



Efficient Agri-horti farming system

for irrigated agro-ecosystem of western plain zone of Uttar Pradesh

M Shamim, Poonam Kashyap, A K Prusty, Nisha Verma, P C Jat, N Ravisankar, S K Dubey* and A S Panwar

ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut, Uttar Pradesh 250 110

The farming situations have the core characteristics of well-defined and unique microclimate. This facilitates ecological activities, habitations and types of crops to be grown. Such microclimate has both the surface and subsurface permeation. Microclimate, thus, becomes the inevitable component in any farmer participatory research because it governs the ecological processes like soil respiration, plant regeneration, wildlife habitat selection and nutrient recycling. Present article highlights the quantification of microclimatic parameters in different types of cropping systems, viz. Banana sole crop, Sugarcane sole crop, Poplar + wheat and Poplar + banana under western plain zone of Uttar Pradesh. Thus, the Influence of various crops and their combination on microclimate i.e. CO₂ (ppm), RH (%) and temperature was analyzed.

Keywords: Banana, Farming situations, Microclimate, Sugarcane

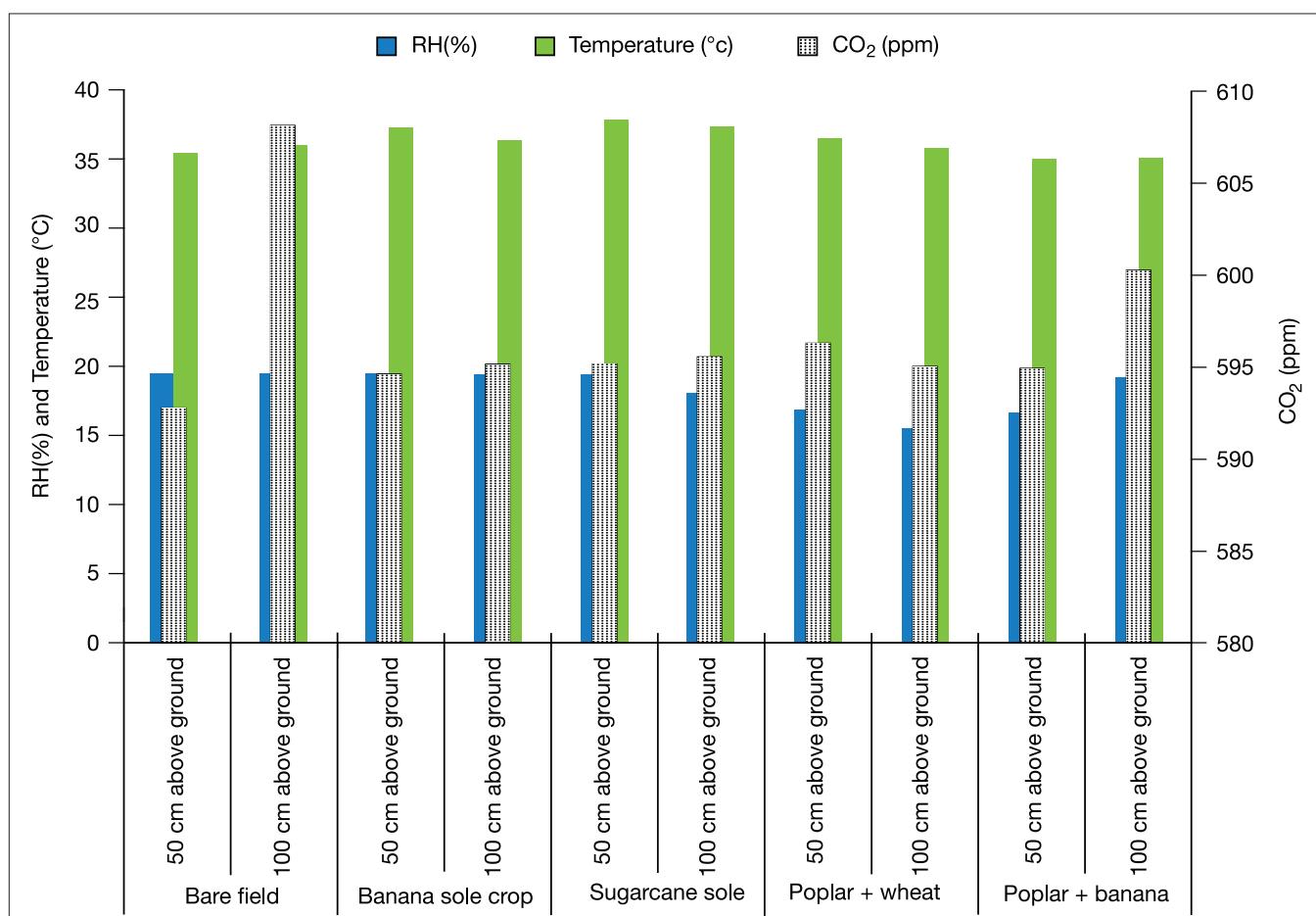
THE microclimate that prevails just few meters over the ground can be studied using environmental variables such as radiation, heat or ambient temperature, relative humidity, and wind speed. Microclimate can provide meaningful parameters for ecological activities, habitat and crop selection such as heliophytes (cereals, pulses etc.) and sciophytes (turmeric, zinger etc). It is closely related to the habitat, and has paramount importance for organisms such as livestock and other domesticated animals on a microscale. Hence, microclimate becomes an essential component in current research because it influences various ecological processes. Soil moisture, soil temperature, light intensity, soil acidity, air temperature, humidity, wind direction and CO₂ level are all important factors in agricultural productivity. These factors can be artificially modified to improve crop cultivation quality and productivity. Microclimate is not limited to the surface; it can also permeate the subsurface. Organisms can live anywhere; and everywhere they can create favourable microclimates and interact. Climate change causes not only an increase in global temperatures, but also a disaster for agriculture production and food security. Farming has become the most unbalanced sector because its production stability is so dependent on water availability. The interaction of human activities and natural processes in agricultural landscapes is required for progress and reinforcement of adaptive capability in response to climate change.

