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CONSERVATION TILLAGE

FACTS

Sunflower Water Use Relationships

How much water does sunflower use, and how does water use affect yield?

To make an informed decision regarding the use of sunflower in dryland crop rotations, producers need to know something about the water relationships of this crop in the central Great Plains. At Akron, CO, rainfall during the sunflower growing season averages about 9 in. But the total amount of water required for sunflower to grow without water stress in this environment averages about 34 in. Some of the 25 in. shortfall in rainfall is made up for by stored soil water. But dryland sunflower in this area is almost always growing under some water deficit condition which reduces yield from the maximum attainable.

Reports of sunflower water use range widely from 8 to 38 in. per year. The higher values come from irrigated studies or high rainfall conditions. Sunflower grown where the soil water profile is full will also use greater amounts of water. Sunflower has the ability to extract water from deeper in a soil profile than other crops. In addition, sunflower will extract more water from each soil layer than other crops. Average stored soil water use for several crops is shown in Fig. 1 Proso millet extracts about 4 in. from the top 3 ft. of soil, whereas sunflower extracts about 7.5 in. from the 6 ft. soil profile. Of course, crop rotational sequence will make a difference on how much soil water is available for sunflower to use (Fig. 2) (S=Sunflower, F=Fallow, W=Winter Wheat, M=Proso Millet, P=Field Pea). Sunflower following millet in a sunflower-fallow-wheat-millet rotation uses more water than sunflower in a sunflower-fallow-wheat rotation because more water is typically available following millet than following wheat. At Akron, the sunflower soil water use ranges from 3 to 9 in. for different cropping systems and different years.

A water use/yield function generated from both dryland and irrigated sunflower (Fig. 3) shows that about 150 lb/a of seed is produced for every inch of water use after the first 7 in. of water use. Dryland sunflower yields

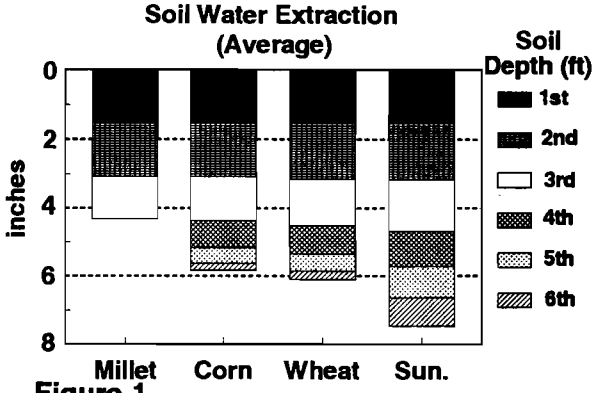

Figure 1

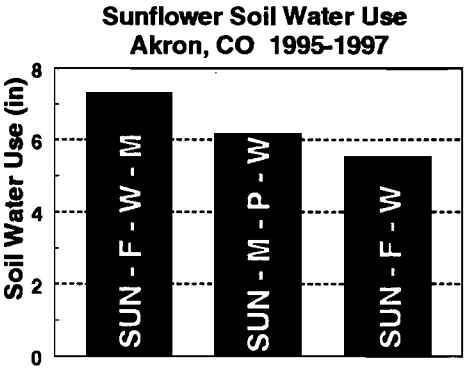

Figure 2

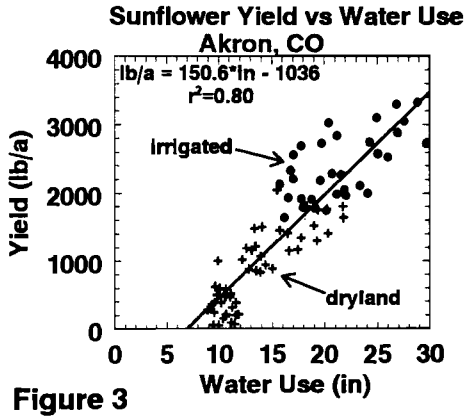

Figure 3

Conservation Tillage Fact Sheet #1-98. Published by USDA-NRCS, USDA-ARS, and Colorado Conservation Tillage Association. By: D.C. Nielsen, Research Agronomist, USDA-ARS, Central Great Plains Research Station, P.O. Box 400, Akron, CO 80720-0400. (e-mail: dnielsen@lamar.colostate.edu)

at Akron have ranged from 100 lb/a to 2000 lb/a. Sunflower yield is very responsive to rainfall received during August and September, just prior to flowering and through seed-filling, (Fig. 4). The relationship for yield vs rainfall (158 lb/a/in.) is almost the same as for yield vs total water use (151 lb/a/in.).

