
Disease-Resistant Tepary Beans Now Available

(We relied on the books *Tropical Legumes: Resources for the Future* by NAS, 1979, and *Food Legumes* by Daisy E. Kay, 1979, in preparing this note.) Probably the most frequent question ECHO receives from people working in the semi-arid tropics is, "It is so dry here! What plants can we grow with so little rain?" The tepary bean, *Phaseolus acutifolius*, is a promising crop for semi-arid to arid regions with infrequent but heavy rains and extreme heat.

This native plant of the Sonoran desert in western North America has been an important cultivated food of native Americans for over 5,000 years. When planted toward the end of the rainy season, tepary beans may receive sufficient moisture in a few heavy rains early in their growth to mature and produce quickly, even when conditions at the end of their life cycle are extremely hot and dry. Sometimes, when planted in recently water-logged soils of certain types, production is possible without any additional rain.

The countless landraces and local varieties vary widely in color, seed size, and growth habit, but most yield their high-protein crop just 60-90 days after planting. The leaves and young pods are a leguminous forage nutritionally comparable to alfalfa. Dried pods may also be fed to animals.

Plants are bushy to semi-vining on dry land, with more extensive vining and foliage growth when water is plentiful. The seeds and trifoliolate leaves are a bit smaller than in the common bean. Because they are extremely resistant to common bacterial blight, which affects other beans in the tropics, they are used in breeding programs to impart this resistance to the common bean *Phaseolus vulgaris*.

Tepary beans can thrive in areas with as little as 500-600 mm (20-24 in) rain per year, and seed production drops with over 1000 mm/year (40 in). Seeds are generally planted 10-20 cm (4-8 in) deep to utilize the lower water reserves. Plants often receive 3 or 4 irrigations in the early stages of growth. (Continued irrigation can actually lead to increased vegetative growth and lower seed yield). Teparies prefer well-drained soils and are fairly tolerant of alkaline or saline soils. They may mature more quickly at mid elevations than coastal regions.

Despite tepary bean's apparent potential to produce food quickly in semi-arid regions, not much attention has been given to research and improvement of this species by the scientific community. Some obstacles to introduction into new areas include disease problems (in climates where it is not adapted), sensitivity to some salty soils of semi-arid zones, poor productivity in humid regions, tendency toward short-day flowering, frost damage (nighttime temperatures must be above 8°C/46°F), unusually small and flat appearance of the bean, a sweet taste different

from the common bean, and long cooking time after long periods of storage. (According to Linda MacElwee of Native Seeds/SEARCH in Arizona, they can take up to 4 hours of boiling, even after soaking, if they have been stored for some time. Even fresh teparies can take longer to cook than many common beans.) Teparies may also cause flatulence and therefore are not recommended as food for babies under one year old.

Agronomists at the United States Department of Agriculture in Mayagüez, Puerto Rico, chose 11 cultivated lines from 70 accessions of tepary after evaluating and selecting under varying environmental conditions. They studied yield, seed size, protein and anti-nutritive factors, and resistance of each line to six diseases.

They found that tepary beans performed best and yielded more than the common bean under higher temperatures in dry regions. (Linda MacElwee says they will produce at 46°C/115°F.) The seed protein concentration for the tested varieties ranged from 17.8 to 26.8%, and anti-nutrients that interfere with protein digestibility were on average less than in the common bean. All lines were resistant to common bacterial blight and susceptible to the bean common mosaic virus, but the lines had varying resistance or tolerance to rust, ashy stem blight, bean golden mosaic virus, and Fusarium wilt.

The seeds supplied to ECHO are photoperiod-insensitive, virus-free, and selected for high yield and disease resistance; in addition, they may be more tolerant of excess rain than other tepary varieties.

We planted the tepary beans in our own semi-arid greenhouse as a trial. They germinated immediately and grew impressively well with none of the disease problems usually evident on tepary beans at ECHO (note: we do not send out the tepary seed grown at ECHO because of the risk of transmitting diseases common here). In two months, most of the varieties already have pods and continue to flower. There is quite a bit of variation in foliage produced, flowering time, and leaf size. We asked Dr. Phillip Miklas, who sent us with the disease-resistant varieties, the following questions on the potential of tepary beans:

Q. In what climates have you found tepary beans to outperform other beans?

A. Tepary beans are outstanding for hot climates, in some cases yielding over three times as much as dry beans when high temperatures cause common bean flowers to abort. They are well-suited to areas which suffer periodic drought. For example, in places which often, but not always, receive enough rain for common beans, you might plant a few plots of tepary beans as an insurance crop. However, in extremely rainy periods, tepary beans will produce a lot of vegetation, but very little or no seed.

Q. The seeds of the disease-resistant beans you supplied are smaller than the seeds we receive from Arizona. Can a grower select for larger seed and, if so, will that affect protein levels?

A. These are true-breeding lines of tepary beans; the plants produced should be genetically similar. It is not likely that you will find wide variation in seed size. Any selection of that nature, though, would not significantly affect other characteristics of the bean.

Q. Are the diseases observed in the study usually a major problem in arid to semi-arid zones, or are they primarily present in humid areas? Is there an advantage for people in extremely arid zones in using the selected disease-resistant varieties over other (larger-seeded) ones?

A. The diseases are present in many tropical climates. For example, common bacterial blight occurs mainly in hot, humid areas, and ashy stem blight occurs in hot, dry areas. One thing to remember is that the strains of each pathogen vary in each region; in other words, we were only able to select for resistance to the strains in our area, but different strains may be present in a new area.

Q. Do you have any comments concerning unique cultural requirements?

A. Fertilization should not be necessary. If you fertilize before the plants have emerged from the soil, nitrogen-fixing nodules may not form. So delay any fertilization until after the seeds have sprouted. [Tepary beans can nodulate with the broad cowpea/lima bean/Canavalia/mung bean group of rhizobia. Under very hot or dry conditions, the nitrogen-fixing bacteria will not persist strongly from one season to the next. In such conditions it may be best to inoculate the seeds.] It is very important with tepary beans to try them at different times in the season to determine their best "window" in the local climate. Do not give up on them if they don't succeed on the first try; planting again at a different time may produce better results.

Q. How easily can tepary beans be crossed with other local beans to impart disease resistance?

A. This is not possible at the field level.

Q. Are there other reasons why someone might want to grow tepary beans if they could grow common beans?

A. Tepary beans will often produce at a different time of year than other beans, when it is too hot or dry to grow common beans. In addition, they are an excellent crop for drought insurance in areas with occasional dry years; such areas may want to maintain a plot of tepary beans in case the common beans do not receive enough rain, for example. They may also be used as a green manure in some areas, although that is not their primary use now.

Q. Do tepary beans have potential as a green manure/cover crop for arid zones? (ECHO has heard of this in the Caribbean.)

A. Since tepary bean is a short-lived annual, it doesn't have as much potential as a cover crop as some other plants would. One of its great potential uses may be in an intercropping system with sorghum during the dry season.

Dr. Miklas has sent ECHO seed of these eleven varieties to distribute to our network. We have combined them according to color (white, grey, black, yellow-brown, and red). Sample packets are free to development workers. When ordering seed, please indicate the dry bean color preferences (if any) for your region.

We are very eager to hear how these varieties perform for you and are accepted in your area. Please note that people with year-round humid weather would probably be wasting their time with this trial. For example, we cannot grow tepary beans at ECHO in the summer.

