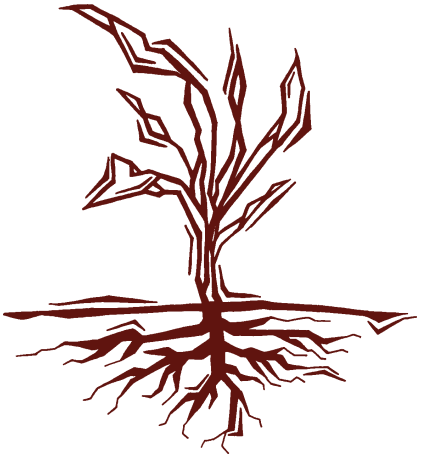

SOIL

Fertilizing Sunflowers no. 0.543

by J.J. Mortvedt, D.L. Johnson and R.L. Croissant [1]

Quick Facts...

Nitrogen normally is the most limiting nutrient for sunflower production.

Apply nitrogen fertilizers at rates based on expected crop yields minus credits for residual soil nitrates and nitrogen mineralized from soil organic matter, manure and previous legume crops.

Apply phosphate fertilizers at rates based on soil test results.

Most Colorado soils contain sufficient available potassium, sulfur, and micronutrients for sunflower production.

Adequate soil fertility is one of the requirements for profitable sunflower production. Nitrogen (N) is the most yield-limiting nutrient, unless there are high residual NO_3-N levels in the soil. Phosphorus (P) is the next most limiting nutrient. Levels of available potassium (K), sulfur (S), and micronutrients generally are sufficient for sunflower production in Colorado soils.

Soil Tests

The value of a soil test to predict nutrient availability during the growing season directly relates to how well the sample collected represents the area sampled. Take surface samples to a 1-foot depth. To improve the accuracy of N recommendations, take subsoil samples to a depth of 2 to 3 feet to determine available NO_3-N. If high residual NO_3-N levels are suspected, take soil samples to 4 feet because sunflower roots will remove NO_3-N from this depth. A good sample is a composite of 15 to 20 soil cores taken from an area uniform in soil type. Sample separately areas with major differences in soil properties or management practices.

Thoroughly air dry all soil samples within 12 hours after sampling by spreading the soil on any clean surface where the soil will not be contaminated. **Do not oven-dry the soil** because this can change soil test results. Place the air-dried soil in a clean sample container for shipment to the soil test laboratory.

Submit a carefully completed information form with the soil sample. This form provides information so fertilizer suggestions can be tailored to your specific situation. Take soil samples for NO_3-N analysis every year for optimum N fertilization of crops. Soil analyses for availability of the other nutrients, pH, and organic matter content every three to four years may be sufficient.

More detailed explanations of the importance of taking proper soil samples are found in fact sheets 0.500, *Soil Sampling*, 0.501, *Soil Testing*, and 0.502, *Soil Test Explanation*. These fact sheets are available at your Colorado State University Cooperative Extension county office or from the Cooperative Extension Resource Center, 115 General Services Building, Fort Collins, CO 80523; (970) 491-6198.

The Colorado State University Soil, Water, and Plant Testing Laboratory is located at Room A319, Natural and Environmental Sciences Building, Colorado State University, Fort Collins, CO 80523; (970) 491-5061.

Nitrogen Suggestions

Base nitrogen rates for sunflowers on the expected yields for each field. Nearly all sunflower crops require some N fertilizer, unless there is a substantial N carryover. As a rule, a 1,500 pounds per acre sunflower yield will require the same amount of N fertility as a 30 bushels per acre wheat crop (about 75 pounds of nitrogen per acre).

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Table 1: Suggested nitrogen rates for dryland sunflowers (expected yield, 1,500 lb/A).

ppm NO_3-N in soil*	Soil organic matter content, % 0 - 1.0	1.1 - 2.0	>2.0
	----Fertilizer rate, lb N/A----		
0 - 6	75	55	35
7 - 12	55	35	15
13 - 18	35	15	0
19 - 24	15	0	0
25 - 30	0	0	0

*Concentration of NO_3-N in the surface 0 - 1 foot soil depth. NOTE: Adjust N rate by 6 lb/A for each cwt difference in expected yield.

Table 2: Suggested nitrogen rates for irrigated sunflowers (expected yield, 2,400 lb/A).

ppm NO_3-N in soil*	Soil organic matter content, % 0 - 1.0	1.1 - 2.0	>2.0
	----Fertilizer rate, lb N/A----		
0 - 6	130	110	100
7 - 12	110	95	85
13 - 18	95	80	70
19 - 24	80	60	50
25 - 30	60	45	35

*Concentration of NO_3-N in the surface 0 - 1 foot soil depth. NOTE: Adjust N rate by 6 lb/A for each cwt difference in expected yield.

