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A study of maximum temperature during March 2004 and its impact on *rabi* crops in Himachal Pradesh

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ABSTRACT

Maximum temperature during the month of March for three years 2002, 2003 and 2004 at eight locations in Himachal Pradesh was analysed to document the impact of temperature on major *rabi* crops. The mean maximum temperature was 2-8 °C higher during 2004 compared to 2003. The number of days with maximum temperature above a given value was also found to be more during 2004. Similar high temperatures were also observed during 2002. The temperature rise was more pronounced in the fruit and vegetable growing areas of Bajaura and Salooni. Rise in temperature and dry conditions during the month of March reduced, green tea leaves (increase over February only by 6 times during 2004 against 29 times during 2002, 25 times during 2003 and 18 times during 2005), egg laying 20.9% during April and reduced yield (wheat 21.3%, rapeseed and mustard 59%) compared to *rabi* season 2001-02.

Key Words : Maximum temperature, peas, apple, wheat, rapeseed and mustard, vegetables crop, tea, dairy animals and poultry

Weather is a vital factor on which the success or failure of agricultural crops depends. Weather manifests its influence on agricultural production through its effects on soil, plant growth and development and yield. Among various weather elements, temperature and rainfall are the major factors in stabilizing the production of the crops. Temperature extremes particularly during reproductive phase determine the production potential of crops. The *rabi* crops are by and large thermo-sensitive and long day plants and prefer low temperature. The month of March in 2004 all over India and its neighborhood was unusually warm. The main reason of abnormally high temperature seems to be passage of less number of western disturbances. Rain spells during February were only three, against average of 4-5 major spells. The dry conditions during month of March and period up to April 20th has caused the temperature rise to 33°C however, the average for the period was 25 °C. During month of March, 4-5 rain spells used to occur over the Himachal Pradesh region. The comparison of actual temperature record of CSK Himachal Pradesh

Agricultural University Agrometeorological Observatory with normal indicated 8-10°C above normal temperature during second fortnight of March 2004. In fact, the summer has set in 20 days in advance. The higher temperature coincided with reproductive phase of majority of the crops grown in the state. An attempt has been made to study the effect of higher temperature on major *rabi* crops of the state.

MATERIALS AND METHODS

Daily maximum temperature of eight locations viz., Dhaulakuan in district Sirmour, Akrot in Una, Kangra, Malan and Palampur in district Kangra and Bajaura in district Kullu and Salooni in district Chamba were collected and days with temperature ≥ 22, 24, 26, 28, 30, 32 and 34 °C were worked out for March 2002, 2003 and 2004. The total monthly production of green tea leaves for four years (2002 to 2005) during March and April were collected from 44 ha of the University Research Farm of Tea Husbandry and Technology and percent increase in April over March were assessed. The egg laying percentage of poultry birds from the University Live Stock Farm were also evaluated. The data of only those birds were included which were raised under uniform conditions like indoor environment, age and feeding schedule. Wheat and rape seed and mustard productivity for the state from 2001-2002 to 2003-2004 were collected from the State Department of Agriculture and percent decrease was assessed. The monthly rainfall data for different locations under study was also considered to note whether there was any cumulative effect of temperature and rainfall on different components of agriculture studied.

RESULTS AND DISCUSSION

The mean monthly temperature at Dhaulakuan was 31.1; Akrot 31.9, Kangra 28.5, Nagrota 29.7, Malan 27.1, Bajaura 27.8, Palampur 23.5 and Salooni 24.0 °C. Dhaulakuan, Akrot Kangra and Nagrota were found to be warmer as compared to other locations. During 2004 mean temperature of March was 4.0 °C higher than that during 2003 at Dhalakaun. Similarly at Akrot, it was 5.3 °C, at Kangra 3.9 °C, 6.0 °C at Nagrota, 4.6 °C at Malan, 6.9 °C at Bajaura, 2.1 °C at Palampur and 7.9 °C at Salooni. The days with temperature ≥28, 30, 32 and 34 °C at Dhaulakuan; 28, 30 and 32 °C at Akrot, Kangra, Nagrota, Malan, Bajaura and Palampur and 22, 24 and 26 °C at Salooni are presented in Fig 1. The numbers of days with high maximum temperature were much higher in case of year 2004 compared to 2003 and 2002 at all the locations. The comparative temperature rise was much higher at vegetable and fruit growing areas of Salooni and Bajaura. The monthly rainfall data from February to April (Fig 2) clearly show that the month of February received only 2.6, 6.6, 4.9 mm rainfall at Dhaulakuan, Akrot and Kangra. The month March was completely dry (with nil rainfall) at all the locations.

