CHAPTER-I
INTRODUCTION

Wheat (*Triticum aestivum* L.) is world’s leading cereal crop in terms of area harvested. It is the third most-produced cereal after maize and rice in the world (FAO). India achieved remarkable progress in wheat production during the last four decades and is the second largest wheat producer in the world. It is the second most important crop in India after rice, both in terms of area and production.

Wheat is a thermo-sensitive and long day plant. Mexican dwarf wheat (*Triticum aestivum* L.) presently grown in India, also known as common bread wheat and belongs to dinkale series (hexaploid 2n=4x=42), was evolved by Dr. N. E. Borlaug at CIMMYT, Mexico. Wheat is most successfully grown between 30° and 60° N and between 27° and 40° S latitudes. It has highest protein among all cereals, ranging from 10 to 12 %, which is known as gluten and is important for the bakery purpose. Wheat also has high amount of niacin and thiamine amino acids.

In the world, wheat is grown on 220.4 million ha area, with production of 729.0 million tonnes and productivity of 3.30 tonnes/ha (FAO, 2014). In India wheat has an area of 30.4 million ha and production of 95.85 million tonnes and productivity of 3145 kg/ha. In Gujarat, wheat is grown on an area of 10.24 lakh ha with total production of 29.44 lakh tonnes, and productivity of 2803 kg/ha (Anon., 2013). Gujarat ranks 6th in productivity of wheat in India. The low productivity of wheat in Gujarat is mainly owing to factors like low soil fertility, moisture stress due to low water holding capacity of soil, lack of required soil depth, imbalanced use of fertilizers, no or very low use of organic manures, non-availability of quality seed of locally recommended varieties *etc*. Besides above factors, non availability of optimum temperature regimes during plant growth and development of wheat, particularly in Saurashtra, is another major factor for low yield of wheat in Gujarat.

Weather is one of the key factors influencing agricultural production and productivity. Studies indicate that weather during cropping season strongly influences crop growth and it accounts for two third of the variation in productivity while other factors including soil and nutrient management accounts for only one third of productivity. The predominant influence of weather is operative even before the crop is sown as the moisture availability and the thermal regime of the seed zone determine the date of sowing and the appropriate genotype to be sown. In spite of
cultivation of high yielding varieties, improved cultural practices and plant protection measures, favorable weather is a must for good harvest (Rao et al., 1999).

Among the climatic factors, temperature plays a key role in determining sowing time and consequently the duration of different phenophases and thus the crop productivity of wheat in almost all wheat growing regions starting from germination to maturity (Tewari and Singh, 1993). The physiological functions and growth stages are severely affected with temperature which decides the duration of life cycle of wheat plant. Wheat varieties generally matures in 150-160 days in Punjab, Haryana and western part of U.P. but the varieties of similar production potential matures within 140 days in eastern part of U.P., Bihar and West Bengal and this governs the low production capacity of a variety even at normal sowing date. Under late sown conditions, the wheat crop forcefully completes its life cycle before stipulated time available for maturity.

The earlier observations indicate that about 20-23°C temperature is required for quick germination and normal development of the wheat crop. Normally, this temperature occurs in first fortnight of November but when sowing is delayed, the temperature gets low which does not allow quick germination, early growth and development of crop. Besides, flowering and maturity period of the crop tend to coincide with high temperature coupled with high wind velocity. This means reduction tendency in all yield contributing characters and finally the yield. Khan and Chatterjee, (1981) indicated that average reduction in yield due to late sowing was about 5 q/ha for every fortnight delay in sowing after 15th November. It is mostly due to shorter growth period available to late sown wheat coupled with high temperature and hot winds during reproductive growth period, which leads to forced maturity and ultimately poor grain yield.

