J. Wheat Res. 3(1) : 43-45 (2011)

Temporal variation of wheat productivity in relation to temperature in semi arid regions of Gujarat

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Abstract

Climatic change is likely to cause significant reduction in wheat production in India. Generally, irrigated wheat is cultivated during winter season from mid November to March in Gujarat. Therefore, temperature variation during crop growing season (i.e. Nov. to March) is an important factor to determine the productivity of wheat. Short winter with terminal heat stress is the typical climatic characteristics of the region. Results of large scale varietal trials since 1990 have been analyzed for temporal variation in wheat productivity with local checks and correlated with variation in temperature difference between maximum and minimum temperature within different growing months. Initially, this temperature difference was narrow (i.e. during 1990 to 1999) which was subsequently widened from 2000 onwards. During last few years (since 2005) this temperature difference was widest and less (between October to march) than the previous years which would be due to the recent weather abrasions. Further the analysis of wheat productivity for last twenty years was clearly indicated a positive correlation between variation in temperature difference and wheat productivity. Generally the wheat productivity was higher when the variation in temperature difference was narrow (i.e. during 1990 to 1994) and vice-versa. Further wheat productivity was increased under late sown conditions particularly 2005 onwards. Therefore, congenial wheat production conditions in changing climatic scenario should be re-assessed particularly for semi arid regions like Gujarat.

Key words: Climatic change, Temporal variation, Temperature, Wheat productivity

Received: 11 July 2011 / Accepted : 09 August 2011

Introduction

The Inter-governmental Panel on Climate Change (IPCC, 2007) has projected that temperature increased by the end of this century is likely to be in the range 1.8 to 4°C. Hot extremes, heat waves, and heavy precipitation events are very likely in high altitudes than most subtropical land regions. Global climate change will affect agriculture through their direct and indirect effects on crops by altering the physiological as well as metabolic mechanisms (like increased respiration rates, reduce crop duration, alter photosynthetic partitioning etc.), by altering survival and distribution of pests, and by altering soil properties as well as nutrient and water use efficiency of the soil. Therefore, temperature variation during crop growing season (i.e. Nov. to March) is an important factor to determine the productivity of wheat. The objectives of the study were to assess the impact of climate change on temperature and wheat production in semi arid regions of Gujarat.

Materials and Methods

The present work is the analyzed results of large scale varietal trials conducted during 1990 to 2009 at Centre of Excellence for Research on Wheat (CERW), S.D.A.U., Vijapur (Gujarat) which is situated at 220° 35' latitude and 720° 55' longitude with 125.58 MSL. The average rainfall is 739mm with average 29 rainy days. The average maximum temperature ranges from 20°C to 46°C and minimum temperature ranges from 8°C to 35°C. Short winter with terminal heat stresses is the typical climatic characteristics of the region.

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Generally, irrigated wheat is cultivated during winter season from mid November to March in Gujarat. The soils are sandy loam with neutral to alkaline in reaction, low in organic carbon and available nitrogen, medium in phosphorus and sulphur and high in potash with good quality irrigation water. The results have been analyzed for temporal variation in wheat productivity with local checks and correlated with variation in temperature difference between maximum and minimum during wheat growing months for the same periods.

Results and Discussion

Generally, three types of wheat namely bread wheat (*Triticum aestivum* L.)-85 %, durum or macaroni wheat (*Triticum durum* Desf.)-15 % and dicoccum (*Triticum dicoccum*) in scattered pockets are grown in Gujarat state. All aestivum is irrigated while; predominant of durum is mainly rainfed, grown under triple stress conditions of water, heat and soil hazards. Gujarat stands good position in respect to wheat cultivation with 8th rank in area (12.74 lakh ha), 7th in production (38.38 lakh mt) and 4th in productivity (30.13 q/ha) in the nation during 2007-08 (Fig. 1 & Table 1).

Temporal variation in ambient temperature during Rabi season in north Gujarat

Short winter with terminal heat stresses are the typical characteristics of climatic conditions during rabi season in Gujarat. The analysis of last twenty years results of ambient temperature clearly indicated that the variation in temperature difference (between maximum and minimum) within different growing months was narrow (i.e. during 1990 to 1999) which were subsequently widened from 2000 onwards (Fig. 2).

