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Microclimatic studies in summer moong (*Vigna radiata L. Wilczek*) and bare fields

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सार — खाली खेतों के परिप्रेक्ष्य में ग्रीष्म कालीय मूंग की सूक्ष्म जलवायु के अध्ययन के लिए एक प्रयोग किया गया था। परिपक्वता की अवस्था की तुलना में एल्बिडो मान पुष्पन की अवस्था में अधिक पाए गए। वायु तापमान मान पुष्पन और परिपक्वता की अवस्था वाले खाली क्षेत्र (खेत) मानों की तुलना में फसल वाले खेतों में कम थे। औसत आपेक्षिक आर्द्रता विचलन, पुष्पन की अवस्था में 0800, 1000, 1200, 1400, 1700 बजे (भा०मा०स०) 1.8, 4.4, 5.0 और 3.6 प्रतिशत और परिपक्वता की अवस्था में 2.2, 3.0, 4.2, 3.8 और 3.2 प्रतिशत थे। फसल वाले खेतों में पवन गतिमान, खाली खेतों की तुलना में कम थे।

ABSTRACT. An experiment was conducted to study the microclimate of summer moong in relation to bare field. Albedo values were higher at flowering than maturity stage. Air temperature values were lower in cropped field than bare field values at flowering and maturity stage. The average relative humidity deviations were 1.8, 4.4, 5.0 and 3.6 per cent at flowering and 2.2, 3.0, 4.2, 3.8 and 3.2 per cent at maturity stage at 0800, 1000, 1200, 1400 and 1700 IST. The wind speed values were lower in cropped field than bare field.

Key words — Crop microclimate, leaf area index, yield potential, shortwave reflectivity.

1. Introduction

The potential productivity of a region is influenced by climatic factors, but the responses of plant are also infuenced by the immediate meteorological factors. These meteorological variables are continuously changing from top of the crop canopy up to the lowest layers of roots influencing the growth, development and yield.

Temperature changes drastically in the first few centimetres from the surface into the soil and into the air. Changes in humidity with elevation are greatest near the surface. Very large quantities of energy are exchanged at the surface in the processes as the ground surface is approached. Thus, there is great change in environmental conditions near the surface. Due to these environmental changes with time and elevation near the surface, the microclimate so differ. At few metres above the surface in free atmosphere, mixing processes are much active and the climate is both more moderate and stable.

The studies of Brown and Covey (1966), Johnson *et al.* (1976) and Baldocchi *et al.* (1983) revealed that the crop microclimate, influencing the growth and development is different from the open observatory microclimate. Therefore, it is essential to quantify the crop microclimate to improve the yield potential. An attempt has been made here to quantify the crop microclimate in summer moong in comparison to bare field data.

2. Material and methods

A field experiment was conducted at the experimental farm of Department of Agricultural Meteorology, Haryana Agricultural University, Hisar (Lat. 29° 10′N, Long. 75° 46′ E, 215.2 m a.s.l.) during summer season, 1989 to study the microclimate over summer moong crop in relation to bare field values. The moong crop was sown on 6 April 1989 with a spacing of 30 cm × 10 cm. All the basic inputs were supplied as per package of practices recommended for moong crop. The profiles of the dry and wet bulb temperatures, with the help of Assmann Psychrometer of Wilh. Lambrecht, West Germany, were recorded. The albedometer (Medoes and Co., Australia) was used for recording the shortwave reflectivity. The wind speed was recorded with the help of portable anemometer. These observations were recorded at 0800, 1000, 1200, 1400 and 1700 IST at ground, 20, 40, 60 and 80 cm height above the ground surface in cropped as well as bare field.