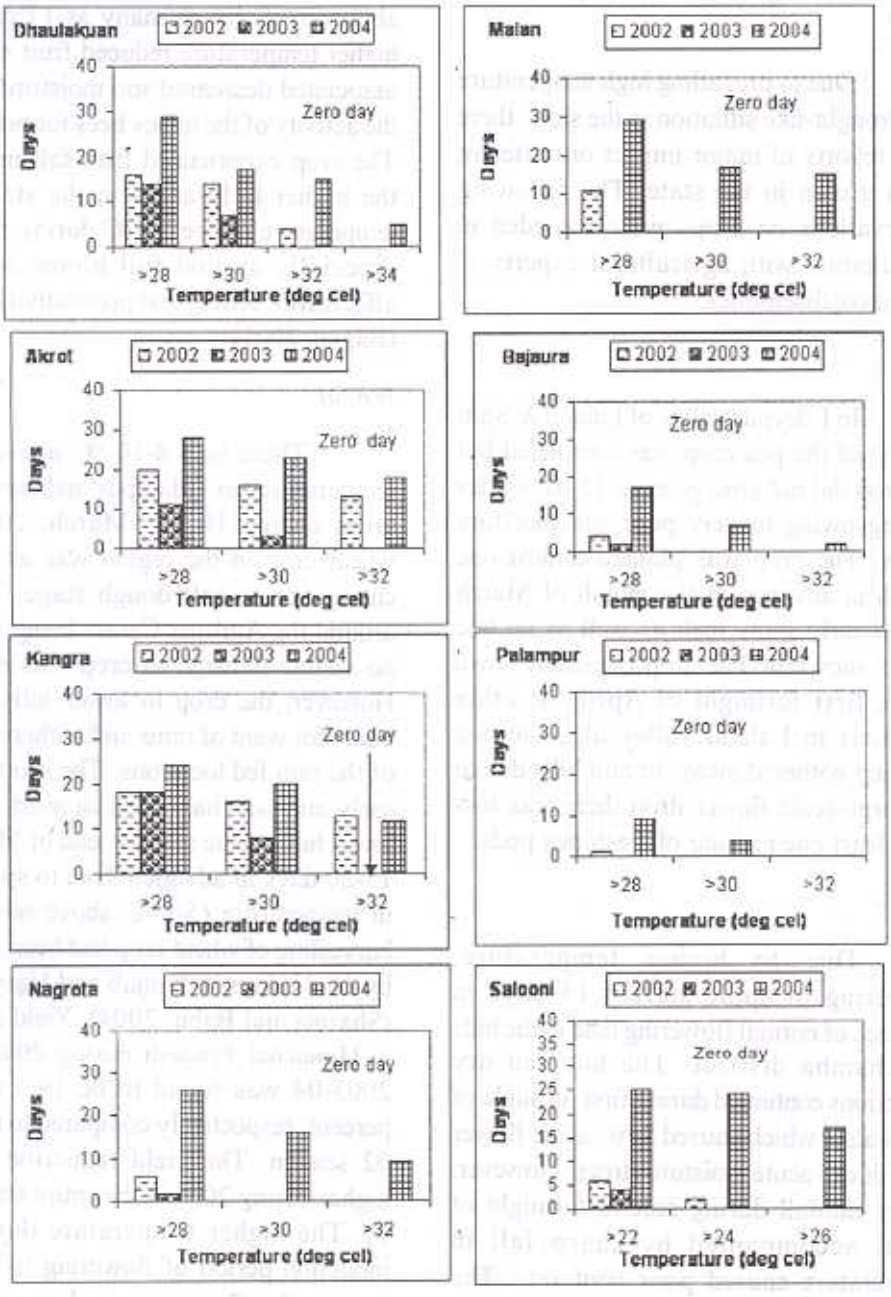

Fig. 1 :Temperature during March at different locations.

