CROP TRAITS RELEVANT FOR SELECTING POTATO GENOTYPES ADAPTED TO LOW NITROGEN AVAILABILITY

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Organic and conventional growers require potato varieties that give reliable and stable yields under low nitrogen input conditions. However, breeders lack suitable selection criteria to select for such varieties. In this research we analysed genetic variation of relevant crop characteristics and physiological processes associated with nitrogen efficiency under low nitrogen input. The aim is to identify crop traits that reflect variation in the ability to deal with low availability of nitrogen and to transform these traits into practical selection criteria.

In 2008 and 2009 field trials were conducted on an organic site (sandy soil) and on a conventionally managed site (clay soil). In 2010 and 2011, both trial fields were on an organic farm (a sandy soil and a clay soil). The nitrogen application treatments were 0 (control), 60 and 210 kg/ha for all year × location combinations. For the in-depth study (2008), nine varieties were studied and six of them were included in the 2009 trails; in 2010 and 2011, 18 varieties were used for validation. Experiments were set up in a split-plot design with four replicates. Pre-sprouted tubers were planted around 22 April. The final harvest was conducted 100 days after planting for all varieties.

During the growing season, percentage ground cover was assessed twice a week, using a grid with 100 rectangular cells. Each cell filled with green foliage for more than 50% was counted as 1% ground cover. We fitted the ground cover progress curve of each plot and the variables Vx (percentage maximum ground cover), T1 (time till maximum ground cover), T2 (time to the end of maximum cover), and TE (time to complete crop senescence) were determined. With these parameters the Area Under Ground Cover Progress Curve (AUGCPC), the period of maximum ground cover (T2−T1) and the period of crop senescence (TE−T2) were calculated. At the final harvest the yield (fresh and dry), the number of tubers, nitrogen uptake, nitrogen use efficiency and the harvest index (based on dry matter or N) were determined.

We found genotypic variation for all canopy cover parameters and traits related to yield. Most of the variation across the varieties was related to maturity type. Late varieties tended to have a higher uptake of nitrogen than early varieties. Early varieties, however, had a higher harvest index (N), which resulted in small genetic variation in the amount of nitrogen in the tuber. In most year × location combinations late varieties had a higher yield than early varieties because of a better nitrogen use efficiency (expressed in kg tuber dry matter / kg tuber nitrogen). The correlation of the curve fit parameters with dry matter production varied greatly between years, locations and nitrogen levels. The AUGCPC and Vx showed the highest correlation.

Late blight infestation and weather conditions strongly affected the shape of the canopy cover curves, thus causing problems in precisely and consistently estimating the parameters, but also providing insight into identifying which varieties can recover after a long period of stress and which cannot. Based on the results we will discuss options for effective selection strategies to select varieties adapted to low nitrogen input conditions.