STUDIES ON THE EFFECT OF SATURATION DEFICIT ON THE YIELD OF TEA

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Abstract:

The study was done to see the effect of saturation deficit on the yield of tea during the production period (April-October) in 2003. The meteorological data were averaged on 7 day interval to correlate the yield and saturation deficit which was also collected in 7 day interval. From the study it was found that saturation deficit (SD) has negative effect on yield of tea. The correlation coefficient between them is r =-0.77 which was statistically significant at 95% level of significance. Moreover effect of saturation deficit (SD) on evaporation was also studied. The study showed the positive correlation between SD values and evaporation also this was statistically significant at 95% level of significant. There was no significant relationship among saturation deficit, rainfall and evaporation.

Introduction:

Saturation deficit is the difference between the actual vapour pressure of the moist air sample at a given temperature and the saturation vapour pressure corresponding to that temperature. It may be called dryness of the air. It is one of the important climatic variables which determined the potential growth of plant (Stepens, Othieno & Carr 1992). It is the difference between the pressure exerted by the water vapour actually present in the atmosphere at a given time and given temperature and the pressure that would be exerted if the atmosphere were saturated with water vapour at the same temperature (Weaver and Clements, 1973). Temperature is the major environmental factor affecting shoot growth and photosynthesis, hence closely linked to the influence of temperature is the influence of large saturation deficit. Squire (1979) in Malawi showed the adverse effect of high saturation deficit on shoot growth of tea. Dry air can result in minimum shoot water potential at midway even when soil moisture is close to field capacity. Carr (1992) identified a critical mid day value, 2.0 kPa beyond which

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shoot growth reduced linearly. Tanton (1982b) also came to the similar conclusion but the critical saturation deficit was 2.3 kPa at air temperature of 25 °C or 30 °C which corresponded to relative humidity of 28%, 45% respectively. Shoot water potential affected shoot extension through its effect on cell turgor. Carr and Williams (1992) have pointed out the practical implication of high SD on lack of response to irrigation in a dry atmosphere and this is one reason why irrigation cannot substitute entirely for rainfall. Saturation deficit in the afternoon exceeded 20 mb (2.0 kPa) on certain days in March and April at Addabari T.E. in the North Bank of the Brahmaputra. Saturation deficit was generally higher in March.

Materials and Methods:

The meteorological data such as data on wet bulb and dry bulb temperature and relative humidity were collected from the local Meteorological Station, Sreemangal and yield data were collected from experimental farm of BTRI. The saturation deficit was calculated by using the following equation:

Saturation deficit (SD) = ea – (RH x ea)

