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Review Article

Micro-Climate Requirements for Tea (*Camellia L. SSP*) Bushes in Fields

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Abstract

Micro-climate requisites for tea bushes and their implications are discussed with reference to adaptive mechanisms developed during its evolution under humid ever green forest conditions.

Keywords

Tea shade; Microclimate.

Introduction

Tea, in its natural habitat, is seenunder forest floor in humid zones in acid soils low in minerals. As such it has developed, during the course of evolution, certain adaptive mechanisms to circumvent the constraints posed by ecological restrictions for survival. Some important of them are; It lacks vacuolar loading and unloading mechanisms and as such tea is very sensitive to salinity conditions. Also it uses photosynthates for osmotic regulations in leaf tissues and imbibed silicon aided C_4 mechanism demanding higher potassium concentration for assimilation and release of carbon-di-oxide for photosynthesis -its low root CEC compared to other dicots helps to increase the efficiency of Potassium uptake in base deficient soil medium. Natural tea habitats receive high cosmicradiations due to the latitude and altitude factors and the forest shade protected it from radiation injury.Tea is also sensitive to high temperature injury, desiccation and salinity. Tea is therefore normally grown under shade in commercial gardens.

Functions of Shade

1. The density and intensity of cosmic radiations in the atmosphere increases with latitude and altitude and it is more intense as the humidity goes down. The radiation and high temperature damages are felt more in western aspects in hilly terrain and is more pronounced in Northern hemisphere than in the southern one. The shade trees are said to cut off radiation damage to a distance twice its height. Radiation damage can occur with or without visible symptom
2. Twenty to thirty percent of light incident on leaves is reflected back to atmosphere and out of 70% absorbed, five % is used for photosynthesis and the rest is converted to heat which raises tissue temperature.The rise in temperature may go as high as by 15^0C and,more so in horizontal leaves and under conditions of restricted heat dissipation (transpiration and evaporation).This occurs irrespective of wind velocity and relative humidity, although they reduce the damages to some extent.

   Shade reduces the rise in leaf temperatureto two to three degrees, well under lethal levels compared to 13 to 15 degrees in open sunshine and this helps to tide over dry monthscomfortably whenreduced transpiration arising from soil moisture deficit restricts heat dissipation. NPP (net photosynthesis production) in tea declines sharply above 35^0C, reaching a plateau of zero level between 39 and 42^0 C and there after it is negative as the respiration continues up to 48^0C till the system completely packs off. Even in hilly terrains, during March to June, the ambient temperature reaches 28^0C and above for several days and the shade helps to maintain temperature regimes in plant tissues particularly that of foliage below lethal levels. In Assam plains, the ambient temperature even during monsoon months may

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linger around 30 to 32^{0}C and go as high as 40^{0}C for several days during July to October and the shade is a must under these conditions for the tea to optimize the performance of its physiological functions. On the other side it helps the pluckers from high temperature distresses while harvesting in fields day after day. A low shade rises temperature at micro levels and helps to reduce the low temperature damages in frost prone areas

3) Shade tree litters and loppings retained in the field amount to 4.5 tons per ha per annum.This constitutes 50% of the total organic matter recycled in tea cultivation system. Soil organicmatter preserves soil tilth-synonym for soil fertility on which all crop husbandry and nutritional practices are evolved to maximize productivity

4) The indirect benefits of shade resulting from its effect on ambient, leaf and soil temperatures and their effect on soil OM and growth of plants are a) increase in water holding capacity of soils, b) buffering effect on soil temperature, and c)a greater flexibility in available period for pruning.

5) Shade helps to reduce build -up of mites during dry months but increases the intensity of Blister Blight, a fungal disease during rainy months. A regulated shade concept was developed and is in use in areas where the twin problem co-exist as in mid elevation estates in South India and Sri Lanka. It involves thinning shade by cutting branches (locally known as lopping or pollarding) prior to monsoon to allow light penetration during wet periods and allowing them to re-foliate prior to entering into dry period to give adequate shade during dry months. The shade tree selected has to stand repeated pollarding and capable of quick re-foliation without defoliation during dry months. A high C/N ratio of leaf fall from shade trees is desirable as they stay for a longer time as soil mulch and also decomposes slowly releasing nutrients to sustain their availability on the long run. On the other hand Tea leaf fall with their low C/N ratio decompose fast meeting the short term needs. Silver oak (*Grevillearobusta.)*fulfills the above requirements and is widely used as the shade tree. Because of its deep roots, Silver oak does not compete for nutrients and moisture with the tea plants.

In North east India with high water table and where more diffused shade is required, *Albizzia ssp.* and *Acacia ssp.* are widely used for shade purposes. Experiments with live and artificial shade in Sri Lanka, South Indiahave shown that the shade to give about 60 % of the light intensity as seen in the open is optimum for efficient physiological performance of growth related functions. A well regulated shade in tea gardens solves more than 30% of crop husbandry problems encountered in its cultivation. Some of the observations made on the effect of shade in South India are given in Table 1.

Table 1: Effect of shade on certain *parameters

	*Parameter	High elevation-marginal rain fall	Mid-elevation- High rainfall
1	*Mean ambient annual temperature*	Reduction by 0.5 to 1.4 C	Reduction by 3 to 6 %
2	*Mean ambient temperature @ 8.00 hr*	Reduction by 0.1 to 0.3 C	Reduction by 3 to 7%
3	*Mean ambient temperature @ 15.00 hr*	Reduction by 0.7 to 1.3 C	Reduction by 3 to 9 %
4	*Relative Humidity*	Very marginal	Increase by 3 to 9 %
5	*Winter crop/dry months*	Reduction in crop	Mean 10 % increase , maximum up to 16 %
6	*Crop in other periods*	Increase in crop up to 5%	Marginal effect
7	*Annual crop:*	Mean 2% increase on a 5 yr. cycle	Mean increase 6±4 % significant at P=50

Summing up Tea has adapted itself to optimize the performance of its physiological functions forthe environment in which it has evolved. In commercial gardens, the shade helps to keep tea's physiological functions at optimum for sustainable productivity management.

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