Sunflower Production in Skip Row Configurations for the Semi-Arid Central Plains

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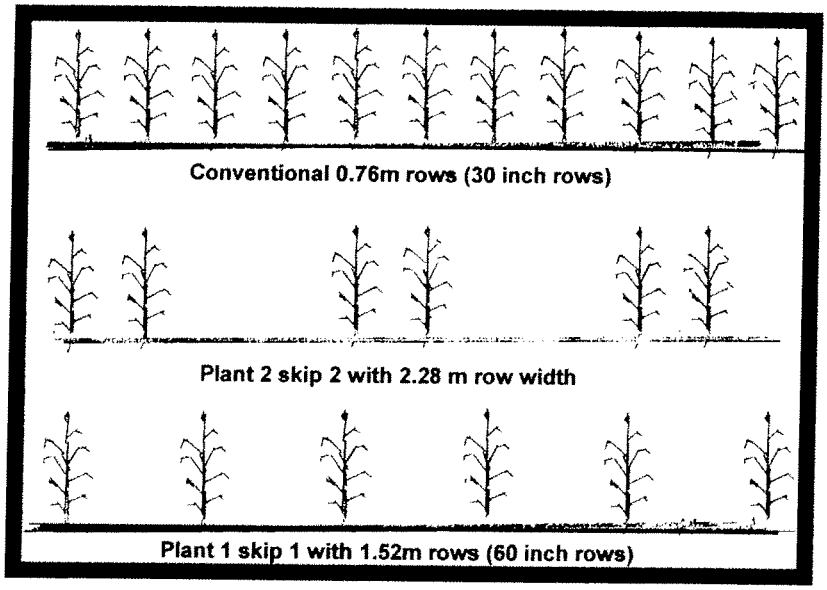
Introduction

Sunflower production in the semi-arid Central Great Plains is usually limited by precipitation. In skip-row planting configurations, one or more rows are omitted in between planted rows (Figure 1), possibly allowing roots to grow into moisture throughout the growing season, thus leaving water available for grain filling. Research with corn and sorghum is showing that skip-row may have increased yields relative to conventional plots on dry years, when yields are below average. Skip-row, then, can be seen as a measure that may lessen the risk of growing a crop on a drought year, but trades off some yield on a good year.

Figure 1. Skip-row planting geometries.



Objectives

1) Determine the sunflower yields for different planting geometries and N fertilizer combinations in the semiarid central Great Plains, 2) Determine the water use by the sunflowers in the different skip-row treatments, 3) Test the hypothesis that added N fertilizer will result in the exhaustion of soil moisture before seed production, which then will reduce oil contents and seed yields. This report presents data from two years of a multi-year project comparing conventionally planted sunflowers with two skip-row

treatments and two fertilizer treatments under dryland conditions in northeastern Colorado.

Methods and Procedures

The experimental sunflower plots were established in Akron, Colorado yearly from 2006-2008. The sunflowers were grown in three geometries: Conventional planting with 30 inch row spacing, plant one skip one (P1S1), and plant two skip two (P2S2). A population density of approximately 14 thousand plants per acre was used in all treatments. The skip-row treatments were combined with two nitrogen rates: low (30 Lbs N added) and high (60 Lbs N added). Oil sunflowers (Triumph 660cl) were planted each season in early June on wheat or barley stubble. There were 4 replicate plots per treatment combination for a total of 24 plots within 4 blocks each year. Moisture was measured weekly with neutron tubes, biomass and growth stage were recorded periodically, and yield and oil content were recorded at harvest.

Results

Year 2008 was unusual because of poor seedling emergence and stand establishment. The possible causes are poor moisture, soil crusting, and rodent pressure. All plots were impacted by the poor stands to some extent, but we were able to obtain data because there were usable sections with reasonable establishment on most plots. Because of this, we decided to abort the neutron tube readings for soil moisture and concentrate on biomass and yield data. Despite the stand establishment problems, 2008 was a high yielding year with sections of plots achieving more than 1600 kg ha^{-1}. Our results show that conventionally planted sunflowers out-yielded the skip-row sunflowers by more than 800 kg ha^{-1} (Figure 2). Nitrogen fertilizer benefitted the skip-row sunflowers, causing a yield increase of ~110 kg ha^{-1}, but no N benefit was observed in the conventional sunflowers. There was only a slight (less than 3%) increase in seed weigh on the skip flowers relative to the conventional. This contrasts with the data from previous years, which shows a clear increase in seed weight in the skip flowers (see below).

Data from the previous two years shows how conventional sunflowers out-yield the skip treatments. The data from the 2007 growth season, for example, shows that the conventionally planted sunflowers yield more than the skip treatments by at least 400 kg ha^{-1} (data not shown). In addition, the N fertilizer increased yields by 320 kg ha^{-1} on average for all the treatments. The 2006 data shows a similar trend with conventional sunflowers performing better than the skip-row, although the N fertilizer did not show a consistent benefit that year. Our water extraction data indicates that sunflowers were able to exploit the soil profile water beyond 100 cm depth even in the middle of the empty P2S2 rows, suggesting that the skip-row approach will not leave increased water

for a following crop relative to the conventional. The 2006 and 2007 data showed that the skip-row sunflowers had on average can be up to 28% heavier on average than the conventionally planted sunflowers.

The seed oil data for the 2007 experiment shows that N fertilizer was associated with a slight increase oil in the skips, not in the conventionally planted sunflowers (Table 2). The skip-row treatments had similar oil composition to the conventional treatment, although P2S2 has slightly lower oil content than P1S1 and conventional. An ancillary experiment used to compare P1S1 planted at a normal population to P1S1 planted to a high population showed no clear effect on the oil composition.

Conclusions:

Over the last three years of this project, the picture is becoming clear that conventionally planted sunflowers yield better in terms of mass and in terms of oil percentage that sunflowers planted in a skip-row geometry. One possible advantage of skip-row planting is that it has resulted in bigger seeds, although this seems to be true in lower yielding years with a low in-row plant population. Our data shows that sunflowers can extract water deep in the soil profile even in the wide P2S2 row spacing, suggesting that a following crop may suffer from yield drag even when planted after the skip-row. Nitrogen fertilizer has resulted in a yield response, although this pattern has not been consistent across years. We intend to carry out this experiment one more year in order to have a more conclusive data set. It would be desirable to obtain data from a drought year because to date all years have been reasonably high yielding.

Table 1. Average seed weight for the sunflower skip-row experiment, 2008 data. n=4.

Treatment	Average seed weight (mg)
P2S2, High N	67.0
P2S2, Low N	69.0
P1S1, High N	71.3
P1S1, Low N	76.4
Conventional, High N	71.5
Conventional, Low N	66.3

Table 2. Average seed oven-dried oil % for the sunflower skip-row experiment, 2007 data. n=4.

Treatment	Average oil %
P2S2, High N	38.2
P2S2, Low N	35.8
P1S1, High N	38.4
P1S1, Low N	37.1
Conventional, High N	36.4
Conventional, Low N	39.0

Figure 2. Average yields in kg ha^{-1} for the sunflower skip-row experiment in 2008. CH = conventional planting, high N; CL = conventional planting, low N; P1H=plant one skip one, high N; P1L = plant one skip one, low N; P2H = plant two skip two, high N; P2L = plant two skip two, low N. n = 4.