BioThink, Vol -2, Issue -2
ISSN: 3048-7943

Impact of canopy regulation on microclimate and quality fruit production

M. P. Ellampirai [1]*, Subramanian Manivannan[2]

1,2Department of Horticulture, school of Life sciences, central university of Tamil Nadu, Thiruvarur, TN, India.

Introduction

The complex of temperature, radiation, humidity, and wind is known as the microclimate. Translocation of the plant metabolism, respiration, transpiration, and photosynthesis are the primary determinants of the quality of fruit produced by canopy control mechanisms. In order to create color and secondary metabolites in the fruit crop, light must be intercepted and distributed by the canopy control mechanism. According to Haile (2001), canopy architecture maximizes radiation interception to boost plant fitness and competitiveness, hence increasing agricultural output.

Canopy Microclimate

Canopy regulating processes change the canopy microclimate. It changes more than just the amount of sunshine. Other variables that are altered include temperature, humidity, evaporation, and wind speed (Smart 1985). Fungal infections in plants are a result of altered evaporation rates (English *et al*., 1989). The amount and quality of light within the canopy is the most important aspect of the changed microclimate. lowering leaf area and raising the percentage of canopy gaps to avoid the shade.

Effect Of Canopy Microclimate

When there was a wide exposed canopy surface, the canopy density decreased and the amount of sunlight interception increased (Shaulis *et al*., 1974). Increased yield and biomass output result from more solar energy being captured by the vegetation. It is not a good idea to place canopies so near to one another that the bases of the canopies are overly shaded. It is better to have vertical canopies. For high-quality production, the fruit needs to be exposed to sunshine. According to Kliewer *et al.*,(1988), grape grapes grown under shaded canopies had lower amounts of sugar, tartaric acid, phenol, and anthocyanins and higher levels of K, PH, malic acid, and botrytis bunch rot. According to Morrison's (1988) research, cluster shadowing reduces anthocyanin levels and phenols, whereas leaf shading affects berry size, sugar, K, and PH. Shade reduces the amount of monoterpenes in fruit and gives grape wine a herbaceous flavor. Changes in the microclimate cause variations in fruit content. High canopy density and less fruit exposure enhance the prevalence of botrytis (Gubler1987). The light microclimate in the renewal zone is crucial for grape yield expression. Reduced bud break, cluster initiation, fruit set, and berry size are the results of shading the renewal zone, which is the base of the shoot that is kept during winter pruning. Reproductive and vegetative growth must be balanced. This shows that photosynthesis is divided between fruit and shoot formation in a suitable manner.

Light interception

The development of flowers and fruit is significantly influenced by light interception. The amount of light that the trees intercept determines the yield efficiency. The shape of orchards and canopy displays mostly determine how much light is intercepted overall (Wunche & Lakso 2000). The planting system, tree height, tree spacing, alley width, row orientation, leaf area index, and growing season duration are all included in the orchard design. The fruit's color and size are further enhanced by high light interception. When compared to the fruit found inside the tree, the fruit found on the periphery is larger and more visually appealing. Therefore, it's critical to effectively control the canopy.

Light Distribution:

The size and shape of the tree mostly determine how light is distributed. The distance between trees and the sun's elevation determine how much shade is cast between them. The more leaf area index there is, the less light can pass through the canopy. To produce fruit of superior quality, the tree canopy must have a sufficient dispersion of light. Because shadowing causes the synthesis of dry matter, total soluble solids, and fruit color to decrease. Producing high-quality fruit with consistent light distribution in the canopy is facilitated by the use of Y-trellis and the V-training system.

Relationship On Canopy Temperature

In plants, the metabolic developmental process is determined by temperature. Internode length increases as the difference between the highest and minimum temperatures widens, and canopy architecture is affected by diurnal oscillations. Cloud cover, height, time of day, and canopy architecture all affect the temperature of the air inside the canopy. The high rate of temperature causes turgor loss, water stress, and the potential for leaf damage. With a thin boundary layer that facilitates better heat transmission mechanisms, little leaves are cooler than larger leaves. The canopy architecture of the plant is altered by scale insect infestation, which lowers the leaf area index and interferes with precipitation while raising soil temperature and moisture content.

Relationship on Canopy Moisture

The canopy architecture, radiation, air, soil temperature, and wind all affect the moisture profile inside the canopy. Wetness of the surface plays a significant role in the development of pathogens. Dense canopies provide prolonged surface moisture and are conducive to the growth of pathogens. Variations in insect dispersal throughout the canopy are related to variations in relative humidity at different elevations (Haile 2001).

Relationship between microclimate, canopy architecture and pathogen interactions

The canopy architecture, host plant microclimate, and pest pathogen population have a complex interaction in which modifications to one relationship have an interacting effect on one or more relationships. Rainfall, temperature, and moisture are examples of weather factors that alter phenology and physiology, as well as canopy growth and structure and resistance to pests and diseases. Interactions have an impact on plant communities' structure, survival, and evolution as well as the terrestrial ecosystem's feedback to the global climate. Because of changes in canopy morphology, the microclimate inside a canopy varies during the growth season and differs from the weather outside.

