High Plains Sunflower Production Handbook

Colorado State University • Kansas State University • University of Nebraska • University of Wyoming
USDA-ARS—Central Great Plains Research Station, Akron, Colorado

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dable task and one likely to discourage the protector long before harvest. Frightening devices will likely be most effective if employed early in the season before flocks become "entrenched" in a field. Devices also should be more effective if they are employed at a time of day just prior to early morning or late afternoon feeding periods. Gas-powered propane and acetylene exploders are the most popular tools. Use one exploder per ten acres and plan on moving exploders frequently as birds will become accustomed to them. Other devices include guns with "cracker" loads and recorded amplified sound.

Starlicide ™ (an avicide) is currently registered for control of blackbirds in sunflowers. It is a cracked-corn bait, which four out of every 100 particles is treated with the active ingredient, 4-aminopyridine. The bait is applied by broadcasting along access lanes placed in the fields, at the rate of 1 pound per acre. When a blackbird eats one or more treated particles, it flies erratically and emits distress calls. This abnormal behavior often causes the remaining birds in the flock to leave the field. It usually kills the bird that eats the bait. Careful consideration must be given to the timing of initial and repeat baiting. The first baiting should be when the birds first initiate damage, and repeat baiting should occur as necessary, about 5 to 7 days apart. Weeds that hide bait, ground insects (e.g., crickets) that eat bait, and excessive rainfall can contribute toward making the product less effective. Instructions on the label, especially the avoidance of baiting field edges, should be carefully followed to avoid contacting nontarget birds. Contact your local county agent, state department of agriculture, or the National Sunflower Association for current registrations status and always read and follow label instructions.

Birdshield ™ is another product that may work for blackbird control. It is a biodegradable taste aversion product made from a grape extract and early results look promising for deterring blackbird feeding in sunflowers. Birds are not killed from this product. They stop feeding in treated sunflower fields as a result of unpleasant tastes when feeding.

Some companies now offer a new generation of electronic sound devices using digital technology to produce distress calls of specific birds. They are only effective against bird species whose distress calls are encoded on the microchip. Following are some companies on the Internet that market bird harassment products. The National Sunflower Association has not evaluated any of the products and cannot verify the success of their use.

www.reedjoseph.com
www.wildlifecontrolsupplies.com
www.birddamage.com
www.betterpestcontrol.com
www.birdbarrier.com
www.biconet.com

More Web Page Listings

National Sunflower Association
www.sunflowernsa.com

CSU Golden Plains Area
www.colostate.edu/Depts/CoopExt/GPA

Sunflower variety test results
www.colostate.edu/Depts/SoilCrop/
www.ianr.unl.edu/ianr/agronomy/varitest2.htm
www.csuag.com
www.ksu.edu/kscpt/
uwadmnweb.uwyo.edu/UWCES

Nutrient Management

Fertile, well-managed soils capable of producing good yields of other crops also can produce good yields of quality sunflowers. Nutrient uptake by sunflowers is influenced by many factors including stage of development, hybrid, and soil fertility. Sunflowers need an adequate supply of nutrients at each developmental stage for optimum growth. High-yielding sunflowers remove considerable amounts of nutrients from the soil. This should be taken into account when developing a nutrient management program. Table 2 summarizes typical nutrient content of sunflowers.

Sunflowers are considered to be efficient in using both nutrients and water from the soil because of a deep, expansive taproot system; however, profitable responses to fertilization can be expected on many High Plains soils.

Fertilizer and lime needs are best assessed by soil testing, field history, and grower experience. Fertilizer rates are suggested for optimum yields, assuming yield potential is not restricted by other factors.

Table 2. *Nutrient content in a sunflower crop producing 1,000 lbs seed/acre.*

	Nutrient Removal lbs/acre		
Element	Seed	Stover	Total
Nitrogen (N)	30	18	48
Phosphorus (P_2O_5)	12	3	15
Potassium (K_2O)	8	28	36
Sulfur (S)	2	4	6
Magnesium (Mg)	2	5	7
Calcium (Ca)	1.2	18.5	19.7
Zinc (Zn)	0.05	0.04	0.09

Nitrogen

Nitrogen (N) is the nutrient of greatest accumulation in the aboveground portion of the sunflower crop. Nitrogen recommendations vary with yield expectations associated with soil, climate, soil moisture, cropping sequence, and residual nitrogen in the soil. The results of a 7-year study conducted at the USDA-ARS Central Great Plains Research Station (Akron, Colo.) indicated that sunflowers require 6 to 7 pounds of nitrogen for every 100 pounds of production. This has lead to an increase from a previous recommendation of 50 pounds of nitrogen for every 1,000 pounds of potential grain production, to 65 pounds of nitrogen for every 1,000 pounds of expected yield.

