

Assessment of potato crop nitrogen status based on leaf chlorophyll and flavonoids contents by use of hand-held fluorimeters Dualex and Multiplex

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INTRODUCTION

Background

Potato crop nitrogen (N) fertilization strategies are more and more based on the assessment of in-season crop N status (CNS) (Goffart et al., 2008). Optical devices that supply indicators can help to assess CNS. Leaf chlorophyll or flavonoids contents are variables closely related to leaf N concentration and therefore could be potentially used for the evaluation of potato CNS.

Objectives

Evaluation of the potentialities of leaf flavonoids content considered alone or combined to leaf chlorophyll content for the assessment of potato CNS. The indicators were investigated on the basis of three criteria:

- 1 Sensitivity to N
- 2 Earliness of the diagnosis for complementary N need
- 3 Accuracy : Precision and Repeatability

MATERIAL AND METHODS

Field experiment:

Trials were conducted in 2012 and 2013 on Belgian loam soil. The trials included two potato [*Solanum tuberosum* (L.)] cultivars: Charlotte and Bintje, and six increasing N rates (0 to 250 kg ha⁻¹ by steps of 50). A split plot design was used with 4 replications, with the N rates as sub-plot level.

Plant sampling:

Plant tissue samples were collected weekly for biomass N concentration and crop yield assessment. The Nitrogen Nutrition Index (NNI) was calculated as the ratio between the actual N concentration and the critical N concentration for a given biomass production (Duchenne et al., 1997).

Statistical analyses:

Data were subjected to ANOVA and orthogonal contrast analyses (SAS 9.2).

Optical measurements:

Individual readings on leaves were collected periodically during potato growing cycle with different devices dedicated to leaf chlorophyll and/or flavonoids contents:



HNT/FLV and HNT/FLAV indices were calculated as combinations between the HNT index and FLV or FLAV index.

RESULTS AND DISCUSSION

Illustration of the Sensitivity, the Earliness and the Accuracy of chlorophyll and flavonoids indices

FLV, HNT/FLV, HNT/FLAV indices in 2012 and FLV, NBI, HNT/FLAV indices in 2013 were able to meet all the requirements successfully and were selected as provisionally promising indices from this study.

Studied criteria

1 - Sensitivity :

*** N effect on 2012 and on 2013

Good discrimination on 2012 and 2013 between all the experimented N rates

** or *** N effect per DAE and per cultivar

2 - Earliness of the diagnosis :

** or *** N effect at the first DAE (15 DAE on 2012 and 9 DAE on 2013)

3 - Accuracy :

Precision:

High Pearson correlation coefficient (***) between the index and NNI

Repeatability:

Good repeatability estimated by the coefficient of variation between the 4 replications

N: Nitrogen effect. DAE: Days After Emergence. NNI: Nitrogen Nutrition Index. **, and *** indicate statistical significance of N rates respectively at $P \leq 0.01$, and $P \leq 0.001$.

CONCLUSION AND PROSPECTS

The indices based on leaf flavonoids content assessed by fluorimetry, and combined or not with the assessed leaf chlorophyll content, appeared after these 2- years field experiments as more relevant to assess potato CNS, comparatively to indices based on transmittance or reflectance. Further studies are needed to establish critical values of chlorophyll and flavonoids indicators that provide threshold for decision on supplemental N need.



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