Fertilizing Safflower

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Safflower is an oil seed crop that grows well under dryland conditions in western North Dakota. Safflower oil is a low cholesterol oil that is used in human food and also has many industrial uses.

Yield Goal:

The most efficient fertilizer rate will depend on the residual soil nutrient level as determined by a soil test and the yield goal. Yield is influenced by: 1) local climate; 2) soil type; and 3) management (timeliness of field operations, plant population, variety, fertility, weed control, etc.). Yield goals should be realistic. They are usually based on long-time averages and the management ability of the grower but adjusted to conditions expected for the upcoming year (see Circular SF-822). When disease and weeds are not a problem, safflower yields as high as 2000 pounds per acre have been obtained in western North Dakota.

Excessive fertilizer use, especially nitrogen and phosphorus, has potential to degrade ground and surface water quality. Establishing realistic yield goals, carefully soil sampling fields and fertilizing crops according to soil tests will help preserve water quality.

Date Of Planting:

In the seedling stage safflower is quite frost tolerant, withstanding temperatures as low as 20�F. With a growing period of 120 days to maturity, safflower should be planted in April or early May. If planted later than the middle of May, an early fall frost could reduce seed quality.

Fertilizer Recommendations:

Table 1 shows the amount of soil nitrate-nitrogen in the top 2 feet of soil plus nitrogen fertilizer needed to meet the crop requirements for various yield goals. These data are based on nitrate-nitrogen levels in soil samples taken between September 15 and April 1. If soil samples are taken between July 1 and September 15 subtract 0.5 pound of nitrogen from the recommendation for each day the soil was sampled prior to September 15. These adjustments are automatically included in recommendations received from the North Dakota State University Soil Testing Laboratory.

The phosphate (P_2O_5) and potash (K_2O) recommendations in Table 1 are for **broadcast application**. Drill-row applications of N + K_2O should not exceed 15 pounds per acre to avoid the possibility of germination damage. If you prefer to band all of the fertilizer, keep the bands at least 2 inches from the seed. To convert the broadcast rate of P and K to a band application rate reduce the broadcast rate by one third. Reduce the broadcast rate only when banding on soils testing **very low**. If the broadcast rate for medium testing soils were reduced, you would not be applying enough phosphorus and/or potassium to maintain the level in the soil. The result would then be an increasingly deficient soil which is not conducive to high yields.

Since phosphorus and potassium move very little in the soil, it is possible to "build up" or increase the available level of these nutrients in the soil. The application of approximately 20 pounds of P_2O_5 per acre will increase the phosphorus soil test level by 1. In other words, if your phosphorus soil test level is 5 and you prefer to operate at test level of 12, the application of 140 pounds of P_2O_5 (305 pounds of 18-46-0) per acre thoroughly mixed in the top 6 inches of soil will raise the soil test level by 7. Likewise, the application of 10 pounds of K_2O per acre will increase the potassium soil test by 1. Nitrogen requirements should be applied each year.

Table 1. Nutrient recommendations for safflower.

		Soil Test Phosphorus, ppm				
Yield goal	Soil N plus fertilizer N required	Bray-I Olsen	VL 0-5 0-3	L 6-10 4-7	M 11-15 8-11	H 16-20 12-15	VH 21+ 16+
lb/a	lb/acre-2'	lb P2O5/acre					
800	40		20	15	10	0	0
1200	60		30	20	10	0	0
1600	80		40	30	15	10	0
2000	100		50	35	20	10	0

		Soil Test Potassium, ppm				
Yield goal	Soil N plus fertilizer N required	Bray-I Olsen	VL 0-40	L 41-80	M 81-120	H 121-160	VH 161+
lb/a	lb/acre-2'	lb K2O/acre					
800	40		35	25	15	0	0
1200	60		50	35	20	0	0
1600	80		65	50	30	10	0
2000	100		85	60	35	10	0

Nitrogen recommendation = 0.05 YG - STN + SDA - PCC
Bray-I P recommendation = (0.0270-0.0014 STP)YG
Olsen P recommendation = (0.0270-0.0017 STP)YG
Potassium recommendation = (0.0480-0.0003 STK)YG

The abbreviations used in the equations are as follows:
YG = yield goal
STN = soil test nitrogen
STP = soil test phosphorus
STK = soil test potassium
SDA = sampling date adjustment
PCC = previous crop credit

Methods Of Application:

The best method of nitrogen application will depend on the nitrogen source used. For example, anhydrous ammonia should be applied 4-6 inches beneath the soil surface, while nitrogen solutions, broadcast urea and other dry nitrogen fertilizer products should be worked into the soil shortly after application. Applying nitrogen fertilizer on well drained sandy soils in the fall is not recommended because of possible loss by leaching.

Crops growing on soils that test very low in P and/or K depend heavily on applied fertilizer. On soils testing medium or above the crop is much less dependent on applied fertilizer for its current needs. Fertilizer is applied on these soils to replace that removed by the crop or as a starter to get the crop off to a fast start. On low testing soils where the plants largely depend on the fertilizer for their needs the method of application will influence the amount of fertilizer a crop recovers. **Broadcast** fertilizer is thoroughly mixed with the soil and as a result some is positionally unavailable to plant roots. **Band or drill row** fertilizer is applied closer to the seed and can be recovered by the crop more efficiently.

Broadcast applications of phosphate and potash will be more efficient when applied before a primary tillage operation. Recent data indicates that a band application of P at a depth of 4 or 6 inches is more effective than when drill row applied. This method of application will also prevent a buildup of nutrients at the soil surface under minimum tillage.

Other Nutrients:

Sulfur deficiencies are not common in North Dakota, but may occur early in the growing season on sandy soils. If a crop appears to be deficient in nitrogen but does not respond to nitrogen applications, sulfur may be deficient. Response to iron, zinc, copper and manganese have not been observed on safflower in North Dakota.

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