Grevillea Robusta Survives On Phosphorus-Poor Soil

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I [mlp] was surprised during a visit to Kenya by the extensive use in agroforestry of this tree that is a popular ornamental in Florida. Commonly called 'silk oak,' 'silver oak,' or 'grevillea,' this native to Australia has become widely utilized in agroforestry throughout Africa and other tropical regions, despite the fact that it is not a legume. We turned to ECHO's library for more information about the tree. The following comes from *Grevillea robusta* in Agroforestry and Forestry: Proceedings of an International Workshop [ICRAF; C.E. Harwood, ed.] except where noted. Grevillea was brought to Africa and India for use as a shade tree in coffee and tea plantations in the early part of this century. While these industries are now reducing their use of grevillea due to indications it may reduce yields of those high-value crops, the use of the tree on small-scale farms has become widespread. Grevillea is a tropical or subtropical tree suited for semiarid regions of 600 to 1700 mm annual rainfall and dry seasons up to 6 months. Grevillea trees are commonly found as windbreaks; interplanted with such crops as maize, beans, black pepper, bananas, potatoes, and cotton; or grown next to the home for wood and/or ornamentation. Grevillea grows straight and has fine foliage, giving a light shade. Growth rates of 2 m height and 2 cm diameter per year for the first 5 years are common on suitable soils; slower rates after 5 years are normal. Grevillea leaves add organic matter to the soil as they fall and decay (though see below for more about nutrients in the leaves). A special trait is its deep tap roots and few shallow roots, allowing crops to be planted very close to the trunk with minimal competition.

Grevillea wood is widely used for lumber, fuel, poles, and rafters. Trees over 30 years old are said to have the best wood, though younger trees are often cut. Trees grown in plantation systems usually do poorly compared to those in agroforestry systems. Once established, grevillea can tolerate severe pruning or pollarding, surviving repeated and complete defoliation and removal of branches for fuel, poles, or fodder. The leaves are used as fodder for animals in parts of Kenya; however, they are not of high quality. One farmer is reported as saying, "grevillea leaves do not increase milk production but keep the cows alive." The tree does not tolerate coppicing (cutting to the ground in expectation of regrowth).

The April-June 1996 issue of Agroforestry Today (AT) discusses new insights regarding another important trait, namely its ability to grow in soils that are lacking in available phosphorus. The article points out that capture of nutrients by a plant involves three steps. It has to find areas of the soil where particular nutrients are located; it has to have a mechanism to make the nutrients soluble so they can be absorbed; then, it has to transport them to areas of growth where they are needed.

"Exploration, exploitation and exportation" is how the article summarized these steps.

Nitrogen-fixing leguminous trees are usually the choice in agroforestry, but sometimes phosphorus deficiency in the soil may be as limiting or more limiting to plant growth than nitrogen deficiency. One way to observe whether the soil contains all the phosphorus a plant needs is to add phosphorus fertilizer and see if it responds with more vigorous growth. A wide range of trees has been screened in this way and almost all species respond positively to phosphorus, except *Grevillea robusta*. This suggests that in soil that has too little available phosphorus for most trees, grevillea is able to find phosphorus, make it soluble and absorb it for its own use.

Grevillea and some trees in the families Casuarinaceae, Myricaceae and Moraceae, have special root structures to capture nutrients. If phosphorus levels are low, they can produce "cluster roots." These root structures live only about 3 months, and do not have root caps.

Do the root clusters form when the root encounters phosphorus? Apparently not. When roots are grown in nutrient solutions lacking phosphorus, these cluster roots develop at fixed distances along any lateral root, so there is probably some internal signal from the plant to start making root clusters to locate and absorb phosphorus. The clusters exude citrate, which is known to help mobilize iron phosphates for use by a plant. The end result is that grevillea can grow in some of the poorest soils in the world, especially where phosphorus is limited.

Does this mean that grevillea leaves make an especially good soil ammendment because they contain high amounts of phosphorus? This question is answered in the OctoberDecember 1996 issue of AT. Analysis of grevillea leaf tissue shows very low levels of nitrogen and phosphorus compared to many tree species. Apparently its adaptability to soils low in phosphorus is due not only to its ability to mobilize existing soil phosphorus but also the ability to maintain a high photsynthetic rate even with low tissue nutrient levels. One species with higher leaf-phosphorus levels (O.3% vs. 0.06% in grevillea) is *Melia volkensii*, indigenous to Kenya. Another plant with high leaf phosphorus content is *Tithonia diversifolia*, a weedy shrub native to Central America but found in most tropical regions [we recently learned that Tithonia is being used in agroforestry research at ICRAF].

If you cannot find grevillea seeds in your region and would like a small packet of seeds for experimentation, they are available from ECHO's seedbank. Trial packets are free to those working with small farmers in developing countries.

http://edn.link/ehn4a4