Sustainability

SUNFLOWER SUSTAINABILITY: Substance Behind the Seed

A farmer and industry organization working to improve the profitability of sunflower for all sectors.

www.sunflowernsa.com
Sunflower and Sustainability

Sunflower (*Helianthus annuus* L.) is a native North American plant. There are 67 species in the genus *Helianthus*, most of which are found in the U.S. Most are considered weeds and most are perennial. Commercial cultivated sunflower became an economically important crop in the late 1960s. The majority of North American acres are oil-type that are either crushed for oil or used as bird food by hobbyists. Oil-type sunflower is a high oil content seed. The edible confection type is used as an in-shell snack or as seeds which are used as an ingredient in a variety of food products.

Commercial sunflower hybrids have many of the characteristics of their wild relatives such as drought tolerance and a deep root system. Thus, sunflower grown in North America is in the semi-arid region encompassing a line from Manitoba/Saskatchewan to the southern tip of Texas.

Sunflower Research and GMO

Public researchers at USDA ARS and various universities are concentrated on identifying pest resistant genes that can be breed into commercial hybrid sunflower planting seed. Private hybrid seed companies concentrate on agronomic factors such as standability, vigor and yield. There is a close partnership between the public and private researchers.

Sunflower is not a genetically modified plant. Europe is a large production region for sunflower and the EU will not accept GMO planting seed. The regulatory hurdles in the U.S. are insurmountable at the present time due to possible gene flow to wild sunflower. Without Europe and the U.S. there is not enough market size for the private sector to make the necessary investment in sunflower GMO.

Soil Management, Tillage and Herbicide Use

Much of the North American region’s sunflower production soils are prone to dry out and blow. Up until the year 2000, the vast majority of sunflower was produced in conventional tillage systems. That means a combination of fall and spring tillage which was used mainly to reduce weeds and prepare a suitable planting bed. The only available herbicides at the time were Dinitroaniline (DNA) and required soil incorporation prior to planting. This double tillage incorporation left a very fine seedbed which was very prone to wind and water erosion. This tillage also dried out the topsoil with a loss of several inches of soil moisture. Historically weed control systems also included between-row cultivation. In sunflower grower surveys in the early 1990s coordinated by North Dakota State University, sunflower growers utilized between-row cultivation on an average of 70 percent of the sun-
flower acres in North Dakota alone. (Lamey, 1990). In 2019, the only between-row cultivation taking place is in organic production. The elimination of between-row cultivation has eliminated soil erosion from heavy rainfall during the production season.

**Figure 1 —**

**Fuel use in combined Tillage, Weed Control, Planting in Sunflower**

In sharp contrast to the past, the nation’s sunflower producers utilized either no-till or minimum tillage practices on 80 percent of the planted acreage in 2019 (Buetow). This compares to about zero acres in 1990. Part of this change is due to greatly improved herbicides and planting machinery. Research indicates that no-till management of crops has reduced greenhouse gas emissions by 50 percent due to soil carbon storage (CSA).

Another important positive is the amount of herbicide active ingredient (a.i.) has declined by approximately 60 percent from 1996 to 2020. One to 1.25 pounds of a.i. herbicide was applied per acre in 1996. (Zollinger, 2010) That compares to .5 pounds of a.i. herbicide per acre soil applied post emergence in 2020 (Jenks 2020). This is a great improvement in the amount of a.i. that is placed in the environment. In addition, the soil surface is protected with the elimination of tillage and important soil moisture is retained. Weed control has been improved considerably resulting in better yields. Sunflower has a comparatively low a.i. herbicide use rate compared to most crops (see Figure 3). Fuel to power equipment across a field has been reduced by 22 percent with a significant reduction of field trips pulling heavy equipment during the period of 1996 and 2020 (Capistran & DeKrey). The DNA herbicide tillage requirements plus between-row cultivation required 1.8 gallons of fuel per acre. Today’s no-till or minimum till system takes 1.4 gallons per acre (see Figure 1).
Figure 2 —
Herbicide A.I. used in Sunflower
1992 compared to 2020

Source: Dr. Richard Zollinger & Dr. Brian Jenks

Figure 3 —
Average Herbicide Rates

Source: USDA, NASS Agriculture Chemical Usage Report, Dr. Rich Zollinger & Dr. Brian Jenks
Other Pest Management

There are a number of native insect pests that attack North American sunflower. Some of the major insect pests that threaten sunflower's yield include stalk and head-feeding insects. Efforts have been under way to manage sunflower insect pests through genetic plant resistance and integrated pest management. Progress has been made in identifying isolines that are resistant or tolerant to these damaging insect pests, and more new developments are expected over the next several years.

