Oilseed rape varietal response to nitrogen fertilization

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Introduction

In Switzerland, hybrids are grown on more than 65% of the 15'000 ha dedicated to *B. napus* Crop response to N fertilization is an important issue related to the introduction of these new varietal types. Hybrids with high yield potential might have high N requirements. On the other hand, the vigor of those plants might also be expressed as improved N uptake by a vigorous rooting system. N fertilization guidelines (Ryser et al., 2001) for field crops do not take into account varietal types for *B. napus*. These are based on a fertilizer norm (140 kg N/ha for a 35 dt/ha oilseed rape grain yield), with corrections according to environmental conditions (crop rotation, climate, soil characteristics, use of manure). The goal of the present work was to assess the response of hybrids and conventional varieties to N fertilization and determine the need of guidelines adaptation to hybrids.

Materials and methods

A three year series of experiments (1998-2000) were conducted on middle textured soils, at 450 m above sea level, in Western Switzerland. Experimental design was a split-plot with 4 replications, 3 N regimes as main factor, 4 cultivars in sub-plots. Fertilizer treatments were: N, N+40 kg N/ha, N- 40 kg N/ha. Treatment N corresponded to 120-150 kg N/ha depending on the growing season and was estimated according to Ryser et al. (2001). Two Ammonium nitrate dressings were broadcast during early spring growth. Winter form of double low cultivars were : Varietal association Synergy, restored hybrid Panther, line variety Express, and line variety Capitol. Drilling density was 100 kernels/m^2 ; harvested area was 29.25 m^2/plot. Fungicide and insecticide applications were sprayed when required. Oil seed content and seed protein content were measured by NIRS, percentage of oleic acid by gas chromatography and leaf area index was measured non destructively.

Results and discussion

Increasing N fertilization had a positive statistically significant effect on yield (Fig. 1). N X Variety interaction was not significant. This indicates that hybrids and line varieties did not differ in their response to N fertilization, although yield of Synergy was almost independent on the fertilizer level. Synergy outyielded Express at the lower levels of N fertilization. Average yield was higher in hybrids than in conventional varieties.

In 2000, Leaf Area Index (LAI) was monitored before flowering. LAI was positively influenced by N fertilization (data not shown). In Fig. 2, the relationship between LAI and yield was close for line varieties as Capitol and Express. However, in hybrid varieties (Synergy and Panther), LAI values were scattered over a limited range, corresponding to high LAI and yield. This indicates that in hybrids, aerial biomass formation and consequently yield was high, even at limited N fertilizer supply. That might be due to high N uptake efficiency related to vigorous growth in automn (Reau, 1994). This hypothesis seems particularly convincing to explain Synergy's response to N fertilization (Fig. 1).

Quality

Seed protein content was positively influenced by N fertilization (data not shown). However, there was no statistically significant interaction among factors nor differences among cultivars (data not shown). Oil content of seed was negatively influenced by high N fertilization. Oil seed content was higher in Express (45.3 %± 0.2 SE, average over three years and N levels) > Capitol (44.9 % ± 0.2) = Synergy (44.9 %± 0.2) > Panther (44.2 % ±0.2). Again, there was no significant N X Variety interaction, indicating that varietal response to N fertilization was similar among varieties.

Oleic acid content decreased in all varieties with increasing N (Fig 3). % oleic acid was positively correlated with oil content of seed (r = 0.73). % oleic acid was higher in Express (65.3 % ± 0.2 SE), > Capitol (64.3 ± 0.2) = Synergy (64.0 % ± 0.3) > Panther (63.0 % ± 0.3). Only a few earlier studies have tackled this question but did not report any effect of N fertilization on fatty acid pattern (Ogunlella et al., 1990 in spring rape; Gendy and Marquard, 1989, in one cultivar). The observations made in the present study are interesting from a biological and industrial standpoint.

Summary and conclusions

The goal of the present work was to assess the response of hybrids and conventional varieties to N fertilization. It was also to determine the need of N fertilization guidelines adaptation to newly released hybrids. A three year series of field experiments were conducted with four cultivars (2 hybrids and 2 line varieties) grown under three N regimes.

N fertilization had a positive effect on yield, leaf area index and grain protein content. On the other hand, N fertilization had a negative effect on oil content of seed and percentage oleic acid. There was no significant Nitrogen X Variety interaction, indicating that hybrids and line varieties did not differ in their response to N fertilization. Both hybrids yielded correctly at the low N treatments and yielded better than other varieties at high N treatments. It is concluded that guidelines used in Switzerland for oilseed rape N fertilization are also adapted to hybrids.

