# Searching for crop characteristics correlated with nitrogen efficiency in potato

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## Introduction

Breeding for nitrogen efficient varieties under low input conditions is necessary. However, breeders lack knowledge about genetic variation in nitrogen response of potato under low-input conditions and about relevant crop traits associated with variation in nitrogen efficiency. Can the parameters of the ground cover curve be used as selection criteria for nitrogen efficiency in potato?

## Material and methods

Four field trials (Droevendaal (organic, sand) and Grebbedijk (conventional, clay), in 2008 and 2009) were conducted with nine (2008) or six (2009) potato varieties and three nitrogen input levels (0, 60 and 210 kg/ha) in a split-plot design with four replicates. Many above-ground and below-ground plant traits were assessed, including percentage ground cover, leaf area, tuber bulking and nitrogen accumulation.

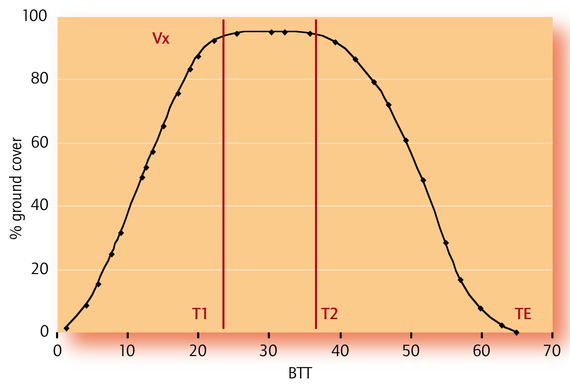


Figure 1. Schematic ground cover progress curve

Foto 1. Ground cover measurement

Figure 1 illustrates the schematic ground cover curve (GCC) including its main parameters (Vx, T1, T2, and TE). We surmised that some of these parameters, or parameters calculated from these parameters (T2-T1 and Area Under Ground Cover Progress Curve, AUGCPC) could be correlated with nitrogen efficiency under low input conditions.

## Results

Nitrogen had an effect on Vx (maximum ground cover), T1 and T2 (table 1). In the early varieties the effect on Vx was the strongest. At low input nitrogen level the canopy did not close entirely as was the case under high nitrogen conditions. In the late varieties however, this effect was less pronounced but more nitrogen led to an earlier closing of the canopy (<T1) and a delay of crop senescence (>T2). This resulted in a prolonged period of maximum soil cover (>T2-T1). All parameters contributed to a higher AUGCPC with an increase in nitrogen supply. The AUGCPC of the late varieties was much higher than of the early varieties.

Table 1: Mean of the parameters in the Ground Cover Progress Curve of both locations and both years

| | early varieties* | | | late varieties** | | |
|---|---|---|---|---|---|---|
| parameter | 0 kg/ha N | 60 kg/ha N | 210 kg/ha N | 0 kg/ha N | 60 kg/ha N | 210 kg/ha N |
| Vx (%) | 87.2 a | 94.1 b | 98.6 c | 92.9 a | 97.2 b | 99.9 c |
| T1 (d) | 22.3 b | 21.4 b | 20.1 a | 24.9 c | 20.7 b | 18.9 a |
| T2 (d) | 28.4 a | 29.2 a | 29.0 a | 33.3 a | 42.4 b | 45.4 b |
| TE (d) | 46.9 a | 46.2 a | 52.0 b | 61.8 a | 61.5 a | 61.1 a |
| AUGCPC (%d) | 26.0 a | 28.1 a | 32.9 b | 41.0 a | 44.0 ab | 45.5 b |
| T2-T1 | 6.1 a | 7.8 ab | 8.9 b | 17.4 a | 22.0 b | 26.5 c |

*Agata, Leoni, Biogold, Bionica, ** Santé, Fontane, Terragold, Agria, Spirit
Different letters of the same color within rows denote statistically significant difference between N-levels, (LSD test, P<0.05)

How do these parameters correlate with tuber yield?

Table 2. Correlation coefficient ($R^2$) of the regression between the curve fit parameters and yield (simple linear regression with variety as group)

| | 2008 | | 2009 | |
|---|---|---|---|---|
| parameter | Droevendaal (n=108) | Grebbedijk (n=108) | Droevendaal (n=72) | Grebbedijk (n=72) |
| Vx | 0.39*** | 0.39*** | 0.65*** | 0.63*** |
| T1 | 0.32*** | 0.33*** | 0.29*** | 0.49*** |
| T2 | 0.41*** | 0.06 | 0.26** | 0.36*** |
| TE | 0.45*** | 0.21** | 0.26** | 0.34*** |
| AUGCC | 0.46*** | 0.30*** | 0.56*** | 0.58*** |
| T2-T1 | 0.43*** | 0.07 | 0.27*** | 0.44*** |

Statistically significant ***=P<0.001, **=P<0.01, *=P<0.05

As you can see in table 2 Vx and AUGCC showed the best correlation with yield, but $R^2$ remained low. The regression per variety can be very different between years and locations. This makes the search for stable parameters more complicated. The search for reliable (combinations of) parameters goes on.