When comparing 1992 to 2020 the number of insecticide applications on a per acre basis has not changed much. However, the number of pounds per acre of a.i. applied has declined by 95 percent during that time period. The classes of insecticides have also changed significantly. In 1992, most insecticides used by sunflower farmers were organophosphates and carbamates. Today, a number of those highly toxic insecticides have been removed by the EPA. In contrast, the majority of sunflower insecticides used in 2020 were from the pyrethroid class, a much more user and environmentally friendly class of insecticides. Sunflower farmers have improved their insecticide decision-making skills by using professional crop scouts. They help determine if insect densities in a field merit an insecticide application to prevent yield losses. Insecticide usage in sunflowers has been refined during the last 15 years by using safer and newer chemistries of insecticides, and by increasing farmer's knowledge on the proper use of insecticides. Overall, these improvements have resulted in optimizing management of sunflower insect pests through judicious use of insecticides and developing a successful integrated pest management strategy.

Figure 4 —
Insecticide active ingredient used 1992 compared to 2020

Source: Dr. Richard Zollinger & Dr. Janet Knodel
management program in sunflowers.

In comparison to several other crops, sunflower is a larger user of insecticides. This is because sunflower is a North American native plant and native insects have evolved or the millennia.

Rotations and Fertility

Sunflower is a rotation crop. It is not planted on the same field the following year. Sunflower rotates well with grass crops such as wheat, barley, corn and milo. Sunflower can be rotated with soybeans but there are some similar broadleaf diseases that can affect both crops. For farmers who have sunflower in their crop rotation, it is typically planted once every 3 to 5 years. Sunflower is a deep rooted crop. The roots can reach depths of six feet and mine residual soil moisture and nutrients. Some farmers follow a particular rotation system using crops that root deeper with each successive crop. An example is two years of wheat, followed by corn and then sunflower and then back to wheat. In this rotation sunflower is likely able to tap unutilized nutrients that have leached to depths the other crops cannot reach.

Sunflower does respond to nitrogen (N) and is the nutrient of greatest need for optimum plant growth and yield. A rule of thumb is 50 pounds of N for each 1,000 pounds of expected sunflower yield. The vast majority of sunflower growers soil test to determine the exact amount of fertilizer to apply. The amount of N required varies greatly with soil type, soil moisture levels, yield goal, cost and residual levels of soil N. The amount of residual soil N also varies greatly from year to year depending on rotations, the type of production year completed and rainfall in the
previous years. Soil tests sample only the top two feet. Depending on a number of variables it can be expected that additional N will be available at the 2 to 6 foot level.

The amount of additional N applied to the soil varies between 40 and 80 pounds of N per acre (Lamey, 1994). This amount has not changed over the past 20 years. Too much N will lower yield by producing a lush plant with a small head.

Phosphate and potash are used in smaller quantities only when soil tests indicate a deficiency. Sunflower yield has not responded to increased levels of phosphate. There has been an inconsistent yield response to micronutrients.

Most fertilizer application in sunflower is strategically placed in the soil near the seed lane. This system is most efficient in utilization of applied N and greatly reduces run off.

Water Use

It has been noted that sunflower is considered to be drought tolerant. There are several conjectures related to the supposed tolerance and the most common is the plant’s deep and aggressive root structure. In a dry year, crops following sunflower can have a reduced yield due to the depletion of soil moisture. Numerous studies indicate that dryland sunflower water use has a range from 8 to 36 inches (Schneiter). Grower experience is that sunflower can survive extended dry conditions better than other crops. Thus, the majority of the production is in the semiarid regions of North America. The vast majority of North American sunflower is grown under dryland conditions.

When access to water is available, small grains use 2 to 3 inches less total

Source: USDA, NASS Agriculture Chemical Usage Report and Sunflower Grower Survey

Average Nitrogen Applied to Soils

Lbs/acre

<table>
<thead>
<tr>
<th>Crop</th>
<th>Average Nitrogen Applied (Lbs/acre)</th>
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<tbody>
<tr>
<td>Corn</td>
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</tr>
<tr>
<td>Sunflower</td>
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<td>Ip Wheat</td>
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</tr>
<tr>
<td>W Wheat</td>
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</tr>
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<td>Cotton</td>
<td>600</td>
</tr>
<tr>
<td>Potatoes</td>
<td>700</td>
</tr>
</tbody>
</table>