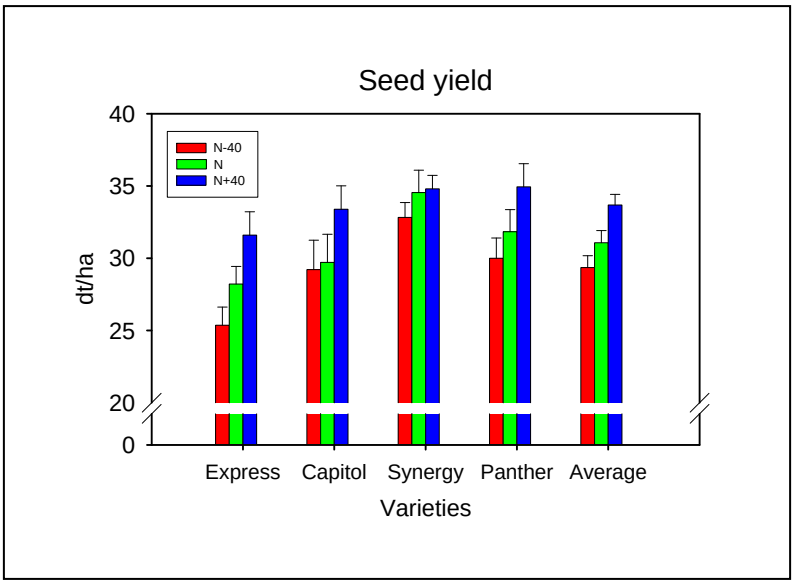

Figure 1: Seed yield (± SE, 6 % H_2O) of 4 cultivars grown over three years at three N fertilizer regimes. Factors of the analysis of variance were: Year (P< 0.001), N level (P< 0.001), N X Year (n.s.), Variety (P< 0.001). Year X Variety (P< 0.01), N X Variety (n.s.), Year X N X Variety (n.s.).

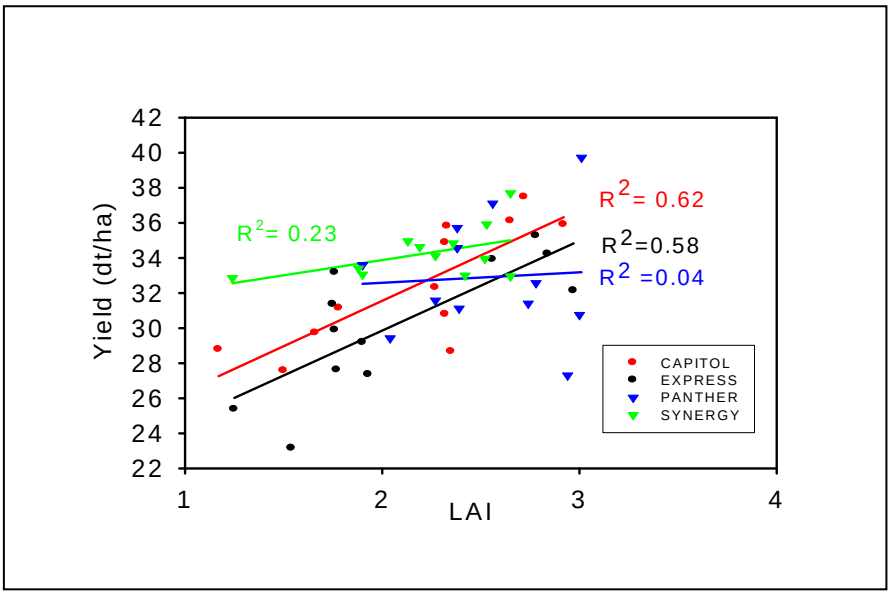

Figure 2: Influence of LAI on yield formation in four cultivars (growing season 2000).

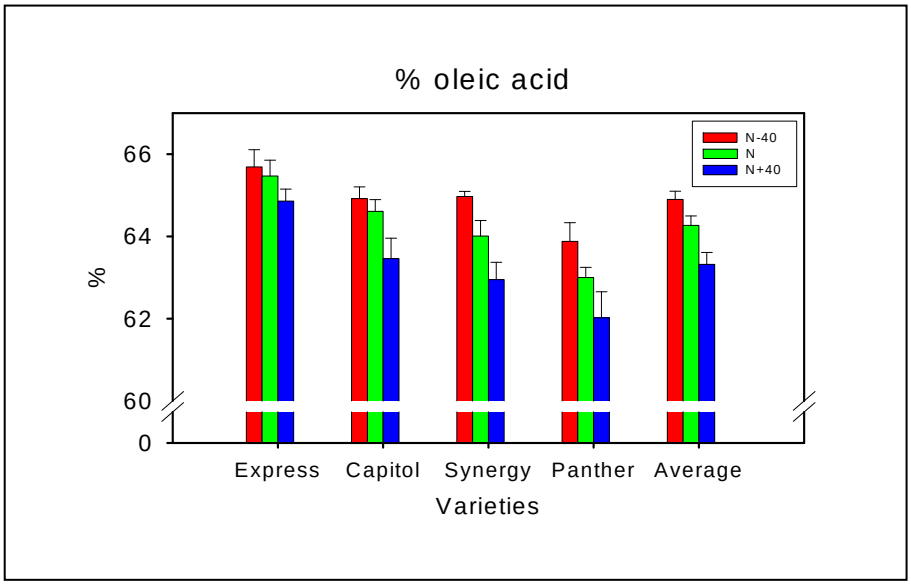

Figure 3: Oleic acid content (% of total fatty acids ± SE) of 4 cultivars grown over three years at three N fertilizer regimes. Factors of the analysis of variance were: Year (P< 0.01), N level (P< 0.001), N X Year (n.s.), Variety (P< 0.001). Year X Variety (n.s.), N X Variety (n.s.), Year X N X Variety (n.s.).