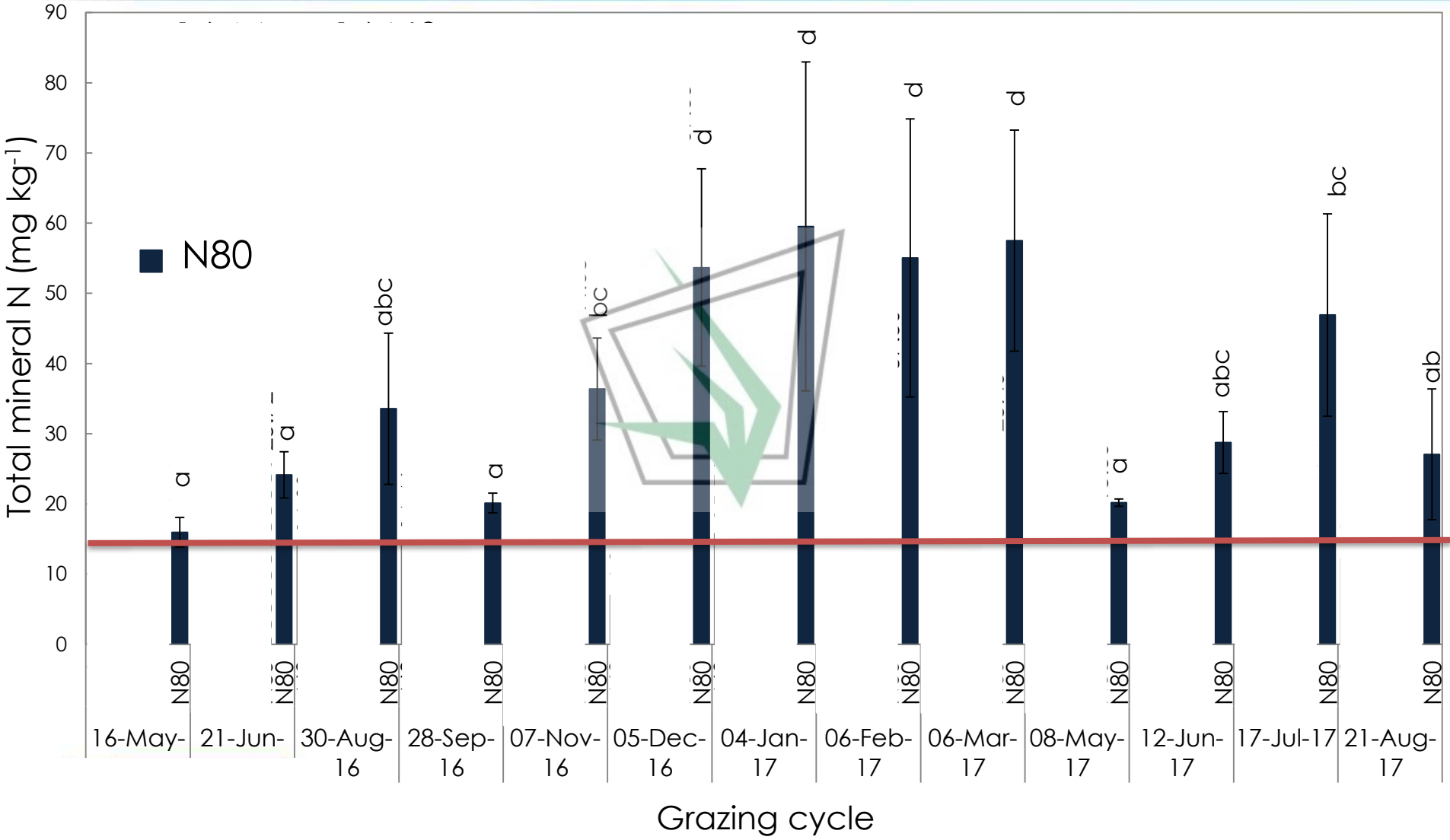

Figure 1: Total mineral soil N (mg kg^{-1}) in soil depth <u>0 - 100 mm</u>

Total mineral N

Total mineral N = Nitrate + ammonium

- ✓ Plant available
- ✓ Possible loss to the environment

Similar effects in all measured depths

- ✓ 0 – 100, 100 – 200 & 200 – 300 mm

Build-up of N

