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Review Article

Nutrtion Requirement, Management and Factor Affecting on Yields of Arabica Coffee (*Coffea Arabica* L.): Review

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Abstract

Coffee is a major export crop and an important source of foreign revenue in most tropical and subtropical regions. Cooler, elevated areas at 3300 feet (more above sea level), tropics/sub-tropics are favored for grown a higher quality/value of Arabica coffee. Some of the common challenges to coffee production are: low yields (old and poorly managing of tree), declining soil fertility, Lack of appropriate erosion control measures, use of poor quality planting materials, Pest and disease problems, high post-harvest loss and the like. Genetics, Environment, The coffee plant and its management are factors which impact on coffee yield and quality. Coffee can be attacked by a range of pests, including beetles such as the coffee berry borer, and the white coffee stem borer, green scales, mealy bugs and nematodes. Most of the important coffee diseases are caused by fungus like: coffee wilt disease, coffee leaf rust, coffee berry disease, coffee bark disease and the brown eye spot. Following the right procedures of picking, processing, drying and stored in recommended materials can positively contribute on the final quality of coffee. In order to assure good quality of coffee by minimize contamination, it is important to passes though primary processing activities. i.g. harvest carefully and safely handle the harvested coffee. This review therefore have indicates the best management techniques of coffee productions for better yield and quality of Coffea Arebica.

Keywords: Arabica coffee; Management; Yield; Quality; Pest and dieses

Introduction

Coffee (Coffea spp.) is among the major source of export revenue for a large number of countries and the second most traded commodity in the world next to oil [1]. The genus Coffea comprises more than 100 species, with particular relevance to *C. Arabica* L. and Coffea Canephora, for about 99% world coffee beans production [2-4].

Arabica is grown in tropical regions mainly growing in Latin America, East Africa including Ethiopia with preferable altitude from 1000 m to 1500 m. Optimum temperature for cultivation range from 18°C to 25°C, cannot stand in frost (temperature below 4°C to 5°C). Flowering is initiated after the first rains and maturation of cherries requires a dry period that can be up to 5 months [5,6]. Arebica is susceptible to the berry borer and coffee rust diseases/ pests [5]. It has a deep root system, requires well-drained deep soils rich in organic matter and the optimum pH range is from 5.4 to 6.0 [6]. It can also result in economic advantage by the generation of extra products and by the opportunity to explore alternative markets and reduce the biennial pattern of coffee yield [7,8].

Ethiopia produces *C. Arabica* L., primary center of diversity in the south-western highlands of the country. Research findings over the past few decades revealed that there is a huge genetic variation for different agronomic traits among accessions of Coffee Arabica in Ethiopia. However, during the last 40-50 years, significant reduction of genetic diversity has occurred due to deforestation and competition for arable land to expand food crops that coupled with rapid population growth [9-12].

Fulfilling optimum soil nutrients with organic fertilization and practice sustainable agricultural management will improve coffee yield and qualities. This review therefore needed to give necessary information on the achievements of nutrition, fertilizer use and practices of best coffee production management. Looking the constraints by identifying common challenges to coffee production, this would be helpful for further amendment of nutritional status in most of the coffee growing Areas [6].

Attributes of coffee production

Shade or no shade: Before 1950s coffee was cultivated and harvested in traditional way under a shade cover, however from 1950s and 1960s a high yielding which has a sun tolerate cultivars developed and transformed in to a modernized unshaded system [13]. In unshaded coffee plantations system, again a negative impact has been identified such as: soil erosions, biodiversity loss and economic costs over the past two decades. This system, unshaded system, requires large amount of fertilizers and pesticides which impacts in environment and soil contamination [14].

Arabica coffee is typically a shade-adapted species and most progenies from natural coffee plants. They have retained the physiological attributes of shade-loving plants, but can tolerated rought and full sunlight much better because of a well developed root system, strong plant vigour and the ability to retain leaves longer under conditions of water stress (Table 1) [15].

