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G89-924 Fertilizing Proso Millet (Revised December 2002)

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Fertilizing Proso Millet

Soil testing and fertilization of proso millet with nitrogen, phosphorus, potassium and other nutrients is discussed.

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Management practices that provide an adequate, but not excessive, supply of plant nutrients are essential for top yields of proso millet in the High Plains.

Soil Testing

Soil testing is the foundation of nutrient management in proso millet production. The goal of soil testing is to characterize the amount of nutrients in the soil prior to planting. Fertilizers can then be applied to ensure optimal nutritional conditions for the crop.

Soil samples from the surface to a depth of 3 feet are necessary for the most accurate prediction of nutrient needs. These samples should be collected to obtain a plow-layer sample from 0 to 8 inches and a sample from 8 to 36 inches. Collect composite cores from at least 15 points in the field for the surface sample and from 8 to 10 points for the deeper samples. More than one set of samples may be necessary from some fields if parts of the field differ in slope or soil characteristics such as color, sand content or previous crop. For more information on soil sampling, refer to NebGuide G91-1000, "Guidelines for Soil Sampling".

The plow layer sample should be analyzed for nitrate and other nutrients of interest, organic matter concentration, and soil pH. The deeper samples should be analyzed for nitrate only. The reasons for this difference in analysis are:

1. while most nutrients are not very soluble and are mainly in the top 8 inches of soil, nitrate is very

- soluble, and rainfall or irrigation may leach it from the plow layer; and
- research and experience has shown that proso millet can utilize nitrate-nitrogen from depths of 3 feet or more. Therefore, soil samples from the plow layer alone do not accurately predict the amount of nitrogen available to the crop.

Soil testing for nitrate-nitrogen is recommended before planting *each* proso millet crop, while soil testing for phosphorus, potassium, and micronutrients is recommended for every three to five years.

Nitrogen Recommendations

Most proso millet grown in Nebraska requires some additional nitrogen fertilizer for profitable production. One hundred pounds of proso millet grain contains about 1.9 pounds of nitrogen. Nitrogen is a building block of amino acids and proteins in plants. Chlorophyll is the most abundant protein in plants. It is involved in photosynthesis - the conversion of carbon dioxide gas and water into sugars with the help of light energy. Chlorophyll gives plants their green color. Plants deficient in nitrogen contain less chlorophyll and appear light green. With increasing severity of nitrogen deficiency, leaves will appear yellow and older leaves will age prematurely. Symptoms of nitrogen deficiency appear first on older leaves.

Residual soil nitrate can be measured effectively with a residual nitrate soil test of the root zone. While the depth of the root zone for proso millet is often four feet or more, most available nitrogen affecting yield is in the top two to three feet of soil. The producer can use soil samples less than three feet deep for making nitrogen recommendations, but they are less accurate.

Proso millet generally is grown under dryland conditions in Nebraska, either by continuous cropping or after summer fallow. Proso millet planted following another crop, such as wheat, has a higher nitrogen requirement than after summer fallow. Summer fallowing provides some nitrogen from the mineralization of organic matter, so yield response to nitrogen fertilizer occurs more often under continuous cropping. This is especially true when planted into high levels of plant residue with a high carbon to nitrogen ratio. The optimum fertilizer nitrogen rate for proso millet can be determined by using *Table I*.

Table I. Nitrogen recommendations for 3-foot soil sampling depths.			
<i>Soil Test</i>		<i>Previous Crop</i>	
<i>Nitrate-N</i>		<i>Fallow</i>	<i>Wheat</i>
<i>Pounds of NO₃-N per acre</i>	<i>ppm NO₃-N</i>	<i>Pounds of N per acre to apply</i>	<i>Pounds of N per acre to apply</i>
0-20	0-1.9	55	75
20-35	1.9-3.2	35	55
35-50	3.2-4.6	20	35
50-65	4.6-6.0	10	20
65-80	6.0-7.4	0	10
>80	>7.4	0	0

All nitrogen fertilizer sources [ammonium nitrate (33-0-0); urea (45-0-0); urea-ammonium nitrate (28-0-0); anhydrous ammonia (82-0-0)] are generally very effective. However, dry and liquid nitrogen sources

vary in their susceptibility to volatilization or gaseous loss as ammonia to the atmosphere. Ammonium nitrate is the least susceptible, while urea is usually most susceptible. Therefore, ammonium nitrate is the preferred nitrogen fertilizer for topdressing where incorporation is impossible. With incorporation soon after fertilizer application, all nitrogen sources should be equally effective.

When nitrogen fertilizers are placed with the seed at planting, not more than 20 lb of nitrogen per acre should be applied to avoid stand damage. Higher rates of nitrogen can be applied safely when placed at least two inches away from the seed.

Phosphorus Recommendations

Many of the soils where proso millet is grown require phosphorus. A soil test is the best way to determine if phosphorus is needed. Phosphorus is involved in energy transfer within the plant and aids in maintaining the structural integrity of the plant cell membranes. Leaves of plants deficient in phosphorus will appear darker green than usual. With increasing severity of the deficiency, plant growth will be stunted. Phosphorus deficiencies will most likely be associated with soils that are high in pH and low in organic matter such as eroded knolls. Most proso millet is grown in the western High Plains on calcareous soils. Tests have shown better results using the Olsen-P soil test (sodium bicarbonate soil test) in these soils. For neutral to acid soils the Bray P-1 soil test is more appropriate.

When phosphorus is needed, the application method is important. Phosphorus fertilizer must be banded for the root system of the young plant to make early contact with the nutrient. Experiments often show no response to broadcast phosphorus. The recommendations in *Table II* are for banded phosphorus only.

Table II. Phosphorus availability indices and recommendations for banded P fertilizer.			
	<i>Soil Test Reading</i>		
<i>Category</i>	<i>Bray P-1 ppm</i>	<i>Olsen - P ppm</i>	<i>Banded* pounds of P_2O_5 per acre to apply</i>
Very low	< 10	< 6.7	35
Low	10-15	6.7 -10	25
Medium	15-20	10 - 13.3	15
High	> 20	> 13.3	0
*Rates should be doubled for broadcast application and broadcast applications should be avoided, if possible.			

Potassium Recommendations

Potassium is important for the function of the stomata, pore-like openings of the plant leaves, through which transpiration of water and uptake of gaseous carbon dioxide occurs. Adequate potassium nutrition of the plant is necessary to ensure the integrity of the water economy within the plant. Early symptoms of potassium deficiency include a tanning and leathery edges of recently matured leaves. More severe deficiency symptoms are a severe interveinal leaf scorch and crinkling that proceeds to the midrib. Most of the soils of the High Plains contain enough potassium for maximum proso millet production. The possibility of response to potassium fertilizer is low. *Table III* shows the amount of potassium needed in relation to the soil test for potassium.

Table III. Potassium availability indices and recommendations for potassium fertilizers.		
<i>Category</i>	<i>Soil Test Level ppm K</i>	<i>Broadcast pounds of K₂O per acre to apply</i>
Very Low	0-39	120
Low	40-74	80
Medium	75-124	40
High	>125	0

Other Nutrients

Occasionally proso millet plants show striping that looks like iron deficiency but is usually caused, or enhanced, by herbicide application. Using iron spray does not correct the symptoms. Sulfur and other micronutrients rarely increase yield of millet. Zinc has proven to be deficient on some crops in western Nebraska. A zinc soil test would indicate the possibility of a deficiency in the proso millet crop. When the DPTA Zn soil test is < 0.5 ppm, zinc application is recommended. It is easy to apply zinc with the seed at planting in liquid form as 10-34-0 + 1% Zn.

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