Innovative Farming
-An International Journal of Agriculture

Popular Article

SHADE MANAGEMENT IN BEVERAGE CROPS

Pranay Kumar*
Department of Spices and Plantation Crops, Faculty of Horticulture,
Bidhan Chandra Krishi Vishwavidyalaya, Mohanpur, West Bengal, INDIA
** Corresponding author's E-mail: pranay.pma@gmail.com*

KEY WORDS: Beverage crops, management, shade, regulations

ARTICLE INFO
Received on: 12.12.16
Revised on: 31.01.17
Accepted on: 02.02.17

ABSTRACT
Shade trees reduce the stress of beverage crops such as tea (*Camellia sinensis* L. Kuntze), coffee (*Coffea arabica* L.), cocoa (*Theobroma cacao* L.) etc. by ameliorating adverse climatic conditions and nutritional imbalances, but they may also compete for growth resources. For example, shade trees buffer high and low temperature extremes by as much as 5°C. Shade tree selection and management are potentially important tools for integrated pest management because increased shade may increase the incidence of some commercially important pests and diseases (such as *Phythphora palmivora* and *Mycenaci tricolora)* and decrease the incidence of others (such as *Colletotrichum gloeosporioides* and *Cercospora coffeicola)*.The relative importance and overall effect of the different interactions between shade trees and beverage crops are dependent upon site conditions (soil/climate), component selection (species/varieties/provenances), belowground and aboveground characteristics of the trees and crops, and management practices.

Introduction

Shade management is one of the important aspects in crop production of coffee (*Coffea arabica* L.), tea (*Camellia sinensis* L. Kuntze) and cocoa (*Theobroma cacao* L.). Because it regulates temperature, minimizes drought, serves as wind break, reduces the radiation injury, helps in the circulation of nutrients, causes less pest incidence, generates additional income by way of timber and finally improves the quality of produce. In order to get good quality produce, shade trees are regulated by lopping or pollarding, pruning, thinning and finally removal of shade trees.

Desirable characteristics of shade trees

- Compatibility with the crop, which means minimal competition for water, nutrients and growing space.
- Strong rooting systems (Not susceptible to wind throw).
- Tolerant to adverse climatic conditions: shade trees are more exposed to adverse climatic conditions than trees in a forest or a plantation and should be capable of adaptation to open-grown conditions.
- Ability to fix nitrogen.
- Non-brittle branches and stem.
- Thornless stem and branches: it helps to facilitate easy management.
- Rapid apical growth.
- Self-pruning and the ability to form a straight unforked stem in open-grown conditions.
- Tolerance of repeated heavy pruning or pollarding.
- High biomass productivity of material that is recycled through leaf fall and/or pruning.
- No allelopathic properties
- Free from major diseases or insect susceptibility which could lead to sudden defoliation.
- Valuable wood, fruit or other product, e.g. rubber from *Hevea spp.*

- Not an alternative host for insects and pathogens which are major enemies of the crop.
- Shade tree species should not have the capacity to become a weed, e.g. *Recinus communis* etc.

Shade management in coffee

- Coffee is a shade loving plant.
- In India, it is grown under indigenous naturally established shade trees.
- The coffee in South Indian conditions is grown on hill slopes and the intense tropical rains; the light intensity beyond certain limits is harmful to coffee.
- Growing coffee under open light or thick shade is having definitely harmful effects.

Fig. 1. Adequate multiple shade protects coffee during dry period

Fig. 2. Coffee under open condition

Earlier till 1880 it was grown under open crop but the outbreak of coffee white stem borer and coffee leaf rust made coffee to grown under shade.

Shade requirement for Arabica coffee

The requirement of shade in coffee is different for both the species of Arabica and Robusta coffee.

- Arabica requires more shade than Robusta because Arabica is very sensitive to high temperature and also high light intensity resulting early senescence of leaves defoliation necessitating its cultivation under shade.
- The optimum temperature for growth and development of Arabica coffee is 15-24^0 C. Arabica coffee requires 50-60% of filtered shade for maintaining good and consistent yield.

Shade regulation

Time of shade regulation

- The Arabica plantations at higher elevations >3700 m, having two tier/ two leaves of shade canopy the regulation could be under taken during the month of February or March after crop harvest.
- However, to avoid the incidence of white stem borer (WSB) during March to May months, it is advisable to undertake shade regulation during the last week of May or June in the South-West Monsoon and during the month of July for the North-East monsoon conditions.

Maintenance of monoculture shade *i.e.* silver oak shade has to be discouraged.

- Because as it will not be helpful for maintenance of micro-climatic conditions as it does not provide adequate shade.
- Thereby it accelerates infestation of white stem borer incidence and leaf rust problems in Arabica coffee.
- In Arabica fields, the planting of silver oak monoculture shade trees should not be promoted at any cost.

