Sunflower

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Oilseed sunflower (*Helianthus annuus* L.) is quickly gaining popularity as a feedstock crop for biodiesel because it shares several positive agronomic features of other common oil crops such as canola and soy; it yields well in a variety of conditions, and can be grown easily and profitably at both small farm and large field scales. The high oil content of sunflower seed, which is often over 40%, makes it an excellent choice for a biofuel crop. Because it is already grown widely for use as food oil, agronomic practices are well established for regions where it is a common component of field rotations. Though pests can present production problems, careful and thoughtful planning of rotations can help reduce the inputs needed from fertilizer to pesticides.

Current Potential for use as Biofuel

Sunflower oil is gaining popularity as a biodiesel feedstock and holds great potential for offsetting petroleum diesel use, especially at the farm scale. Sunflower oils are already used for high-grade food oils, and the meal can be readily used as a livestock feed. Oil composition is similar to that of other vegetable oils such as soy and safflower, and biodiesel from sunflower is expected to have properties similar to biodiesel from soy. Most sunflower oil is produced for human consumption and this high value oil nets a premium for producers. The value of sunflower for biodiesel end-use may not provide adequate economic returns in some oil producing regions.

Biology/Adaptation

Sunflower grows in a variety of soil conditions but performs best in well-drained soils with a high water-holding capacity. In drier regions it often needs at least supplemental irrigation to consistently optimize yields. However, sunflower is considered a drought tolerant crop and has a deeper root system than most crops. Sunflower is commonly considered a long season crop planted in mid to late spring, and maturing between early September and early October, depending on exact planting date, variety, and GDD accumulation. Many hybrids have been developed, however, that have shortened the maturity period to less than 90 days, allowing harvest to take place as early as late September. Because wild sunflower is native to most regions of North America, the conditions necessary for growing cultivated sunflower exist widely, though best agronomic practices have not been well established outside of the Midwest, the High Plains, and Western Canada (Meyer et al. 1999, MAFRI 2006, Berglund 2007).

Production

Stand Establishment

Ensuring good crops of sunflower begins with attention to hybrid selection. There are many factors that a producer needs to pay attention to when selecting a hybrid for production. Some important selection criteria include yield, oil percentage, maturity, and pest resistance. It is best to consult variety trial results from near-by universities and/or commercial seed companies. Another option is to conduct on-farm variety trials. Once the proper hybrid selection is made it is important to prepare properly for plant establishment. Sunflowers like most crops prefer a fine seedbed. However, no-till production systems have been successful and are gaining popularity. Sunflowers generally perform well under a wide range of planting dates. Most regions suggest planting sunflower between early May and mid-June. Similar to corn, sunflowers require a soil temperature of 50 F to germinate. A range of plant populations and row spacing can be suitable for sunflower production. If organic methods are used to produce sunflowers, 20 to 30 inch row spacing would aid in mechanical weed control strategies. The recommended seeding rate for oilseed sunflowers ranges from 15,000 to 25,000 plants to the acre. Lower seeding rates are primarily recommended in areas of low rainfall. Small modifications to seeders and seed metering systems can have large benefits in stand establishment. A variety of sunflower-specific modifications are available for many seed metering systems, such as shorter finger-pickups, and different cell plates (http://www.sunflowernsa.com/growers/default.asp?contentID=416).

Fertility Application

The best way to determine fertilizer application rates for sunflowers is through soil testing and setting realistic yield goals. Soil samples for sunflower production should be taken to at least a two foot depth and preferably 3 foot. Sunflowers have exceptionally long and extensive taproot systems that allow them to efficiently scavenge for nutrients and water often beyond a depth of 4 feet. Once soil test results are received university crop recommendations from your production area should be implemented. In general a soil classified as very low in a nutrient will give a yield response to applied fertilizer close to 100% of the time. On the other hand fields testing very high in a nutrient will not respond because the reserve of nutrients in the soil is adequate for plant growth. In general, sunflower yields (of seed tonnage and oil content) respond favorably to increased levels of nitrogen, though several studies have shown increased rates of lodging at high N rates (Hussein et al. 1980, Ruffo et al. 2003, Darby et al. 2009). General guidelines suggest applying 100 lbs. per acre of N per ton of expected yield after crops with high N requirements or in poor soils, while 30 or fewer lbs. per acre should be applied after legumes or fallow (MAFRI 2006).

