The Coffee Manual

A guide to sustainable coffee farming in Northern Thailand

Interactive Qualifying Project (WPI)

&

Interactive Science and Social Project (Chulalongkorn)

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Chapter I: What Is This?

This booklet is a guide to promote sustainable coffee production, processing, and marketing in Northern Thailand, where hill tribes grow Arabica coffee. The booklet is not a tool to educate farmers on appropriate methods and practices, but rather a tool to facilitate such.

Providing knowledge and resources to rural farmers so they can successfully produce and sell coffee independently coincides with the mission of the **Raks Thai Foundation**, the sponsor. One of this organization's goals is to work with underprivileged communities to help with challenges they face. This includes developing skills to help achieve a sustainable living and source of income.

The booklet is a result of a social project by students from the **Chulalongkorn University** (Thailand) and from the **Worcester Polytechnic Institute** (USA).

raks thai
Foundation

WPI

Chulalongkorn University

Chapter II: Coffee in Thailand

Coffee is one of the most popular beverages; consumed by millions of people on a daily basis. It is one of the most important commodities worldwide and ranks second, only after crude oil, among all commodities today. About 60 tropical and subtropical countries produce coffee extensively. For some of the countries, it is the main agricultural export product (Esquivel and Jimenez, 2012).

In Thailand, the Royal Project introduced coffee as an alternative crop to opium in 1972. After extensive research conducted by the Royal Hill Tribe Assistance Project, it was decided that Northern Thailand's colder weather and higher altitude was ideal for growing Arabica coffee (Angkasith, 2001). Since then, it has dramatically contributed to the income of many communities in the North of Thailand.

Chapter III: Coffee Production

Planting

The first step in the coffee production is planting. There are three (3) methods of planting coffee:

1. Direct Sowing (introducing the seeds directly to the soil)
2. Sowing in a seed-bed and transplanting to the soil
3. **Sowing in a seed-bed, transplanting into a nursery and then introducing the young plant to the soil. (Recommended)**

- Seeds should be planted with the crease facing down, and covered with a thin layer of soil.
- Only seeds from coffee plants free of any disease should be used.

TIP: Only plant seedlings with straight tap-roots.

- When transplanting young plants to the soil, they should not be planted deeper than the depth at which they have been growing in the nursery.
- Coffee plants should be planted after 6-12 months in the nursery (preferably in the beginning of the raining season).
- To protect young plants' roots when transplanting, their roots should be dipped in mud.
- Planting fruit plants (plums, bananas, etc.) around coffee trees provides shade, and protects the coffee trees and the beans from being blown away by regular winds. **(Recommended)**

TIP: It is better to grow coffee in tree shade, because coffee grown directly in the sun requires more pesticides and fertilizers.

Mulching

Mulching is the process of protecting the soil underneath a plant with vegetative material.

- The best materials are **dried grass and dried banana leaves**.
- Mulching should be done during the beginning of the raining season.

TIP: Adding dry leaves and grass (mulching) underneath coffee trees preserves moisture in the soil during the hot and dry months. Additionally, weeds do not grow as much when covered by mulching.

Weeding

Weeding is the process of removing small plants and grass (weeds) that may grow around the coffee tree and compete for its resources.

- **Weeding should be done throughout the year.**

Watering

- Watering is mainly done to young plants after the raining season.
- **Each plant should be fed 5-10 liters of water per week during the dry season**.
- As each coffee plant gets older less watering is required.
- In more **wet and humid areas less watering is required, as the soils tends to be moist**.

TIP: For the coffee trees planted on the side of mountains, trenches should be dug to allow the collection of water.