Source: USDA, NASS Agriculture Chemical Usage Report and Sunflower Grower Survey
water than sunflower during the growing season, whereas soybean water use is slightly greater. Corn uses 1 to 4 inches, and sugar beets use 2 to 6 inches more than sunflower, respectively, during the growing season” (Berglund) In irrigation trials over a three successive seasons, dryland sunflower had a mean yield of 2,020 lb/ac while irrigation of 17.96 inches of water yielded a mean of 2,503 lb/ac. Given that relationship there is not an efficient cost relationship of using nearly 17 inches of irrigation water to increase yield by only 500 pounds (High Plains Production Handbook). Crops like corn and alfalfa provide a greater yield potential under irrigation.

Limited irrigation is an emerging concept due to the declining Ogallala aquifer and the Republican River Basin in the High Plains region. The concept is to get crops through drought periods to maintain yields while saving scarce water resources. Sunflower is the crop of choice for limited irrigation. Examples include an irrigation circle of 140 acres divided between corn and sunflower. The irrigation unit stays on corn only until sunflower on the other half is at risk due to drought. Other examples include a pre-plant irrigation only to insure good stand establishment or other combinations at key water use times in the plant’s maturity. This is often used on confection sunflower where limited irrigation not only improves yield but also seed size, an important quality standard.

**Land Stewardship and Wildlife Enhancement**

It has already been established that the majority of sunflower is produced in a reduced tillage system. Leaving the stalks stand and fields undisturbed over winter also provides an excellent food source for wildlife. Sunflower seeds are high in fat content and thus an important winter food source.

During the growing season, sunflower fields are an important resource habitat for a number of bird species. The heavy canopy and large leaves provide good protection for numerous species against predators. Research directed by North Dakota State University and USDA counted 78 species of migratory birds using sunflower as a ‘stopover’ habitat in the fall and 29 species using sunflower fields in the spring. The researchers found twice as many non-blackbird species using sunflower habitat when compared to other crops (Hagy). Game birds such as pheasants use sunflower fields year round. Sunflower fields provide excellent habitat and food for deer and smaller mammals. It is not uncommon in the areas close to the US/Canadian border for farmers while harvesting to find moose in their sunflower fields. It has been reported that bear find sunflower fields as excellent habitat. Both moose and bear can cause considerable damage to ripening sunflower.

There is rising concern about the increase of saline soils in the North America. Saline soils can greatly impact crop growth and yield. Sunflower is one of the few crops that can survive and thrive on slight to moderate saline soils. It is important to have plant growth on saline soils to help dry out that land. Again, the deep tap-root is likely one of the reasons for the plant’s success on saline soils (Lilleboe).

**Transportation and Processing**

Sunflower is a light weight seed at 28 pounds/bushel compared to wheat which is 60 pounds/bushel. Therefore, transporting sunflower long distances is
not economical. Sunflower processing plants which include oilseed, confection, hulling and bird food are strategically located in the production area. Trucks are the most common transport mode to a processing plant. Back hauls of another commodity are common when one-way distances are 200 miles or more. Rail transport is generally not competitive for distances under 200 miles.

All of the sunflower processing plants are energy efficient and use renewable energy sources whenever possible. For example, two of three large oilseed processing plants remove a portion of the hull prior to extracting the oil. This reduces the amount of energy required to remove the oil from the seed. Hulls are high in BTUs and are burned at the plant as a heat source. One large plant is located near a city landfill. The processing plant purchases methane gas from the city landfill for its energy needs. Confection processors who have excess hulls sell them to turkey ranchers who use the product for bedding.

Oil is the main product of oilseed sunflower. In most cases the oil is fully refined at the processing plant sites and shipped by rail to end users in the food industry. Sunflower protein meal is a by-product of the oilseed crushing industry. The meal is sold to dairies and cattle feedlots and transported by rail or truck.

Confection processing plants prepare the product for direct human consumption. They roast and salt in-shell seeds and often package the product for direct retail shelves. Removing the hull is a common practice among all confection processors. The hulless seeds can be further processed or bagged and shipped to food manufacturers where it is used as an ingredient in foods such as breads and cereals. Broken seeds in the hulling process are used in specific birdseed packaging. Birdseed processors remove impurities from the seed and bag the product for retailers.
References


Capistran, Kevin, 2020. Personal communication. Sunflower producer, Crookston MN.


DeKrey, Tim. 2010. Personal communication. Sunflower producer, Steele ND.