- ✓ ≥ 60 kg N ha^{-1} $grazing\ cycle^{-1}$
- ✓ Risk of leaching

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Results: Pasture

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Results: Production

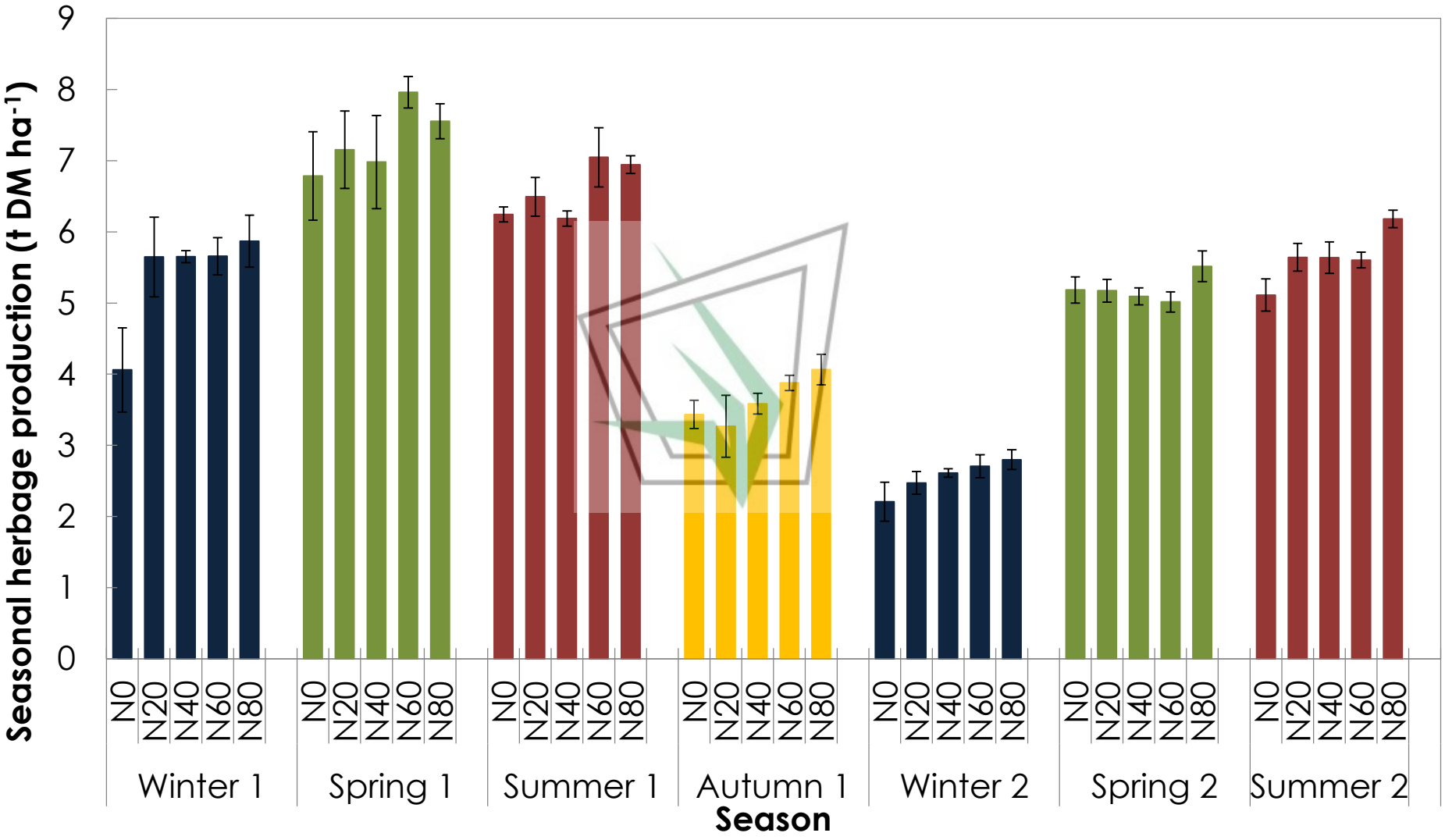

Figure 3: Seasonal herbage production (t DM ha^{-1}) of kikuyu-ryegrass during different seasons