White stem borer control

- Two tier or two level of shade canopy with indigenous mixed shade trees is must to reduce white stem borer spread and maintain consistent productivity.
- The blocks or estates exposed to western aspect should have shade canopy *i.e.* 0-70% and also the lower branches of shade trees should be maintained on the border rows and also the *Casurinan equisetfolia* or Silver oak could be planted in zig-zag manner as a wind belt to reduce the exposure to evening sun.
- In the entire Arabica field, establishment of lower canopy shade tree such as dadap is

must to protect the coffee from white stem borer problem and maintenance of micro-climatic conditions.

- Ficus species such as *Ficus glomerata* shade tree should be planted in Arabica estates, as *Ficus sps*. keep the micro climate conductive for coffee and also provide plenty of leaf litter biomass, which will improve the soil fertility and conserve soil moisture.

Dadap planting and Lopping

- If, the white stem borer incidence is low and the plantations maintained with lower canopy of dadap (*Erythrina lithosperma*).
- Dadap lopping should be under taken immediately after the onset of monsoon *i.e*. May month.
- Wherever the temporary shade tree such as Dadap is problematic, the alternative fast growing temporary shade trees *i.e. Tesbania* sps and *Mesopsis* sps could be planted.
- Under multiple cropping systems, ending upon the shade level the permanent shade trees could be maintained.

Fig. 3. Looping of Shade Tree

Shade requirement for Robusta coffee

- Robusta coffee also requires shade especially for un-irrigated field on account of its susceptibility drought, although it has tolerance to high light intensity and temperature to some extent.
- Shade trees have positive effects on micro-climate and soil biological properties, which are key to long-term sustainability of coffee eco-system.
- The optimum temperature for growth and development of Robusta coffee is 24-30^{0}C.

Fig. 4. Shade pattern in Robusta Coffee

Shade regulation

Time of shade regulation

- Normally the shade regulation could be done after the crop harvest and before undertaking light pruning of irrigated Robusta coffee.
- Shade regulation has to be done only after the receipt of 4-5" rainfall (100-125mm) for the un-irrigated Robusta coffee.

Types of shade regulation

- Shade lopping or thinning: to achieve optimum shade level, shade thinning or lopping could be done once in four years, depending upon the shade trees.
- Shade lifting: shade lifting has to be under taken once in every year wherever it is necessary based upon the conditions for 10-14 mts. (35-45,) above the coffee.
- Whiskering: chopping/filtering/trimming of small branches.

Some of the important shade trees preferred for coffee plantations

<u>Botanical name</u>

1. *Albizzia lebbeck* L.
2. *Albizzia moluccana*t L.

3. *Albizzia odoratissima* (L.f) Benth.
4. *Albizzia stipulate* (Roxb.)
5. *Albizzia sumatrans*
6. *Atrocarpus integrifolia* L.
7. *Chlorozylon swietenia* (Roxb.)
8. *Dalbergia latifolia* (Roxb.)
9. *Ficus infectoria* (Roxb.)
10. *Ficus nervosa* (B. Heyne ex Roth)
11. *Ficus retusa* var. nitida (Thunb.)
12. *Ficus tsiela* Roxb.
13. *Maesopsis eminii* Engl.
14. *Pterocarpus marsupiam* (Roxb.)
15. *Syzygium jambolana* Lam.
16. *Terminalia bellarica* (Roxb.)
17. *Sapondias mangiiera* (L.f.) Kurtz.
18. *Stereospermum tetragonum* DC.
19. *Cedrella toona* (Roxb.)
20. *Ficus glomerata* (Roxb.)
21. *Ficus retusa* L.
22. *Ficus tjakela* Burm. f.
23. *Acrocarpus fraxinifolians* Arn.
24. *Erythrina lithosperma* Miq.
25. *Grevillea robusta* A. Cunn.
26. *Gliricidia sepium* Jacq.

Recommended range of LUX

- Arabica= 700-900 µ E =55,000-70,000 LUX
- Robusta =1000-1200 µ E=75,000-90,000 LUX

Time of measurement:

- The LUX measurement needs to be taken between 12.00 to 2.00 PM above the canopy of coffee bushes.
- A minimum numbers of 50 reading have to be recorded per acre and average to be taken for assessing the shade requirement.

Shade management in tea

- Tea is a shade loving plant.
- The success of tea plantations depends on the adequate and uniform yearly distribution of rainfall and soil moisture. This is where shade trees come in.
- Shade regulates temperature, minimises drought, serves as wind break, reduces radiation injury, helps in the circulation of nutrients, causes less percent incidence, and generates additional income by way of timber and fuel.