3. Results and discussion

3.1. *Shortwave reflectivity (albedo)*

Data pertaining to shortwave reflectivity of summer moong and bare field at flowering and maturity stage at 0800, 1000, 1200, 1400 and 1700 IST are depicted in Fig. 1. The albedo values were higher in evening and morning hours and lowest at noon hours at both the stages, *i.e.*, flowering as well as maturity stage in cropped

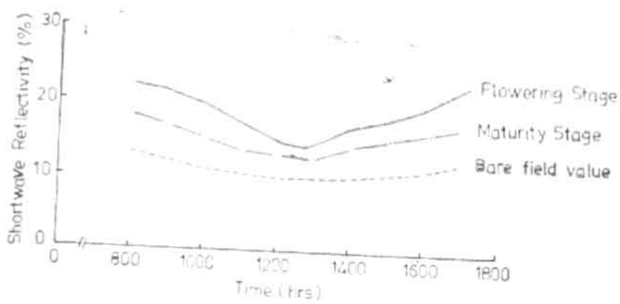


Fig. 1. Shortwave reflectivity over moong and bare fields at flowering and maturity stage

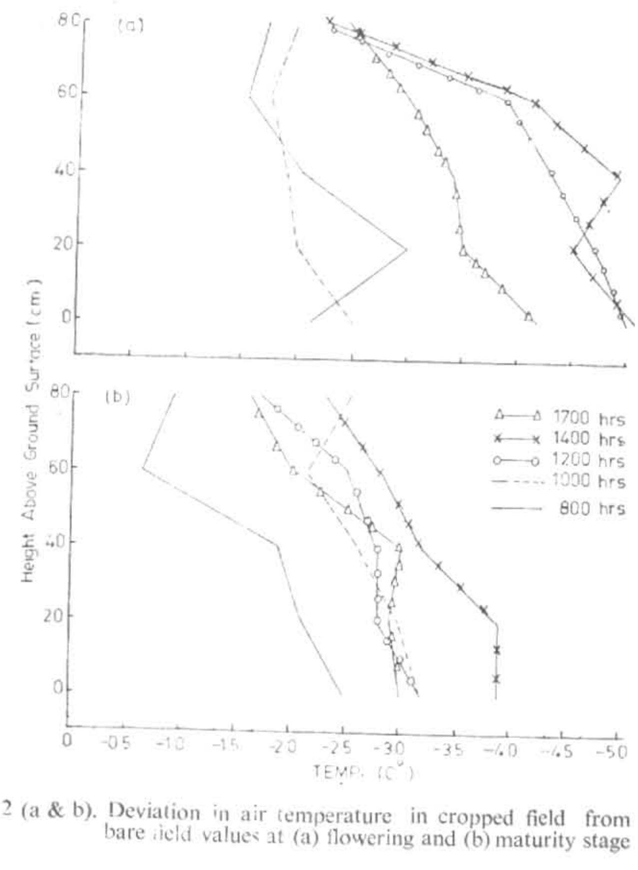
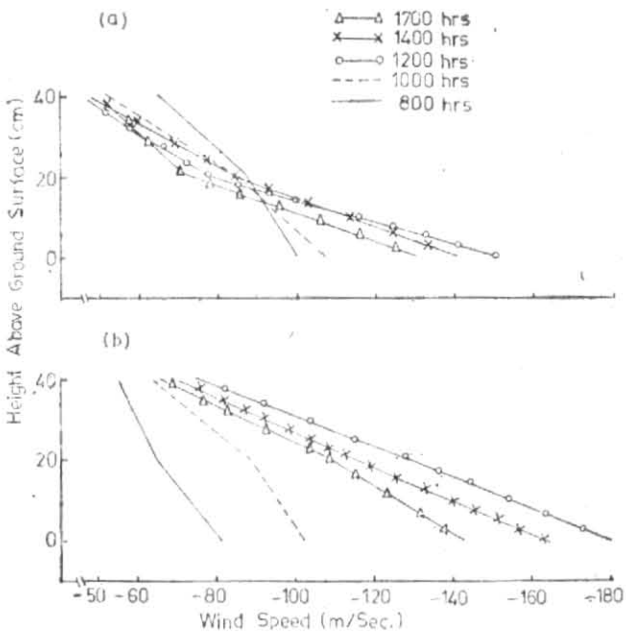


Fig. 2 (a & b). Deviation in air temperature in cropped field from bare field values at (a) flowering and (b) maturity stage



Figs. 3 (a & b). Deviation in wind speed in cropped field from bare field values at (a) flowering and (b) maturity stage

TABLE 1

Deviations in relative humidity (per cent) in cropped field from bare field values at (a) flowering and (b) maturity stage

