Informationsblätter

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Diversität

Enset research in Ethiopia

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Background

Enset, the botanical species *Ensete ventricosum*, has been utilised as a crop in Ethiopia since ancient time. Everyone who has been in Ethiopia has seen enset plants: they are the large banana-look-alike plants (Figure 1, next page) that are grown in groups in parts of countryside and there are often one or a few plants in gardens around the country, also in Addis Ababa. Enset is a multipurpose crop: food (from pseudostem and corm), fodder (leaves and residues), fibres (pseudostem and leaves) and traditional medicines (different landraces and different parts of plants). However, despite its close relation to banana, the fruits are not consumed: enset fruits are full of large and very hard seeds, with only little fruit flesh between. Enset propagation, management and food processing techniques rely on indigenous technical knowledge of farmers.

Enset grows readily in different agro-ecological zones of Ethiopia and established plants, holding large amount of water, withstands extended droughts. It is recently reported that it is the most efficient crop grown in Ethiopia regarding amount edible yield per time and area unit. In enset agriculture, plants grow for about 3-6 years and are planted and harvested individually – the field is never left bare. Therefore, the soil and local environment benefit as from any perennial crop: avoiding erosion and keeping nutrients and moisture. Similar to forests, enset can be regarded a carbon dioxide sink, since the root system is extensive and remain in soil for long after harvest.

The enset plant is not a tree according to botanical definition: the corm (underground) is the botanical stem, anchored by the extensive root system. The apical meristem, where new leaves develop (as in the top of a tree), are in the top of the corm and therefore well protected against drought or heat. The root system grows around the year, and the fine roots grow most during dry season, showing enset's capacity to utilise its stored water to grow and collect more water when needed. The pseudostem is formed by dense layers of leaves sheaths, and the blades spreads in top of it (Figure 1, next page), with the youngest leaf always in the centre. When the plant has reached certain size or age it will flower. The flower stalk emerges from the apical meristem, stretches through the pseudostem and appears in the centre of the leaves (Figure 1, next page). It takes several months from the first observed flower to mature fruits. When plants are harvested for food production, they are usually harvested at the onset of flowering, which gives the highest yield.

As food crop, enset has values similar to potato. For a balanced diet, it should be combined with protein and different vitamins, which is facilitated by the fact that enset is suitable for intercropping with for example peas and beans; agroforestry with enset is one established farming system. The most common enset food product, kocho, is fermented pasta from pseudostem and corm that benefits from the same characteristics as sourdough bread and other lactic-fermented foods: inhibits growth of pathogenic bacteria, extends product shelf-life while ensuring consumer safety, and the perceived quality even increases during storage.

Given all the above mentioned positive sides of enset agriculture, it is logical to ask why the practice is not more common and established in larger area. One reason is the limited possibility to get agricultural advice for enset, while annual cereals are given much attention and are subjected to extension programmes. Further, as there has not been genotype improvement such as con-

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scious breeding of enset, farmers use the same landraces as always. Recently, ARC (Areka Research Centre; the national centre for enset research) selected six of the landraces for different agronomic performances and released as cultivars. Since enset is utilised as a crop only in Ethiopia, there is little possibility to utilise findings from other parts of the world, and the research on agricultural practice and development has been limited. Our aims are to contribute with findings relevant for direct implementation in production and to establish knowledge for further improvement of the crop.

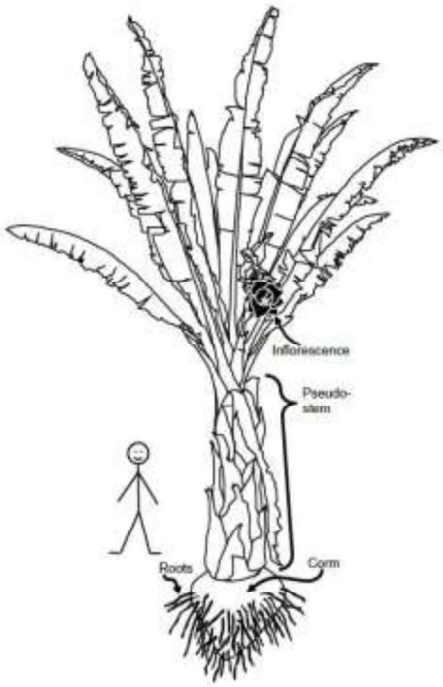

Figure 1. Mature Enset plant. The corm (the botanical stem) is underground, the pseudostem is layers of leaves sheaths with the youngest leaf in the centre and the inflorescence (many small flowers at base of the bracts, the bracts looks like one large flower) on a long flower stalk emerging from the corm. Drawing: Laila Karlsson.

Experiments

In 2010, together with Ethiopian colleagues Dr. Tamado Tana (Haramaya University) and Mikias Yeshitila (ARC) we established an enset research area at Wolaita Sodo University campus (N 06°50'00", E 37°45'07", 1882 m a.s.l.), about 300 km south of Addis Ababa, in a region where enset is traditionally grown as food crop. A ca. 25×25 m plot was protected from animals, especially porcupines, by fence (150 cm high, 25 cm into soil) and ditch 50 cm wide and 30 cm deep.

Sprouts from corms

The traditional way to propagate enset is to take a corm, cut off the apical meristem and bury it in the soil. The corm will react in the same way as a pelargonium that got its tip cut off: it will produce side-shoots. Each such enset shoot can be planted separately and become a new plant, having the same genome as the parent plant, since the propagation is a way to clone the original plant. From ARC we got corms from the six released cultivars: Endale, Gewada, Kelisa, Mesena, Yanbule and Zerita. When farmers plant the corms they use different methods, and all farmers claim they use the best method. Therefore, we wanted to compare three common pre-treatments of corms.