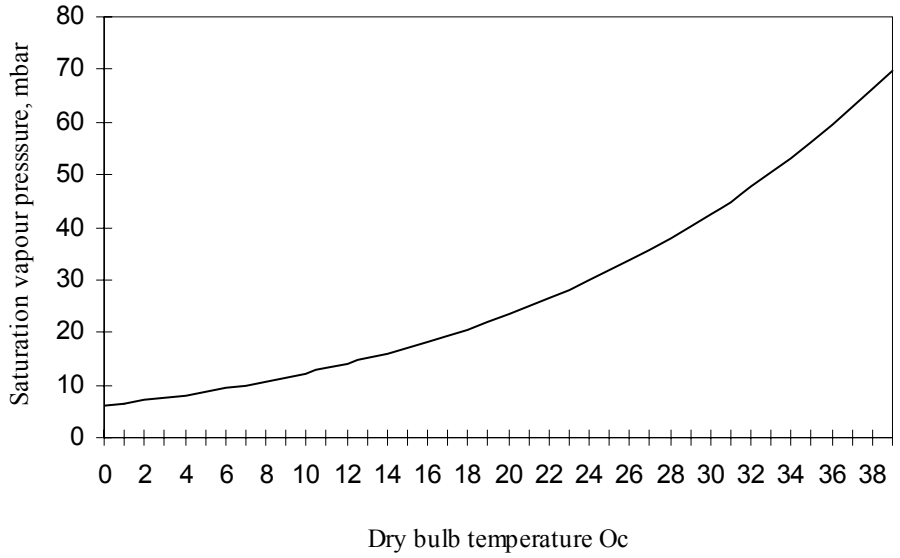

Fig. 1: Saturation vapour pressure in mbar as function of mean air temperature

Where,

ea = Saturation vapour pressure at t °C (dry bulb)
RH = Relative humidity

The values of saturation vapour pressure to the corresponding values of temperature were taken from Table F-6 (Michele, 1996: Irrigation theory & practice, P- 761) which is graphically shown in Fig-1. The daily dry bulb temperature and relative humidity were averaged for 7 day period to calculate weekly dry bulb temperature and relative humidity. The yield data were taken 7 day interval (plucking interval) for the study period (cropping season i.e.,. April-October in 2003).

Results and Discussions:

Effect of SD on yield:

The weekly yield per hectare and corresponding SD values are plotted in Fig-2 during the study period. From the figure it is seen that the SD has a negative effect on yield of tea. The graph indicates that the SD values in April and May were relatively higher than the remaining months. It might be due to relatively less and uneven rainfall received during this period (Table-1). Because uniformity of rainfall is more important than the total rainfall which affect the yield. Moreover November- March is considered as dry (winter) season and April-May is considered as pre-monsoon season in Bangladesh. During this time soil becomes dry because of less and uneven rainfall after the dry season. From the Fig-2 it is seen that evaporation is also higher than in April and May than the reaming months which affect the Saturation deficit of soil. As a result the yield was relatively less in this period (April-May) than the remaining months. The yield per hectare in June, July and August were much higher than the preceding months while the SD values were relatively lower than April and May. From the Table-1 it is observed that the rainfall during the period (June-August) is higher and more uniform than the other months of the year which might be responsible for the lower SD values result in more yields. The maximum yield was obtained during the months September to October due to lower values of saturation deficit and uniform distribution of rainfall during the period. From the statistical analysis it was found that the correlation value between Saturation deficit (SD) and yield was $r = -0.75$ which was significant at 95% level of significance.

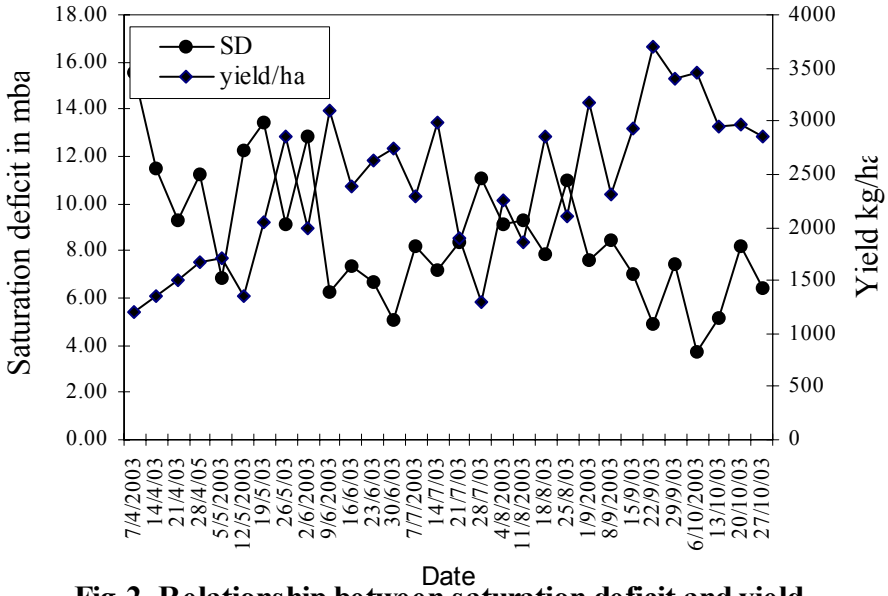

Fig-2. Relationship between saturation deficit and yield of tea

Table-1: Saturation deficit, evaporation and rainfall of 7 day interval during April-October, 2003