Pruning

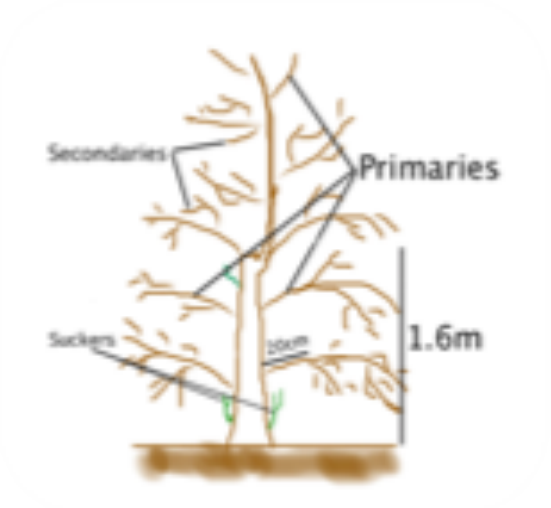
Pruning is the practice to cut or remove branches from a tree.

- Maintain a **single stem system for the first year plants,** to avoid competition from suckers.
- In the third year when trees are capable of producing good cherries, **cut the main stem to a height of around 1.6m-1.8m from the ground. (Recommended)**

TIP: The height of 1.6m-1.8m allows the tree to yield the most berries, and allows farmers to pick up cherries more easily.

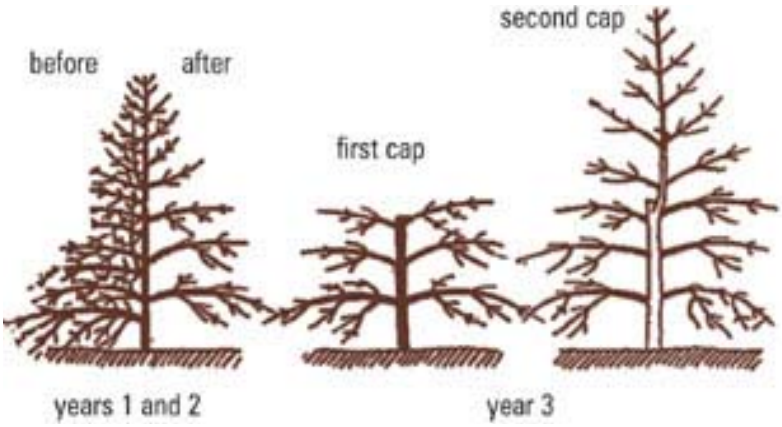
- **Remove secondary branches within approximately 20cm of the main stem. (Recommended)**

TIP: By removing secondary branches around 20cm from the main stem, allows farmers to pick cherries easier, and prevents some pests to spread to nearby branches.



- When one branch is no longer producing as much as the other branches, it should be removed (after harvesting) and let one new primary take place.
- **Pruning should be done after the harvesting period, and the pruning should be done with a saw (to leave a clean cut).**
- De-suckering should be carried out several times through the year.
- All cherries produced by trees either in their first or second year should be completely removed.

TIP: Cut branches so that the tree is shaped like a small bush, so that cherries can be easily collected.



Composting

- Pit Composting is advisable because it is effective, cheap, and easy to set up.
- **Three (3) pits should be dug out for a 45 days decomposing cycle.**
- The compost material should be passed from pit to pit every 15 days. (From the third pit it is ready to be used on the fields).
- The Compost after 45 days should look dark brownish like the soil.
- The layering should be the following:
    - **Wood materials and other heavier and hard to decompose materials should be placed in the bottom.**
    - **Easier to decompose materials (like fruit and vegetable peals, plant leaves, animal manure, and coffee shells) should be placed on the top.**

This picture shows the first step of the decomposing cycle, after 15-days it will be moved to the next pit.