The recent studies have shown that mean winter maximum temperature, mean winter minimum temperature and mean annual minimum temperature has increased while cold days during winter have decreased significantly during 1984-2012 in Saurashtra (Sahu et al., 2010). The increase in temperature is expected to affect productivity of wheat as temperature plays the most dominant role in wheat production. The minimum, optimum, and maximum temperature for wheat growth are 4 to 5°C, 25°C, and 30 to 32°C (Arnon, 1972). Soil temperature plays a significant role in the rate at which germination proceeds, which is in the range of 20 to 25°C for wheat. Even the ideal temperature for the different stages of wheat plant
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varies considerably, like high temperature in early phase results in poor tillering, poor vegetative growth and very early heading. High temperature at ripening stage leads to premature ripening. For good tillering, lower temperatures are needed at early growth stage. Production of fertile tillers will be optimum when mean maximum and minimum temperature in the tillering phase are 30 and 10º C, respectively. Temperature during ear emergence and anthesis is considered very important and as the new high yielding varieties are more thermosensetive during anthesis, the number of grains/ear decrease if the maximum temperature during anthesis and grain development increases above 32º C and 30º C, respectively. Asana and Saini (1962) reported that high temperature initially increased the rate of grain filling but reduced the final grain weight. At Dehli, 5 % rise in maximum and minimum temperature reduced test weight by 15 %. Day temperature more than 25º C affects grain formation due to increased respiration leading to depletion of photosynthates (Asana and Williams, 1965). A mean maximum temperature of 25º C and a mean minimum temperature of 12º C is considered optimum for development of wheat plants (Asana and Saini, 1962).

Therefore, it is important to identify suitable coping strategies to reduce adverse effects of climate change related increase in temperature on wheat. The date of sowing is one such adaptation strategy which can help to reduce temperature related adverse affects on growth and development of plants. Even though the optimum date of sowing of wheat in south Saurashtra is 15th November, there is need to revalidate the same in light of increase in temperature and decrease in number of cold says over the years in Saurashtra (Sahu et al., 2010). It may require to delay wheat sowing beyond 15th November by few days to escape the effects of increased temperatures on plants. However, to be cautious, more delay may affect wheat performance again by reducing the tillering period and hot weather during critical period of grain filling leading to forced maturity.

Further, selection of varieties tolerant to heat stress is another major adaptation strategy to reduce the adverse effects of high temperature on wheat crop. Patel et al., (2012) in a simulation study found that projected increase in temperature reduced yield of wheat cultivars GW 322 and GW 496 by 38 to 43 % at Anand. Further, they also reported that the yield reduction was lower under late sown condition (30th November) and higher in early sown condition (01st November). Higher reduction in LAI and total dry matter, but no change in maturity and anthesis
days was observed at 01st and 15th November sowing as compared to later sowing in both the cultivars. GW 322 was found to give higher yield when sown at 30th November and 10th December as compared to GW 496. Singh et al. (1984) obtained maximum number of spikes/unit, test weight and grain yield by VL 421 and UP 368 variety at 15th November. Khokhar et al. (2010) reported that variety V 7002 had significantly higher grain yield as compared to V 7004 at 15th November. Similarly, Kumar et al. (2013) found K 0307 variety superior over Raj 4229 at different dates of sowing. Meena and Verma (2015) found highest grain yield with UP 2565 variety among six different varieties viz. PBW17, RAJ 3765, UP 2526, UP 2565, UP 2572 and UP 2584 when sown at 14th November.

It was on these considerations that the present investigation entitled “Identification of Suitable Date of Sowing and Variety of Wheat (Triticum aestivum L.) For South Saurashtra, Gujarat under Changing Climatic Conditions” was conducted during rabi 2015-16 at Instructional Farm, Department of Agronomy, College of Agriculture, JAU, Junagadh with the following objectives:

1. To revalidate the date of sowing of wheat for south Saurashtra under changing climatic conditions.
2. To test the suitability of wheat varieties for different dates of sowing in south Saurashtra.
3. To find out date of sowing x variety interaction effects on wheat productivity.
4. To work out the economics of cultivation of wheat under different dates of sowing.