Results: Production

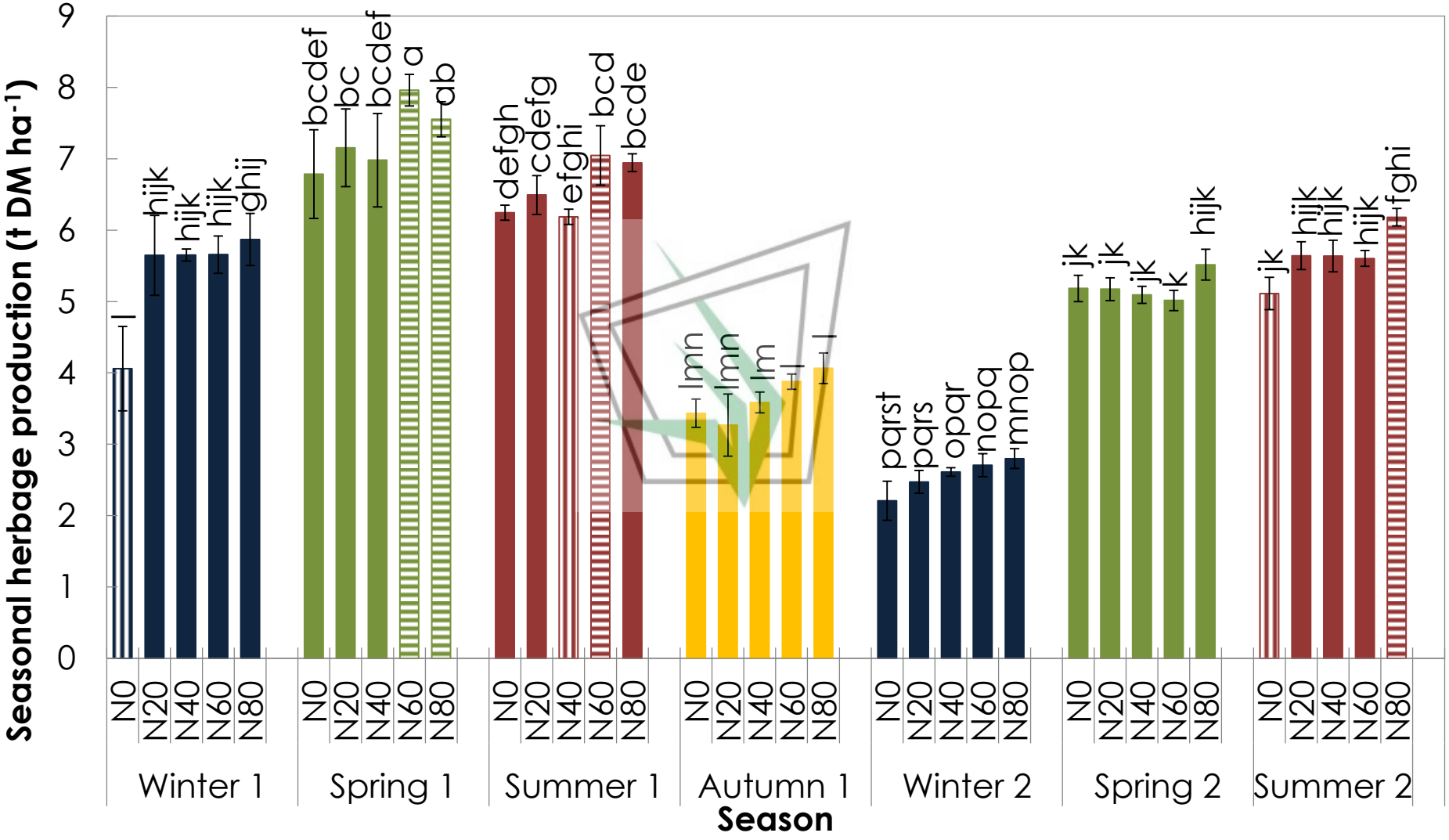

Figure 3: Seasonal herbage production (t DM ha^{-1}) of kikuyu-ryegrass during different seasons

