Crop traits relevant for selecting potato genotypes adapted to low nitrogen availability

Marjolein Tiemens-Hulscher[1], Edith T. Lammerts van Bueren[1], and Paul C. Struik[2]
[1] Louis Bolk Institute, Hoofdstraat 24, 3972 LA Driebergen, The Netherlands, e.lammerts@louisbolk.nl
[2] Centre for Crop Systems Analysis, Wageningen University, Wageningen, The Netherlands

Introduction

Identifying crop traits correlated with adaptation to low nitrogen availability in potato is required for successful breeding of potato for organic agriculture.

Materials and Methods

We monitored the canopy cover development over time of 6 to 18 varieties at 3 nitrogen levels at 3 research sites for 4 years and analyzed the effect of nitrogen and variety on curve fit parameters from a curve fit model describing the canopy cover development over time (the so called GCPC, figure 1). We correlated these curve fit parameters for canopy development with dry matter production and assessed their suitability as selection criteria to breed for potato varieties adapted to low nitrogen availability.

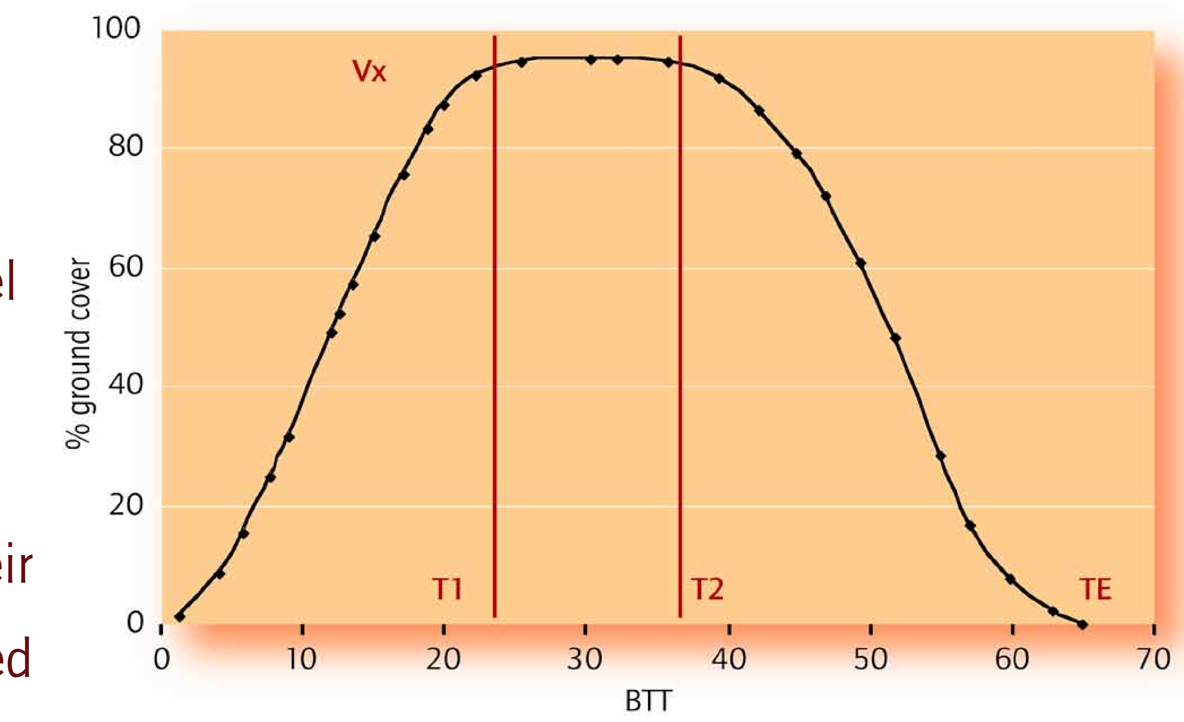

Figure 1. Schematic ground cover progress curve.

Results

For each year x location combination we identified the 33% best performing varieties for each of the curve fit parameters and for dry matter production. Subsequently we analyzed how many times there was a positive match between the best varieties based on the curve fit parameters with the highest producing varieties (dry matter, ton/ha) (table 1).

Table 1. Mean percentage match of 33% best performing varieties based on the curve fit parameters with the highest producing varieties (dry matter) at different nitrogen levels. R^2 is the mean correlation coefficient over all year x location combinations between the curve fit parameters and dry matter production. Between brackets the range over the year x location combinations.

parameter	0 N kg/ha	60 N kg/ha	210 N kg/ha	R^2
AUGCPC* (highest)	71 (33 – 100)	65 (50 – 100)	53 (0 – 100)	0.56 (0.35 – 0.79)
Vx (highest)	72 (50 – 100)	60 (33 – 100)	67 (33 – 100)	0.54 (0.32 – 0.65)
T2-T1 (longest)	69 (50 – 100)	62 (33 – 100)	42 (0 – 67)	0.39 (0.11 – 0.64)
T1 (lowest)	24 (0 – 50)	24 (0 – 50)	36 (0 – 67)	0.39 (0.10 – 0.62)
T2 (highest)	55 (33 – 100)	48 (17 – 100)	43 (0 – 83)	0.33 (0.06 – 0.54)
TE (highest)	53 (33 – 100)	67 (33 – 100)	37 (0 – 50)	0.41 (0.18 – 0.59)
TE-T2 (longest)	33 (0 – 100)	47 (0 – 100)	17 (0 – 50)	0.31 (0.19 – 0.43)

*AUGCPC = Area Under Ground Cover Progress Curve

Table 1 shows that the best matches and the highest correlation were found for AUGCPC, maximal percentage ground cover (Vx) and the period of maximum ground cover (T2-T1). The percentage of positive matches decreased with a higher nitrogen level, because a higher nitrogen application suppresses the expression of varietal differences.
We assessed in detail which varieties belonged more than 50% of the year x location combinations to the 33% best performing varieties for each curve fit parameter at the two lowest nitrogen levels together (table 2).

Table 2. Varieties that belonged for more than 50% of the year x location combinations to the 33% best performing varieties for the curve fit parameters AUGCPC, Vx and T2-T1and dry matter production (ton/ha).

AUGCPC	Vx	T2-T1	dry matter production
YP03-107	YP03-107	Agria	YP03-107
Musica	Musica	Campina	Musica
Fontane	YP03-3	Fontane	Fontane
	Spirit	Mozart	Terragold
	Sarpomira		Santé

Selection for the highest Vx or the longest T2-T1 resulted in different varieties. These two crop traits are supplementary and can both be used as selection criteria in breeding for varieties adapted to low nitrogen input. Because of nitrogen x variety interaction we recommend to use a low nitrogen input selection environment. Our experience is that at a high nitrogen level other varieties performed best than at low nitrogen levels.