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Editorial

Micrometeorological measurements in agricultural research

Micrometeorological measurement systems have evolved profound transformations in last 50 years with development of wide range of sensor based instruments capable of recording and integrating digital values of biophysical parameters though fast response data loggers. The domain of modern measurement systems have expanded from conventionalmeteorological elements like temperature, humidity, wind speed, radiation, evaporation etc. to greenhouse gas (GHG) exchange (Eddy covariance system), dissipation rate of turbulent kinetic energy and momentum flux (Scintillometer) in the surface boundary layer as well as the typical surface properties like radiative temperature (infrared thermometer), surface wetness duration, spectral characteristics of vegetation surfaces etc. which are crucial to crop growth and development. These modern measurement systems have widened the domain of micrometeorology to emerging fields like energy, water and carbon balance, GHG emission, crop stress monitoring etc. at different spatial and temporal scales leading experimentalists to move into forays of considerable challenges.

Many of the agricultural research activities rely on discreet measurement of microclimatic parameters like temperature, radiation, humidity etc. within and above the crop canopies and their relationship with growth, development and productivity of crops. However, the representativeness of crop canopy, timing of measurements as well as interpolation and integration of discreet observations over the growth cycle of crops are three major issues critical to interpretation of crop- microclimate interactionin agronomic experiments.

In spatial scale the micrometeorological measurements will ideally represent the crop surface by careful adjustment of the geometry of measurement with respect to target canopy structure. While the field of view, exposure angle of instrument andsolar geometry play important role in defining the representativeness of radiation measurements, the direction of wind, intensity of turbulence as well as the roughness of the target surface largely define the footprint of instruments for the measurands like humidity and gas concentration through IRGA or other sensors that depend on the characteristics of surface boundary layer.For example, the popularly used infrared thermometer, can measure the temperature of a single leaf or a typical plant canopy or even the whole experimental plot by adjusting the distance between the sensor and the target surface. Similarly, the representativeness of aerodynamic properties like canopy vapour pressure, gas concentration etc. depend upon the placement of sensors with respect to height from the canopy surface, size of the experimental field unit and distance of measurement point from the edge of the plot or fetch length. It is worth mentioning that the crops grown in isolated plot experiments are prone to higher mass and energy exchange and thus, more water use and biomass production than that of real field scenario owing to advection effect under windy condition. This impact is more pronounced in pot experiments. Hence, it is always advisable to increase the plot size in agronomic experiments that allows reasonable fetch length for the development of a steady surface boundary layer above the crop surface within which micrometeorological measurements may become more representative.

The micrometeorological variables also show wide fluctuation in temporal scale. The diurnal variation of solar radiation often follows a predictable pattern which makes it possible to estimate the radiation utilization from discrete point measurements by adopting appropriate empirical transformation methods. On the other hand, the parameters like photosynthesis and transpiration rate, stress index etc. may record rapid fluctuations in diurnal scale. The time schedule of measurement should be synchronized with the active period of crop metabolic processes in diurnal as well as seasonal scale. Utmost care should be taken while drawing generalized conclusion on crop - microclimate inter-relation from the discrete point measurements recorded from the treatment plots in field experiments.

Despite all the delicate issues associated with the reliability of micrometeorological measurement systems particularly in field experiments, such research studies help in better understanding of crop response to the physical environment which is required for increasing efficiency production system. This also provides crucial inputs towards effective application of robust land surface process models (LSPM) in agriculture.However, adequate attention must be given to some critical issues of effective micrometeorological measurement and their application in agricultural research.

a) Periodic calibration of sensors and quality checking for reducing uncertainty and increasing accuracy of measurement

b) Optimum field size and geometry of measurement system with due consideration of 'fetch', 'footprint' and 'field of view' of instrument

c) Developing a standard protocol for timing of measurement, interpolation and integration of discrete point measurements for valid interpretation of crop-microclimate interaction

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