Results: Botanical composition

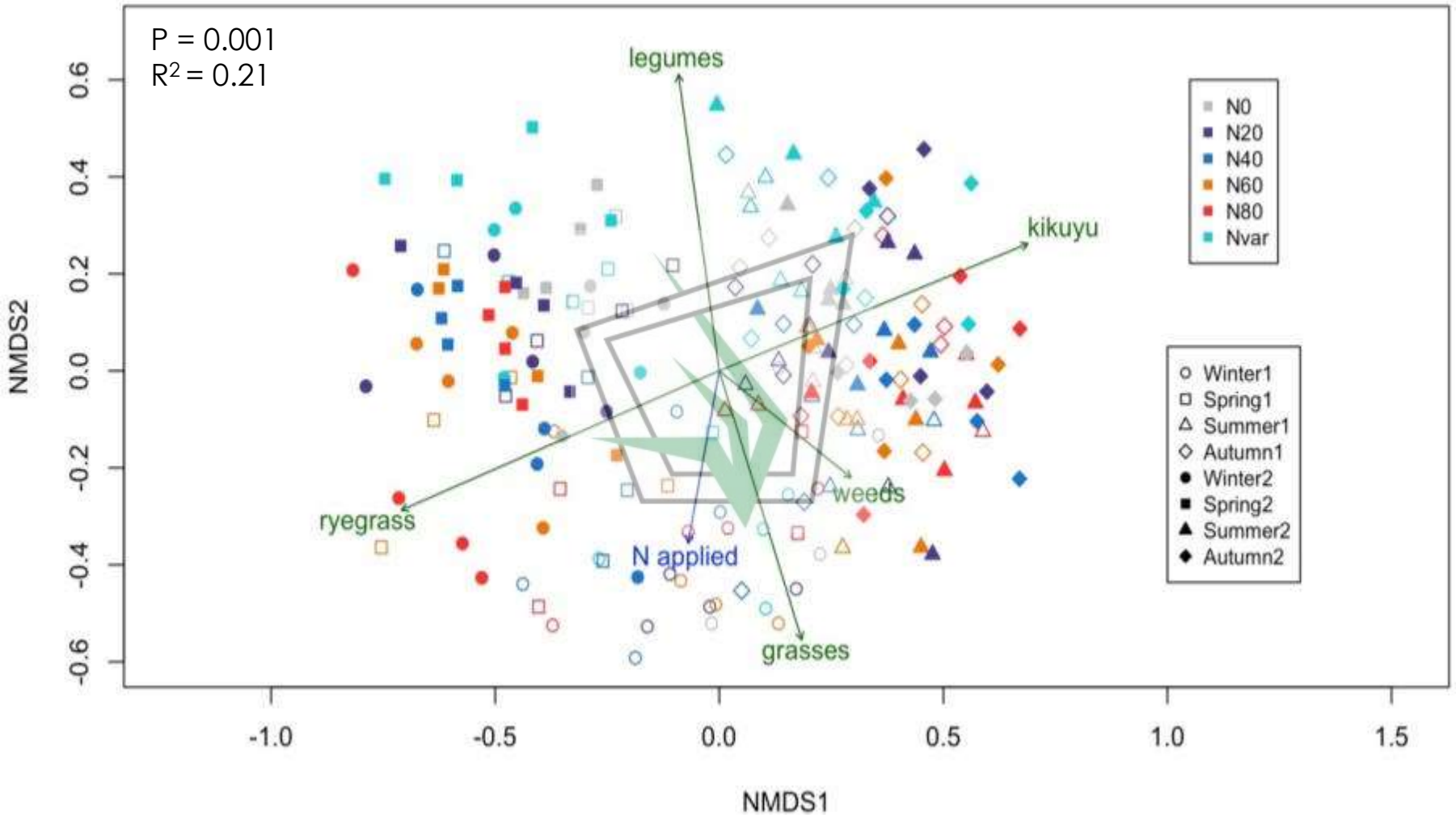

Figure 5: Nonmetric multidimensional scaling (NMDS) ordination axis 1 and 2 of botanical composition component in kikuyu-annual ryegrass pasture as influenced by season