Using the water use/yield relationship (Fig. 3 and the Akron rainfall record from 1965-1997, and conservatively assuming 6.75 in. of soil water use, we see a predicted sunflower yield distribution of 570-2090 lb/a, with an average yield of 1360 lb/a (Fig. 5). Nearly half of the years of record would have yields in the 1000-1500 lb/a range.

The very dry condition of the soil profile following sunflower requires significant water recharge prior to the planting of the next crop in rotation. It is essential that stalks be left standing in good condition such that snow trapping can occur during storms with strong winds. Tall stalks will trap more snow than short stalks. Overwinter soil water change is closely related to sunflower silhouette factor (height x diameter x population) due to the increase in snow trapping that occurs with taller stalks at high populations (Fig. 6). A population of 14,000 stalks per acre (3.57 stalks per 1600 in^2), one inch in diameter, and 16.7 in. tall would have a silhouette factor of 60, and be expected to recharge the soil water profile by about 4 in. under average winter conditions at Akron.

In summary, precipitation falls far short of evaporative demand in dryland sunflower production in the central Great Plains. Sunflowers are able to extract water from deep in the soil profile and are able to extract more water from each soil layer than other crops. About 150 lb/a of sunflower seed are produced for every inch of water used after the first 7 in. of water use. Based on this water use/yield relationship and local rainfall records, sunflower yields should average about 1300 to 1400 lb/a near Akron. Because of the very dry condition of the soil following sunflower, it is essential to catch as much snow as possible by leaving tall stalks standing through the winter so that the soil water profile can be recharged.

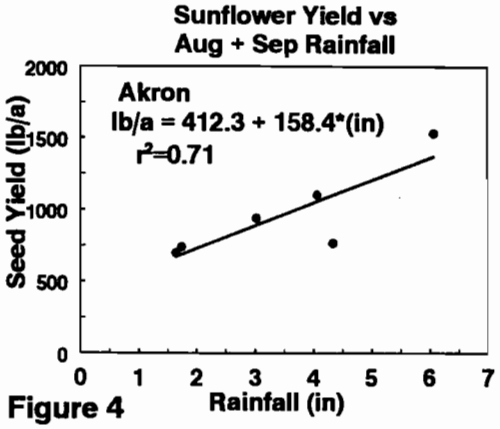

Figure 4

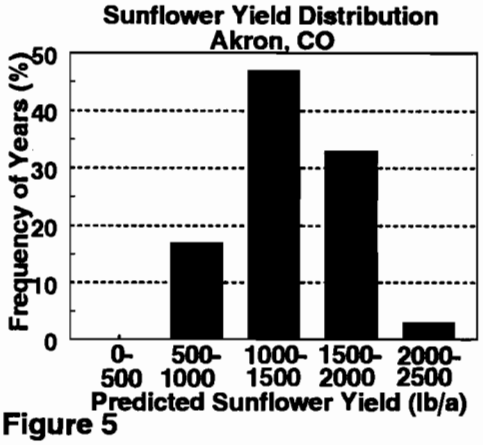

Figure 5

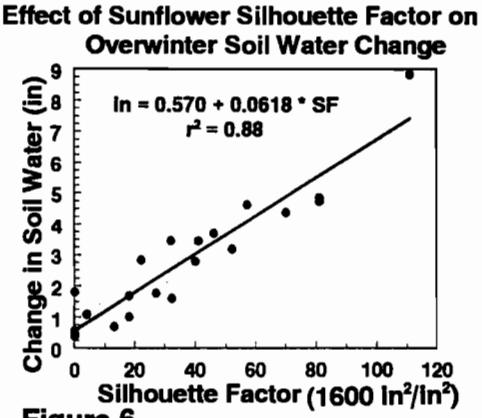

Figure 6

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