Modifiaction Microclimate Using Mulches:

Using aluminum plastic film in alleyways for three months prior to harvest, Moreshet *et al.*,(1975) in Isarel discovered that the lower half of the tree had improved in terms of fruit size, color, and soluble solids. Using aluminum tar paper beneath a row of apple trees (Mclontosh, Cortland, and Spartan) in Poland, Mika (1980) enhanced the color of the fruit at the base of the trees. In Ohio, Doud and Ferree (1980) discovered that using metallic polyester film beneath the tree rows enhanced the color of the fruit on the lower portion of apple trees. Shaded leaves have fewer palisade layers and are thinner, according to Baldini *et al*., (1983). When Shahak *et al.*,(2001) applied reflective metalized polyethylene mulches on mangos, they noticed that the fruits' red coloration improved. Fruit crops experience more fruit and bloom dropping when there is more shade. Jackson and Palmer (1977) discovered a 36% decrease in flowering spurs. The amount of photosynthetically active sunlight that the canopy of peach and apple trees intercepts should be determined by a training system, according to Sansavini *et al.*,(1997). According to Suley (1980), apple fruit weight and soluble solid concentration are suppressed by shadow.

Advanced Techniques To Detect Microclimate Ecology

To identify the environment's microclimate, sophisticated technology is used. Using sophisticated microclimate modeling and mapping techniques, remote sensing methods are used to measure the ecosystem's three-dimensional structure and thermal composition.

The remote sensing technology known as airborne light detection and ranging is used to analyze the earth surface environment in three dimensions. It is employed for vegetation structure measurement. By the time the light pulse reaches the upper canopy, it is wider than a normal leaf, which means that some of its energy travels to lower layers and even the ground through the upper canopy. By accurately collecting return times and their location in the air, the sensor transforms the continuous waveform of returning energy into "discreet returns" and builds a three-dimensional point cloud of item positions. High-resolution information on topography, canopy height, and vertical vegetation structure that is spatially continuous over wide areas can be obtained using the point cloud. In order to provide comprehensive information about the entire vertical forest profile, certain LiDAR sensors record the complete waveform. Microclimate can now be mapped across huge areas and at precise spatiotemporal resolution for the first time because to advancements in remote sensing technologies. This expands our knowledge of how organisms and their environments interact at fine scales and advances our comprehension of how ecosystems and species react to changes in their surroundings on a larger scale.

Conclusion

The microclimate is crucial to the cultivation of high-quality fruit. Enhancing the parameterization of canopy microclimate contributes to a deeper comprehension of the relationship between microclimate and quality. It's a frequent misconception that high yield results in lower-quality wine; nevertheless, dense canopies can have their canopy microclimate improved while still increasing production and quality. For fruit production to be efficient without sacrificing fruit quality, the canopy control mechanism is crucial.

References

Alberto Palliotti, Sergio Tombesia, Oriana Silvestroni , Vania Lanarib, Matteo Gattic, Stefano Ponic.(2014). Changes in vineyard establishment and canopy management urged by earlier climate-related grape ripening: A review. Scientia Horticulturae 178 (2014) 43–54.

C.corelli, S.Sansavini.(1989). Light interception and photosynthesis related to planting density and canopy management in apple. Orchard and plantation system. Acta Horticulture 243.

Carlos L. Ballare, Carlos A. Mazza, Amy T. Austin, and Ronald Pierik.(2012). Canopy Light and Plant Health. American Society of Plant Biologists.Vol. 160, pp. 145–155.

D. Wang, J. Gartung. (2010). Infrared canopy temperature of early-ripening peach trees under postharvest deficit irrigation. Agricultural Water Management 97 (2010) 1787–1794.

E. A.Gladstone and N.K. Dokoozlian.(2003). Influence of leaf area density and trellis/training system on the light microclimate within grapevine canopies. Department of Viticulture and Enology, University of California, Davis. Vitis 42 (3), 123–131.

G. Sepulcre-Canto, P.J. Zarco-Tejada, J.C. Jimenez-Munoz, J.A. Sobrino, M.A. Soriano, E. Fereres, V. Vegad, M. Pastor.(2006). Monitoring yield and fruit quality parameters in open-canopy tree crops under water stress. Implications for ASTER. Remote Sensing of Environment 107 (2007) 455–470.

H.Mabrouk, H.Sinoquet.(1998). Indices of light microclimate and canopy structure of grapevines determined by 3D digitising and image analysis,and their relationship to grape quality. Australian Journal of Grape and Wine Research 4, 2-13, 1998.

Jean Stephan, Herve Sinoquet, Nicolas Dones, Nocolas Haddad, Salma Talhouk, Pierre.(2008). Light interception and partitioning between shoots in apple cultivars influenced by training Heron Publishing—Victoria, Canada Tree Physiology 28, 331–342.

Jones, H.G. (1983) Plants and Microclimate. Cambridge University Press.

Kara Annamarie Senger Lewallen, Dr. Richard P. Marini.(2000). Effect of light availability and canopy position on peach fruit quality.

M.B. 12. Peacock, J.M. (1975) Temperature and leaf growth In Lolium perenne. The site of temperature perception. Journal of Application. Ecology 12, 115-123.

Matthew Alan Jones.(2018). Using light to improve commercial value. Jones Horticulture Research (2018) 5:47.

Peter.R.Dry.(2000). Canopy management for fruitfulness. Australian Journal of Grape and Wine Research 6, 109–115.

R.R. Sharma, Room Singh.(2006). Pruning intensity modifies canopy microclimate, and influences sex ratio, malformation incidence and development of fruited panicles in ‘Amrapali’ mango (Mangifera indica L.). Scientia Horticulturae 109 (2006) 118–122.

Richard M. Bastias, Luca Corelli-Grappadelli.(2012). Light quality management in fruit orchads: physiological and technological aspects. Chilean journal of agriculture research72(4).