Parameters influencing agricultural productivity through microclimatic effects

Soil moisture, soil temperature and heat, air temperature, light flux, air humidity, wind direction and its speed are the major parameters which are having potential to influence the microclimate of the crops or livestock which ultimately affect the growth and yield through physiological activities. Adequate availability of soil moisture in the field works as primary factors in farm productivity. Soil temperature affects the crop through germination to harvesting because a certain amount of heat unit is required for germination to emergence of seedlings and for further reaching to each phenological stage. It also affects the microbial activities of the soil which are affecting the nutrient release pattern particularly in the case of phosphorus solubilising bacteria for releasing phosphorus and rhizobium for nitrogen fixation in leguminous crops. Soil microclimatic conditions such as temperature and humidity have direct roles in the success of mycorrhizal growth as more ectomycorrhizal growth has been reported at or below 14°C however more arbuscular mycorrhizal growth was reported at or higher than 14°C in a study. Therefore, nutrient release pattern is highly influenced by the microclimatic situation of the rhizosphere of the plants. The range of air temperature and its diurnal variation plays a vital role in deterring the crop growth and its duration for attaining the physiological



In situ observation of the CO₂ (ppm), RH (%) and temperature (°C)



Influence of various crops and their combination on microclimate i.e. CO₂ (ppm), RH (%) and temperature

maturity. Air humidity helps the plant in maintaining the turgidity through reducing the transpirational loss of the water. But higher atmospheric humidity may help in development of many insects and pest infestation. It also augments the growth of shoots and leaves at the cost of productivity of the crops. A good air circulation within the crop canopy is always desired to maintain the CO₂ level for photosynthesis, remove excess humidity thereby reducing the potential of diseases infestation which is possible through wind direction and its speed.

Effect of crops and trees on microclimate under Agri-horti farming system

Four crop environments, viz. Banana sole crop, Sugarcane sole crop, Poplar+wheat and Poplar+banana were undertaken under western plain zone of Uttar

Pradesh for quantification of the microclimate influenced by the different crop combinations. To quantify the variation in microclimate, *in situ* observations of CO₂ (ppm), RH(%) and temperature (°C) were recorded during clear sky mid-day at two heights i.e., 50 cm and 100 cm above the ground level. The microclimate condition at 50 cm above the ground in banana sole crop was found to be moderate with 594.2 ppm CO₂, 18.9% RH and 36.9°C temperature in comparison to bare field (592.6 ppm CO₂, 19.3% RH and 35.1°C temperature) and sugarcane sole crop (594.8 ppm CO₂, 19.2% RH and 37.7°C temperature). In Poplar-banana system significantly higher concentration of CO₂ (596.0 ppm) was recorded however, RH (18.2%) and temperature (35.6°C) were found lower than the banana sole crop. At 100 cm above the ground level, the highest CO₂ concentration (599.9

ppm) was recorded in Poplar+banana farming systems with 18.4% RH and 35.5°C ambient temperature followed by Poplar+wheat with 595.3 ppm CO₂. Better condition of banana crop was recorded under Poplar+banana forestry-horti system than in banana sole crop.