- Water should be added during layering, to increase the moisture level, and the **pits should be covered with soil**.
- **The compost should be applied underneath coffee trees in beginning, middle, and again in the end of the raining season.**
- The following portions should be used (if not using fertilizer):
    - Year 2: 0.7 kg/tree
    - Year 3: 1.0 kg/tree
    - Year 4: 2.0 kg/tree
    - Year 5+: 2.5 kg/tree

TIP: Compost should be used more regularly than fertilizers, and farmers

Fertilizer

- In addition to compost, which is an organic fertilizer, farmers may add inorganic fertilizers to improve productions.
- **Inorganic fertilizers should only be used after manure and compost**.
- Generally fertilizers are **applied 3 times a year (during the beginning of the raining season, in the 7th month, and again in the end of the raining season**).
- Coffee trees need good nutrition especially during the berry season expansion stage (usually 2 to 3 months after flowering).
- **The portions for coffee plants (if no compost used) should be the following:**
    - Year 1: 100 g/tree (**50% NPK 15-15-15 and 50% NPK 46-0-0**)
    - Year 2: 200g/tree (**50% NPK 15-15-15 and 50% NPK 46-0-0**)
    - Year 3: 300g/tree (**50% NPK 13-13-21 and 50% NPK 46-0-0**)
    - Year 4+: increase the dosage every year by 100g/tree (**50% NPK 13-13-21 and 50% NPK 46-0-0**)

TIP: For the Northern Areas of Thailand Farmers should buy the following: **NPK 46-0-0 (urea), NPK 0-0-60 (potassium chloride), NPK 18-46-0 (di-ammonium phosphate), *and* NPK 13-13-21.**

Recipe for NPK 15-15-15 (used for production of fruit plants):		
42% NPK 18-46-0	**26% NPK 46-0-0**	**32% NPK 0-0-60**
Recipe for NPK 13-13-21 (used for agricultural plants):		
36% NPK 18-46-0	**21% NPK 46-0-0**	**43% NPK 0-0-60**

*Percentages are based on weight measurements.

All the mentioned fertilizers dosages are recommended by the Agriculture Research Center of Chiang Rai; therefore they are appropriate for the cold and humid areas of the North.

- **If compost is being used at the same time as fertilizers, the quantities as well as the frequencies mentioned above should be reduced, depending on each farmer. (Recommendation: try on a sample of plants first to determine appropriate dosages).**

TIP: Do not store fertilizers in the same area as coffee beans.

Chapter IV: Coffee Processing

Harvesting

Harvesting is the process of collecting ripe cherries.

- The quality of the coffee can be seriously be affected by how the cherries are picked and dried.
- Farmers should **only pick the mature red cherries,** and should leave the greens ones to ripen in the tree.
- **Cherries should not touch the ground at any circumstance. Similarly, cherries on the ground should not be picked up.**
- It is ideal for farmers to use a tarp (or any other material that would avoid contact between the cherries and the ground) under the tree while harvesting, so that the cherries do not touch the ground.

TIP: Sort the cherries according to sizes, prior to the next step (Pulping).

Pulping

Pulping is the step where the skin of the coffee cherry is physically removed.

- This can be done either by hand or by the use of Pulping machines.
- The process requires clean and cold water; therefore farmers may **use thermal gloves or rubber gloves** to remove the cherries' skins in the water.

TIP: It is advisable to use the pulping machine (if available), because it is cost efficient, and a perfectly good way to ensure constant quality.

Pulping Machine

Fermenting

Fermentation is the process in which the mucilage is fermented for easy removal through washing.

- Clean water should be added and **left with the beans for 1-2 days to allow fermentation**.
- Fermenting tanks should always be clean prior to fermentation use.

Washing

Washing is the processing of removing the fermented mucilage.

- If using the hand process, the beans should be washed 2-4 times with clean water to remove any traces of mucilage.

TIP: A demucilager machine is preferred (if available) because it is cost efficient, and it is a good way to ensure constant quality. The unit uses around 0.5L of water per Kg of parchment, and prevents over-fermentation.

Demucilager Machine

Hand Process

Drying

- After washing, the beans should be **dried until they acquire a moisture level of 12%.**

TIP: Parchment coffee dries in 9-10 days. Biting the dry parchment is a form of checking the 12% moisture level and the teeth texture should barely mark. If the parchment breaks then it over-dried (7-10%).

- The **drying should be done with full sun, and should not be done on the ground directly** (use a tarp, or similar tool).
- Make sure the beans are thoroughly spread out, and move them around a couple of times.

