Canadian Agronomist

DIGGING INTO RESEARCH

Canola nutrient and water use efficiencies reviewed

CATEGORY **agronomy** | *October 25, 2022*

A research study reviewed factors affecting nitrogen, sulphur and water use efficiencies, and found that 4R stewardship of nutrients and some agronomic practices provided the greatest improvements.

Economic and environmental sustainability of canola production is gaining more scrutiny in this era of emissions reductions and climate change. This study reviewed 24 recent North American research publications looking at how to improve nutrient and water use efficiencies in canola.

The objectives of this study were to (i) assess the effect of nitrogen (N) and sulphur (S) fertilizer inputs, applied as single or combination treatments, irrigation, and indirect soil moisture management (stubble management and tillage) on the nutrient and water use efficiencies of canola; (*ii*) understand the influence of field management practices on these nutrients and water use efficiencies, (*iii*) provide recommendations for future research, and (*iv*) identify suitable strategies to improve canola production efficiency in North America.

The 24 research publications in North America contained a dataset of 355 measurements for Nitrogen Use Efficiency (NUE) from 12 peer-reviewed publications from 2008 to 2020, 276 measurements for Sulphur Use Efficiency (SUE) from 4 peer-reviewed publications from 2002 to

2020, and 99 measurements for Water Use Efficiency (WUE) from 8 peer-reviewed publications from 2004 to 2020.

NUE was calculated as the crop yield divided by the amount of N fertilizer applied. Similarly, SUE is the crop yield divided by the amount of S fertilizer applied. WUE is the crop yield divided by the total amount of irrigation water (if applied) plus rainfall.

NUE depended on management practices

Overall, the various research studies found that canola responded well to increasing rates of N fertilizer, but plateaued at some level, depending on growing environment. This resulted in a decreasing NUE as fertilizer N rates increased, mainly because of diminishing returns as N fertilizer application increased past the optimum rate. For the best NUE, N fertilization needs to be aligned with environmental conditions, soil N supply and rainfall. Soil testing will help ensure that NUE and economic returns are maximized.

NUE was usually higher with spring applications compared to fall application. Spring banded controlled release urea (CRU) was sometimes more effective than urea, and as effective as urea in increasing crop yield and nutrient recovery. Split application of 50% urea banded at seeding with 50% applied in-season was as effective as applying all the N fertilizer at seeding, and can reduce the risk of leaching and corresponding decrease in NUE. Split application of CRU also improved NUE, with the advantage of providing N fertilizer early in the season with the reduced risk of N losses.

These types of management practices require further evaluation on NUE in canola, especially as it relates to 4R nutrient of right source, rate, time, and source, and how these best management practices can sustainably increase canola production while reducing greenhouse gas emissions.

SUE also depended on 4R stewardship

The S fertilizer rate for optimum yields was found to be 13 to 27 lbs. S/ac (15 to 30 kg S/ha) in field trials on the Canadian Prairies.

Application of S in combination with N was shown to increase SUE. Research has found that N and S fertility must be in balance for optimum yield and SUE.

4R stewardship is also important for optimum canola yield and SUE. Sulfate (SO_4-S) forms of S fertilizer are readily available for plant uptake. Spring applications are better than fall applications for yield and SUE. Fall applications can result in leach of sulphate-S, especially on sandy soils.

Elemental S fertilizers must be oxidized to the sulfate form before it is available for plant uptake. Spring application of elemental S fertilizer was not effective, as this oxidization process is not fast enough for plant uptake. Results from fall application of elemental S were often close to that of spring applied sulfate-S with similar SUE. Conversely, fall application of elemental S had higher SUE compared to fall applications of sulfate-S fertilizers – likely due to leaching of sulphate-S.

Under adequate soil moisture conditions, spring broadcast, in-soil banding or seed placement have all been proven to adequately supply sulphate-S to canola. Applying S in bands had improved SUE under drier conditions.

If a sulphur deficiency is observed during the growing season, an in-season application of sulphate-S fertilizer at rosette to early bolting can help to correct the deficiency in time to improve yield, although yield can be less than if all the S had been applied at seeding.

Improving WUE

Several management strategies improved WUE. Early seeding canola was found to improve WUE by achieving early canopy closure to reduce soil moisture evaporation. Evaporation losses can be further reduced by targeting a plant stand that will allow early canopy closure, and selecting vigorously growing hybrids.

Leaving tall stubble standing also improved WUE. Research on the Prairies found that extra tall stubble (18 inches) had the best WUE, followed by tall (12 inches) and short (6 inches) stubble, compared to cultivated stubble. Tall stubble changed the micro-climate near the soil surface by reducing wind speed, solar radiation, and soil temperatures.

Some of the research also found an interaction between genotype and NUE, SUE, and WUE. This shows there is a need for further research on canola hybrids to evaluate their response to nutrient and water use efficiencies.

This work was supported by the University of Lethbridge using funding from the Canola Council of Canada.

Dilumi W. K. Liyanage, Manjula S. Bandara, and Michele N. Konschuh. Main factors affecting nutrient and water use efficiencies in spring canola in North America: a review of literature and analysis. *Canadian Journal of Plant Science*. **e-First Open Access** https://doi.org/10.1139/CJPS-2021-0210