Pests

Sunflowers are often considered a high risk crop because of its susceptibility to a variety of pests. This risk factor requires that growers use a multi-pronged approach to pest management including crop rotation, resistant cultivars, modified cultural practices, and often chemical control. Like other oilseeds, sunflower is susceptible to Sclerotinia diseases and Downy Mildew, and carefully planned rotations are the most important element in disease management. Other strategies such as wider row spacing to increase air circulation and planting resistant varieties also help with disease management. A wide variety of insects can also present problems, which reinforces the need for regular field scouting to uncover emerging infestations before they present economic problems. Some sunflower pests also infest other crops regularly used in rotations, including wireworms (small grains, especially wheat), long-horned beetles (soy), and pale-stripped flea beetles (vegetables, alfalfa, and soy). Planning rotations to disrupt lifecycles of these pests is essential to keeping yield high (Knodel et al. 2010).

In areas where migratory birds are common in the fall, harvesting before the end of September can reduce huge losses to flocks of birds that are preparing for migration. Migratory birds, particularly red-winged blackbirds, can impose large losses on fields. Various control methods, such as chemical deterrents, decoy crops, and harassment with explosions, gunshots, airplanes, and “squawkers”, have all been variable in their success. Red-winged blackbirds adapt quickly to any regular disturbance, so the best effects have been seen with random but frequent changes in deterrent methods used. Where possible, avoiding nesting habitat provides the best management.

Sunflower does not compete well with weeds early in its development. Together with the use of herbicide tolerant hybrids (Clearfield and Express Sun), pre-plant or pre-emergence use of herbicide is helpful for controlling weed pressure before sunflower crops can become well established. A number of herbicides are registered for sunflowers. However, In the Northeast, cultivating with a tineweeder at one and two weeks after planting has been shown to control weeds as effectively as herbicide, though cultivating does cause small declines in standing sunflower population (Darby et al. 2009).

Harvest and Storage

Harvest usually occurs in late September to October, ideally once the seed has reached close to 12% moisture. Combining the plants earlier at high moisture contents (up to 25%) can reduce losses from seed shattering and birds, but wetter seed requires subsequent drying. Desiccants can hasten seed drying in the field, but must be applied after the plant reaches maturity. Sunflower should be stored at around 9% moisture - at 10 or 11% the seed becomes more susceptible to insect and mold infestation, and oil extraction can become more difficult below 7%. Maintaining good seed condition is important for maintaining good oil content and quality. Air drying below 110 deg. F is best for sunflower seed because fine hairs on the hull can ignite if they circulate through the drying fan and heat source, and in turn ignite the seed, which burns easily due to its high oil content (Harner 1987).

Potential Yields

Dryland sunflower yields generally average 1300 pounds/acre, but yields over 2000 pounds/acre in irrigated or high rainfall conditions are not uncommon. Though oil content of the seed can range from 35 to 50 percent, 40 to 42 percent is average. Oil yield extracted from the sunflower seed can range from 35 up to 80 gallons per acre. The quantity of oil extracted from the seed varies depending on growing conditions, post-harvest seed handling, and whether the oil was extracted through chemical or mechanical methods.

Production Challenges

The major challenge to pre-harvest production is losses to pests. Migratory birds, disease, and insect pests all pose as a threat to sunflower production. An integrated pest management program is a sustainable and effective approach for managing these pest issues.

Maintaining seed quality for use as a feedstock provides the largest challenge post-harvest. Heating over 200 deg. F (e.g., during the drying process) degrades oil quality by increasing the concentration of free fatty acids, which must be removed in the beginning stages of the biodiesel production process. Over drying the seed can also present problems because it reduces the efficiency of oil extraction if processed by a mechanical seed press. Drying seed quickly after harvest and maintaining the seed at good storage moisture is important for keeping high seed and oil quality.

Summary

Sunflowers are a strong component of oilseed and biofuel cropping systems, because they adapt well to a variety of conditions and often require fewer agricultural inputs than more common crops. Because the oil has several potential markets and because the pressed meal can fill niche cattle feed markets, sunflower is a good choice for growers at both small scales and large scales.

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