Mulches: The different plant resuge remain in the plots can be

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used as mulching material. Mulches used in coffee farming include Eucalyptus branches, Grevillea branches, sorghum thatches, Panicum spp., Cymbopogon spp., sugar cane leaves, banana leaves grasses, and wheat straw, maize stover and mixed residues. Mulching is usually used as a soil conservation measure [18-20]. Mulches increase the content of soil organic matter, soil aggregate stability and soil nutrients. It helps to control soil erosion and weeds, preserve soil moisture [9]. The trimming of the accompanying foliage should be timed to coincide with the nutrient requirements of the coffee plants. Depending of the rainfall and the local site conditions trim two to three times a year [18-20].

Table 1: Effects of shade trees on coffee [16,17].

Effects of shade trees on coffee	
Positive	**Negative**
Reducing the extremes low altitudes and high altitudes air and soil temperatures	Progressively lower yields, due to a reduction in flowering nodes, inflorescences per node and flowers per inflorescence
Breaking the force of wind and rain fall	Competition for water between shade and coffee trees in seasonally dry regions
Suppressing weeds	Damage of the coffee trees by falling branches from the shade trees and occasional tree felling
Controlling erosion on steep slopes	Additional labor costs for regularly pruning of over-head trees to avoid excessive shading
Producing annually 5-15 t (dry weight) organic matter per ha from litter and pruning's	Potential increase of some diseases (e.g. South American leaf spot) and pests (e.g. coffee berry borer).
Providing additional revenue (timber, firewood and fruits)	
Recycling of nutrients and reducing nutrient leaching	
Preventing over-bearing and shoot dieback	
Potentially reducing incidence of diseases (e.g. leaf rust) and pests (e.g. white stem borer).	

Weeds: Weeds compete with coffee for moisture and plant nutrients, while some perennial grasses and sedges produce root exudates that are toxic to coffee. Working the soil to regulate weeds should be avoided to prevent doing damage to the shallow roots of the coffee bushes. Weed control is particularly difficult (and expensive) in unshaded coffee [19,20]. Control by herbicides has all the advantages of zero tillage, including no damage to superficial feeder roots of the coffee [9]. The use of cover crops, although effective also in controlling weeds, is not common in unshaded Arabica coffee because of excessive competition for moisture [21].

Factors affecting yield and quality

There are three factors (Genetics, Environment, The coffee plant and its management) which impact on coffee yield and quality [22].

Genetics (genotype-species and varieties): There are two main species of commercial coffee- *C. Arabica* and *Coffea canephora* (robusta) and two minor species - *Coffea liberica* and *Coffea excelsa*. Arabica is a higher quality and higher value coffee normally grown in cooler, elevated areas of the tropics and sub-tropics at 3300 feet (1000 m) or more above sea level. The quality of instant coffee can be improved by blend roasted and grounded Arabica coffee with Robusta coffees [22,23]. The varieties choice regards characteristics of high yield, leaf rust resistant, dwarfish/compact growth; tremendous cup quality improves the genotype of Arabica coffee. Proper selection of varieties helps to resist common coffee dieses like coffee wilt and coffee leaf rust dieses [23].

Environment (site selection): For best quality, the world market requires high elevation Arabica Coffee rather than the Low elevation and also possesses potential cupping quality [22].

Temperature: The optimum daily temperature of Arabica coffee lies between 18°C and 24°C. It prefers a cool temperature, greater than 30°C cause plant stress and leading to reduce photosynthesis. In addition to this, at higher temperatures, bud formation and growth are stimulated. The mean temperatures less than 15°C is sub-optimal; as a result it limits plant growth and productivity. As Arabica coffee is susceptible to frost damage, use of shade trees will reduce the incidence [22,20].

Rainfall and water supply: The ideal rainfall for Arabica coffee lies between 1200 mm to 1500 mm per year. Both the total amount and the distribution pattern are important. Coffee plants react positively to a drought period that should nevertheless not be longer than 3 months. For better cropping, uniform distribution of rain recommended seven to nine months per year. Irregular rainfall causes uneven flowering and fruit maturity. To promote uniform flowering and a good fruit set, coffee requires a dry stress period followed by adequate rain or irrigation [22,20].

