

# Pack 104, Item 14

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**Backgrounder on growing tef**

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**Introduction**

Ethiopians plant more tef than any other cereal, and produce and consume more tef than any other cereal except maize. Approximately five million Ethiopian households grow tef on about three million hectares of land. The scientific name of tef is *Eragrostis tef*, and the crop is believed to have originated in Ethiopia.

Tef accounts for approximately 15% of the calories consumed in Ethiopia. *Enjera*, made from tef flour, is a staple for most Ethiopians.

***Why is this subject important to listeners?***

Tef is an important crop in Ethiopia for several reasons:

* The crop performs better than other cereals where there is little moisture, and also in waterlogged conditions. It can grow in a wide range of agro-ecological zones and a variety of soils, ranging from acidic to alkaline soils and from heavy black to light red soils.
* Tef grain can be stored for a long period of time without being attacked by storage pests.
* Tef has never been seriously attacked by disease.
* Tef straw is one of the main sources of feed for livestock in many parts of the country. The straw is a nutritious cattle feed, and is used as a material to plaster houses.
* Both grain and straw fetch a high price and have potential for the export market.
* Tef is a relatively healthy and nutritious crop. It is gluten-free and contains more iron, calcium, and copper than other cereals.

***What are some key facts?***

Tef is the staple crop of most Ethiopians.

Farmers produce tef mainly for the market because the market is reliable and the price less variable and increases from time to time than other crops.

While tef is grown in all soil conditions, one benefit of tef is that it resists waterlogging, and is therefore also grown in waterlogged soils. It is also less affected by disease and not attacked by storage pests.

***What are the big challenges of growing tef?***

* Tef has a lower yield than wheat or maize. The average national yield is 1.5 tonnes per hectare, but the potential yield in suitable growing areas is close to 3 tonnes per hectare.
* Low productivity of the local varieties which are grown widely.
* Lack of varieties suitable for varied agro-ecological conditions.
* Tendency to lodging\*. Yield losses can be 20%-25%.
* Lack of appropriate row planter and other improved production equipment.
* Broadcasting seeds leads to poor yields.
* Weeding is labour-intensive and not always effective.
* Land and environmental degradation, depletion of soil fertility and high input prices reduce productivity.
* Late harvest and poor handling lead to shattering and loss of yield.
* Lack of suitable improved tools and equipment for post-harvest management.
* The absence of seed dormancy means that, if there is unseasonal rain after the crop matures and dries, it can start to germinate immediately, even after harvesting.
* Common threshing practices, whether by hand or using domestic animals on the ground, increase losses and decrease grain quality.
* Limited access to credit, absence of collateral. and high interest rates from micro-finance institutions.

***Is there misinformation about this subject that I should cover?***

Tef is the second-most popular cereal in Ethiopia, but has been historically neglected compared with other staple crops. The nutrient levels in tef are similar to other cereals, and exceed other cereals in iron, calcium, and copper than other cereals. But, until recently, there was a misconception that tef had low nutrient levels.

***Gender aspects of growing tef***

* In Ethiopia, an estimated 15% of households are headed by females, and married female farmers are engaged in all stages of farming from land preparation, planting, weeding, crop management, and harvesting, to threshing and storage.
* By its nature, tef is a labour-intensive crop and farmers currently use a high tillage frequency compared to other cereal crops grown in Ethiopia. Using improved technologies and good agricultural practices will increase yield and lessen the labour-intensity of growing tef, which will reduce the workload for women. Increasing tef yields and reducing labour requirements would raise the status of women-headed households and reduce their workload.

***Predicted impact of climate change on production***

* There are a wide range tef varieties that can adapt well to the changing climate in Ethiopia and, therefore, farmers face low risk when they access and properly implement expert advice and research based on the predicted weather.
* In some environments where farmers might face complete crop failure because of moisture stress, tef is a good substitute for failed crops and will produce some harvest. When long-season crops such as maize and sorghum do not perform well because of drought, pests, or diseases, Ethiopian farmers often plow the crop and re-sow tef.