Date	SD	Total evaporation during 7 day interval	Total rainfall during 7 day interval
	mbar	mm	mm
07/04/03	15.52	33.9	1 (1)
14/04/03	11.52	32.3	55 (2)
21/04/03	9.31	29.7	90 (4)
28/04/03	11.21	30.2	30 (3)
05/05/03	6.88	29.8	178 (6)
12/05/03	12.23	31.9	15 (1)
19/05/03	13.47	35.7	0 (0)
26/05/03	9.15	40.0	166 (6)
02/06/03	12.80	18.7	2 (1)
09/06/03	6.25	23.2	334 (6)
16/06/03	7.34	26.1	60 (5)
23/06/03	6.71	26.5	78 (5)
30/06/03	5.09	7.80	167 (6)
07/07/03	8.23	21.1	40 (5)

14/07/03	7.21	22.7	45 (4)
21/07/03	8.38	24.3	39 (5)
28/07/03	11.06	35.0	35 (3)
04/08/03	9.15	35.7	44 (6)
11/08/03	9.33	35.1	43 (3)
18/08/03	7.88	25.2	1 (1)
25/09/03	10.94	25.4	74 (3)
01/09/03	7.57	31.2	12 (4)
08/09/03	8.42	23.0	76 (6)
15/09/03	6.98	18.7	91 (3)
22/09/03	4.94	20.3	42 (4)
29/09/03	7.40	22.9	29 (5)
06/10/03	3.70	23.7	16 (4)
13/10/03	5.19	21.2	59 (3)
20/10/03	8.21	22.1	43 (2)
27/10/03	6.40	21.3	105 (3)

Relationship between SD and evaporation:

The Relationship between SD and evaporation is shown in Fig-3. The figure shows that the Saturation Deficit (SD) is positively correlated with evaporation. It shows a general decreasing trend in saturation deficit with decrease in evaporation of the succeeding months. It is interesting to see that at every evaporation reading, the SD values varied widely. This is probably due to other factors affecting saturation deficit such as rainfall.

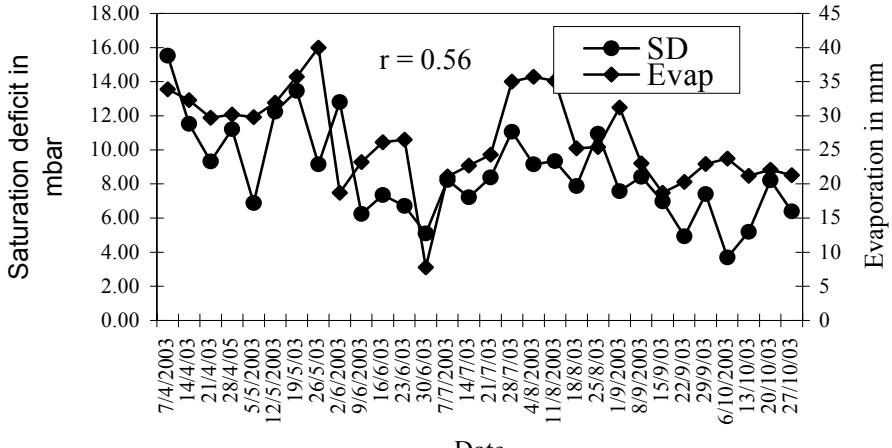

Fig-3. Relationship between saturation deficit and evaporation

It was observed from the Table-1 that rainfall reduced saturation deficit as well as evaporation to some extent. On certain days saturation deficit was high inspite of low evaporation and high rainfall might be that SD was measured over 24 hours period but saturation deficit is measured at certain time. The weather condition for a short time around the time of measurement of saturation deficit can cause a significant difference in the reading. From the statistical analysis it was found that the correlation value between Saturation deficit (SD) and yield was r = 0.56 which was significant at 95% level of significance. But there was a little bit positive correlation among SD, evaporation and rainfall which is not statistically significant.

Conclusion:

From the study it was observed that saturation deficit and yield per hectare is negatively correlated. The values of saturation deficit were higher in April and May which decreased the yield markedly. The yield per hectare was higher during September-October due to lower saturation deficit. The correlation between SD and yield was found significant at 95% level of significance.

The evaporation data were also collected to see the effect of saturation deficit on evaporation. It was found that a positive correlation (r=0.56) between SD and evaporation existed which was also significant at 95% level of significance. There was no significant relationship among saturation deficit, evaporation and rainfall.

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