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Short Communication

Effect of weather on yield, heat and water use efficiency of wheat crop in a semi-arid environment

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Wheat (*Tritium aestivum* L.) is the major food crop of India contributing 12 per cent of the total food grain production, covering an area of 31.5 Mha with production and productivity of 86.5 Mt and 2.8 tha^{-1} respectively (http://eands.dacnet.nic.in/). In India, wheat is grown during November to March, as it requires cool and moist weather during the vegetative phase, and warm and dry weather during reproductive phase. Cardinal (minimum, maximum and optimum) temperature is one of the most critical parameter that decides fate of crop productivity in wheat. However, wheat sowing after rice is delayed because of late harvesting of rice, large turn around time and poor soil tilth of seed bed which forces delaying of wheat sowing to varying degrees. Wheat yield under such circumstances is mainly affected by terminal heat and water stress.Reproductive phase is the ultimate determinant of yield, if faces high temperature stress shows a significant impact on yield (Mitra and Bhatia, 2008). Different wheat cultivars take different time from germination to maturity under varied agro-climatic condition. Therefore, crop development phases alone cannot be considered as a good predictor for measuring abiotic stress. The more scientific way of characterizing abiotic stressis through meteorological indices like growing degree-days, heat use efficiency, etc. Considering all these, a study was undertaken to investigate the impact of sowing date on yield, heat and water use efficiency of three wheat cultivars in Indo-Gangetic Plains of India.

A field experiment was conducted during the *rabi* season of 2011-12 and 2012-13 at the experimental farm of Indian Agricultural Research Institute (IARI), New Delhi. Soil of the experimental site was sandy loam (*Typic Ustochrept*) with alkaline nature (pH 8.3) having electrical conductivity of 0.16 dS m^{-1}. Soil was low in organic carbon and available nitrogen and medium in available phosphorous and potassium. Bulk density in 0-30 cm of the soil varied between 1.55-1.61 Mg m^{-3}. Experiment was laid out in split plot design with three replications. The treatment consisted of three wheat varieties (V1: HD2932, V2: WR544 and V3: HD2967) with three sowing dates [D1: Normal sowing (15 November in 2012-13); D2: Late sowing (30 November) and D3: Very late sowing (15 December). The seeds were sown at a depth of 5cm with the recommended spacing of 22.5 cm. Nitrogen was applied @120 kg ha^{-1} in the form of urea in three splits; 50 per cent at sowing, 25 per cent at CRI stage and rest 25 per cent at maximum tillering stage. Phosphorous (60 kg $P_2O_5 ha^{-1}$ as SSP) and potassium (60 kg K_2O ha^{-1} as MOP) were applied at sowing. Desired meteorological observations were collected from the meteorological observatory of IARI which is located 500 m away from the present experimental site (Table 1). Leaf area index (LAI) was measured by a leaf area meter (Model LI-3100, LI-COR, Inc., USA) in which individual green leaf was measured at flowering stage. Growing degree days (GDD) and heat use efficiency were computed from daily weather data. Base temperature for wheat was taken as 5°C (Gill *et al.*, 2014). Heat use efficiency (HUE)was calculated as yield (kg ha^{-1}) per unit of accumulated heat units (°C day)(Kingra and Kaur, 2012) and water use efficiency (WUE) as grain yield per unit of evapotranspiration (mm) (Pradhan *et al.*, 2018). Crop was harvested manually and biomass and grain yield were expressed in $kgha^{-1}$. Statistical analysis of the data was performed using SPSS where means were compared at $P \leq 0.05$ level of probability.

The mean monthly temperature, relative humidity, total rainfall and pan evaporation are given in Table 1. Mean monthly temperatures were almost similar in both the years of study except for the month of November. The November month of 2011-12 experienced 2.1°C higher temperature than the year 2012-13. The cropping season of 2011-12 received a total 43 mm of rainfall in four rainy days, whereas 2012-13 received 176 mm of rainfall in 10 rainy days, which coincided with flowering and milking stage of wheat crop.