Results: Crude protein

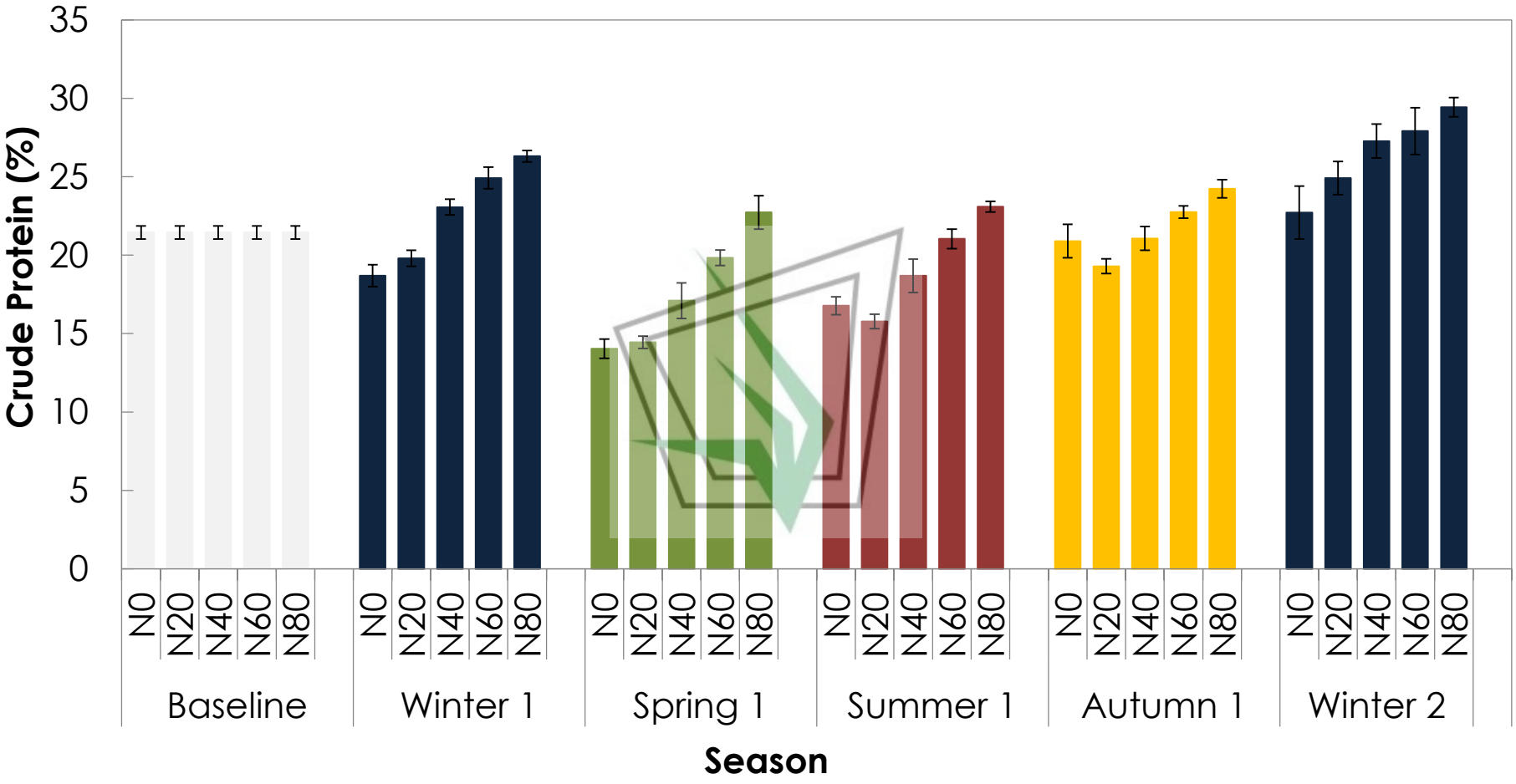

Figure 6: Crude protein content (%) of herbage as affected by treatments compared within and across seasons