Fertilizer nitrogen rates should be lowered if legumes are grown in rotation before sunflowers. Table 3 summarizes nitrogen credits for various legumes.

Since sunflowers are efficient in recovery of residual nitrogen, a soil test for available nitrogen in the profile is strongly encouraged. Profile nitrogen samples should be taken to a depth of at least 2 feet. On deep, well-drained soils, deeper sampling may be justified to 4 feet.

Nitrogen recommendations can be calculated by using the following equation:

N Rec = { [YG × 0.065 pounds nitrogen per pound of yield] × STA] - PCA - PYM – PSNT – (Nmin)

N Rec Fertilizer nitrogen recommended in pounds per acre
YG A realistic yield goal in lbs per acre
STA Soil texture adjustment (1.1 for sandy soils less than 1.0 percent organic matter, 1.0 for other soils)
PCA Previous crop adjustment [use Table 2 for previous legumes, 20 pounds for fallow (if no profile N test) and 0 for all other previous crops]
PYM Previous years manure (50 pounds for last year, 20 pounds for 2 years ago and 0 for no manure history)
PSNT Profile nitrogen soil test results where:

Surface:
ppm nitrogen × 0.3 × depth, inches = pounds per acre
Subsoil:
ppm nitrogen × 0.3 × depth, inches = pounds per acre
Total Profile nitrogen = pounds per acre
Note: If profile nitrogen test is not run, use 30 pounds per acre as a default value for PSNT.

Table 3. *Nitrogen credit for legumes used in crop rotations.*

Previous Legume	Nitrogen Credit pounds per acre
Alfalfa > 80% stand	100–140
60–80% stand	60–100
< 60% stand	0–60
Second year after alfalfa	½ first year credit
Red Clover	40–80
Sweet Clover	80–120
Soybeans	30–60

Nmin Estimate of nitrogen mineralized from soil organic matter. Credit 30 pounds of nitrogen for every 1 percent of soil organic matter in the top 6 inches of soil.

Example:
Yield Goal = 1,800 pounds per acre
Soil Texture = Silty Clay Loam
Previous Crop = Wheat
Previous Manure = None
Soil Test Results:
0 - 6 inches = 8 ppm nitrogen, 6 - 24 inches = 6 ppm nitrogen, 1 percent soil organic matter
N Rec = ((1,800 pounds per acre × 0.065 pounds per pound) × 1.0) – 0 – 0 – 46.8* – 30 = 40
*(8 ppm × 0.3 × 6 inches) + (6 ppm × 0.3 × 18 inches) = 46.8

Under these conditions, 40 pounds of fertilizer N is recommended.

Subtract residual soil test results from following recommendations.

Yield Goal	1,000 lbs/a	1,500 lbs/a	2,000 lbs/a	2,500 lbs/a	3,000 lbs/a
Total Nitrogen Need	65 lbs N/a	98 lbs N/a	130 lbs N/a	163 lbs N/a	195 lbs N/a

The use of excessive nitrogen rates is not advisable. Research in North Dakota, Colorado, and Nebraska indicates that excessive nitrogen can result in decreased oil content and increased lodging.

If fertilizer is placed in contact with the seed, the starter material should contain no more than 10 pounds of actual nitrogen plus potash per acre. The nitrogen and potash can cause germination damage because of their high salt index when placed with the seed. Much higher amounts can be applied in a 2 × 2 band (2 inches deep and 2 inches away from the seed), or broadcast applied without seedling damage. These fertilizer placement statements hold true regardless of the crop.

Field comparisons of nitrogen sources conducted by K-State researchers indicate little agronomic difference between alternative nitrogen materials, when properly applied. Nitrogen source should be based on applied cost, availability, adaptability to your management system, and dealer services.

Nitrogen application for sunflowers can be made preplant, sidedress, or a combination of these methods with equal results. Applications should be timed so nitrogen is available for rapid plant growth and development.