Table 3: Suggested phosphorus rates for dryland and irrigated sunflowers.

ppm P in soil AB-DTPA	ppm P in soil $NaHCO_3$	Relative level	Fertilizer rate, lb P_2O_5/A
0 - 3	0 - 6	low	40
4 - 7	7 - 14	medium	20
> 7	> 14	high	0

NOTE: Suggested P rates are for band application.

Table 4: Suggested potassium rates for dryland and irrigated sunflowers.

ppm K in soil AB-DTPA or NH_4OAc	Relative level	Fertilizer rate, lb K_2O/A Dryland	Irrigated
0 - 60	low	30	50
61 - 120	medium	0	30
> 120	high	0	0

Give credit for the level of residual NO_3-N in the root zone. Other credits for N include the N expected to become available during the season from mineralization of soil organic matter, manure, and previous legume crop residues, as well as NO_3-N in irrigation water. Subtract these credits from the total crop needs to determine the suggested N fertilizer rate. When a soil test for organic matter is not available, assume a level of 1.5 percent organic matter for eastern Colorado soils.

Dryland Sunflowers

Suggested N rates are lower for dryland sunflowers because of lower plant populations and less than optimum soil moisture conditions. Table 1 suggests N rates at an expected yield of 1,500 pounds per acre. Fertilizer rates decrease with increasing levels of NO_3-N in the top foot of soil and increasing soil organic matter content. Suggested N rates in this table do not account for other N credits. Subtract these credits from the N rates in Table 1 to determine the N rate for the field.

Irrigated Sunflowers

Table 2 suggests N rates for irrigated sunflowers at an expected yield of 2,400 pounds per acre. Fertilizer N rates decrease with increasing levels of NO_3-N in the top foot of soil and increasing soil organic matter content. Suggested N rates in this table do not account for other N credits. Subtract these credits from the N rates in Table 2 to determine the N rate for the field.

Methods and Timing of N Applications

Apply nitrogen fertilizer preplant or sidedressed. Some N may be applied in combination with starter fertilizers, but the rate should be less than 10 pounds of N per acre. Most efficient use can be obtained by applying N just ahead of planting. However, apply all of the fertilizer before heading (bud stage) to maximize yields and N use efficiency. All sources of N fertilizers are equally effective per unit of N if properly applied. Base choice of N fertilizer on availability, equipment available and cost per unit of N.

Sunflower roots grow quickly into the soil between the rows. Sidedress N fertilizers early in the growing season to avoid root pruning.

For irrigated sunflowers, it is convenient to apply N fertilizers with high-efficiency irrigation systems. This method allows for split applications that improve N use efficiency.

Use in-season soil or plant analysis to determine the nutrient status of the growing crop. If the N status of the crop is low or growing conditions appear to be above average, apply additional N with the next irrigation.

Phosphorus Suggestions

Crop responses to applied P are most likely on soils with low or medium levels of extractable P. The main tests for extractable P in Colorado soils are the AB-DTPA and sodium bicarbonate ($NaHCO_3$) tests. Suggested P fertilizer rates (Table 3) are for banded applications related to soil test levels.

Placement of P fertilizers in the root zone is important because P is not mobile in soil. Band application at planting (starter fertilizer) is the most efficient placement method for P, and suggested rates for broadcast application are about double those for band application.

Incorporate broadcast applications of P fertilizers into the soil prior to planting. Sunflower seed is sensitive to salts in fertilizers. Use popup placement (directly with the seed) with caution because seedling emergence may decrease in dry soil, especially at rates supplying more than 10 pounds of nitrogen per acre. Monoammonium phosphate (MAP, 11-52-0), diammonium phosphate (DAP, 18-46-0), and ammonium polyphosphate (10-34-0) are equally effective per unit of P if properly applied. Base your choice of product on availability, equipment available, and cost per unit of P.

Potassium Suggestions

Most Colorado soils are relatively high in extractable K, and few crop responses to K fertilizers have been reported. Suggested K rates related to soil test values (AB-DTPA or NH_4OAc) are given in Table 4. The main K fertilizer is KCl (potash). Broadcast application incorporated into the soil prior to planting is the usual method.

Other Nutrients

Most Colorado soils contain adequate levels of available S, and soil tests for available S are not routinely performed. Irrigation water from most surface waters and some wells often contains appreciable SO_4-S, so irrigated soils usually are adequately supplied with S. Some deep well waters are low in SO_4-S, so analyze water samples if soils are low in organic matter content and you suspect S deficiency.

There have been no confirmed deficiencies of boron (B), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), and zinc (Zn) in sunflowers in Colorado.

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