Fig. 5. Drought adversely affects tea bushes in open conditions

Fig. 6. Regulating the shade of Silver oak through pollarding is essential in managing tea estates Silver oak best suitable tree for tea plantation due to following reasons

- Silver oak (*Grevillea robusta)* has evolved into perhaps the most preferred shade tree species in tea plantations.
- Its unique leaves effectively filter light and provide enough shade during the dry months, because of its deep roots, Silver oak does not complete for nutrients and moisture with the tea plants.
- Moreover, it can withstand pollarding, lopping and de suckering.

- It recovers and grows fast, is immune to common pests and diseases, and can serve as windbreaks.

Fig. 7. Shade regulation and looping

Fig. 8. Ring barking in shade trees

Carbon sequestration potential of trees

- Integrating shade trees in tea plantations is a low-cost but effective carbon sequestration strategy.
- It is estimated that a 20-year old silver oak shade tree can sequester up to 41.8 Mg/ha of carbon.
- Planting silver oak as shade trees in the plantations of Western Ghats is a near-perfect example of complementary resource sharing in perennial agro forestry systems.

Shade management in cocoa

- A multitude of shade trees and combinations are possible.
- Usually a combination of permanent and temporary shade tree is planted to provide shade for cocoa.

The subject of shade management systems is a rather complex issue because

- The cocoa tree is not what might be termed a robusta type of either in its vegetative or sexual parts and compared with those yield para rubber, tea, coconut and even cinchona, proves to be relatively weak when exposed to serve conditions of air or soil.
- The leaves are when young easily torn by strong wind and the tender flowers readily detached by heavy rains and wind.

Cocoa requires constant strong light

- Cocoa requires constant strong light in order that the leaves may perform their proper functions.
- The flowers are effectively pollinated and disease be kept in check.
- Cocoa requires more or less continuous shade during vegetative and once in plantation is in bearing & the branch of adjacent begins to overlap and constitute self shade.

Shade requirement

- Cocoa need more shade during their vegetative period that is about 60-70% and it requires less shade during their stage that is about 30%, because once it reaches its reproductive stage its constitute shelf shade thereby it lessen the shade requirement
- A combination of *Gliricidia* and *Casuarina* provide adequate shade in 6-7 months.

Shade regulation

- A good result is obtained when the shade is regulated in such a manner that the light is not allowed to play on the cocoa to its maximum variation.
- If the branches of the shade trees are lopped at the beginning of the dull rainy season and allowed to retain their foliage during hot dry season.
- The cocoa receive additional light during dull weather when the period of maximum flower production and setting of fruits occur.

Benefits of shade trees

1. Consequences which facilitate crop management.

- Suppression of weed growth
- Product diversification, e.g. fruits and timber
- Control of crop physiology, e.g. fruit setting and maturation
- Shade may improve the quality of crop
- Prevention of overbearing results in less variable annual yield

2. Beneficial influences on the hydrological cycle

- Reduction of evapotranspiration of the shaded crop
- Removal of access soil moisture by transpiration of a heavy shade tree cover

3. Protection of the crop from pathogens, insects and adverse climatic conditions

- Extension of the productive life of the crop
- Reduction of damage caused by hail and heavy rain
- Reduction of some diseases, pests and parasitic plant infestation
- Reduction of wind velocity in the crop strata

4. Improvement of soil fertility and / or soil protection

- Reduction of erosion on slopes
- Reduction of the decomposition rate of soil organic material
- Nitrogen fixation by shade tree root nodules
- Recycling of nutrients which are not accessible to the crop

Disadvantages of shade trees

1. Consequences which hinder crop management

- Natural fall of branches and trees will damage the under story crop
- Sudden defoliation of the shade trees by insects are diseases, could cause severe shock to shade adopted crop
- Additional manual labour is necessary for combinations where the trees are regularly pruned
- Mechanization of the underlying crop is hampered
- Establishment of erosion control structures is hampered once the trees are established
- Heavy shading can reduce the quality of a crop

2. Promotion of adverse influences such as pathogens, insects and detrimental environmental conditions

- Reduced air movement and increased humidity may favour fungal diseases
- Insect attack may be greater when the crop is shaded
- Allelopathic effects
- Shade trees can act as alternative hosts for pests and diseases

3. Reduction in soil fertility and increased erosion

- Shade tree root compete for nutrients
- Stem flow and the drip of rain drops which coalesce on shade leaves can adversely redistribute rainfall thus increase in erosion, crop damage and reducing moisture absorption by the soil.
- Harvesting of fruit and /or wood from the shade tree constitutes an additional drain of nutrients from the site.

Conclusion

Shade management plays an important role in beverage crops in order to achieve higher crop yields and also to get good quality produce. Selection of desirable shade trees and their proper management increases crop yield to a great extent. Too much or thick shade in beverage crops also depresses the crop yields. Maintenance of judicious and optimum shade level helps in getting the good quality produce and high sustainable yield.

How to cite this article?

Pranay Kumar. 2017. Shade management in beverage crops. *Innovative Farming*, **2**(1): 26-31.