One cropping system such as Sugarcane+black gram-ratoon-wheat was grown with improved technological interventions and was compared with the net returns per hectare of benchmark data of predominant cropping system such as Sugarcane-ratoon-wheat (Table 1). Results of net income obtained from both cropping systems clearly showed net gain of ₹54,377/ha from Sugarcane + black gram-ratoon-wheat which was 55.0% higher than the predominant cropping system of the region. Turmeric was also grown with poplar as intercrop and it was compared with the net returns per ha of sole poplar productivity.

SUMMARY

The microclimate of the given crops and their combination reflected the fair to moderate condition. Banana crop was recorded better performing under Poplar+banana based forestry-horti system as compared to the banana sole crop. In another system of Poplar-banana, there was significantly higher concentration

Table 1. Effect of microclimate on productivity of Agri-horti farming system

Crop/cropping system	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)
Sugarcane + black gram-ratoon-wheat	3,17,181	1,64,000	1,53,181
Poplar sole	11,25,000	37,500	10,87,500
Poplar+turmeric	14,07,500 (20,000)*	50,000 (12,500) *	13,57,500 (7,500) *
Sugarcane-ratoon-wheat	2,62,225	1,63,421	98,804

*Figures in parentheses related to the turmeric crop.

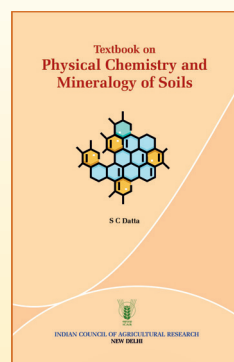
of CO₂ (596.0 ppm) although the RH (18.2%) and temperature (35.6°C) were lower as compared to banana sole crop. The combination of poplar+turmeric emerged as the most profitable combination as compared to others.

*Corresponding author's e-mail: skumar710@gmail.com

Textbook on Physical Chemistry and Mineralogy of Soils

Physical chemistry of soil and soil mineralogy are the two pillars which form the basic foundation of soil science. Once the students become familiar with these basic concepts, they can easily understand the other properties of the soil, say physical and biological properties, pedology and soil fertility. To become an expert of soil fertility, comprehensive knowledge of all the soil properties is essential which in turn is supported by the knowledge of physical chemistry of soils and soil mineralogy.

The present Textbook on 'Physical Chemistry and Mineralogy of Soils' has been written very cogently by the author who has been a teacher with an experience of nearly four decades of teaching in a premier Institute that is ICAR-Indian Agricultural Research Institute. The book includes all the topics prescribed by ICAR for the Postgraduate students of Soil Science. The introductory chapter describes basic definitions of soil science. Chapters like 'Bonding in solid structures', 'Elements of crystallography', 'Chemical thermodynamics' and 'Electrochemistry of soils and clays' are basic in nature and have been dealt very lucidly for easy understanding of students. Two chapters on characterisation of soil minerals are practical oriented. Other chapters focus on the structures of soil minerals, weathering and formation of minerals in soil environment, adsorption and ion exchange on soil colloids, double layer theory of soil colloids—its evolution and application, chemisorption and precipitation reactions in soil, soil organic colloids and their properties and chemistry of submerged soil. This book will be very much useful for the Postgraduate students of Soil Science.



TECHNICAL SPECIFICATIONS

No. of pages : i-xii + 348 • Price : ₹ 650 • ISBN No. : 978-81-7164-228-1

For obtaining copies, please contact:

Business Unit

Directorate of Knowledge Management in Agriculture
Krishi Anusandhan Bhavan-I, Pusa, New Delhi 110 012
Tel : 011-25843657, Fax 91-11-25841282; e-mail : bmicar@gmail.com