Hulling (Optional):

Hulling is the process of removing the parchment.

- This process is very hard to do by hand; therefore a hulling machine should be used.
- **This step should only be performed in the event of a buyer's request.**

TIP: Hulling should always be done days before transportation, so that the green beans are stored in jute sacks and for no longer than a week.

Chapter V: Quality Maintenance

A guide to assure the highest quality is met during the coffee production and processing.

Process step	Factors reducing quality	Potential problem
Harvesting	Harvest green cherry	*Green or grassy flavor*
	Harvest over-ripe cherry	*Fermented or fruity flavor*
	Pick fallen old cherry from the ground	*Fermented or fruity flavors. Mold contamination producing moldy or musty flavors*
	Hold fresh cherry for long periods before pulping	*Fermented or fruity flavors*
Pulping	Poor quality pulping equipment or poorly adjusted equipment	*Nipped beans causing stinker beans*
Fermentation	Over-fermentation	*Fermented, fruity, sour or onion flavor*
	Poor hygiene in fermentation tanks leaving a small number of extremely over fermented beans	*Stinker beans producing foul rotted or sour flavors*
Washing	Poor washing leaving mucilage on parchment	*Mold growth producing moldy or musty flavors*
Drying	Contaminated by drying on the ground or dirty drying surfaces	*Earthy flavors. Mold contamination producing moldy or musty flavors*
	Stored partially dry for long periods or rewet during drying	*Mold growth producing moldy or musty flavors*
	Machine drying too fast, too hot, or uneven	*Poor, mottled or faded color, dull or bland flavor*
	Coffee is over-dried	*Poor, faded bean color. Damages easily during hulling*

Process step	Factors reducing quality	Potential problem
Storing dried parchment	Stored dried parchment too wet	*Mold growth producing moldy or musty flavors*
	Stored near fuels or chemicals	*Contaminated with foul odors*
Hulling	Incorrect huller setting	*Bean damage*
	Coffee too dry	*Bean damage*
Storing green beans	Storing too wet	*Mold growth producing moldy or musty flavors*
	Stored near fuels or chemicals	*Contaminate with foul odors*
	Stored in jute bags made on machinery lubricated by petroleum oils	*Contaminated with baggy or oily taints*
	Stored in hot humid condition for long periods	*Mold growth producing moldy or musty flavors. Surface oxidation of beans causing woody flavors. Faded bean color*
Transport	Rewetting of coffee due to leaky tarpaulins or containers	*Mold growth producing moldy or musty flavors*
	Stored near fuels or, chemicals	*Contaminated with foul odors during storage*

Chapter VI: Selling Strategies

Seller

A seller is important in two aspects: their knowledge of the product and their charisma.

Knowledge

- In order for them to be successful they must be well-versed in their product in preparation for any questions that will be asked by potential buyers. Especially for coffee, knowing stats of the coffee form they are selling will also give confidence to the buyers to rely on the sellers in return

- Having a forecast of what has been produced and what is the expected outcome for future production will also give the buyers a better idea of your product and production.

Charisma

- Choose someone who has a natural ability to talk to people.

- They should be able to create a relaxed professional atmosphere while presenting the product to the buyer. They should be well-versed and well informed of the information as they will be leading the presentation.

How to Find Buyers (Customers)

- Word-of-mouth about buyers is a great way to find reliable buyers that have been doing business with other sellers.

- Constant communication with other sellers is also a great way to know about other buyers and current trends

- Network with people in the same business. This will allow you to be on equal footing with everyone.

- The internet is a treasure box of potential buyers looking for sellers. Researching there will also give you many options while keeping up to date on the current trend of the market as well.

- To get an audience with the buyers, we as sellers must be the first to approach them and go to them to introduce them to our product.

- Establishing a point person within the buyer's company will allow you to communicate with the company better and set up a first meeting.

- Finding buyers is all about the first meeting. If a good impression is made you'll be a likely candidate for future business together.

