Journal of Agrometeorology 8(1) : 117 - 120 (June 2006)

Short Communication

Variation of relative humidity and vapour pressure within wheat canopy

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Humidity in the atmosphere is of great biological importance. Hoffman (1973) has shown that atmospheric humidity influences the internal water potential of plants and the rate at which plants transpire water into the atmosphere. Humidity conditions also affect the growth and development of many phytopathogens, especially the fungal organisms. So the present investigation was undertaken to study the relative humidity and vapour pressure profiles within wheat canopy during daytime hours.

A field experiment with wheat (*Triticum aestivum* L) variety UP2338 was conducted during the post-rainy (*rabi*) season of 1997-98 in G-3 block at the Crop Research Centre of the G.B. Pant University of Agriculture and Technology, Pantnagar, U.P. (29°N, 79°30'E, 243.83 m a msl). The climate of the region is humid subtropical, characterized by dry hot summer and cool winter. The crop was sown on 24[th] November 1997 in a north-south direction, well fertilized and irrigated.

The vapour pressure and relative humidity were measured with the help of an experimental set up made of thermocouples installed on a wooden support. One thermocouple junction was maintained wet through a wick dipped in a water reservoir and the other was suspended vertically in the open air to serve as wet and dry bulbs respectively. The wet and dry bulb temperature were measured at three heights *viz.*, 0.15 m, 0.6 m and 1.25 m above the ground surface *i.e.* within and above the crop canopy. A flask containing ice served as reference temperature source for both dry and wet bulb thermocouples. The flask was buried ¾th in the soil within the crop canopy along with the wooden stand. Measurements were made at hourly intervals throughout the observation day.

The electromotive force (E.M.F.) produced due to temperature difference between the measuring and the reference junctions was observed with the help of a DC microvoltmeter, which was then converted to temperature from the already established calibration curve. The actual vapour pressure (e_a) was calculated using the formula: $e_a = e_w - A.P.(T_d - T_w)$ where, e_w = Saturation vapour pressure at the temperature of the wet bulb, T_d = Dry bulb temperature(°C), T_w = Wet bulb temperature (°C), P = Barometric pressure of the air in mb for given altitude = 984 mb, A = Psychrometric constant which depends

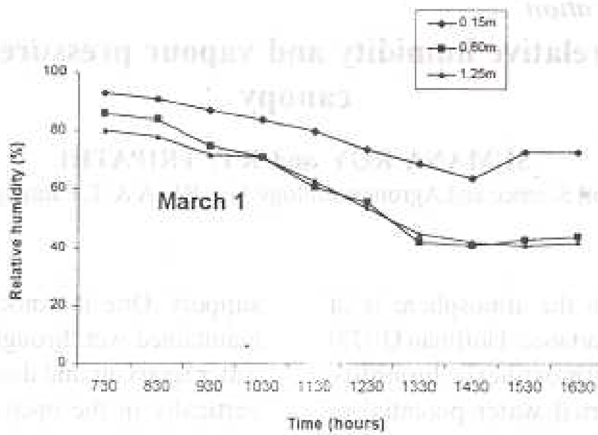

Fig. 1. Temporal variation in relative humidity within and above wheat canopy

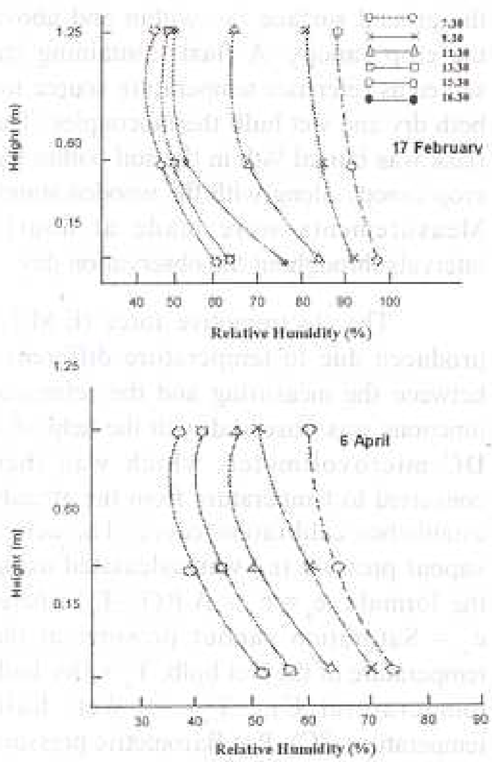

Fig. 2 : Profile of relative humidity within and over wheat canopy

on type of ventilation of the wet bulb = 0.0008 in this case.

The relative humidity (R.H.) was then calculated using the relation:

R.H. (%) = $[(e_a/e_s) \times 100]$ where, e_s is saturation vapour pressure at dry bulb temperature (T_d).

The daytime RH (March 1) within and above the wheat canopy (Fig.1) shows a general decrease from morning to 1230 h followed by almost a constant value until 1430 h. The RH was 96% at 0730 h, which decreased by 37% during noon hours. However, RH increased by 3% at 1630 h to that at 1430 h.

Relative humidity decreased with height as observed on Feb 17 and April 6 (Fig. 2). Changes in RH from 0730 h to 0930 h were small (8.5 to 12 %), the variations (shift in the curve towards left) were almost constant and the curves move parallel.