Results: Crude protein

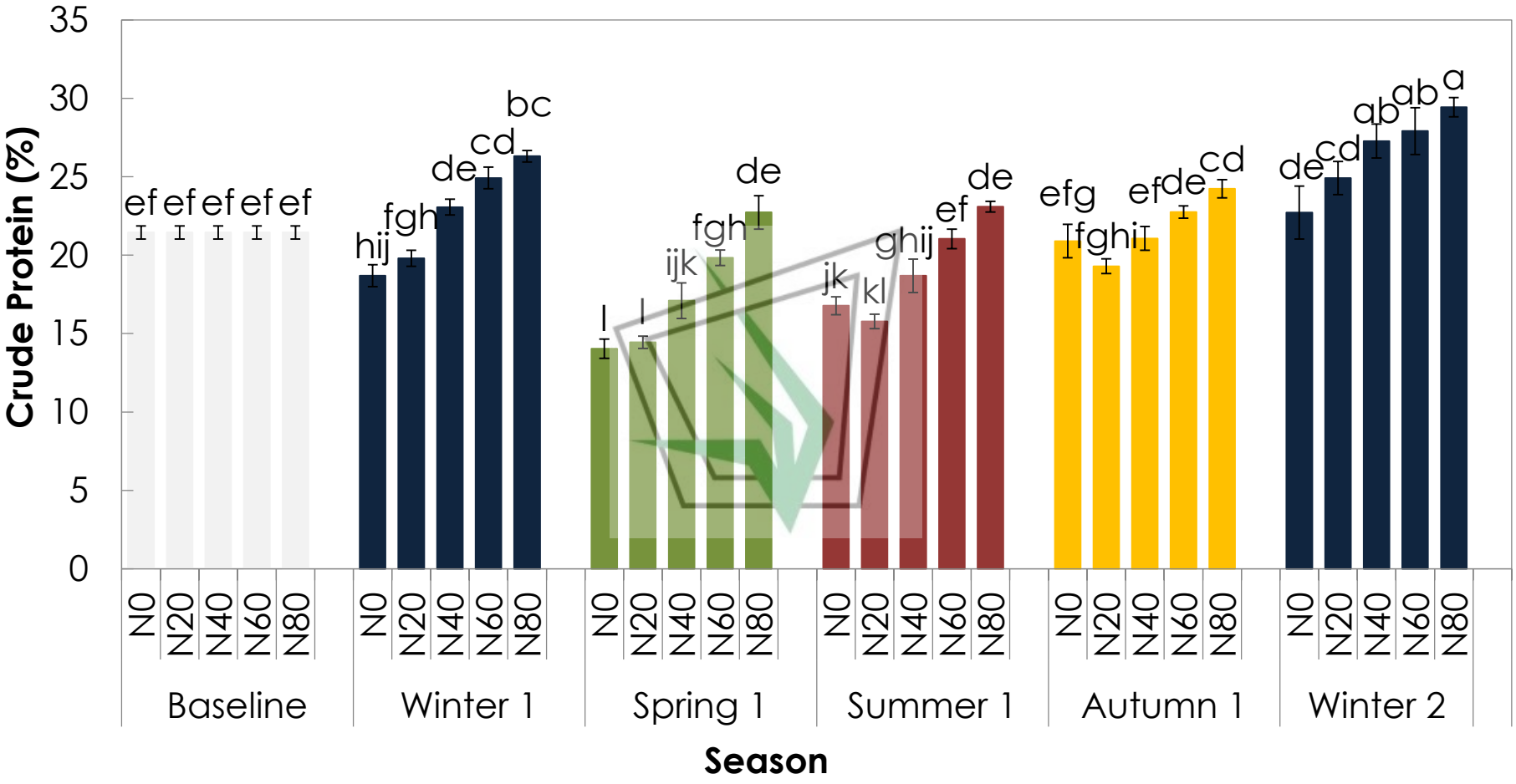

Figure 6: Crude protein content (%) of herbage as affected by treatments compared within and across seasons

Conclusion

N fertilisation could be adjusted to season:

Winter and spring

≤ 40 kg N ha^{-1} grazing $cycle^{-1}$

Risk of leaching similar to control

Ryegrass contribution highest

Volunteer legumes negatively affected compared with control

CP might be to high for dairy cows during winter (23 – 28 %)

Summer and autumn

≤ 20 kg N ha^{-1} grazing $cycle^{-1}$

Production similar to higher rates

Risk of leaching similar to control

CP more acceptable for dairy cows (16 – 19 %)

Volunteer legumes negatively affected compared with control

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Conclusion

Total annual N of 300 kg N ha^{-1} $year^{-1}$
Equal to lower limit of the recommended guidelines

<u>It might even be possible to apply lower amounts N</u>

- ✓ Little production differences
  - does it justify applying higher rates for small production increases?
- ✓ Low rates = more legumes
  - better quality and N return
- ✓ Lower risk of leaching
- ✓ **BUT** what about long term??

Little treatment differences due to high N in soil

Result of high long term fertilisation & high carbon, high potential to mineralise N

- ✓ Further studies necessary to determine long term effects

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Thank you!!

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