Impacts on agricultural crops during 2004

Due to prevailing high temperature and drought-like situation in the state, there were reports of major impact on different crops grown in the state. The following observations on crops were recorded in consultation with agricultural experts of respective disciplines:

Peas

In Udeypur valley of Lahaul & Spiti sowing of the pea crop was completed but the crop did not emerge even 15 days after sowing owing to very poor soil moisture status. The crop was planted almost one month in advance in the month of March due to early snow melt as well as no late winter snowfall. The crop is usually sown in the first fortnight of April. At other locations in Lahaul valley also the pea seedling withered away. In mid hills due to the large-scale flower drop there was loss of at least one picking of fresh pea pods.

Apple

Due to higher temperature, flowering in apple started 15 days in advance of normal flowering date in the hills of Chamba district. The hot and dry conditions continued during first fortnight of April also, which caused large-scale flower drop due to acute moisture stress. However, heavy rainfall during second fortnight of April accompanied by sharp fall in temperature caused poor fruit set. The optimum temperature for fruit set is 24 °C and the region experienced temperature above 26 °C for as many as 17 days. The higher temperature reduced fruit set due to associated decreased soil moisture and also the activity of the honey bees for pollination. The crop experienced fruit fall in most of the higher hilly areas in the state. High temperature above 26 °C during flowering especially around full bloom adversely affects fruit setting and productivity of apple (Bajpai, 2001).

Wheat

There was 8-10 °C above normal temperatures in Palampur and surrounding areas during 16-23rd March, 2004. The wheat crop in the region was at ear head emergence to soft dough stage. The area around the Agrimet Centre being irrigated, no visible damage to crop was observed. However, the crop in lower hills suffered badly for want of rains and withered at most of the rain fed locations. The crop matured early and was harvested in most places in lower hills of the state by end of March i.e., 15-20 days in advance. Due to sudden rise in temperature (5-9 °C above normal) the harvesting of wheat crop had been advanced by 10-15 days in Punjab and Haryana also (Sharma and Babu, 2004). Yield reduction in Himachal Pradesh during 2002-03 and 2003-04 was found to be 19.3 and 21.3 percent, respectively compared to the 2001-02 season. The yield reduction was 2% higher during 2004 in the entire state (Table 1). The higher temperature during post induction period of flowering is known to hasten the flowering and consequently