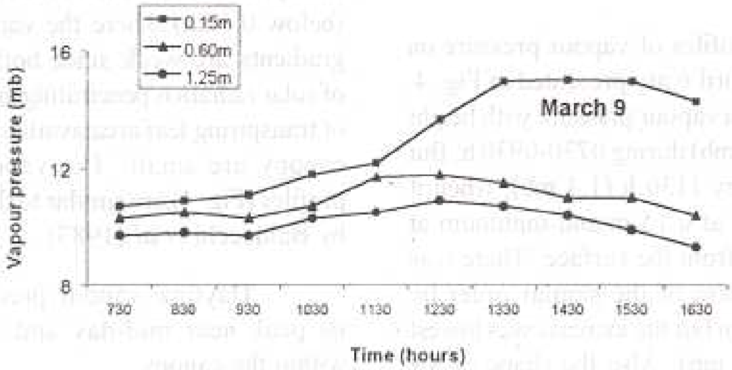

Fig. 3 : Temporal variation in vapour pressure within and above wheat canopy.

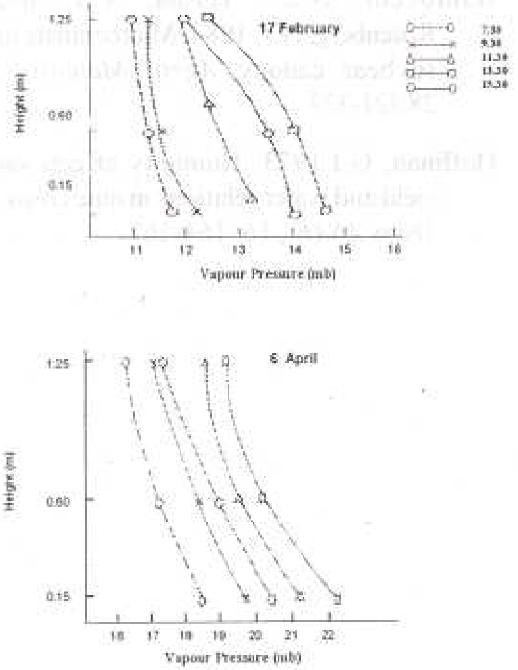

Fig. 4: Profile of vapour pressure within and over wheat canopy

Humidity profile at 0930 h was just a reduced image of that at 0730 h. However, by 1130 h the reduction in RH was almost of the same order as was between 0730 and 0930 h. the variations become much larger at 0.6 m followed by that at 1.25 m. By 1330 h the daytime conditions influenced the RH such that further reduction from 1130 h was almost same throughout the depth. At 1530 h the reductions were very small. By 1630 h this slow reduction in humidity reversed and RH increased throughout the height above the surface. The increase was however largest at 0.15 m. on April 6 near maturity of the crop, when the canopy became less dense and soil moisture content reduced than on Feb. 17, the changes in RH were small both spatially and temporally. Also, the magnitude of RH decreased than on Feb. 17.

The daytime vapour pressure within and above the wheat canopy increased continuously from morning (on

March 9) and reached its pick near mid-day (Fig. 3).

The profiles of vapour pressure on Feb. 17 and April 6 are presented in Fig. 4. The variation in vapour pressure with height was small (0.7 mb) during 0730-0930 h. But became large by 1130 h (1.4 mb), when it was maximum at 0.15 m and minimum at 1.25 m height from the surface. There was a further increase of the similar order by 1330 h at 0.15 m but the increase was lowest at 1.25 m (0.4 mb). Also the shape of the curve, which was concave during 0730 h to 1130 h, became convex thereafter. On April 6, the changes in vapour pressure with time of the day were almost same throughout the crop height and shape of the curve was always concave.

Vapour pressure profiles on Feb. 17 exhibit two distinct segments during the sunlight hours. (a) An upper segment (above ~ 0.50m), where the gradients are strong because of intense solar heating and transpiration rate and (b) A lower segment (below 0.50m) where the vapour pressure gradients are weak since both the amount of solar radiation penetrating and the amount of transpiring leaf area available in the lower canopy are small. The vapour pressure profiles (Fig. 4) are similar to those observed by Baldocchi *et al* (1983).

Daytime vapour pressure reached its peak near mid-day and was greatest within the canopy.

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Table 1 : Correlation and regression between weather parameters (X) and the development of smut severity (Y)

Sr. No.	Weather parameter	r	Regression equation
1.	Max. temp.	0.82**	Y= 122.65 – 3.54 X
2.	Min. temp.	0.47**	Y= -57.31 + 2.82 X
3.	Mean temp.	-0.59**	Y = 195.79 – 6.71 X
4.	Relative humidity	0.80**	Y = 43.18 + 0.634X
5.	Total rainfall	0.78**	Y=2.98 + 0.02 X
6.	No. of rainy days	0.82**	Y=-2.085 + 0.59 X
7.	Average sunshine hours	0.82**	Y=19.125 – 1.52 X

** Significant at p=0.01

that the temperature, relative humidity and wind speed are the principal environmental factor in influencing production and dispersal of *Tolyposporium penicillariae* sporidia.

Regression equation revealed that the infection and development of smut sori occurs in between 20-35 °C. Regression equation between humidity and smut severity shows that the disease appears only when the average humidity increased above 68% and there after every one per cent increase in humidity will result in increase of smut severity by 0.63 per cent. These finding are supported by Thakur and King (1988), who reported that smut infection and spread are most favoured by the prevalence of high relative humidity (>80%) and optimum temperature (25-30 °C) at the flowering stage of the crop.

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