Phosphorus

Phosphorus (P) application should be based on a soil test. Consistent sunflower response to phosphorus fertilization has generally occurred on soils testing very low or low in available phosphorus where yield potential is not restricted by lack of moisture or other environmental factors. With medium-testing soils, yield responses have been erratic and normally quite small. Phosphorus applications are recommended with medium and low soil tests for potential yield response and to maintain the soil in a highly productive condition. Table 4 shows phosphorus recommendations.

Phosphorus should be applied preplant-broadcast, preplant-knifed, or banded at seeding. Starter applications are most efficient, particularly when small amounts are applied on soils low in available phosphorus. Phosphorus can be placed in direct contact with the seed or to the side or below the seed with no restrictions in economical rates. If placed in contact with the seed, the starter material should contain no more than 10 pounds of actual nitrogen plus potash per acre. The nitrogen and potash can cause germination damage because of their high salt index when placed with the seed. Preplant applications can be made in the fall or spring and should be thoroughly incorporated because phosphorus does not move much in the soil.

Liquid and solid fertilizers, as well as varying chemical forms of phosphorus (ortho- and poly-phosphates), are available. Research conducted in several states indicates that, in general, all are agronomically equivalent. Selection of a phosphorus source should be made on the basis of cost, availability, and adaptability to the operation.

Potassium

Like phosphorus, a soil test is the best guide to potassium (K) need (Table 4). Potassium removal is much greater with silage than with grain production. Potassium deficiencies are not likely unless soil tests levels are low, which normally occur in sandy soils.

Potassium should be applied preplant-broadcast or as a starter. Remember, sunflowers are sensitive to fertilizer salts (N and K). When applying starter applications with the seed, limit application to no more than 10 pounds actual nitrogen plus potash per acre. Preferred fertilizer placement is 2 inches deep and 2 inches away from seed. Broadcast applications should be thoroughly incorporated to place the potassium in the root zone. The most common potassium source is muriate of potash (potassium chloride); however, potassium sulfate, potassium nitrate, potassium-magnesium sulfate, and mixed fertilizers are other sources. Little difference in potassium availability exists among these materials. Selection should be based on cost, availability, and adaptability to the farm operation.

Lodging of sunflowers at maturity has been a problem in some areas resulting in considerable harvest loss. Research has shown that many factors such as weather stress, insect and disease damage, hybrids, date and rate of planting, and nutrient imbalance can cause lodging. Adequate potassium is essential for sturdy stalks and may help reduce lodging on medium- to low-potassium test soils.

Liming

Acid soils are not common in the High Plains, but soil pHs less than 5.5 have been reported in northwest Kansas.

Lime recommendations are intended to maintain soils in a productive condition. Sunflowers are not the most responsive crop to lime, but liming of acid soils should not be ignored. Although yearly yield increases may be small, liming is a sound farming practice. Lime is recommended for sunflowers on all soils with a pH of 6.0 or less. If sunflowers are grown in a cropping system that includes legumes, liming to obtain a higher pH (6.2 to 6.5) should be maintained. However, most High Plains soils test quite high in pH and therefore, liming is not common.

Other Elements

Perhaps because of the extensive root system, reports of secondary and micronutrient deficiencies in field-grown sunflowers are rare. In most states in the region for example, sulfur, iron, and/or zinc deficiencies have been reported on other row crops, small grains, and forage crops. However, there have been no reported deficiencies of any of these nutrients in sunflowers. In fact, sunflowers are often suggested as an alternative crop on severely iron deficient soils. Likewise, there should be no problems with boron, copper, or manganese nutrition in sunflowers.

Soil Fertility and Micronutrients

Iron availability decreases with increasing soil pH. However, sunflowers are tolerant of low iron availability. Sunflower production is usually successful on soils that

Table 4. *Phosphorus and potassium recommendations for sunflowers.*

		Soil Test Phosphorus, ppm					Soil Test Potassium, ppm[1]				
		VL	L	M	H	VH	VL	L	M	H	VH
Yield	Bray-1 P	<5	6–12	13–25	26–50	>51	<40	41–80	81–120	121–160	>161
Goal	Olsen P	<3	4–7	8–12	13–16	>17					
lb/a		lb P_2O_5/a					lb K_2O/a				
1,000		30	20	15	0	0	50	40	15	0	0
1,500		40	30	20	0	0	60	50	25	10	0
2,000		50	40	25	10	0	70	60	35	15	0
2,500		60	45	30	15	0	80	70	45	20	0
,3000		70	55	35	20	0	90	75	55	25	0

[1] *When sunflowers are used for silage, add 40 lb K_2O/a to recommendation in low-testing soils.*

cause deficiencies on sensitive crops such as corn, sorghum, or potatoes. Severe iron deficiency of sunflowers in the seedling stage shows interveinal chlorosis on the youngest leaves with stunted plants.