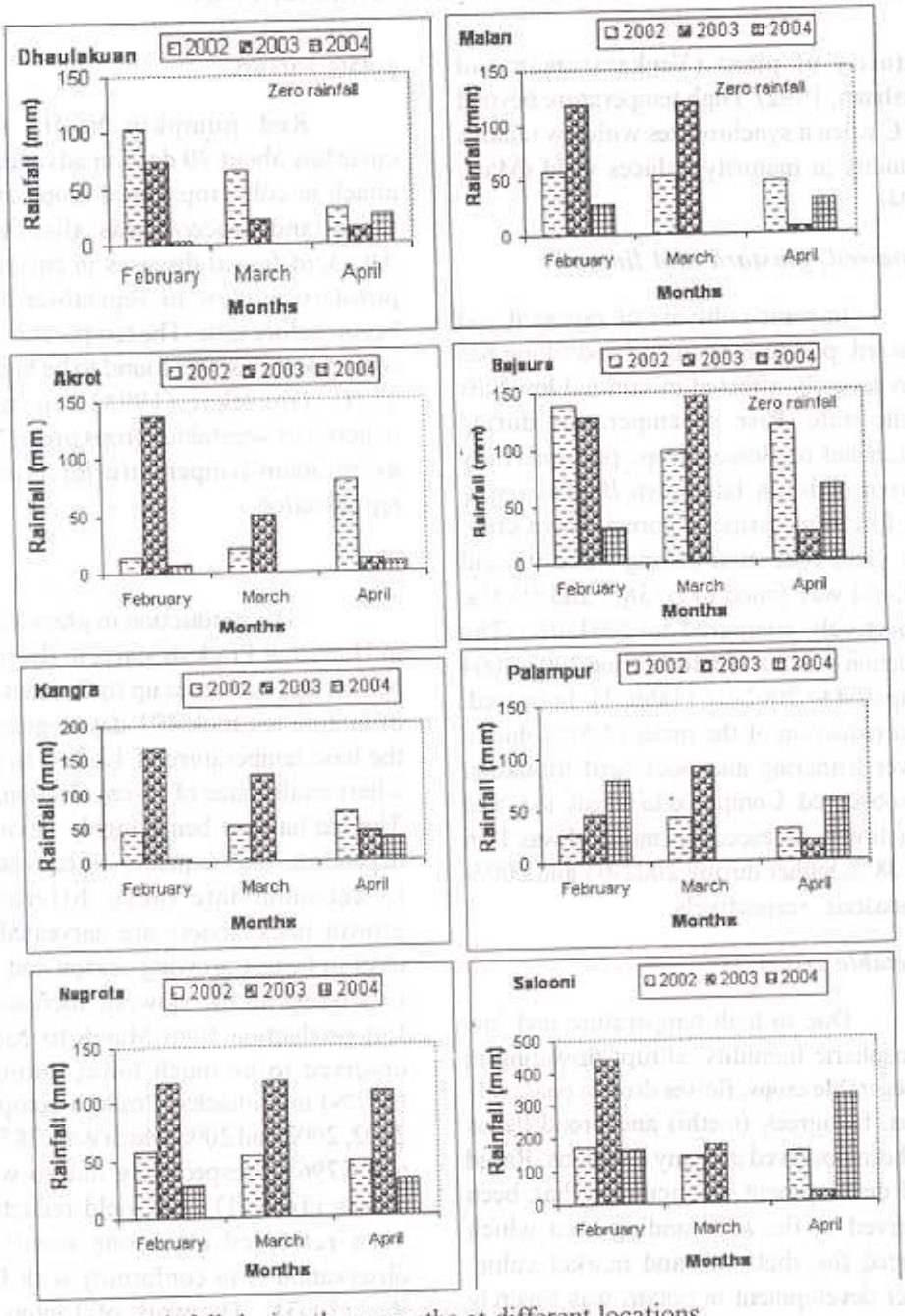

Fig. 2 : Rainfall during three months at different locations

maturity of plant (Venkataraman and Krishnan, 1992). High temperature beyond 30°C when it synchronizes with low relative humidity at maturity reduces yield (Mavi, 1994).

Rapeseed, mustard and linseed

In some cultivars of rapeseed and mustard, pod formation and pod filling has been severely affected in rain fed low hills of the state. Rise in temperature during March led to flower drop, pod infertility (barren pods) in late sown *Brassica* spp. and forced maturity in normal sown crop. The yield reduction during 2002-03 and 2003-04 was found to be 38.9 and 59.3%, respectively compared to 2001-02. The reduction was 20% higher during 2003-2004 compared to 2002-03 (Table 1). In linseed, yield reduction of the order of 50% due to flower withering and poor seed formation was observed. Compared to wheat, the yield reduction in rapeseed and mustard was 19.6 and 38 % higher during 2002-03 and 2003-04 seasons, respectively.

Vegetable crops

Due to high temperature and low atmospheric humidity, abrupt flowering in all vegetable crops, flower drop in peas, cole crops, fenugreek (methi) and broad beans has been observed at many locations. Rapid seed development in cucumber has been observed in the surrounding area which reduced the shelf life and market value. Tuber development in potato was severely affected and the crop headed towards maturity much in advance, which led to lower potato harvest.

Red pumpkin beetle infested cucurbits about 20 days in advance. Aphid attack in cole crops, seed crops of radish, turnip and broccoli was also observed. Attack of fungal diseases in cucurbits and powdery mildew in vegetables had also begun before time. The temperature at most of the locations was found to be higher than 30 °C. Ghadekar (1998) reported that majority of vegetables crops prefer 10-28°C as optimum temperature for growth and reproduction.

Tea

The production in green tea leaves in Himachal Pradesh starts in the month of March and continues up to October. Shoots of mature tea took 491 day degrees above the base temperature of 12.8 °C to grow to a harvestable size of 15 cm (Tanton, 1982). The tea harvest being highly environment dependent, the frequency of harvest varies to accommodate these differences in growth rates; shoots are harvested 7 to 9 days in fastest growing season and every 3 to 4 weeks in the slowest. Increase in tea leaf production from March to April was observed to be much lower during 2004 (617%) in Himachal Pradesh compared to 2002, 2003 and 2005 which were 2877, 2536 and 1796%, respectively due to warming effects (Table 1). The yield reduction has been reflected after one month. This observation is in conformity with Prasada Rao (2003). The work of Tanton (1982) suggests that the high temperature effects

Table 1: Effect of high temperature during March on different agricultural activities in Himachal Pradesh

Months/ Year	2002	2003	2004	2005
Green tea leaves (kg/ha)				
March	15.1	24.0	48.8	36.4
April	449.5	632.7	350.1	690.3
Percent Increase over March	+2877	+2536	+617	+1796
Egg laying (%)				
March	45.5	-	78.1	60.9
April	47.1	-	57.2	63.0
Percent Increase over March	+1.5	-	-20.9	+2.2
Wheat (q/ha)				
Season	**2001-02**	**2002-03**	**2003-04**	**2004 -05**
Productivity	17.38	14.02	13.67	20.12
Percent decrease over 2001-02	-	-19.3	-21.3	+10.01
Rapeseed and Mustard (Kg/ha)				
Productivity	884	540	360	470
Percent decrease over 2001-02	-	-38.9	-59.3	-8.24

were most likely to be the result of the associated vapour pressure deficit.

