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Short communication

Effect of leaf temperature on Alternaria blight in wheat-mustard intercropping system

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Macroclimatic parameters viz. maximum and minimum temperature, relative humidity, cloudiness, rainfall and bright sunshine hours affect the development of disease, particularly *Alternaria* leaf spot in *Brassica*. Besides microclimate, leaf physiological conditions, viz leaf temperature, stomatal diffusion resistance and transpiration rate of mustard leaf have a significant contribution in the development of *Alternaria* leaf spot caused by *Alternaria brassicicola* (Chakraborty, 1993). Intercropping of groundnut with bajra, sorghum, pigeon pea and maize in the ratio of 3:1 significantly reduced the incidence of peanut bud necrosis disease (Sunkad *et al*, 2005). But no information is available, whether intercropping of mustard with a cereal like wheat affects the development of *Alternaria* leaf spot in mustard. To have an understanding on the development of *Alternaria* leaf spot in mustard under intercropping, an experiment was conducted for two consecutive years (2008-09 and 2009-10) in which leaf temperature- an important leaf physiological condition of mustard was measured under mustard-wheat intercropping system and correlated with the disease occurrence.

Both wheat (variety PBW-343) and mustard (variety B-54) were together sown in three row ratios with sole wheat and sole mustard on 5th November in 2008-09 and 2009-10, at the Instructional farm Jaguli, BCKV (22^0 58'N Lat and 88^0 32'E Long, 9.75m amsl). The pH of soil is 6.80, having 5.4gkg^{-1} organic carbon, 85 kgha^{-1} N,15.3 kgha^{-1} P_2O_5 and 40 kg K_2O ha^{-1}. The treatments were sole wheat[T1], sole mustard[T2], and wheat: mustard (2:6)[T3], wheat: mustard (4:4)[T4] and wheat: mustard (6:2)[T5]. The treatments were replicated for five times and laid out in a complete randomized block design in a plot of 50m^2 (5m 10m).

Twenty five plants were selected from each plot and labeled. Five leaves each from upper, middle and lower tiers of the mustard canopy were selected and thermocouples were placed on each leaf. The leaf temperature was measured in voltage output. The leaf temperature was measured on 14th December(D_1),21st December(D_2), 28th December(D_3),5th January(D_4),12th January(D_5) and 19th January(D_6)(2008-09 and 2009-10) with simultaneous measurement of *Alternaria* spot per leaf were counted. The disease data were recorded from twenty five randomly tagged plants/plot on the basis of 1-9 scoring scale and Percent Disease Index (PDI) was computed on the basis of the recorded data using the formula developed by Wheeler (1969) which is

PDI = (Sum of Numerical values)/ (No. of Plant parts observed) X (100)/ (Maximum disease rating)

The data were analyzed statistically for interpretation of results. The PDI data have been represented to the nearest whole number in the tables. But the angular transformation values with which the statistical analyses were done were accommodated after the decimal place.

The *Alternaria* leaf spot appeared on 14th December (both years) when leaf temperature was above 23^0C. It was observed that the temperature of leaf increased gradually from upper to lower tier of the canopy in all the treatment combination, the sole mustard recorded the maximum leaf temperature and the PDI also increased in the same way. Among the different treatment combinations, the sole mustard recorded the maximum leaf temperature and PDI. As the number of wheat rows increased, the leaf temperature in mustard decreased and also the PDI values. The six wheat: two mustard row ratio recorded the lowest leaf temperature and the PDI values (Fig. 1). Significant differences in leaf temperature as well as PDI values were

Table 1: Correlation values between mean leaf temperature (ºC) and of *Alternaria* leaf spots (PDI) across the various dates of observation under wheat-mustard intercropping in different tiers of the mustard canopy.

Canopy level	14th Dec.	21st Dec.	28th Dec.	5th Jan.	12th Jan.	19th Jan.
Upper canopy (N=20)	0.836**	0.844**	0.837**	0.908**	0.926**	0.916**
Middle canopy (N=20)	0.916**	0.896**	0.933**	0.944**	0.906**	0.859**
Lower Canopy (N=20)	0.872**	0.840**	0.923**	0.864**	0.876**	0.947**

