

Short Communication

A climatological study on minimum temperature at Hisar

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Temperature exerts major control in agricultural production through the thresholds of its critical values. Frost hazards occur when the minimum temperature falls below freezing point, which destroys standing crops (Mather, 1974). Several attempts have been made to study behavior of minimum temperature and frequency and severity of cold waves. Raghavan (1967) and Bedekar *et al.* (1974) studied occurrence of cold waves that prevailed over Indian sub-continent during 1911 to 1967. Recently, more such studies regarding variations in minimum temperature over different regions in India have been reported such as Jain and Dubey (1991) for Bhopal region, Samui and Gupta (1992) for two hill stations in Sikkim, Attri *et al.* (1995) for Gangtok in Sikkim and Deosthali and Payyappalli (1997) for Niphad region in Madhya Maharashtra. The present study is an attempt in this direction for Hisar region in Haryana state. The main crops in the region during winter season are wheat, gram and mustard.

The daily minimum temperature values at Hisar (Lat. 29°10'N, Long. 75°46'E, and Alt. 215.2 m amsl) for the period from December 1969 to February 2001 have been used in the present study which were collected from the Department of Agricultural Meteorology, CCS Haryana Agricultural University, Hisar (Haryana) and

were analyzed for the following aspects:

1. The extreme values of minimum temperature,
2. Events having zero or negative minimum temperature,
3. The daily departure of minimum temperatures from the normal
4. Persistence of minimum temperature for number of days, classified into three categories viz. no change (within $\pm 1^{\circ}\text{C}$), rise ($> 1^{\circ}\text{C}$) and fall ($< 1^{\circ}\text{C}$).
5. The number of cold waves has been computed as per criteria given by India Meteorological Department (IMD), which is defined as under

If the daily departure of minimum temperature from normal is negative by 6 to 7 °C, then it is called moderate cold wave and if $>7^{\circ}\text{C}$, it is said to be under severe cold wave condition.

The highest and the lowest minimum temperature recorded at Hisar in three months of winter season during 1969 to 2001 are given in Table 1. The highest minimum temperature of 17.5 °C was recorded on 25th February, 1973 and lowest of -2.9 °C on 6th and 7th February 1974 during the period 1969 to 2001.

The number of events with zero or

Table 1 : Extreme values ($^{\circ}\text{C}$) of minimum temperature at Hisar (1969-2001)

Month	Highest			Lowest		
	Date	Year	Value	Date	Year	Value
December	17	1977	15.8	29	1973	-2.4
January	22	1981	16.4	16	1974	-2.6
February	25	1973	17.5	6&7	1974	-2.9

Table 2 : Number of events with zero or negative values of minimum temperature at Hisar (1969-2001)

Years	December	January	February	Total
1970	1	-	-	1
1973	5	-	-	5
1974	-	3	5	8
1977	1	2	-	3
1978	-	3	1	4
1980	-	-	1	1
1982	-	-	1	1
1986	6	-	-	6
1996	5	1	-	6
1997	-	7	2	9
1998	-	3	-	3
2000	3	3	-	6
2001	-	6	3	9
Total(13)	21	28	13	62

negative values recorded at Hisar are given in Table 2. Total number of events(13) when minimum temperature recorded either zero

or negative were counted as 62 out of total 2798 observations during the last 31 years and the maximum number (28) occurred in

Table 3 : Number of cases (%) of departure of minimum temperature from normal at Hisar (1969-2001)

Month	Nearly normal + 1.4 to -1.4°C	Above normal +1.5 to +3.4°C	Appreciably above normal +3.5 to +5.4°C	Markedly above normal ≥+5.5°C	Below normal -1.5 to -3.4°C	Appreciably below normal -3.5 to -5.4°C	Markedly below normal ≤ 5.5°C
December	43	13	6	5	22	10	1
January	31	14	8	8	26	12	1
February	30	14	11	9	20	11	5

the month of January, such maximum events occurred during the years 1997 and 2001 on 9 occasions each followed by the year 1974 with 8. The minimum temperature was not recorded as zero or negative during the remaining 18 years.

Departure of minimum temperature

The percentage number of cases of departure of minimum temperature from the normal values in different categories is given below in Table 3. The cases of nearly normal were found maximum in all the months varying from 30 per cent in February to 43 per cent in December. The second place was occupied by below normal category in all the months representing the highest value in January (26 per cent).

Persistence in minimum temperature

Table 4 represents the percentage number of continuous days by which minimum temperature either did not change or rise or fall continuously. This table indicates that the persistence for all categories in all the months decreased with increase in number of days. Changes that persisted for one day were found varying

from 61.4 percent in February to 63.8 per cent in January. On an average, 62.5 per cent of total cases were observed for the changes lasting for one day and 22.9 per cent for two days when all the months were taken together.

It is important to note that the changes were persistently lasting more than seven days for the category of no change where as in respect of rise and fall categories, there were no changes lasting for more than five days.

The incidence of moderate and severe cold waves during the months of December, January and February is given in Table 5. The maximum number of cold waves were recorded in the month of February (42) where 31 and 11 numbers were calculated for moderate and severe cold waves, respectively. The minimum of these occurred in January (9) and there was no severe cold wave in this month during the period of study. There was one incident when the severe cold waves were continuing lasting for four consecutive days in February in 1974. Two incidents were recorded when Hisar was under the grip of moderate and severe cold

Table 4: Percentages of occurrence of persistence in minimum temperature at Hisar.

Month	Number of continuous days						
	1	2	3	4	5	6	≥7
	No change						
December	15.8	7.5	4.9	3.9	2.4	1.0	2.0
January	20.6	7.3	4.8	1.6	0.1	0.7	1.4
February	19.7	7.5	2.4	1.0	1.0	1.0	1.6
Rise							
December	25.0	4.7	1.4	-	-	-	-
January	19.6	7.8	1.0	0.3	0.1	-	-
February	21.3	11.2	2.6	0.2	0.2	-	-
Fall							
December	21.5	7.1	2.4	0.2	0.2	-	-
January	23.6	8.8	2.8	-	-	-	-
February	20.4	8.4	1.9	0.6	-	-	-

Table 5 : Frequency of cold waves at Hisar (1969-2001).

Month	Moderate	Severe	Total
December	11	2	13
January	9	0	9
February	31	11	42
Total	51	13	64

waves together each lasting for five consecutive days.

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