The studied pre-treatments were to keep the corm entire, part it in halves and part it in quarters (Figure 2). Each corm also had the apical meristem removed, and three corms to each pre-treatment of each cultivar were used. Holes were dug 40 cm deep and 50 cm in diameter, refilled with 10 cm softened top soil, the corm thereon and above it 15 L of 50/50 % mix of dry cow manure and soil, then levelling with remaining soil and dry grass on top for shade. After 50 days, with only very little rain, sprouts begun to emerge.

Figure 2. Zemach Chelo (research technician) with enset corms parted in halves or quarters before burial for sprout production. Photo: Laila Karlsson.

Since farmers have told us that it is impossible to water on planted corms, they say they will rotten, we wanted to test that. In addition to the above procedure, we used nine corms of one cultivar (Zerita) to repeat the study with the same pre-treatments and planting procedure but in addition water each corm with 5 L of water every day until rainy period.

At planting it was dry period (January) and very little rain came until late April, when all corms had sprouted with at least one new shoot. The sprouts were allowed to grow attached to corms during the main rainy season, until mid-October. At that time, there were many and large sprouts (Figure 3).

Regardless of pre-treatment and cultivar, the seven largest sprouts from each corm had an average circumference of 28.7 cm nine months after burial; thus, they were really large plants after short time. The results showed that shoots from corms parted in smaller pieces emerged sooner (average 61, 70 and 85 days for first emergence from corms parted in quarters, halves or kept entire), and had more sprouts (average 80, 66 and 26 for corms parted in quarters, halves or kept entire). The drawback with parting corms in smaller pieces is if there is unusual prolonged drought, since an entire corm will keep its moisture better.

Figure 3. The authors with 4405 enset sprouts from 63 corms, nine months after burial and six months after sprout emergence. Photo: Getachew Kefita.

The watered corms did not rotten; instead they emerged earlier (average over the three pre-treatments were 62 days compared to 73) and the sprouts were more equal-sized (standard deviation 1.5 dm^3 compared to 2.2). Thus, if a farmer has access to a water source, planted enset corms can, without any risk, be given water if unexpected prolonged drought occurs after corm burial for propagation.

The sprouts were larger than expected, and farmers were amazed. Sprouts of different sizes were planted individually, and there were clear correlation between planting size and plant size even after three years of growth, showing that it is beneficial to achieve large sprouts initially.

New genotypes from seeds

Cross-fertilisation, seed setting and germination is the way nature achieves new genotypes, and among these new seedlings the most suitable in the present environment will give most offspring to the future. This has been utilised for conscious breeding since the rise of agriculture 10,000 years ago, and could also be used to develop new enset cultivars. Since enset is usually propagated through cloning, before seed set, it is necessary to make agreement with individual farmers to keep certain plants until seed maturation and to search for wild plants with mature seeds. This study was done to get knowledge on seed germination and seedling growth.

To study seed germination and growth of seedlings, seeds from eleven enset plants, wild and cultivated, were collected. The seeds have very hard seed coat, and they are impermeable to water except at thin channels at one side of the seed. We included several physical and chemical treatments known to weaken different kinds of seed coats, but none of these had any positive effect on germination. Thus, the water uptake through the thin channels should be the natural way before seeds germinate. When we placed seeds on moist sand, germination varied from 5 to 55% for seeds from different mother plants, with no significant difference between wild and cultivated origin. More research is needed to investigate if there is possibility to get higher and even germination percentage or if the germinability is naturally low and varied.

For the germinated seedlings, growth was very efficient (Figure 4). They grew well in natural local soil but growth was enhanced if given manure as for corm burial.

Figure 4. Enset seeds, newly germinated, three week seedlings and 21 months after germination with inflorescence, and the authors. Photo: the authors.

Conclusions and future research

The experiments with propagation from corms show clearly that knowledge of great importance for smallholder farmers can be achieved without advanced research techniques.

The results of corm pre-treatment and watering are directly useful and can be communicated to farmers, and there is a brochure in Amharic that can be used by agricultural advisors. Further studies should be done on details in amount of manure and to what extent digging large and deep hole is required, but currently the advice to follow our method is useful. Probably the large sprout sizes were connected to the fact that we put effort in digging large holes and put back softened soil for the corms to sprout into (the soil is naturally quite hard and compact) and that we placed dry manure direct in contact with the corm; the belief among farmers is that this will cause rotting and they put instead soil on corm and manure on soil surface. However, we used dry, pulverised manure and mixed with 50 % soil, which should allow the new developing roots easy access to nutrients and thus favour strong growth without risk of causing rotting.

More research is needed on germination, and it is also needed to study flowering, pollination, fertilisation and seed set to be able to deliberately cross between genotypes in a desired and controlled way. However, it

shall not be forgotten that there are already six registered cultivars (selected from old landraces and very suitable for kocho and other uses) and many additional utilised landraces. However, as for all crops it is important to not lose the natural gene pool, and by utilising the variation existing among wild plants for crossing with selected landraces, it should be possible to increase the number of cultivars to choose from in the future.

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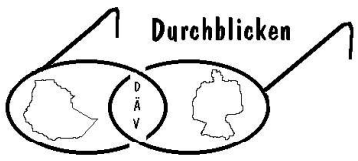

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