** significant at 1 % level

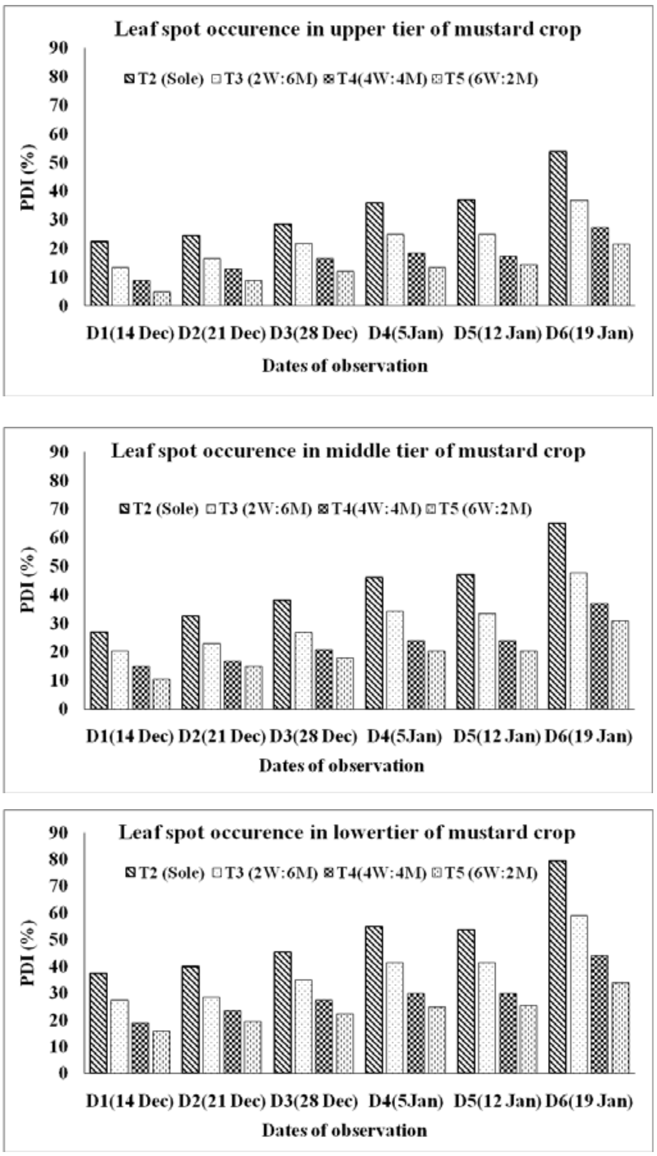

Fig 1: Graphical representation to show variation in Leaf Spot (PDI) across dates of observation of mustard crop in wheat- mustard intercropping.

observed under different treatment combinations where the sole mustard recorded significantly higher leaf temperature as well as PDI values than all other treatments. On the 2nd date (21st December), leaf temperature was reduced because of low air temperature and the PDI values did not change, but the trend in leaf temperature and PDI values did not alter.

On the 3rd date (28th December), leaf temperature again showed an increasing trend and the PDI values were also increased. On the 4th and 5th dates (5th January and 12th January), leaf temperatures again recorded a reduction with the no alteration in disease spread. On the 6th date (19th January) leaf temperature of mustard crop increased sharply with the concomitant increase in PDI values; the lower and mid tier leaves were highly affected by the *Alternaria* leaf spot.

On all the dates of observations, leaf temperature and PDI values were significantly higher in sole mustard stand and the lowest values were obtained in case of six wheat and two mustard row ratios. As one goes from upper to lower tiers, leaf temperature increased significantly with the concomitant increase in the number of *Alternaria* leaf spots , leading to the maximum infection in the lowermost tier of the crop canopy.

The correlation studies showed that significant correlation did exist in between leaf temperature and PDI of *Alternaria* leaf spot in all the tiers of the canopy throughout the period of disease infestation (Table 1). This shows that the temperature is one of the key factors for the occurrence as well as spread of *Alternaria brassicicola*. As the pathogen infects a host, the host, according to the general principle of immunity, tries to defend itself from the pathogen (Chakraborty, 1993). The spot development is the ultimate expression of pathogen domination where the leaf resistance is over. The increase of leaf temperature in infected leaves might be due to biochemical defensive mechanism where ATP had to be utilized for resistance (Chakraborty, 1993). The upper tier leaves were subjected to wind flow and thus abled to transpire which cooled the leaf tissues in comparison to middle or lower tier leaves. Chakraborty (1993) also observed that increased leaf temperature in mustard caused an increase in stomatal diffusion resistance with the resultant decrease in transpiration rate. Among the intercropping treatments, it was observed that leaf temperature decreased with the increase in the number of wheat rows. This might be due to different geometric arrangement of wheat leaves which invited the variation in radiation receipt and wind flow within the canopy. The results clearly showed that intercropping reduced the occurrence of *Alternaria* leaf spot in mustard and six wheat: two mustard was found to be the best row ratio in the context of *Alternaria* leaf spot development. Sunkad *et al* (2005) also observed that intercrops acted as barrier for the movement of insect vectors from one place to another thus controlled the viral disease. These results also indicated that the leaf temperature played a regulatory role in the development of *Alternaria* leaf spot, when the leaf temperature increased above 23^0C disease appeared.

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