Tef Demonstration Planting Results for 2003

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Tef (Eragrostis tef) is a warm season annual grass native to Ethiopia. It grows as fine-stemmed clumps with many tillers. The clumps vary in height from 10 to 50, inches depending on the variety. The numerous leaves are narrow, hairless, and smooth and grow nearly as tall as the seed heads. The root system is fibrous and shallow growing but massive. The seeds are tiny (1.25 million/pound) and grow in various shades of white, red, brown, or almost black in color, again depending variety. They are produced in heads that range from very open to compact. Figure 1 is a line drawing of a typical tef plant.

Uses

Tef is used for both human and animal feed in Africa. As a human food source, the seeds are normally ground into flour. The flour is fermented and used to make Injera, a sour-dough type of flat bread. It is also used for making porridge and an alcoholic drink. Because the flour is essentially gluten free, it is gaining popularity among those who suffer from gluten allergies. It is also used to thicken stews and soups.

Tef is highly valued as an animal feed in Africa due to the higher quality of straw it produces when compared to other grain plants. The increased quality can be attributed to a high leaf stem ratio (73:27), superior digestibility and relative high protein content.

Figure 1. Typical tef plant showing leaf shape and seed head.
Adaptations

Tef is reported to grow in a wide variety of soils and climatic conditions. In Ethiopia it is produced on elevations ranging from sea level to over 8000 ft. It is very drought tolerant but production is reported to suffer when inadequate moisture is supplied. The best tef production areas in Ethiopia receive from 12 in to 2 in of precipitation annually. Tef is a warm season plant and will be damaged by early or late frosts. It is normally planted after the last frost is expected. In the United States tef has been successfully grown from California to the states of Montana, South Dakota and Minnesota.

Agronomy

Tef is normally planted about the same time as or slightly later than corn. It can be seeded much later but research indicates that grain yields will be lower and may fail due to early frosts. Tef varieties are available that mature in as little as 95 days, with later maturing varieties requiring up to 130.

Because tef has such small seeds, obtaining an even plant density can be difficult. It is best seeded with a spinning broadcast implement or a “Brillion” seeder. It is normally seeded at approximately 2-3 pounds/acre for seed and 4-8 pounds/acre for hay. The seedbed should be firm and the seed placed no deeper than .5 inches into the soil. If a broadcast seeder is used a cultipacker implement should be used, following the seeding operation. Frequent shallow irrigation following seeding is required. After the plant is established, the irrigation regime should be adjusted to wet the soil to a depth of at least 6-8 inches.

Tef seed is normally combined after it has been swathed and the windrows allowed to dry. Direct combining is possible, but seed is easily dislodged from the plant and excessive losses are possible. When cut for hay, tef should be harvested between the boot and soft dough stage. If planted in late May, two cuttings may be possible.

Fallon Demonstration 2003

In early 2003 a major tef producer from Idaho contacted the author concerning the possibilities of tef production by local agricultural producers. Although interested, no local producers would commit to a tef production contract. Because of the interest shown, Cooperative Extension and a local cooperator initiated a preliminary demonstration trial to begin evaluating survival and production potential in the Lahontan Valley. The results presented are preliminary and the data is being used as a first step to determine if tef has any real potential as a rotation crop in the Lahontan Valley.

The demonstration trial was established in the Lahontan Valley on June 5, 2003. The purpose of the demonstration was to collect some initial data on survival and production of tef variety. The demonstration was 2.5 acres of tef planted for seed, 2.5 acres of tef planted for hay and 2 acres of Sudangrass planted for hay as a comparison. The plots were not replicated and no statistical comparisons were attempted.

The tef variety “Dessie” was used in both tef demonstration plots. The plots were preirrigated on May 31, 2003 and the field was dragged with a blanket harrow immediately prior to seeding to break up the surface crust and destroy any weed seedlings present. The tef seed grain plots were planted at a rate of 2.0 pounds/acre and the hay plots were seeded at 4.0 pounds per acre. The plots were seeded using a “gandy” fertilizer box, which dropped the seed onto a spinning platform, resulting in a seeding swath approximately 16 feet wide. The seed was spread evenly on the plots. The plots were rolled with a cultipacker immediately following the seeding operation. “Piper” sudangrass was seeded at 30 lbs/acre to compare hay yields.