Soil type and quality: Coffee will not tolerate water logging or 'wet feet' [22]. Soil quality provide a medium for plant growth and biological activity, regulate water flow and storage in the environment and serve as a buffer in the formation and destruction of environmentally hazardous compounds [24]. A fertile, volcanic red earth/deep, sandy loam, a free draining soil with pH of 5 to 6 are an ideal and preferable soil quality indicators for enhancing yields [21,22].

Slope and aspect (slope % and direction) Steeper slopes leads to a major erosion risk and require terracing/ special management like contour furrows or preferably grass strips. A slight slope will improve air drainage and reduce damage from frost. It is not advisable plant coffee at the bottom of a slope or in shallow dips where cold air can pool, as frost damage is more likely here [22].

Nutrition and fertilizer management

Nutrient management: Nutrients are applied to replenish those that are lost through tissue formation, yields, leaching and those that form compounds where they cannot be easily extracted by roots. This calls for application of fertilizers so as to apply the necessary nutrients in the required amounts [25]. The amount of plant nutrient required by coffee trees may vary depending on several factors. The amount of rainfall and its distribution, the species and amount of other plants grown in association with the coffee trees, seasonal variation, the topography, the soil type and the prevailing cultural practices are a few. Estimation of the nutrients required by the new crop is based on soil and plant tissue analysis [26].

Nutrients from inorganic sources are immediately available usually, while organic matter must first decompose to release N and other nutrients for uptake by crop plants, with the exception of K+ and other dissolved ions which are readily leached from organic residues. Organic matter and manures are, therefore, more appropriate as basal inputs, whereas inorganic fertilizers offer flexibility in timing of application in relation to crop demands [27].

The role of essential minerals and plant nutrient flows in coffee: Nutrients are utilized by the plant for different functions. Some are vital for the uptake of water from the soils, whereas others have a function in the development of leaves or fruits [28]. Coffee plants requires N

and K dominantly, K being more important in fruit development and N for vegetative growth [21,29]. The nitrogen supply, the number of flower buds and number of leaves are close and direct relationships among each other. If a sufficient nitrogen levels exists in coffee tissue it will favored for starch and other carbohydrate productions needed for fruit formation and growth [30, 31]. Potassium also plays a major role in coffee plant physiology especially during fruit growth and maturation. The Potassium quantity exported at harvest exceeds that of Nitrogen which helps to explain why it can become limiting after a few years [32]. A good correlation exists between leaf K status, stored starch and yield. If the tissue potassium is adequate, the proportion of floats and branches with symptoms of overbearing decreases [31].

The demand for P is much lower, but it is essential for root, flower bud and fruit development. Ca, Mg and other major and micronutrients, although often essential for a balanced nutrition of the coffee plant [9,33].

The following table has shows the functions and deficiency symptoms of different nutrients (Table 2) [28].

Coffee makes higher demands on soil quality and more nutrients are removed annually by the harvested products in comparison to other tree crops like cocoa and tea (Table 3) [34,35].

The re-utilization and remobilization of certain nutrients is an important metabolic feature during development /in cases of seed germinations. This occurs when in vegetative growth under stress conditions and in the reproductive stages before leaf fall. The degree of both N and K mobilization is large when the deficiency symptoms which develop in the coffee leaves [35].

Optimum leaf and soil nutrient levels: Soil and leaf samples have been taken for physic-chemical analysis. With regards to the quantity that has been determined, It can be devise nutrition management program by comparing the level obtained to the world optimum nutrient coffee plantation (Tables 4 and 5) [29,36].N.B. Different extraction methods would give different results and different optimum levels [36].

Fertilizer management

Coffee generally responds quite well to fertilizer applications. When applying fertilizers, one has to realize that various factors determine the maximum possible yield: climate, variety and age of the coffee tree. Whether this maximum yield may be reached depends partially on the management of the crop, where important activities are pruning and stumping and weed, pest and disease control. If these practices are not done in a correct form, the maximum attainable yield will be lower than the maximum possible yield. Whether the maximum attainable yield can be reached, depends on the availability of nutrients to the crop. Concerning the tree itself, requirements are influenced by variety, age and expected yield. Soil, weather, and shading conditions also play an important role [28].