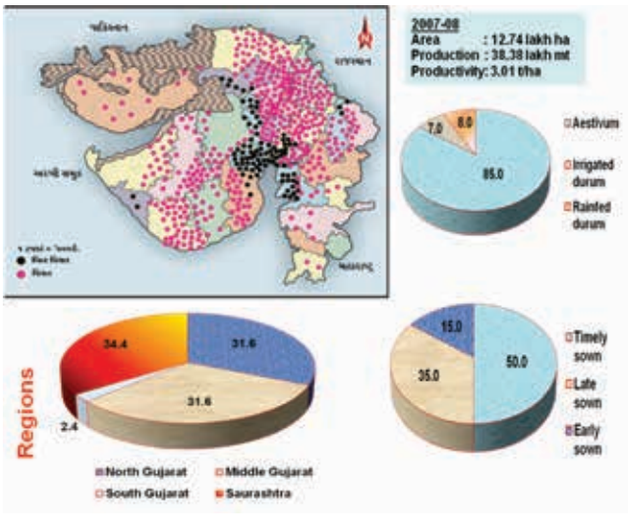

Fig 1 Diversity and distribution (%) of wheat in Gujarat

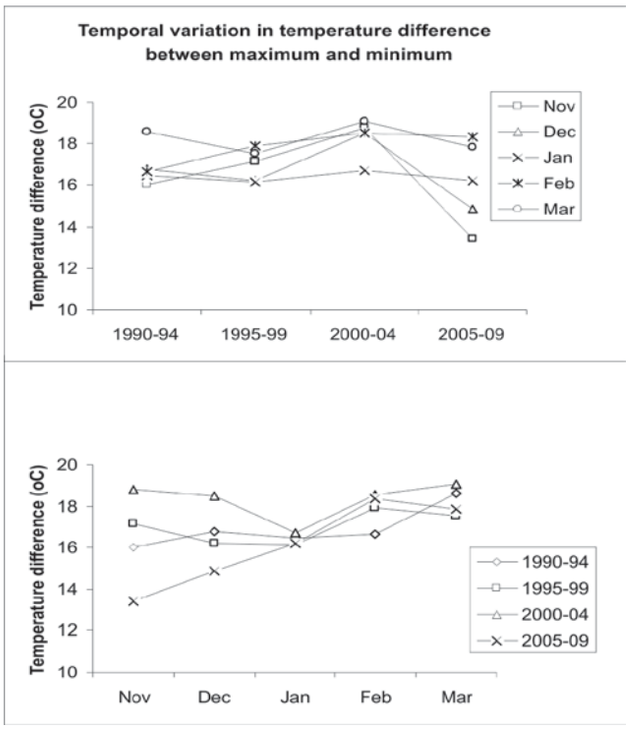

Fig. 2 Temporal variation in temperature difference between maximum and minimum during wheat growing seasons (Average of five years)

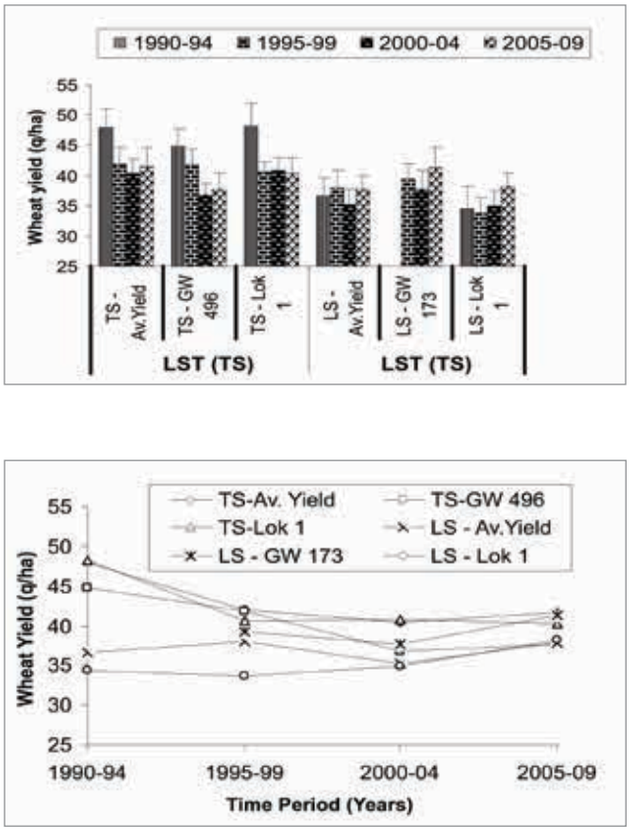

Fig. 3 Temporal variation in wheat productivity

Table 2 Relationship between temperatures on productivity of wheat in Gujarat

Temperature Difference	R^2	Temperature Difference	R^2
November	0.422	February	0.791**
December	0.805**	March	0.970**
January	0.992**	Overall	0.787**

