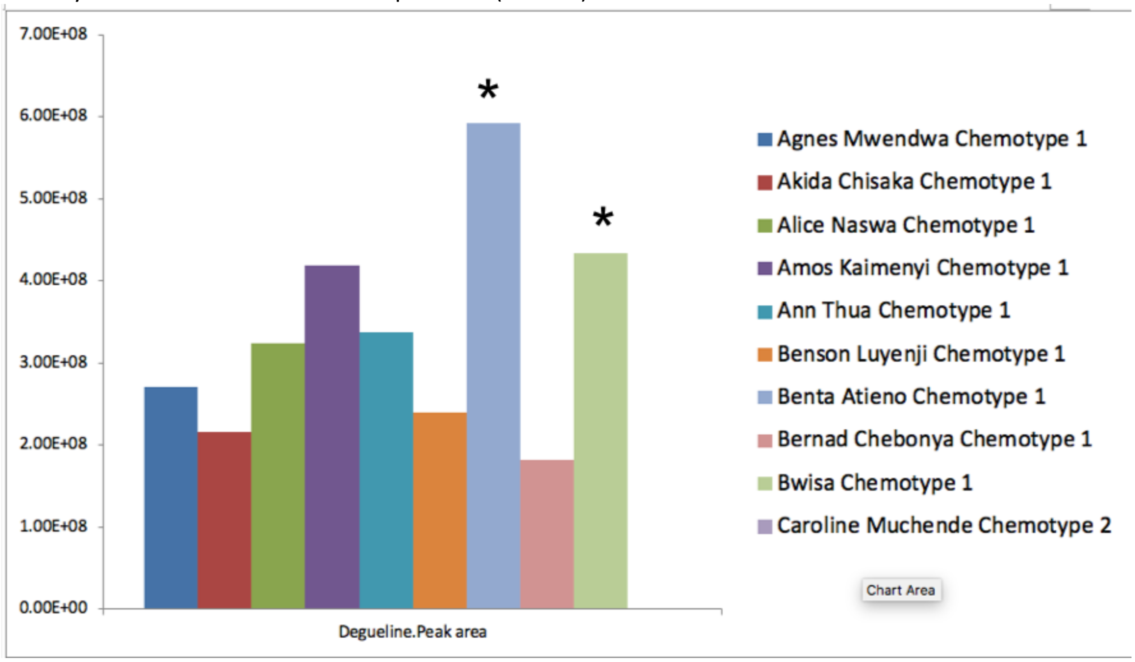
Practical issues and actions related to the Tephrosia FRN

1. *Seed multiplication of effective chemotypes at Manor House*
The AE Hub is a seed source for effective Tephrosia chemotypes. We're multiplying seed from farmers whose sample tested positive as chemotype 1, as reported at last year's CoP. We are bulking seed from Benta and Bwisa, two farmers who had the highest levels of deguelin (the active ingredient) in our sample set (Figure 1).

Figure 1: Provenance and relative abundance of deguelin in sample plants collected in Kenya, including those used by Manor House for seed multiplication (starred).



In 2019 we planted around 100 seedlings of Bwisa (Figure 2). In 2020, we planted more than 600 seedlings of Benta. Please contact us if you need seed for your farmers. We are selling at a fair cost.

Figure 2: Shiundu showing the Tephrosia seed multiplication at Manor House, January 2020.

2. Developing a farmer-friendly assay to discriminate between effective and ineffective types

The sampling we did in 2019 confirmed that there's a mix of effective and ineffective chemotypes in the western Kenya region. Unfortunately, it's not possible to tell if a plant is Chemotype 1 (effective) or Chemotype 2 simply by its physical appearance. Hence, we've been keen to develop a simple procedure that farmers can follow to determine the chemotype status of Tephrosia already established on a farm.