Table 3: Approximate nutrient uptake by arabica coffee producing 1 t green beans ha-1 year-1.

For…	N(kg)	P (kg)	K (kg)
Green beans (1.0 t dry weight)	40	4	45
Pulp + parchment (1.25 t dry weight)	35	7	53
Vegetative growth	60	5	22
Total	135	16	120
Crop related output	105	13	107

There is nothing wrong with inorganic fertilizers when applied according to best practices. Inorganic fertilizers and organic matter are both sources of nitrate and phosphate ions to the plant. However, only organic matter provides carbon sources to the soil micro-organisms, which are essential for nutrient cycling of organic matter and soil aggregation. Inorganic fertilizers also increase SOM, as more crop residues will be returned at higher levels of crop production [37].

Application during the first three years: during planting, a first application of manure or compost and fertilizer is required to give the new tree a good start. Especially Phosphate is important for root development during this phase. During the first year, no yield should be expected on the tree. The tree needs all its energy to establish a sound structure and root system to start a productive live. After the second year a small harvest is permissible, but care should be taken that this crop is not too big, say no more than 1.5 kg fresh cherry/ tree. Production starts from the third year onwards and nutrient requirements change according to expected yield levels. As yield levels can be expected to vary between fields and crop years, so should nutrient applications [28].

Processing, Minimizing Post Harvest Lose and Quality Requirements

Processing

Processing is a sequence of activities aimed at attaining a coffee of high quality. Raw coffee is made by processing the ripe red coffee cherries of the bush-like coffee tree, species coffee, and traded on the

Table 2: Nutrient functions and its deficiency symptoms.

Nutrients	Function	Deficiency symptoms
N (nitrogen)	formation of chlorophyll	Leaf drop
	water uptake	Discoloration (yellowing) and rolling up of leaves
		Dieback of tips
P(phosphorus)	Photosynthesis, Respiration	Stunted growth
	Energy storage, Cell division	Pale leaves (starting with younger ones)
K(potassium)	Photosynthesis, Protein synthesis	Discoloration
		Necrosis on leaf edges
Ca (calcium)	Root and leaf development	Leaf color yellow from the center outward
	Affects uptake of other nutrients	
Mg(magnesium)	Central element of chlorophyll	Brown, bronze discoloration of leaf sections from center to edges
	Photosynthesis	
Iron (Fe)	Catalyst for chlorophyll formation	Initially at young leaf's; Severe cases show yellow to bleached white discoloration with green veins
Zinc (Zn)	Necessary for chlorophyll formation;	First at young leaf's; Leaf deformations; and yellow discoloration
	Production of sugars	
Boron (B)	Germination of pollen	Stunted growth of young leaves; Light green discoloration of young leaves, Reduced flowering
	Transport of sugar and formation of proteins	

Table 4: Optimum leaf nutrient levels for coffee plant [29].

Optimum leaf nutrient levels for coffee plant												
	(%)							(mg/kg)				
Nutrient	**N**	**P**	**K**	**S**	**Ca**	**Mg**	**Na**	**Cu**	**Zn**	**Mn**	**Fe**	**B**
Optimum range	2.5 - 3.0	0.15 - 0.2	2.1 - 2.6	0.12 - 0.3	0.75 - 1.5	0.25 - 0.40	<0.05	16 - 20	15 - 30	50 - 100	70 - 200	40 - 100

Table 5: Optimum soil nutrient levels for coffee plant [36].

		(meq/100 g)			(mg/kg)									(%)
Nutrient	pH	Na	Mg	Ca	K	S	P	Cu	Zn	Mn	Fe	B	NO_3-N	OM
Optimum range	5.5 -6.0	<l.0	>1.6	03-May	>0.75	>20	60 -80	0.3 - 10	02 -Oct	<50	Feb -20	0.5 -2.0	>20	01 -Mar

The extraction methods for: Ca, Mg, Na and K is ammonium acetate; For Cu, Zn, Fe and Mn is DTPA; 1:5 aqueous extract for pH&NO3-N; Hot calcium chloride for B; walkley and black for OM; Bicarb for phosphate and KCl-40 for S.

world's markets. The 'dry and the wet methods' are the two techniques of coffee cherries process [20].