Presentation of Product

- Focus on the advantages, benefits and the originality of your product in comparison to others in the market.

- Keep it straightforward and simple by showing why they need your product in the first place.

- Concentrate on the background of your product. Emphasize it.

- Highlighting your product's physical form (i.e. size, quality) by showing them examples from your best coffee sample collected will allow them to appreciate your product better.

- Persuasion is the key- therefore BE persuasive throughout the presentation. Choose someone who has a way to speak with people for the presentation.

- Concentrate on the processing of the product. Explain how processes have been optimized to produce the best quality.

- Emphasize the strengths of your product, whether it has been organically planted, the logistics, cheap prices or reliability.

- Background research should be done about the buyer prior to the presentation in order to be prepared for any questions coming from them.
- Have a sample of your best coffee to present to them, so they can appreciate it with their hands.

The Relationship between Buyer and Seller

- The relationship between the buyer and seller will depend on how the first contact is as it is the most fragile point to establish a reliable and trusting connection.

- Confirm how much your prospective buyer wants or needs your product. Gauge your audience's feelings. Observe their reactions, listen to them carefully, and ask them clear questions about what they actually need.

- Reconsider the nature of your product (i.e. how it appears to the buyers, what you are trying to emphasize). Put yourself in the position of the buyer and see if the presentation appeals to you.

- Consider how your presentation may have made promises to the buyers- in what ways will you have to continue marketing your product for customer satisfaction?

- Know your customers. Do background research on them. This will allow you to gauge how to approach them, know what to do and not to do.

Chapter VII: Maintenance of Old Trees

When a tree is old and is no longer producing after 2 years, it should go through a rejuvenation cycle, which involves the growth of a new main stem. There are two ways of doing such:

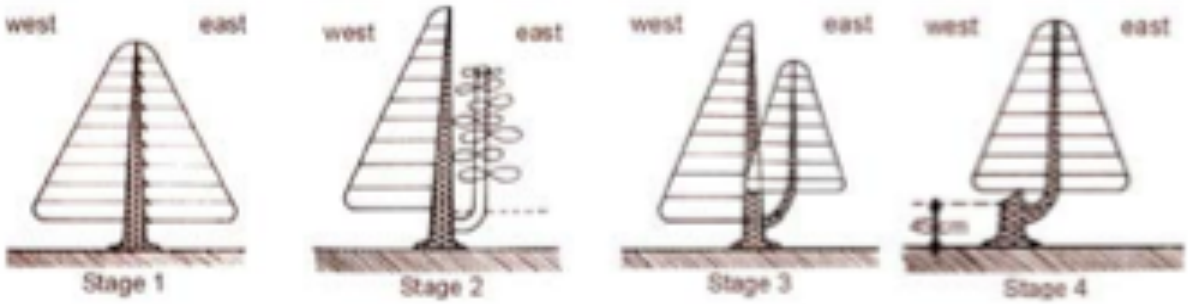
(1) Cut half of the primaries and once a new sucker grows remove the original stem.

a. Cut the primary branches of the east side of the tree.

b. Allow one sucker to develop into a stem in the east side.

c. After 2 years the main stem should be cut 40-50cm above the ground, at an angle of 45º with a saw (producing a clean cut).

d. The following year the tree should produce coffee.



(2) Cut the main stem and then allow a sucker to become the new main stem.

a. Cut the main stem 40-50cm above the ground, at an angle of 45 º with a saw (producing a clean cut).

b. Allow one sucker to develop into a stem, and on the third year the tree should produce coffee.

TIP: The (1) method should be adopted if the tree is old and is producing very little coffee. The (2) method should be used if the tree is no longer producing any beans.

Chapter VIII: Pesticide Control

Berry Borer:

Coffee Borer is a pest that can seriously damage coffee yields (as much as 50%). The coffee borer is a small beetle that feeds of the green beans; it can easily reproduce, and can last for a long time. It is a very prevalent pest among Arabica productions, therefore it is important to know how to deal with the pest. Very often it comes as the result of not harvesting all the cherries on the tree or even disposing of the beans on the ground.

