Indeterminacy and nitrogen management in different cultivars of lentil in Saskatchewan

Hossein Zakeri (hoz130@mail.usask.ca) and Dr. Rosalind Bueckert (Rosalind.bueckert@usask.ca)
Department of plant sciences, university of Saskatchewan, 51 Campus Drive, Saskatoon, SK S7N 5A8

Abstract

In Saskatchewan, lentil is best adapted to the Brown and Dark Brown soil zones, but can be grown successfully in the Thin Black soil zone in years without excessive moisture. Lentil has a wide range of maturity and, as a result, different seed yields are caused by environmental conditions and the phenology of each cultivar. In the Dark Brown, Moist Dark Brown, and Thin Black soil zones, lentil grown on stubble tends to continue to flower as long as growing conditions remain favorable for vegetative growth. Therefore, a stress is needed to reduce the time to maturity, prevent excessive vegetative growth, and reduce the risk of damage from early fall frost. Fallow fields with high levels of available nitrogen and moisture may produce excessive vegetative growth, at the expense of seed production, especially in late-maturing varieties. In Western Canada, the large-green market class is classified as highly indeterminate and late maturing. The medium-green, small-green, french-green and the small-red market classes have medium maturity, early maturity and early and medium maturity cultivars, respectively (Saskatchewan, Agriculture and Food, 2006).

Control of nitrogen fertility, timely irrigation management and use of chemical growth regulators are the strategies for inducing earliness in indeterminate crops like cotton which don not fix nitrogen. In soybean, nitrogen application depressed seed production of the main stem in indeterminate cultivars, but resulted in higher seed yield in determinate cultivars. Nitrogen fertilizer application stimulated excessive vegetative growth, increased node number, lodging, and depressed grain filling period, HI and seed yield in soybean. These adverse impacts of

nitrogen on determinate cultivars were much weaker (Flavio, H. et al, 2003). In the Mediterranean climate of Syria, nitrogen did not affect lentil growth and yield. All the rainfall in this experiment was achieved during September to May (Erskin and Goodrich, 1988). Management of indeterminate growth in lentil on the Prairies relies on either terminal stress (drought, frost, lack of N) or chemical desiccation. A small fraction of starter nitrogen fertilizer, soil inorganic and organic nitrogen, and nitrogen fixation are major sources of nitrogen for lentil production on the Prairies. In wet years and with high rainfall, especially during the late growth stages, nitrogen management and use of desiccants are the only available option to overcome of lentil indeterminacy.

In the present study we hypothesized that different sources of N (soil N, N fixation and fertilizer N) provide different amounts of N at the end of the growth season to plants, and as a result, plant maturity and determinacy will be affected by the source of N. To test the hypothesis, two experiments were conducted in 2006 and 2007 in the Dark Brown soil zone of Saskatchewan in Saskatoon. Eight cultivars of lentil from different market classes (CDC Greenland, CDC Plato and CDC Sedley from the large green seed group; CDC Viceroy and CDC Milestone from the small green class and, Rouleau, Blaze, and a non-released breeding line, 1308M-7 from red seed group) were seeded in three fertility treatments: Inoculants; 50Kg/ha N fertilizer; and the control. Plant growth, yield, N accumulation and N fixation were measured in both years and days to maturity recorded for each cultivar. Soil N in the top 30 cm of soil in the beginning of season was 15 and 13 kg $ha^{-1}$for 2006 and 2007, respectively. Deep soil (30-60 cm), however, had more N in 2006 (30 kg ha^{-1}) than 2007 (9 $kgha^{-1}$).

The average of biomass accumulation rates of cultivars was affected by the fertility treatments and plants had higher biomass accumulation rates in fertilized plots than the others two treatments. Meanwhile, N accumulation rate did not change due to the fertility treatments. Inoculated and fertilized plants had the same or higher N accumulation rates than the control.

Lentil plants accumulated more N at the beginning of season in fertilizer treatment; however, the inoculated treatment had the same amount of N as fertilizer later in the growth season. Among cultivars, large-green seed market class had higher total N than the red market class, because of higher biomass. Although all cultivars had a few more nodes in the inoculated plots, N fertility did not significantly change the average number of nods per plant. Both harvest index and seed yield were not affected by fertility treatments, but plants had slightly higher average seed yield and harvest index in the inoculated treatment compared with the fertilizer and the control. Analyzing seed yield and harvest index for each cultivar showed that CDC Sedley, CDC Milestone, and CDC Blaze had significantly higher harvest index in inoculated plots than other treatments. Averaging across cultivars, days to maturity was not significantly different for fertility treatments, but 2 to 10 days later maturity was observed in inoculated large-green cultivars. Although later seeded cultivars in 2007 in a lower initial soil N caused significantly lower N, harvest index and seed yield in 2007 than 2006. Overall, data showed that:

- In dry years (like 2006 and 2007) and in the dark brown soil zone of Saskatoon, lentil yield does not benefit from Nitrogen fertilizer in comparison to inoculant;
- Although large green cultivars may accumulate more biomass and produce more nodes per plant in inoculated fields, higher HI and higher plant N in these cultivars resulted in equal or greater yield in inoculated plots than fertilized plots.

References

Erskine, W. 1983. Relationship between the yield of seed and straw in lentil. Field Crop Research 7:115-121.

Flavio, H. et al. 2004. Late season nitrogen fertilization of soybeans: Effects on leaf senescence, yield and environment. Nutrient Cycling in Agroecosystems 68:109 - 115.

Saskatchewan, Agriculture and Food. 2006. Lentil in Saskatchewan. www. Agr. Gov. Sk. ca/docs/crops/ pulses/production_information/LENTIL2005. pdf1-19.

Tullu, A., et al., 2001. Characterization of core collection of lentil germplasm for phenology, morphology, seed and straw yields. Genetic Resources and Crop Evolution 48:143-152.

Van Kessel, C. 1994. Seasonal accumulation and partitioning of nitrogen by lentil. Plant and Soil 164:69-76.