**Key information about growing tef**

1. ***Suitable land and land preparation:***
* Tef grows best at altitudes of 1800-2100 metres above sea level with an annual rainfall of 750-850 mm and a temperature range of 10-27**°**C, but can be grown in areas up to 2400 metres above sea level with rainfall up to 1200 mm.
* Tef grows on a very wide range of soils, including the black cotton soils that are notoriously hostile to other crops, and in acidic soils where the pH\* is below 5.
* Tef is able to withstand wet conditions, perhaps better than any other cereal crop except rice.
* Tef fields are traditionally ox-ploughed two to five times a season, depending on the type of soil, level of weed infestation, and whether the soil is waterlogged. The reason for the high frequency of tillage is that tef seeds are very small and thus germination is difficult in heavy, unbroken soil. Repeated plowing also minimizes weed infestation.
* Heavy clay soils and high weed populations need more frequent ploughing than loam or sandy soils.
* Vertisols\* in waterlogged areas need more frequent ploughing to open drainage furrows. A farm implement called the broad bed maker (BBM) is recommended. In the absence of BBM, it is advisable to drain excess water by using the traditional furrow-making practice known in Amharic as *zikosh* or *shurube* and in Tigrigna as *metsinfaf*.
* Over the last 10 years, some farmers have successfully tried no-till methods for tef, so frequent tillage might have more to do with tradition than agronomy.
1. ***Seeds, varieties, and planting****:*
	* Most Ethiopian farmers use traditional/local varieties, which are available all over the country, but, since 1970, over 40 improved varieties of tef have been developed and released to farmers.
	* The two most important sources of tef seed are the formal “commercial” seed system and the “informal system”—farmer-saved seeds and seeds bought in the local market. Recently, a third source of seeds, the “intermediate seed system” was started by organizing trained seed producer groups. These groups produce certified seed, working closely with extension and research personnel and the regulatory body in collaboration with development organizations. The improved varieties which are most widely-grown and accepted in the country are Quncho, Cross37 (Tsedey) and DZ196 (Magna). Recently=released high-yielding varieties for high rainfall areas include Kora, Felagot, Tesfa and Negus; for low rainfall areas, Boset, Simada (Harsh Kolla) and Tsedey (Cross-37), and for cool highland areas Gimbichu and Dega Tef.
	* Ethiopian farmers broadcast tef seeds, mainly because the very small size of the seeds make row planting difficult. Farmers use 25-50 kgs of seeds per hectare.
	* Planting in rows has several advantages over broadcasting: it makes weeding easier, and reduces the seed rate to 10-15 kg per hectare, depending on the type of soil. Using lower seed rates for lighter soils and a higher rate for heavy vertisols of up to 15 kg per hectare uses fertilizer more efficiently, and reduces lodging. With the help of appropriate planters, a seed rate of 3–5 kg per hectare can be used.
	* Though research does not recommend the practice, farmers traditionally practiced moderate soil compaction to increase germination and suppress weeds. This is usually accomplished with domestic animals, and sometimes humans.
	* Tef can be drilled with 20 centimetres between rows at a depth of 2-3 centimetres depth. It can also be transplanted with 20 centimetres between rows and 10-15 centimetres between plants. Two to three seedlings are planted in each hill at a depth of 2-3 centimetres.
	* Seedlings can be transplanted at 3-4 weeks or when seedlings have 3-4 leaves, but grow better and yield more when transplanted at 20-21 days. The advantages of transplanting are:
		+ harvest is 2-3 weeks earlier than broadcasting or drilling and can bypass any unexpected shortage of rainfall at the seed-filling stage,
		+ improved, uniform, early, and vigorous growth,
		+ reduces seed rate, up to 250-400 g per hectare of seed suffice,
		+ can increase the number of productive tillers per plant,
		+ can increase the amount of straw,
		+ suitable for farmers who have no oxen and plough,
		+ reduces weed pressure,
		+ suitable for hoeing and side dressing urea.
	* The disadvantage of transplanting is that it is labour-intensive and it is difficult to transplant in a large field.
	* Tef matures in 45-160 days, depending on the variety and altitude. Very early-maturing types are ready to harvest in 45-60 days, early types in 60-120 days, and late types in 120-160 days.
2. ***Growing practices:***
	* In most parts of Ethiopia, tef is grown during the main rainy season (called *Meher*), though it is grown during the short rainy season (*Belg*) in some areas.
	* Tef is useful as a catch crop, and as a low risk and reliable crop to the farmers.
	* Tef is generally grown as a mono-crop. Under rainfed growing conditions, tef can fit into various cropping systems, including monocropping, sequential, relay cropping, double cropping, mixed cropping, and intercropping. Many farmers, particularly in the highland and mid-altitude areas of northeastern Ethiopia intercrop tef with oil crops and pulses, including sesame, safflower, and faba bean.
3. ***Soil fertility:***
* Low soil fertility is one of the major challenges in Ethiopian tef production.
* Traditional soil fertility management practices include using crop residues, manure, and intercropping or rotation with other cereal and legume crops.
	+ Commercially available fertilizers include NPS, NPSB, NPSZn, NPSBZn and urea.
* Fertilizer recommendations for tef production are:
	+ 40 kg ha-1 of N and 60 kg ha-1 P2O5 (phosphorus pentoxide) for light-textured red soils
	+ 60 kg ha-1 of N and 60 kg ha-1 P2O5 for vertisols

Based on these recommendations, the amount of urea fertilizer depends on the recommended and available source of fertilizer for P2O5 in the area:

* + - In areas where there is NPS:
	+ 157.89 kg NPS ha-1 and 89.13 kg urea ha-1 for vertisols and
	+ 157.89 kg NPS ha-1 and 45.65 kg urea for light-textured red soils
		- In areas where there is NPSB:
	+ 159.15 kg NPS ha-1 and 89.35 kg urea ha-1 for vertisols and
	+ 159.15 kg NPS ha-1 and 45.86 kg urea for light-textured red soils
		- In areas where there is NPSZn:
	+ 172.41 kg NPS ha-1 and 92.6 kg urea ha-1for vertisols and
	+ 172.41 kg NPS ha-1 and 4913 kg urea for light-textured red soils.
		- In areas where there is NPSBZn:
	+ 173.9 kg NPS ha-1 and 92.8 kg urea ha-1for vertisols and
	+ 173.9 kg NPS ha-1 and 49.34 kg urea for light-textured red soils
* All P2O5 should be applied two days after planting as NPS or a blend of NPS with B (Boron), Zn and BZn. But 50% of N should be applied 10-12 days after planting as urea, and the remaining 50% at the tillering stage 35 days after planting.
1. ***Weeds:***
* Because tef is grown in a wide range of climatic and soil conditions, it is exposed to a wide range of weeds that affect its production and productivity.
* The most important weeds in tef production are *Cyperus rotundus, Phalaris paradoxa* L. (called *Asendabo* in Amharic), and *Convolvulus arvensis* L*.* Witch weeds like *Striga hermonthica* and *Parthenium* species can also greatly reduce production. Yield losses because of weeds range from 23% to 65%.
* Weeding is labour-intensive, but is critical to getting a good yield. Hand-weeding is the most widely used practice.
* If weed populations are low, hand-weeding once before tillering stage (15-18 days after emergence) is sufficient. If weed populations are high, a second weeding should be done at the stem-elongation stage (25-30 days after emergence).
* In the absence of sufficient labour, herbicide recommended by research can be applied to protect against all types of weeds.
1. ***Pest and disease management:***
* Tef rust and head smudge are the most important diseases of tef, but diseases are not a serious problem.
* Crop rotation, using clean and healthy seed, early planting, and using early-maturing varieties can reduce disease infestation.
* Welo bush-cricket, known as *degeza,* is a major pest. Farmers can slash weeds in the field margins before cereals have headed, depriving the pest of food and reducing its population near crops. Early sowing allows tef to mature before the natural food sources of this pest mature, reducing pest populations and damage.
1. ***Harvest:***
* Tef is harvested when the leaves and stalks turn yellowish in order to prevent losses from shattering\*.
* Harvesting can be done in different ways: with small mechanical harvesters or with a traditional sickle.
* The small size of tef seeds and the tendency of tef stems towards lodging are major problems during harvests because it is difficult to use machines and manual harvesting is cumbersome.
* Pure whitish-coloured tef fetches a higher market price. So producing clean/pure seed can bring farmers more income.
* Farmers thresh tef traditionally on special flat ground called *awdma* which is usually plastered with cattle dung. The harvested tef is scattered over the *awdma* and cattle or pack animals are run over the harvested tef to separate the grain from the straw. This leads to contamination of the grain with soil and livestock waste and reduces quality. Winnowing tef in the wind to separate grain from chaff leads to grain loss and reduces the market value of tef.

**Where can I find other resources on this topic?**

*Note: There are very few online resources on growing tef which use non-technical language.*

*Online resources*

1. The National Academies Press, 1996. *Lost Crops of Africa, Volume 1: Grains*. Chapter 12: Tef. Pages 213-236. <http://www.nap.edu/read/2305/chapter/15#227>
2. Alemayehu Refera, 2001. *Tef: Post-harvest operations*. Institute of Agricultural Research Organization, Holetta Agricultural Research Center. <http://www.fao.org/3/a-ax445e.pdf>
3. Hailu Tefera, Getachew Belay, & M. Sorrels (eds.), *Narrowing the Rift: Teff Research and Development.* Ethiopian Agricultural Research Organization (EARO). Addis Ababa, Ethiopia. <http://www.etteff.com.et/Output.pdf> *Note: This document is the proceedings of a workshop on tef production and contains a lot of very useful information. But it is generally written in technical language. You might want to read the abstracts of the different workshop papers before reading the papers themselves.*
4. Bay, Kaleab. (2014). *Teff: Nutrient Composition and Health Benefits*. Ethiopian Development Research Institute and International Food Policy Research Institute, Ethiopian Strategy Support Program, Working Paper #7. <https://www.researchgate.net/publication/266316373_Teff_Nutrient_Composition_and_Health_Benefits>

**Key definitions**

* Lodging: When a plant, especially a cereal, cannot stand upright because it has been flattened or damaged by weather conditions, or because the stem is not strong enough to support the plant.
* pH: A number that represents the acidity or alkalinity of soil; 7 represents neutrality, lower numbers indicate increasing acidity and higher numbers increasing alkalinity
* Shattering: The dispersal of a crop's seeds after they ripen. Most crop varieties retain seeds for longer than non-domesticated plants, which makes harvesting them much easier and more effective.
* Vertisol: A clay-rich soil which forms deep cracks during the dry season.

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