Ht. above ground (cm)	0800 (IST)	1000 (IST)	1200 (IST)	1400 (IST)	1700 (IST)
(a) Flowering stage					
Ground	4	7	6	5	3
20	2	6	6	6	4
40	1	6	6	7	5
60	1	2	5	4	4
80	1	1	2	3	2
Avg. dev.	1.8	4.4	5.0	5.0	3.6
(b) Maturity stage					
Ground	4	3	6	5	3
20	3	3	5	4	4
40	1	2	4	4	4
60	2	3	4	5	3
80	1	2	2	1	2
Avg. dev.	2.2	3.0	4.2	3.8	3.2

and bare fields. This might be attributed to the oblique sun rays at noon hours. Similar results were reported by Ram Niwas *et al.* (1988) in *raya* crop. The albedo varied from 15 to 22 and 13 to 18 per cent in cropped field at flowering and maturity stage respectively. The bare field albedo values varied between 10 and 13 per cent. Albedo values were higher at flowering than maturity stage. It may be due to higher leaf area index at flowering as compared to maturity. Albedo values were higher over the crop at both the crop growth stages than bare field. The higher albedo values over crop may be attributed to the presence of green foliage in the cropped field.

3.2. *Air temperature profiles*

The deviations in air temperature values in cropped and bare field at 0800, 1000, 1200, 1400 and 1700 IST with different crop heights above the ground level at flowering and maturity stage are depicted in Fig. 2. The average deviation in air temperature values (4.16° and 3.22° C) were higher at 1400 IST as compared to morning and evening hours at flowering sand maturity stage respectively as shown in Figs. 2 (a & b). This might probably be due to more transpiration during noon hours which caused more cooling in the cropped field than morning and evening hours. In both the stages, the temperature deviations are very less in morning hours. During morning hours, the temperature deviations were inverse of lapse rate from 60 to 80 cm (above crop canopy). Among the two stages, the deviation in temperature values were higher at flowering stage. The possible reason might be the higher leaf area index (LAI) at flowering stage resulting in more transpiration and less energy available for sensible heat. Also, the cooling effect due to more transpiration might have contributed to lower temperatures inside the canopy at flowering stage as compared to maturity stage.

The negative sign of deviation values showed that the air temperature was lower in cropped field than bare field. Similar trend in deviation have earlier been reported by Ram Niwas *et al.* (1989) in *raya* crop.

3.3. *Relative humidity profiles*

The deviations in relative humidity values were higher at flowering than maturity stage as shown in Table 1 (a & b). The average deviation during noon hours (5%) was higher than morning (1.8%) and evening hours (3.6%) at flowering stage. Similar trend was observed at maturity stage (Table 1b). The relative humidity showed a reverse trend than that of air temperature. The positive sign of deviation showed that relative humidity was higher in cropped field than bare field. Similar trend was reported by Shriniwas (1984) in rice crop.

3.4. *Wind speed profiles*

The deviations in wind speed in cropped and bare fields at 0800, 1000, 1200, 1400 and 1700 IST at different crop heights above the ground level at flowering and maturity stage are depicted in Figs. 3 (a & b). The deviation in wind speed increased with the advancement of the day up to noon hours, but afterwards, the deviation gradually decreased. At flowering stage the deviation, in wind speed decreased from 151 to 2 m/sec from ground to top of the crop canopy at 1200 IST. This deviation at maturity stage changed from 180 to 4 m/sec. This might be attributed to large obstructions to wind speed caused by biomass present in cropped field. In both the stages, at crop height, the wind speed deviations were very less when compared to near the surface. Above the crop canopy, the wind speed is almost same in cropped as well as bare field as there was no vegetative obstruction in the cropped field above canopy. The negative sign in deviation values showed lower wind speed in cropped field than bare field. These results were in full agreement with the earlier reports of Singh (1981) in *arhar* and Ram Niwas *et al.* (1989) in *raya* crop.

4. Conclusions

During summer season, the high temperature and low relative humidity significantly influenced the growth and development of moong crop. In cropped field temperature values were lower and relative humidity data were higher in comparison to bare field. The wind speed values were low in cropped field.

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