Dry processing: Drying should remove moisture from the coffee bean in a slow continuous process until the bean is a translucent, jade green color and 12% moisture content [22]. During the dry processing procedure, small stones, twigs and leaves etc are removed from the harvest in a type of floating chamber, concrete slabs, tarpaulins, mats, raised tables or trays with a mesh base [20,22]. Depending on the weather, the drying process can take up to eight days. It has been completed when the beans rattle around in their shells when shaken. In inappropriate weather conditions, the beans may begin to deteriorated and result in a drop in quality [20]. Over-dried coffee is easily damaged during hulling and may also result in a bad flavor of the final cup quality [22].

Wet processing: During the dry processing procedure, the freshly picked coffee cherries are filled into large water tanks. The healthy, ripe cherries sink immediately to the bottom of these containers, which are usually built of raised concrete, whilst twigs, leaves and damaged or mouldy coffee cherries float on the surface and can easily be collected [20].

This also means that the harvest is simultaneously washed. The coffee cherries are then fed into swelling containers via a water channel, where they remain for a maximum of 12 hours. In the next stage, the slightly swollen cherries are fed into a pulper, there; the majority of the fruit pulp is separated from the pellicle membrane of the beans. The remaining, smarmy fruit flesh residues are separated from the coffee beans through brief fermentation (2-4 days during cool weather). Finally the coffee beans are washed and dry out on large shelves in the sun, or with hot air in drying barrels. In order to correctly stock the coffee beans, it is useful to reduce the water content down upto 10% (Table 6) [23].

Storage: It's recommended to store the raw coffee in dark areas at low temperatures and relative humidity. Under optimum conditions, dried fruits can be stored for up to 1 year. It is proscribed to carry out chemical storage measures like gassing with methyl bromide in mixed storage spaces. Storing both conventional and organic products together in the same warehouse/storage should be avoided [23].

Minimizing post harvest losses

The final quality of coffee depends a lot on how well the coffee has been picked, processed, dried, packed and stored. Carefully harvest and safely handle the harvested coffee through primary processing activities helps to minimize the contaminations and losses. Coffee farmers in Africa they lose on average up to 30 % of the harvest due to poor handling during primary processing. This occurs mainly due to moulding as a result of slow drying /poor ventilation in the storage units. Such coffee also develops bad-flavors and eventually affects its cupping quality. Most of these losses are avoidable by carefully handle the harvested produce [23].

Many farmers traditionally mix red ripe berries with shrivelled, black, discolored and defective beans. The unripe berries produce beans that break easily, are of lower quality, are small in size and are usually eliminated as part of the husks during milling, resulting in qualitative and quantitative postharvest losses. Furthermore, the immature beans give a bitter taste to the coffee [23].

Recommendations for proper coffee harvesting [23]:

- Carefully pick, do not strip only the mature red beans leaving the green ones.
- Spread out propylene bags/Hessian bags to avoided harvested beans falling on to bare ground
- In order to reduce the spreads of pest's infection like coffee berry borer, mix the collected beans in the ground with composting materials. This ensures that any beans infested with pests will be destroyed.
- Remove foreign matters and all inferior beens from harvested coffee.

Quality requirements

The following table have shown the quality characteristics of raw coffee which is required by importers/officially as a standards (Table 7) [20].

Table 6: Processing, Packaging and storage.

Primary processing	Recommendations
(a) Wet processing	Wash with clean water the fermented beans and dispose of the mucilaginous water in a 3-series ditch.
	Spread the washed coffee beans and dry up to 12% moisture content.
	Dry coffee in batches following the fermentation procedure and avoid mixing coffee fermented on different days.
(b) Dry processing	Avoid drying coffee on the bare ground, instead use mats, tarpaulins, concrete floors or mesh.
	In case do not have any materials available, but it is recommended that a fence around the drying area.
	Dry the coffee in batches as it is harvested and avoid mixing coffee harvested on different days.
(c) Packaging and storage	Pack in clean sacks made from natural fibers. If possible, construct special rooms for storage. This avoids introducing other aromas into the coffee.
	Ensure that dried coffee does not get wet again, which would otherwise spoil the quality of the coffee.
	Place coffee sacks on pallets or wooden poles, of the wall, in a leakproof store with good ventilation.