A suitable assay will target pests that are ubiquitous on smallholder farms, be easy to use and give repeatable results. We discussed the assay at CoP1 with the Botanicals team. We agreed on a protocol for testing against bean bruchids in stored grains. However, after trying this practically ourselves, we felt it didn't give clear enough outcomes to use with farmers. The biggest issue was getting reliable/accurate counts on the numbers of bruchids killed by the treatment. Some may fly out when you open the container to do the counting, messing up the number recorded as being introduced at time 0. Others, played dead (a common beetle behavior) at the bottom of the container. We'd have to move on to another container and then come back to check if the immobile ones had moved. Given we were doing the evaluation using multiple containers (treatments plus replicates), it became a challenge for us to get good counts, and there was always some nagging uncertainty whether an immobile individual was actually dead or not. Another possible issue had to do with our beetle cultures. We were raising the beetles on beans in containers in the lab. Normally, when an experiment like this is being done by scientists in a lab, you'd introduce young adults from the same age cohort into the test containers. But in our case, which would be more similar to farmer conditions, we used beetles from our mixed age beetle culture. Thus, the natural mortality of older adults was also another potentially confounding factor, even though we had an untreated control, due to the counting issues already detailed. All in all, we concluded that the bean bruchid assay was too problematic to be an easy and reliable assay that would work well for farmers.

We have been investigating alternative assays including ticks killed on livestock and treatment against poultry ecotoparasites.

3. Drying and processing the leaves for use as a pesticide

Both infestation by mold and exposure to direct sunshine degrades the pesticidal compounds in harvested leaves. Hence, to maintain quality, once the leaves have been harvested, they need rapid drying in the shade. We found a photo of a dryer made by a group of Honduran coffee farmers that looked good, and a local artisan who could copy it. It's made out of welded lightweight metal tubing, rather than wood, so we can move it if need be (Figure 3). It's extremely effective but expensive, unless several farmers collaborate on the costs, as was the case with the Hondurans from whom we got the design. Check out the Botanicals FRN page to see if they showcase the more economical versions made by their farmers.

Figure 3: Locally fabricated structure to facilitate shade drying of pesticidal plants.

Once the leaves are dry, and before they can be used for making pesticidal sprays, they need to be processed into powder. It might be possible, though not easy, to pound small amounts of leaves into powder with a mortar and pestle. But for large quantities we needed an alternative.

Local artisans make simple residue choppers for turning crop residues into livestock feed. These machines, which cost several hundred dollars, have been purchased by Botanicals FRN groups for their farmers' businesses. One of the Manor House workers had a machine and let us use it (Figure 4). He was also able to make a screen so that the machine ground the leaves into fine powder, as required.

Figure 4: Left: Local residue-chopping machine that was able to grind the dried leaves to the desired consistency. Right: Resultant leaf powder being added to a container for making a pesticide solution.

4. Increasing leaf production

In their instructional videos, the Botanicals project recommends using a 10% solution for reliable pest control. We needed to control aphids in our vegetable biofertilizer experiment, and when we prepared it according to their instructions, we were shocked at how much powder 1 kg actually is (Figure 5). It raised the question whether farmers could produce sufficient leaf materials for even a fraction of their pest control needs with a couple of plants. The 1 kg was the amount of leaf harvest from very many plants.

Figure 5: Quantities of Tephrosia leaf powder: Left: mass- 1 kg of Tephrosia powder, the recommended rate for mixing with 10 L water to make a 10% solution; center- volume- amount of leaf powder that fills a 1 kg container; right- 2 common metal tea cups full of Tephrosia leaf powder.

This begged the question as to how smallholder farmers could produce sufficient powder to meet pest control needs, considering that they could potentially be using it for treating maize for stem borers, vegetables for aphids and caterpillars, livestock for ticks and poultry for ectoparasites and disease prevention. Currently we have a Hub farm trial in progress to assess different ways of managing the plants to encourage more leaf production per plant and/or per unit area. We'd like realistically assess a realistic number of plants for a farmer with one acre, given the most promising uses.