Water use in a winter camelina – soybean double crop system

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Introduction

Double-cropping winter camelina (*Camelina sativa*) with soybean can be a means of increasing land-use efficiency by producing fuel and food on the same land in a single season, and can be done even in relatively cool short-season climates (Gesch and Archer, 2013). Success of double-cropping is often highly dependant on water use of the cropping system and having enough moisture to successfully grow both crops.

Objectives

A 2-Yr field study was conducted in west central Minnesota to determine seasonal water use among different methods of double-cropping winter camelina and soybean and evaluate rooting depth and density of camelina.

Methods

➢ Camelina (Joelle) was drill seeded into spring wheat stubble in mid- to late-September and harvested in late-June. Soybean was inter-seeded into camelina (relay-cropping) in early spring before bolting or sown after camelina harvest (double-cropping).

➢ Crop water use (WU) was calculated on a weekly basis as WU = P ± Δ SW, and summed for the season; P = precipitation and ΔSW = change in soil water content.

➢ Soil water content was measured within the 0 to 0.6 m soil depth by neutron attenuation.

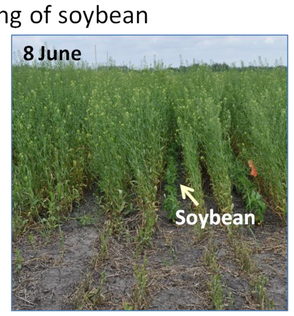
➢ Soil cores to 1.0 m deep were taken from the DC-Soy for camelina to evaluate rooting depth and density (Johnson and Morgan, 2010).

➢ The following table describes the double crop treatments

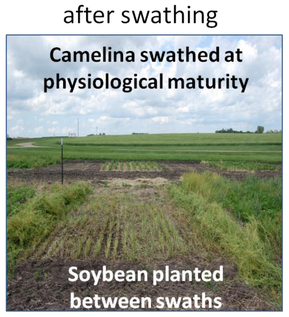
Cropping treatment	Cropping description: Winter crop	2nd crop	Double-crop	Relay-crop
*DC-Soy	Camelina	Soybean MG 00	yes	no
†Relay-Soy	Camelina	Soybean MG I	no	yes
‡Swath-DC-Soy	Camelina	Soybean MG 00	yes	no
Mono-Soy	Fallow	Soybean MG I	no	no

* DC- refers to sequentially following camelina after it is harvested with soybean.
† Relay- refers to inter-seeding soybean between camelina rows prior to bolting.
‡ Swath-DC- refers to swathing camelina at physiological maturity and seeding soybean between swaths.

Relay-cropping of soybean



Double-cropping soybean after swathing



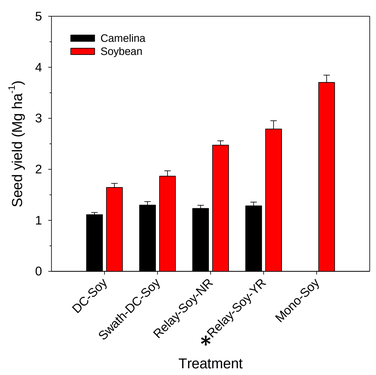


Fig 1. Camelina and soybean seed yields for the cropping treatments. Values are means ± SE over both years.

➢ Camelina yields were consistent across treatments at about 1.2 Mg ha^{-1}.

➢ Relay-cropped soybean yields were 68 to 76% of that of the full-season mono-cropped soybean.

* **YR** – denotes glyphosate applied to camelina at physiological maturity; **NR** = no glyphosate treatment.

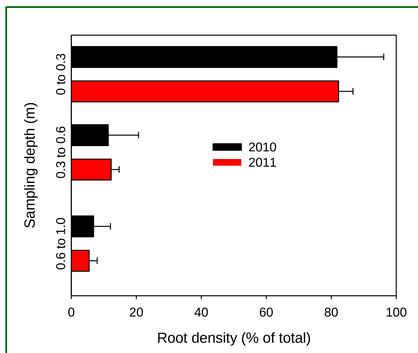


Fig 2. Camelina root density distribution

➢ About 80% of camelina's root density was within the top 0 to 0.3 m of soil and about 90% within the top 0 to 0.6 m.

➢ Only about 5% of camelina's root mass was within the 0.6 to 1.0 m depth and in 2011 less than 1% was found below 0.8 m.

➢ Camelina's root to shoot ratio ranged from 0.23 to 0.53.

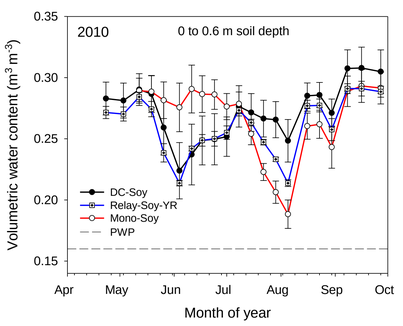


Fig 3. Comparison of soil water content in the top 0.6 m of the soil profile for cropping treatments during the 2010 growing season.

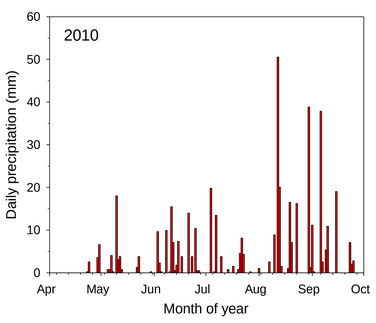


Fig 4. Precipitation pattern for the 2010 growing season.

➢ The pattern of change in soil water content was similar for the double- and relay-crop treatments.

➢ Substantial soil water depletion occurred in late-May to mid-June corresponding to camelina seed filling and maturation and again in late-July to early-August corresponding to soybean development.

➢ Soil water depletion from mid-July through early-August was greater for the mono-cropped soybean than the double crop treatments.

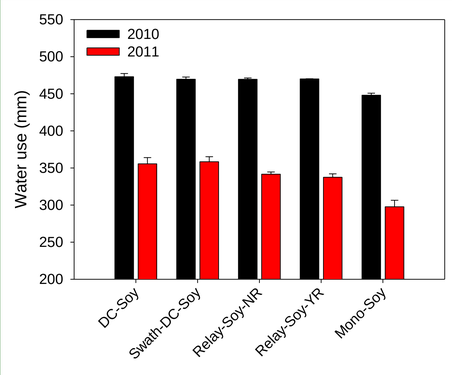


Fig 5. Seasonal crop water use during the 2010 & 2011.

➢ Seasonal water use was similar for the double- and relay-crop treatments.

➢ Water use was only about 5 to 20% greater for the double crop treatments compared to the full-season soybean crop.

Summary

➢ Winter camelina has a relatively shallow root system and short lifecycle.

➢ Water use was greater for camelina-soybean double crop treatments compared to full-season soybean but the absolute difference was not large.

➢ Double- and relay-cropping winter camelina with soybean may be suitable cropping systems for many dryland cropping areas in the Corn Belt region.

References

Gesch, R.W. and D.W. Archer. 2013. Double-cropping with winter camelina in the northern Corn Belt to produce fuel and food. Industrial Crops and Products 44:718-725.

Johnson, J., and J.A. Morgan. 2010. Chapter 2. Plant sampling guidelines. p. 2-1 - 2-10. In: R.F. Follett editor, GRACEnet sampling protocols [Online]. USDA-Agricultural Research Service, Washington, DC. Available at www.ars.usda.gov/research/GRACEnet

Root sampling with hydraulic probe.