Table 7: Quality characteristics.

Quality characteristics	Minimum and maximum values
Cup quality	Aromatic
	Clean
	Free from foreign tastes and smells
Bean shape	Homogenous
Water content	Max. 13%
Residues	
Pesticides	Not measurable
Bromide and ethylene oxide	Not measurable
Mycotoxins	
Aflatoxin B1	Max. 2 µg/kg
Total aflatoxins B1, B2, G1, G2	Max. 4 µg/kg
Ochratoxin A	Max. 2 µg/kg (4-437)
Patulin	Max. 50 µg/kg

Effective Pests and Diseases Management

Managing pests and diseases in coffee requires regular scouting of the coffee fields. Early identifying infections give enough time to intervene before much damage is happened [23]. Successful pest and disease prevention starts at planting. A plantation that has been created carefully will be less susceptible to pests and diseases. Careful establishment centers amongst others on soil selection (Soil identification and improvement) but also planting distances have influence (Land preparation and planting) as well as fertilization (Plant nutrition and fertilization and Composting) [28].

Effective pests management

Coffee can be attacked by different pests such as coffee berry borer (*Hypothenemus hampei*), white coffee stem borer (*Monochamus leuconotus*), mealy bugs, green scales and nematodes. Coffee berry borer is one of the most devastating pests which reduce yield and quality of the marketable product. Many natural enemies of the coffee berry borer (parasitoids, ants, birds, thrips, nematodes, and fungal entomopathogens) have been reported [23].

Therefore the coffee berry borer can be controlled by: Encouraging natural enemies (by introducing shade trees and cover crops) provide the habitat for the natural enemies that feed on the pests; and Proper cultural management: by regular removal and destruction of infected branches and leaves. Restricting the movement of organic materials like mulches, using natural sprays including black jack, *Tephrosia*, neem extracts by covering them under nets to protect Nursery seedlings [23].

Effective diseases management

Most of the important coffee diseases are caused by fungus like: coffee wilt disease, coffee leaf rust, coffee berry disease, coffee bark disease and the brown eye spot. Effective management of these coffee diseases starts with the choice of suitable varieties for the local climatic conditions. Soil fertility improvement, Pruning & de-suckering, routine sprays of nursery plants with a protective, copper based fungicide (e.g. Bordeaux mixture or Copper oxychloride) are an example of coffee tree management by tolerate and limit the diseases infections [23].

Coffee wilt disease (*Fusarium* wilt or tracheomycosis): Coffee wilt disease is the most destructive coffee disease and can lead upto 100% yield losses. The first signs of the disease include yellowing, folding and inward curling of the leaves. The leaves dry up, become brown then eventually drop off and finally the trees completely leafless. Fusarium wilt disease spreads when infected trees are dragged for use as firewood, fencing, or left in the garden. It also spreads through contaminated soil that gets into contact with healthy plants and though tools that can be used during managements of the coffee trees [23].

Coffee berry disease: Coffee berry disease is caused by *Colletotrichum kahawae*, specific to immature berries and can lead to 20% to 30 % harvest losses. Older coffee will have higher disease pressure due to the buildup of primary inocula in the bark. Selection of resistant varieties to replace traditional susceptible varieties and remove infected beans is helpful measures for controlling the diseases [23].

Coffee leaf rust: Coffee Leaf Rust spreads through spores. The spores require water for germination; this explains why Coffee Leaf Rust hardly occurs during the dry season. The optimum temperature for germination is 20°C to 25°C; with a maximum of 28°C. During temperatures below 15°C Coffee Leaf Rust does not develop. Weak trees, such a caused by overbearing or under-fertilization, will display more problems [28].