The pictures above are evidence of the presence of berry borers. When this pest affects coffee beans, the beans fall prematurely, the leaves turn yellow, and small holes can be observed on the tip of the beans.

Solutions:

1. **Old berries on the tree and in the ground should completely be removed before the flowering stage, to prevent the new crop from being affected.**
2. Drying the parchment to 12% moisture keeps the pest from surviving in the beans.
3. Use Beauveria Bassiana (Follow instructions of the product).
4. Use ChiangMai University's CMU-C1, which is similar to Pheromone chemicals (Follow the instruction of the product).
5. Prepare a solution of 50% ethyl alcohol and 50% methyl alcohol, place it in an open container and place near affected trees (not directly bellow the trees).

Coffee Berry Disease:

The coffee berry disease (CBD) is caused by a fungus that if not controlled can damage yield as much as 75%. Affected beans quickly turn brown and black in affected areas, and eventually the entire bean becomes covered.

The disease is very hard to treat with traditional methods pesticide stores might be the best approach.

Solutions:

1. **Use organic eradicants/protectants (such as Cholorothalonil)**
2. Use copper based fungicides (such as Dithianon , Anilazine, Cobox, and Funguran; and follow instructions on the product).

Sooty Mold:

Sooty mold is a pest that develops when the coffee plant is infested with scale or mealybugs. Mealybugs and scales excrete sweet material, which attracts ants and causes them to spread the pest around the tree. The Mealybugs and scales feed on moisture from newly grown branches, suckers, and baby cherries.

Solutions:

1. **Cover infected area with soap solution.**
2. Use mulch, manure, compost and fertilizers to maximize the plant's growth and resistance.
3. Badly affected (completely covered with sooty mold) branches should be cut-off and destroyed
4. Use petroleum spray oil (white oil) for the mealybugs, and any ant-pesticide for the ants.

Stem Borers (Pesticide Control):

Stem borers are very common on Arabica trees, and they eat the inside of the stems and branches, causing the tree to weaken (the leaves of the tree become yellow and fall). There are two predominant species of stem borers (and they can be observed bellow).

White stem borer adult (left) larva (right)

Red stem borer larva (left) adult (right)

Stem borers infections can be identified by holes in the stem of the tree of about 1cm in diameter, by the yellowing of the coffee leaves, and by branches that break very easily. Well-maintained coffee trees hold a lower chance of getting attacked by stem borers. The adult borers lay their eggs in the crack of the coffee tree bark near the base of the stem, and when the eggs hatch into worms, they begin to decay the tree.

Solutions:

1. Growing trees under shade reduces the frequency of stem borers.
2. Burn affected trees before the raining season begins.
3. Apply a solution of water with lime (10%) to the stem of the tree with a brush.
4. Use a knife or scissors to rip out the worms and kill them.
5. Use backlight (Ultraviolet) to attract and kill the adult borers.
6. Smooth the bark of the tree for about 0.5m up from the ground level. Use a rough cloth, dried maize cob, or even a knife, but make sure not to hurt the tree itself.
7. Apply any diluted Fipronil (according to the instructions: usually 1L per 20L

Evidence of the presence of stem borers

White Mealybug:

The white mealybug is a mealybug that feeds off young branches, shoots, and suckers. They are generally a bigger problem in the dry season when rains are infrequent. It can be identified by white waxy colonies on the underside of tender leaves and in soft stem areas around berries.

Since a mealybug also provokes this problem, solutions should be similar to that of sooty mold.