Zinc-deficient plants are stunted with distorted upper leaves. As the deficiency intensifies, leaves tend to wilt. Zinc deficiencies or responses to added zinc are not likely in the region.

When setting yield goals, considerations must include individual management skills, soils, and average weather conditions. Adequate fertilizer nutrients must be provided as required for selected yield goals. The most limiting factor, however, for yield on dryland sites, is often stored soil water and effective summer precipitation. Decisions for choosing yield goals therefore should be based on yield histories and future expectations.

Recent research with micronutrients applied foliarly two times during the season in a 2-year study at Akron, Colo. did not provide a return on investment that was great enough to pay for the micronutrient application. Although in one of the years, a significant increase in seed oil content was measured with micronutrient application.

Likewise, researchers at Colorado State University found no yield advantages to adding micronutrients to sunflowers applied either foliar applied or as a soil-applied granular regardless of soil moisture conditions.

Weed Control

Weed management is an important component of successful sunflower production. Sunflowers in the High Plains are grown in rotation with other crops. The weed control benefits associated with crop rotation can be realized only if good weed management was practiced in the preceding crop. Because sunflowers are usually planted at low densities and grow slowly during the first 2 weeks, weeds that emerge and establish during this time can be competitive and reduce sunflower yield. Sunflowers are strong competitors with weeds that emerge 3 or more weeks after sunflower emergence. Therefore, early season weed control is important to minimize yield losses.

Preplant Weed Control

It is essential that sunflower seeds be planted into a seedbed free of growing weeds. Weed control before planting can be accomplished with tillage, herbicides, or a combination of both. If tillage is the predominant method of weed control, implements such as the V-blade, tandem disk, or field cultivator may be used before planting. Soil that is warm and dry on the surface, and moist below, encourages rapid sunflower development and may delay weed seed germination. In double-cropped sunflowers, appropriate weed control must be practiced in the small grain crop. However, sunflowers should not be planted into wheat stubble if Glean, Ally, Ally Extra, Peak, Amber, Rave, Finesse, Maverick, Olympus, Beyond, or Tordon herbicides were applied in the preceding small grain crop because of the risk of sunflower injury from herbicide carryover. Nonselective burndown herbicides must be applied prior to sunflower emergence to avoid severe crop injury.

The use of a nonselective herbicide such as glyphosate (several) or paraquat (Gramoxone Max) is an alternative to preplant tillage for weed control. These foliar-applied herbicides can control seedling broadleaf weeds and grasses. Since paraquat is a contact (nontranslocated) herbicide, it may give incomplete control of grass plants that have tillered, or broadleaf plants with well-developed axillary buds. Glyphosate is a systemic (translocated) herbicide that controls a wide spectrum of grass and broadleaf weed species, but is weaker on certain species such as wild buckwheat, kochia, common lambsquarters, and marestail. Tank mixing glyphosate and sulfentrazone (Spartan) may antagonize glyphosate activity and require that additional glyphosate be added to the tank. It may be best to avoid tank mixing the two herbicides.

Applying glyphosate or paraquat before planting uses the "stale seedbed" technique. In contrast to the flush of new weed seedlings that usually follows tillage and rainfall, few weeds germinate following use of preplant burndown herbicides, because there is no tillage to bring a new supply of weed seed into germination position near the soil surface and weed seed lying on the surface is not buried into moist soil. In sunflower crops, where there are few herbicide options, alternative weed control techniques such as stale seedbed are especially important.

Glyphosate prepack or tank mixtures containing 2,4-D or dicamba have a high potential for causing crop injury when applied before sunflower planting and should not be used within 3 months of planting (refer to herbicide label guidelines).

Another alternative to tillage for weed control in double-crop sunflowers is to burn the small grain stubble ahead of sunflower planting. Fire can kill existing weeds, reduce the potential for volunteer wheat problems, and eliminate interference of residues with planting and cultivation equipment. Fire generally will not destroy weed seed in direct contact with the soil surface. The advantages of burning must be compared to the benefits of leaving the wheat stubble standing for control of soil erosion by wind and water. Burning may increase moisture loss from the profile and reduce moisture stored in the profile during the growing season because it leaves the soil surface exposed to wind and sunlight.