Animals and poultry

The conditions inside animal houses are affected to a considerable extent by the meteorological factors of the external environment and the construction itself (Padmanabhamurty, 1983) and the animals housed in them. Microclimatic data from several studies from open, loose house and several other kinds of shelters show that maximum temperature inside the barn was similar to that of open and it was invariably higher in loose house by about 2 °C in all the seasons (Yadav, 2004). Most animals are generally adapted to wide range of climatic conditions provided their feed and water requirements are met. There are, however, direct climatic effects on the normal body functions of the animals. Dairy animals could adapt to slowly rising temperature conditions and their productivity may not be affected. The milk production in the University Dairy Farm was not affected significantly during March and April. This observation is in confirmation with Singh *et al* (1999). Warming in March 2004 caused reduction of 20.9% in poultry egg production in the University Farm. For egg laying hens, 21 °C is optimum house temperature. Singh *et al* (1999) reported that feed consumption of poultry birds is higher when temperature is cooler than

during the hotter periods. Under high temperature conditions birds stop feeding for several hours which could be the reason for lower egg production observed during March 2004. Dietary manipulations are known to reduce the temperature stress on one hand and production costs on the other. In poultry, when barn temperature crosses 29 °C, with every one degree further rise in temperature feed is reduced by 2g/ bird.

The above study shows that the weather conditions during March 2004 have reduced the tea production, egg laying in poultry, wheat and rapeseed and mustard yields.

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REFERENCES

Bajpai, P.N. 2001. Prospectus of horticulture in next millennium. In: Productivity of temperate fruits issues and strategies. Edited. K.K. Jindal and D.R.Gautam. Department of Pomology, College of Horticulture, Yaswant Singh Parmar University of Horticulture and Forestry, Solan, H.P. pp. 9-12.

Ghadekar, S. R. 1998. Crop Climatology, In Meteorology. Agromet Publishers Dharampeth Nagpur Maharastra.

Mavi, H.S. 1994. Climatic normals for crop and livestock. production. In: Introduction to Agro meteorology Second Edition. Oxford and IBH publishing Pvt Ltd.New Delhi.

Padmanabhamurty, B. 1983.Climate and animal husbandry. In: Compendium of Summer Institute on Impact of environment on Livestock Production. pp.46-63. Indian Veterinary Research Institute Izatnagar.

Prasada Rao, G.S.L.H.V., 2003. Weather and Crops. In: Agricultural Meteorology. Kerala Agricultural University , Thrissur, Kerala , India pp.326.

Sharma A.K. and Babu K.S. 2004. Crop health situation during March 2004. Crop Protection programme Directorate of Wheat Research Karnal. *Crop News Letter* 2003-04 April 2004 vol 9: 6.

Singh, S.V.; Rathore L.S. and Trivedi H.K.N. 1999. Weather advisories and livestock/ poultry management. pp 45-51 In: *Guide for Agrometeorological Advisory Service*. DST, NCMRWF New Delhi.

Tanton, T.W. 1982. Environmental factors affecting the yield of Tea (*Camellia*

sinensis). I. Effect of air temperature. *Exp. Agric.* 18: 47-52.

Tanton, T.W. 1982. Environmental factors affecting the yield of Tea (*Camellia sinensis*). II. Effect of soil temperature, day length and dry air. *Expe. Agric.* 18: 53-63.

Venkataraman and Krishnan, 1992. Effect of weather on soils, seed materials and crops.pp14-17. In: Crops and weather ICAR publication Pusa Anusandhan Bhavan Pusa, New Delhi.

Yadav, R.S. 2004. Effect of environmental factors on performance of Dairy Animals. In: Weather based Agro-advisories: Value Addition. A Course Manual, CCS Haryana Agricultural University, Hisar, India pp.88-100.