** Significant at 1% level of significance

Table 1 Area, production and productivity of wheat in Gujarat during 2007-08

Year	Area (,000 ha)	Production (,00 MT)	Productivity (Kg/ha)
Total Wheat	12739	38377	3013
Irrigated Wheat	11872	37779	3182
Rainfed Wheat	867	598	690

An abrupt fluctuation in temperature differences was observed among different growing months particularly during 2005 onwards which would be due to weather abruptions prevailed during last few years which might be the major cause of reduction in productivity of timely sown wheat in Gujarat. A drastic reduction with wider temperature difference was observed during the month of November and December resulted from higher day and night temperature particularly during 2005 onwards (Fig.2). In contrary, comparatively higher temperature with narrow range of difference during the month of January, February & March (Fig. 2) with constant stability in January during the course of study leads to be the most congenial conditions for higher wheat productivity under late sown in Gujarat. Therefore, appropriate sowing time for wheat cultivation is to be re-assessed for getting higher wheat productivity in Gujarat.

Temporal variation in wheat productivity and its relationship with temperature

The results presented in Fig. 3 clearly indicated that a considerable reduction in wheat productivity was observed during 90's under timely sown conditions in north Gujarat which was higher for Lok 1 as compare to GW 496. Thereafter, irrespective to wheat varieties the productivity of wheat was almost constant under timely sown conditions. In contrary, the wheat productivity trend was almost constant under late sown condition up to 2005 which was slightly increased thereafter. The performance of GW 173 was comparatively better than Lok 1 under late sown conditions. A significant correlation between variation in ambient temperature and wheat productivity was observed during all the years (Table 2). A non-significant correlation was observed between temperature variations and productivity of wheat during the month of November. Although, these results are difficult to predicate but probably it might be due to the weather abruptions particularly during 2005 onwards. The predicted effects of climate change on wheat production include physiological traits (Yadav *et al*., 2010) that are associated with wheat yield in heat-prone environments are canopy temperature depression, membrane thermo-stability, and leaf chlorophyll content during grain filling, leaf conductance and photosynthesis, senescence etc. which reduced grain yield over most of India, with greatest impacts in the lower potential areas (Ortiz *et al*., 2008). To clarify changes in production in potential regions for cultivating cereals under the present climatic conditions and after climate change, Leemans and Soloman (1993) developed a model to detect potential regions for cereal cultivation based on the daily air temperature, daily soil moisture and solar radiation. They predicted that in the higher latitude, climate change would cause an increase in the production owing to longer growing period, but in the middle or lower latitudes, the production would remain at the same level or decrease.

Conclusion

A considerable temporal variation in ambient temperature as well as wheat productivity was observed during recent years which were significantly correlated. Therefore keeping in view the potential wheat area in semi arid regions of Gujarat facing heat as well as drought stresses, an appropriate sowing time for wheat cultivation is to be re-assessed for getting higher wheat productivity. Further, estimating the effect of climate change on wheat production as well as the congenial conditions in changing climatic would be important to predict the food supply in the future.

References

1. IPCC 2007 Climate change 2007: Synthesis report, summary for policy makers. *IPCC,* Geneva, Switzerland. pp. 22

2. Leemans R and Solomon A M. 1993 Modelling the potential change in yield and distribution of the earth's crops under a warmed climate. *Climate Res* **3:** 79-96

3. Ortiz R, Sayer K D, Govaerts B, Gupta R, Subbarao G V, Ban T, Hodson D, Dixon J M, Ortiz-Monasterio J I and Reynolds M. 2008 *Agr Eco and Env* **126**: 46-58

4. Yadav A, Singh S S, Jain N, Singh G P and Prabhu K V. 2010 Wheat production in India: Technologies to face future challenges. *J of Agri Sci* **2(2)**: 164-173