Coffea Arabica Propagation Fact Sheet

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Introduction

Coffee was accidentally discovered over 1400 years ago in Ethiopia, and ever since then, it has grown to be the second most desired commodity in the world, with an industry that is worth more than $100 billion (Menke 2018). The original Arabica tree was a shade-loving tree. However, over years of breeding the tree, a bunch of varieties resulted with coffee plants that provided higher yields in full light. Arabica is grown in tropical regions usually within altitudes of 1000-1500m. Better quality coffee crops have been associated with plants grown at higher altitudes. Coffee plants prefer wet climates, and annual rainfall needs to be within 1200-2000mm.

Arabica is not cold tolerant and does not survive any frost. The minimum temperature that the plant can tolerate is 4-5°C. The ideal temperature range for Arabica cultivation ranges from 18-25°C. After the first rainy season, the trees will flower and then the maturation of cherries begins, requiring 5 months of dry weather to have a successful harvest. Arabica prefers well-drained soils that are deep and not compacted, and are plentiful in organic matter. The[(grow it in vermicompost?!?)] organic matter is important as it buffers the crop against fluctuations in available moisture and nutrients. The optimum pH range is from 5.4 to 6.0. The Arabica coffee plant is part of the *Rubiaceae* family, which contains over 70 different species! However, only Arabica and Robusta are the two species that are grown on a commercial scale (Kuit 2004).

Propagation Methods

Seed propagation

Propagation for Arabica is usually done by seed. An example of a traditional method for propagation by seed is to plant 20 seeds with each hole in the soil sized 3.5 x 3.5m at the beginning of the rainy season. Half of the seedlings are eliminated naturally due to different causes. The remaining seedlings are bred for their hardiness and disease resistance. Another technique is to raise seedlings in shaded nurseries. At 6-12 months old, the seedlings are taken to fields, hardened, and then planted on contoured fields 2-3 m apart in 3-5 m rows. The holes

are prepared 40 x 40 x 40 cm, and 4 seedlings placed in each hole. Sometimes the plants may be shaded by taller trees or left unshaded. In addition, coffee is often intercropped with food crops, such as corn, beans, or rice, during the first few years. Weed control is often intensive and necessary throughout the entire season.

Other maintenance in some areas includes pruning the coffee plants, to prioritize the growth of healthy leaves and cherries. Mulches and green manure are commonly used with chemical fertilizers coming more and more into use. A typical application consists of 175 g N per bush, 100 g P, and 175 g K. P and K added in two applications and N added over a longer period with 4-5 applications (Duke 1983). Keeping young plants in shade promotes leaf and shoot growth, but may result in less root growth. For Arabica plants, strong root buildup is essential for long term yields. Furthermore, as the plants mature keeping them in shade usually reduces yields, so they are grown in full light. (Duke 1983).

The *Catmior* genotype is one of the more desirable genotypes among growers. Careful selection of seeds is crucial to the successful propagation of the desirable species. A rule among growers is to only take seeds from mother trees planted between 1993 and 1995 because they are clones of a mother tree. After 1995 the species began to vary due to uncontrolled breeding and cross-pollination. There is also a preferred part of the tree to pick the cherries from. Cherries from the middle part of the tree are considered preferable over those from the bottom and top part of the tree, as these cherries developed in a shaded environment, which leads to better quality cherries and seeds.

The process for selecting seeds and propagating new trees from seeds is a long and complex process. The first step in seed propagation is to put all the cherries that are harvested in water and skim the floaters from the surface. Any cherries that are still green and not as ripe are removed and discarded. The cherries are squeezed until the beans pop out, then the beans are sorted and go through a pulping process. Final cleaning of the seed parchment is done by fermentation. After the beans ferment they are washed repeatedly and then they are dried in sunlight, but growers have to be very careful as direct sunlight is often too strong and overheats the seeds. Then for the next few days, the beans are intensely rotated so that they all dry evenly.

At around 25% moisture content the drying is finished and the seeds are ready to be stored. Then the seeds are then stored in a ventilated place at room temperature to avoid fungus development. To avoid pathogens, the seeds may have fungicides apply (Kuit 2004).

Vegetative propagation

Coffee Leaf Rust is a very contagious fungus that affects coffee leaves. It infects the stomata of coffee leaves and then spreads by physical means. It has been found that the splashing rain droplets on the leaves are an important means of local dispersal of the fungus; therefore, during the two rainy seasons per year, there are two peaks of coffee rust (Arenson 2011). One common propagation is the combining of Arabica and Robusta. Growers will choose to graft an Arabica scion onto a Robusta rootstock because the Robusta roots tend to be deeper and contribute to the plant's drought resistance. Also, the Robusta rootstock is resistant to attack from nematodes, which is another benefit of this combination. However, there are many different factors that affect each of these species, so growers are still experimenting with this combination at different climates, temperature, and soil types ("Grafting Arabica Scion onto Robusta Rootstock").

Tissue culture

Some experiments have studied the growth of callus cultures from stem segments of coffee plants, as well as the caffeine production from tissue culture of Coffea arabica. The dry weight of the subcultures exponentially increased within 12 to 13 days. The formation of caffeine is closely related to the increase of callus dry weight, which results in a fairly constant production per unit of dry weight. It was noticed that when the tissue caffeine concentration exceeds the limit of 900–1000 μg/ml tissue, both the callus growth and caffeine formation were inhibited. This then suggests that the synthesis of caffeine synthesis is connected with the growth processes. (Frischknecht 2009)

Micropropagation can be an efficient method for multiplication of individual lines from segregating populations for a perennial crop like coffee. Certain hybrids such as the *F1* Arabica hybrid which was grown in Central America yielded 25 to 30 percent more, due to a combined

resistance to various diseases, pests, and nematodes. Currently, large scale propagation on an economically feasible scale is being sought after The goal is to use somatic embryogenesis as a means to reproduce valued plant material that is all around resilient and hardy. One of the most popular hybrids was discovered in the Timor Islands as a naturally occurring hybrid called Hybrido-de Timor (HDT), a combination of Arabica and Robusta that is highly resistant to Coffee Leaf Rust fungus. There are many more combinations that are being tested because the coffee industry has realized that the impacts of human-caused climate change are impending and will dramatically affect the coffee yields unless more resilient plants are successfully bred.

Sources

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