Solutions:

1. Cover infected area with soap solution.
2. Use mulch, manure, compost and fertilizers to maximize the plant's growth and resistance.
3. Badly affected (completely covered with sooty mold) branches should be cut-off and destroyed.
4. **Use petroleum spray oil (white oil) for the mealybugs.**

IMPORTANT NOTICE:

- **If any chemicals are used to fight pesticides and diseases, the containers should be kept in a safe place, away from children and away from processed beans.**
- **Chemical alternatives should only be implemented once organic solutions have been tried and have failed.**
- **Before using any chemical, read the instructions on the container and use the required protective gear.**
- **Recently disinfected plants and trees should be kept restricted (especially for children).**

Chapter IX: Resources

General Information

- **Research and Development of Highland Agricultural in Chiang Rai (Doi Wawee/Doi Chaang)**

  Email: wawee.doa@doa.in.th

  Tel: 0-5360-5941, 0-5360-5955

- **Chao Thai Pu Kao Highland Agricultural Project (Hillkoff)**

  Email: info@hillkoff.com, hillkoff@windowslive.com

  Website: www.coffeethai.org

  Tel: 0-5321-3078 ext. 7, 0-5321-3030

- **Highland Coffee Research and Development Center (Chiang Mai University)**

  Tel: 053-944-052

Buyers

- **Doi Chaang**

  Website: www.doichaangcoffee.net

  Tel: 087-031-1919

- **Duang Dee Hill Tribe Coffee**

  14/23-24 Soi Insuan, Maneenoprat Road, A. Muang, Chiang Mai, 50000

  Email: duangdee@iname.com

  Tel and Fax: 0-5321-9361

Fertilizer Companies

- **Pui Orient Co.,Ltd.**

  191 Moo 1, Mae-Phing, A. Prao, Chiang Mai, 50210

Chapter X: References and Sources for Further Reading

The following list includes sources where information and images were obtained for the creation of this booklet (manual), which are useful references for further information.

- Winston, E., Laak, Op de Laak, J., Marsh, T., Lempke, H., Chapman, K., Aung, O. and Nyunt, T. (2005). Arabica coffee manual for Myanmar. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand.

- Winston, E., Laak, Op de Laak, J., Marsh, T., Lempke, H. and Chapman, K. (2005). Arabica coffee manual for Lao-DPR. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand.

- Rutherford, M. A., & Phiri, N. (2006). Pestsand Diseases of Coffee in Eastern Africa: A Technical and Advisory Manual. CAB International.

- Manual for Sustainable Coffee Production. (2005). Ibero. DeFoundation, Uganda.

- McCormack, Mark H. (1984). What They Don't Teach You at Harvard Business School. Bantam Books, Toronto and New York.

Glossary

Corporations (Co-ops): a business that is owned and administered by a group of farmers rather than individual farmers.

De-suckering: the act of removing suckers from the coffee tree. *See suckers.*

Eradicants: tools (ex: chemicals) that destroy something completely.

Fungicides: chemicals that kill fungi.

Insecticide: a substance used to kill insects.

Manure: fertilizer made from animal fecal matter.

NPK: reference use for fertilizers, which signifies Nitrogen-Phosphorus-Potassium concentrations.

Nursery: a place where plants grow for the first months; involves a protected site where farmers can upkeep the plants thoroughly.

Parchment: the hard coating around the green beans.

Pesticides: a chemical substance used to kill pests, especially insects.

Primary (branches): are the branches that grow out of the main stem of the coffee tree.

Secondary (branches): are the branches that grow out of the primary branches. *See primary (branches).*

Seed-bed: a wooden box with soil constructed to grow coffee seedlings. *See seedlings.*

Seedlings: a young developing plant that has been grown from a seed.

Soot: black powdery substance that covers leaves when they are infected with mold.

Sowing: the action of planting seeds in the soil to grow crops.

Stem: is the main stalk (body) of a plant, which primary branches grow on.