Symptoms, prevention and treatment: The first symptoms are yellowy circular spots on the underside of the leaves, after about a week these are covered by an orange powdery substance. Slowly these spots form larger circles. The upside of the leaf shows brown/yellow spots. On older leaves, the entire leaf area may be covered, but usually the leaf drops down before that stage is reached. The best way of prevention can attain by applying correct techniques of propagation, planting, weeding, fertilization and pruning. If Coffee Leaf Rust still appears, a preventive treatment with a copper based fungicide can be done. If the disease becomes visible and continues to spread other fungicides can be used [28].

Brown eye spot disease: Brown eye spot disease is caused by the fungus *Cercospora coffeicola*. It manifests on the leafs of cherries.

Symptoms, prevention and treatment: It is normally found on leaves of young plants, although it also occurs in mature trees. Infection is shown by brown lesions, ranging from 3 mm to 6 mm in diameter. Massive infections can lead to leaf shed and loss in vigour of the tree, although this is only rarely occurs. Brown Eye Spot is essentially a nitrogen deficiency underlying imbalance in fertilization. Decent field management is normally sufficient to prevent Brown Eye Spot. If it does occur a copper treatment at the beginning of the rainy season can be used. However, although the copper treatment will reduce the proliferation of the fungus it does not remove the underlying cause, i.e. nutrient deficiency or lack of shade! [28].

Dieback: Dieback is mainly a result of one or more sub-optimal growing conditions. Most common is a lack of nutrition. Dieback can also occur as a result of other diseases such as Coffee Leaf Rust, or excessive exposure to sunlight or heavy fluctuations in temperatures [28].

Symptoms, prevention and treatment: Branches start dropping leaves and fruits from the branch tips inwards. Usually starting at the middle of the tree and slowly developing downwards and then upwards to the top of the tree. Finally, the young top-leaves will be shed. Ultimately the tree will die. Dieback can be handled with proper management in the field: ensure sufficient nutrient availability, regular pruning and if possible the use of a light shadow to regulate yield levels. In addition, two copper based fungicide applications can be done at the beginning of the rainy season to ensure sufficient micro-nutrient availability [28].

Summery and Conclusions

There are three factors (Genetics, Environment, The coffee plant and its management) which impact on coffee yield and quality. Temperature between 18°C and 24°C; ideal rainfall 1200 mm to 1500 mm per year; fertile, sandy loam pH 5-6 soil type are the favorable conditions for growing Arabica coffee there for better to select environment (site) that fulfilled it before planting. Best coffee species and varieties can resist to common diseases like coffee wilt disease, coffee berry disease or coffee leaf rust therefore it should be select proper variety (cultivar) which ideally have characteristics of: dwarfish or compact growth; high yield; leaf rust resistance; outstanding cup quality. Providing optimum level of soil nutrients for coffee plant from organic and inorganic fertilization leads to give good yields, this has to be supported by soil analysis. During planting, a first application of manure or compost and fertilizer is required to give the new tree a good start.

Recommendations for proper coffee harvesting (to get good yields and better quality): Always pick, do not strip (carefully pick only the mature red beans leaving the green ones on the trees to ripen further), avoid harvested beans from falling onto the bare ground and remove all inferior or green beans, leaves, twigs and foreign matter from harvested beans. Pre question should be taken to mix harvested dry coffee with freshly harvested coffee. To avoid introducing other aromas in coffee, Pack the coffee in clean sacks made from natural fibres followed by placing on pallets or wooden poles, off the wall, in a leak proof store with good ventilation.

Before much damaging happen with pests and dieses in coffee plant it's important to manage by regular scouting of the coffee fields to identify infections early. Coffee berry borer Pests can be controlled by introducing shade trees/cover crops and by regular removal and destruction of infected branches and leaves. Pruning and de-suckering (increase airflow and reduce the humidity around the plant), Proper sanitation by ensuring infected plants, restrictions on the movement of coffee materials (seedlings, beans, husks, etc.) from affected areas, routine sprays of Nursery plants with a copper based fungicide (e.g. Bordeaux mixture or Copper oxychloride) are effective management of coffee dieses.

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