The plots were irrigated on June 6, 12, 19, July 3, 10, 25, and August 15. A liquid formulation of nitrogen was applied in the irrigation water at 35 pounds actual nitrogen per acre on July 3 and 10.
Broad leafed weeds were treated with 2,4-D amine at 2 pounds acid equivalent per acre on July 7, 2003. Longspine sandbur (*Cenchrus longispinus* (Hack.)Fern) was present throughout the field but was not treated.

The seed harvest began on Sept 4, 2003. The seed were cut and windrowed using an older New Holland® swather without any crimping attachment. The crimper was removed to avoid dislodging seeds during the swathing operation. The tef and sudangrass hay plots were cut and conditioned with a Hesston 8400® swather.

The harvest from the hay plots was baled on September 7, 2003. The seed crop was harvested on September 8 and 9 2003 using a small Massey Ferguson® plot combine. The combine concave setting was closed tightly as possible and the cylinder speed was approximately 1000 rpm to avoid plugging. The air flow was set low to avoid blowing the tef seed out the rear of the combine.

**Results**

Plants on both of the tef grain seed and hay plots had emerged by June 13, 2003. The plant populations in both plots were excellent and met expectations according to Wayne Carlson of The Tef Company of Caldwell Idaho. No insect or disease pests were noted over the course of the growing season.

The grain seed yields were disappointing. The total gross seed yield was 646 pounds from 2.5 acres. The clean seed yield was approximately 71% of the gross weight or 461 pounds total clean seed.

Seed quality concerns are color, plumpness and taste. Seed quality was determined to be satisfactory in all areas.

Hay yields of the sudangrass and tef were nearly equal. Table 1 lists hay yields for tef and sudangrass. Both yields are much lower than expected. Normally, sudangrass hay will yield at least 7-8 tons/acre in the Lahontan Valley. Yields of tef hay in other trials in the U.S. have ranged from 1 to 6 tons/acre.

The quality of the tef hay and straw was determined after the crops were harvested. Samples from the tef straw and the hay were analyzed using standard wet chemistry methods in a commercial laboratory. The tef hay was cut when mature because total annual production was considered more important in this demonstration than cutting for quality.

Table 2 indicates the average quality obtained from the tef straw and hay in 2003.

The poor yields from the sudangrass, and tef seed and hay in this trial indicate some general factor that limited production. The plants were irrigated adequately and never showed signs of drought stress.

A stark difference in color between portions of the tef plots (hay, seed) was evident while the crop was growing. Large areas of dark green colored plants were scattered throughout the plots, which were uniformly light in color. Plant tissue samples revealed that the light colored plants contained excessive amounts of boron (173 ppm) and were deficient in zinc (14 ppm). They were low in sulfur and phosphorous. The dark colored plants were low in phosphorous and zinc. All other nutrients were present in sufficient levels. The light colored plants were smaller in stature, leafiness, and had smaller seed heads.

Soil sample results indicated very high levels of phosphorous and calcium and high levels of sodium from dark and light colored plant areas, respectively. Soluble salt levels were low. Both soils exhibited excessive pH with the light and dark colored plant areas reading 8.4 and 8.5 respectively. All other values were moderate to low. Excessive salts and sodium as evidenced by the presence of white soil crusts affected the lower ends of the test plots. The lower portions of the plots were dominated by saltgrass and no tef plants survived.

This demonstration is being replicated in 2004 on different soils to gain additional information on this potential crop.
Table 1. Yields of Tef and Sudangrass products 2003.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Hay Yields (t/ac)</th>
<th>Seed Yields (lbs/ac clean seed)</th>
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</thead>
<tbody>
<tr>
<td>Tef</td>
<td>1.6</td>
<td>184</td>
</tr>
<tr>
<td>Sudangrass</td>
<td>1.75</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 2. Quality of Tef hay and seed straw in 2003

<table>
<thead>
<tr>
<th>Crop</th>
<th>Crude Protein (100% DM)</th>
<th>Digestible Protein (%)</th>
<th>Crude Fat (%)</th>
<th>Fiber (%)</th>
<th>Ash (%)</th>
<th>Total Digestible Nutrients (%)</th>
<th>Nitrogen (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tef hay</td>
<td>11.55</td>
<td>7.39</td>
<td>1.85</td>
<td>27.00</td>
<td>8.94</td>
<td>53.72</td>
<td>1.85</td>
</tr>
<tr>
<td>Tef straw</td>
<td>8.72</td>
<td>5.58</td>
<td>2.17</td>
<td>28.83</td>
<td>7.87</td>
<td>54.35</td>
<td>1.40</td>
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