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 ± ΔSW, 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

<table>
<thead>
<tr>
<th>Cropping treatment</th>
<th>Winter crop</th>
<th>2nd crop</th>
<th>Double-crop</th>
<th>Relay-crop</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC-Soy</td>
<td>Camelina</td>
<td>Soybean MG 00</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Relay-Soy</td>
<td>Camelina</td>
<td>Soybean MG I</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Swath-DC-Soy</td>
<td>Camelina</td>
<td>Soybean MG 00</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Mono-Soy</td>
<td>Fallow</td>
<td>Soybean MG I</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

* 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 swathes.

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


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

Fig. 2. Camelina root density distribution.

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.

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

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.

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.

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

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.