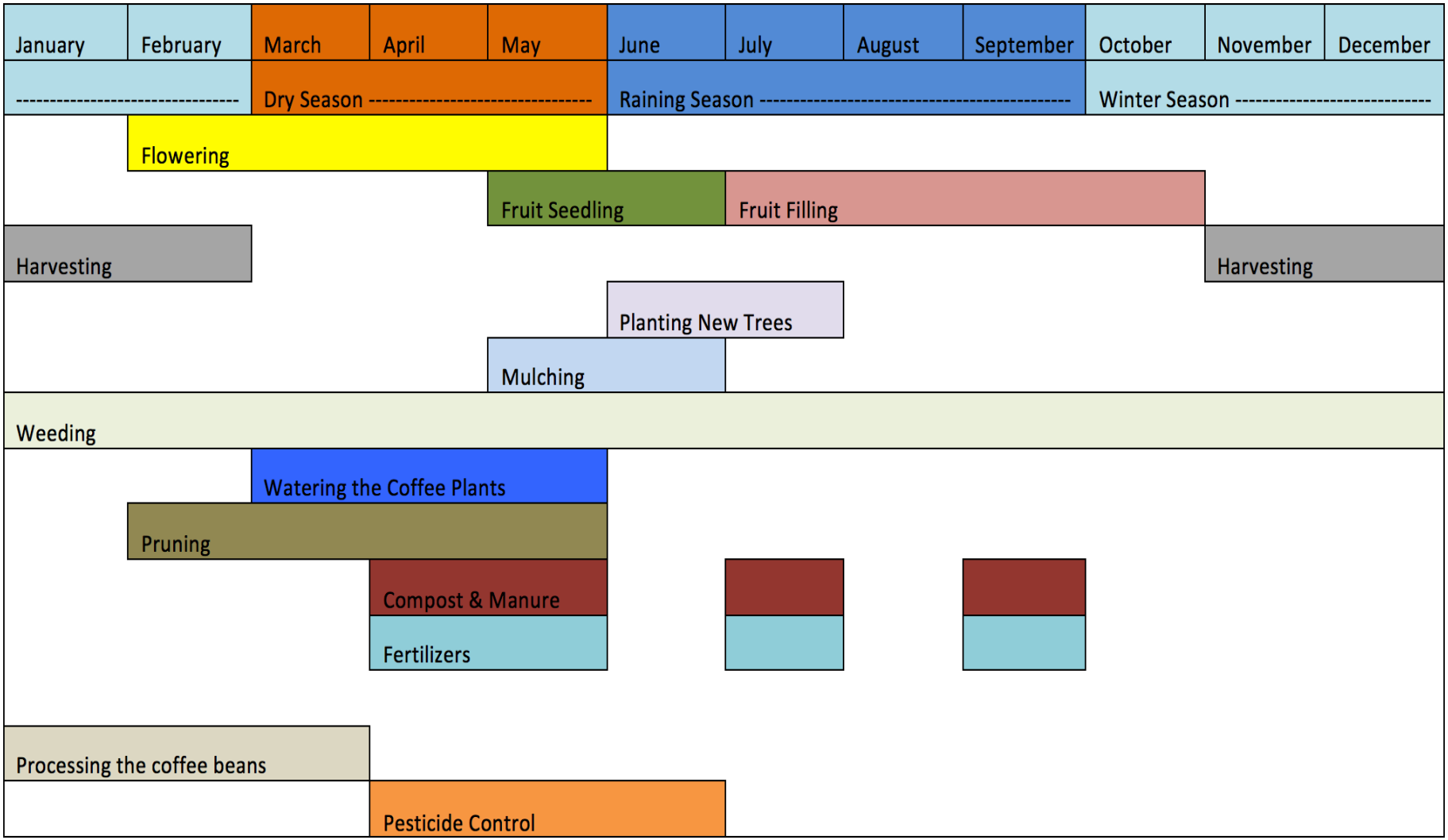
Sucker: a shoot (baby stem), which often grows at the bottom of the main stem.

Sustainable: able to sustain itself for a long period of time.

Tap-roots: the main root of a coffee tree that extends downwards.

Tarp: *same as Tarpaulins.*

Tarpaulins: a waterproof material that is used to protect things from moisture.



The calendar highlights conditions for the North of Thailand, and suggests steps of production.

Acknowledgments

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NOTES: