

Winters in the Punjab.

By J. B. Seth, M.A. (Cantab.), I.E.S.,
Professor of Physics, Government College, Lahore.

I WAS much interested to read the two articles in *Current Science* of February, 1935, on the recent cold waves by Drs. Ramdas and Roy of the Indian Meteorological Department. The cold wave of January, 1935, was undoubtedly much longer and, judged by the minimum shade temperatures (of air), much severer than that of 1929. Thus according to the tables given in Dr. Roy's paper, the 1929 cold wave lasted only 5 days while this year's lasted 9 days. Moreover, the air temperatures registered this year were decidedly lower than those in 1929.

I am writing this to bring it to the notice of those interested that the length and severity of a cold wave as judged by air temperatures do not seem to have much correlation with ground frosts, at least so far as the Punjab is concerned, if one may generalise from the weather data about Lahore which alone are available to me. Dr. Roy implies in his paper, and one would certainly be inclined to think, that since the minimum air temperatures registered in 1935 were much lower and for a much longer period than those registered in 1929, the ground temperatures in the current year would also have been lower than those in 1929. The state of affairs, however, at least so far as Lahore is concerned, is, strangely enough, just the opposite.

During the cold wave of this year the lowest temperature on grass registered in the local meteorological observatory was $19^{\circ}\cdot 0$ F. on the 18th January on which day the minimum shade temperature of air was also the lowest recorded during the cold wave, namely, $27^{\circ}\cdot 8$ F., which is, incidentally, the lowest air temperature ever recorded in Lahore since January 1879—data for years previous to this are not available in the local meteorological observatory. The lowest temperature on grass registered in 1929 was more than 4 degrees lower than that registered this year, namely, $14^{\circ}\cdot 7$ on the 31st January, 1929, on which date was also reached the lowest of air temperatures for that year's cold wave at $29^{\circ}\cdot 0$ F.

During the cold wave of this year the minimum air temperature in Lahore continued to remain below or at the freezing point for 7 mornings (13th to 19th January);

during 1929 the corresponding number was only three (31st January—2nd February). But this year ground frosts took place, besides, of course, the frosts of the seven mornings of the cold wave, only one day before and one day after the cold spell: on the 11th January the grass minimum was $37^{\circ}\cdot 0$, from the 12th to 20th it remained below the freezing point but then it shot up from $28^{\circ}\cdot 0$ on the 20th to $43^{\circ}\cdot 2$ on the 21st morning, due of course to the incidence of cloudy weather; and it never went below freezing after the 20th January though it once again touched $32^{\circ}\cdot 0$ on the 27th January. It may also be mentioned at this stage that before the incidence of the cold wave of this year there had been two to three degrees of ground frost for seven mornings from the 3rd to 9th January and that altogether during the 1934-35 winter there had been, before the incidence of the cold wave on the 12th January, 16 frosty mornings, the first frost of the season having been registered on the 26th November, 1934, when the minimum grass temperature went down to $28^{\circ}\cdot 9$ F. The minimum grass temperature of the 20th November had only just touched the freezing point, having been $31^{\circ}\cdot 9$ F. Thus the total number of mornings during the 1934-35 winter when the minimum grass temperature reached or went below 32° F. was 27 including the days of the cold wave.

The winter of 1928-29 in Lahore was much severer than this year's judging from ground frosts. Thus the frosts during the mornings of the cold wave of that year had been preceded as well as followed by three successive mornings. During the days when the cold wave was actually passing through Lahore, the grass minimum temperatures were $14^{\circ}\cdot 7$, $16^{\circ}\cdot 9$ and $15^{\circ}\cdot 2$ on the 31st January, 1st and 2nd February, 1929, respectively. These were followed altogether by 14 more frosty mornings upto the 19th February and had been preceded by a very large number of similar mornings. Thus between the 5th December, 1928, when the first frost of the season was registered, the grass minimum being $29^{\circ}\cdot 0$, to the 30th January, 1929, the eve of the incidence of the cold wave and on which morning $25^{\circ}\cdot 4$ was reached on grass, there had been 38 mornings on which the

minimum grass temperature went down to or below the freezing point. Altogether during 1928-29, the number of such mornings was 58, the first being the aforesaid 5-12-1928 and the last, 4-3-1929 with $29^{\circ}.1$ F.

It should be mentioned here that in 1929 the minimum grass temperatures were registered by a thermometer the bulb of which was kept in contact with a woollen pad laid on the ground. Since October 1933, however, the grass temperatures are being registered by a thermometer kept about an inch above the ground level on wooden cross supports. The so-called grass temperatures observed according to the latter, *i.e.*, the current practice will probably be a little higher than if the older method were used. But all the same, residents of Lahore will have no doubt about the frosts of January-February 1929 having been much severer than those of January, 1935.

It is interesting to note that January of this year (1935) had been preceded by an abnormally warm December. Between the 1st December, when the grass minimum had just gone below freezing (to 31.8) to the 29th December, when it went again below freezing (to 30.2), the mean temperature of the day (the mean of the maximum and minimum air temperatures in shade) remained above the normal mean temperature almost every day, so that the average of the daily mean temperatures for the month reached 57.6 , nearly two degrees above the normal monthly average (the mean of the 31 daily normal temperatures) of 55.7 . January was also followed by a warm February, the monthly average having been 59.4 as against the normal average of 57.9 . However, compensation for these abnormally high averages was provided by the length of the cold wave and its having been followed as well as preceded by quite cold days. This made the monthly average temperature for January abnormally low, being only 51.2 as against the normal average of 54.4 . With the result that the mean temperature for the 1934-35 winter season (1st November-15th March) comes out to be 59.2 , only a fifth of a degree above the normal mean for the same period.

I understand that officially the winter is regarded to last from the 15th October to 15th March. I have, however, regarded it to commence on the 1st November for the normal daily temperature of Lahore goes down below 70 (to 69.5) on the 2nd November and remains below 70 till the 16th March

the normal temperature for which day is 69.6 . The normal temperature of 1st November is 71.1 and of 17th March 70.6 . These normal temperatures for each day of the year were supplied to the local meteorological observatory certainly more than 20 years ago and perhaps should be revised. Returning, however, to the duration of winter in Lahore, I feel it should be regarded to last only for that period during which the normal daily average does not exceed 65°F . Applying this criterion the winter in Lahore should be taken to last from 15th November (normal temperature, 64.7 ; the normal of 14th being 66.1) to 6th March (normal temperature 64.6 ; the normal of 7th being 65.7). Table I summarises the points brought out in the foregoing.

TABLE I.

(giving a few details about the winters of 1928-29 and 1934-35 at Lahore. Temperatures are in degrees F.)

	1928-29	1934-35	Normal
Average temp. for Nov.	66.0	64.7	64.5
" " Dec.	56.9	57.6	55.7
" " Jan.	54.2	51.2	54.4
" " Feb.	58.0	59.4	57.9
" " March 1-15	69.0	67.6	66.1
Average temp. from 1st Nov. to 15th March. ..	59.6	59.2	59.0
Average temp. from 15th Nov. to 6th March. ..	57.6	57.1	57.2
No. of days when grass minimum reached or went below $32^{\circ}.0$..	58	27	..
No. of days when air minimum reached or went below $32^{\circ}.0$..	3	7	..
Lowest minimum air temperature recorded (with date) ..	29.0 (31/1)	27.8 (18/1)	..
Lowest minimum grass temperature recorded (with date) ..	14.7 (31/1)	19.0 (18/1)	..

I should also like to mention here that it does not seem to be very uncommon in Lahore and I suppose, therefore, in the plains of the Punjab generally, to find quite severe frosty mornings without the minimum air temperatures reaching even the freezing point. This as well as several other interesting features about Lahore winters are brought out in Table II which goes back to the winter of 1921-22.

TABLE II
(showing the relative severity of winters in Lahore.)

Season	Average temperature 1st Nov.—15th March. Normal for the period = 59.0	No. of days when grass minimum reached or went below 30° F.	No. of days when 8 degrees or more of ground frost was registered	Average frost during the season (total of degrees of frost each day ÷ the number of mornings)	The first day when the grass minimum reached or went below 32, giving the temperature	The last day for above	Lowest grass temperature giving date	Lowest air temperature in shade giving date	Extra data about the last two columns where necessary. g = grass min. a = air min.
1921-22	61.3	21	0	2	10/12(30.5)	7/3(31.8)	27.0(22/1)	37.4(4/1)	g 27.8 on 4/1; a 38.6(22/1).
1922-23	59.3	24	2	3	17/11(31.3)	10/2(31.2)	21.8(2/1)	35.4(2/1)	
1923-24	59.4	39	8	4	15/11(31.9)	19/2(30.9)	23.0(31/12)	35.6(31/12)	
1924-25	58.5	63	17	5	20/11(29.9)	2/3(31.2)	19.9(24/2)	34.7(15/1)	g 21.0(15/1); a 37.4(24/2).
1925-26	58.9	59	16	5	21/11(31.2)	21/2(32.1)	20.9(21/12)	35.3(21/12)	
1926-27	58.4	81	36	7	16/11(30.0)	8/3(27.2)	15.3(11/1)	32.0(11/1)	
1927-28	61.4	26	1	3	23/11(30.3)	18/1(31.7)	23.4(17/12)	37.9(17/12)	
1928-29	59.6	58	12	5	5/12(29.0)	4/3(29.1)	14.7(31/1)	29.0(31/1)	
1929-30	59.2	52	13	5	6/11(30.2)	4/3(31.4)	20.0(7/1)	34.1(19/1)	g 21.3(19/1); a 34.9(7/1).
1930-31	58.4	50	14	6	8/12(24.9)	23/2(27.2)	17.0(25/12)	31.8(23/12)	g 17.3(23/12); a 37.2(25/12).
1931-32	60.6	19	0	2	16/12(31.4)	17/2(32.0)	26.2(30/12)	33.6(30/12)	
1932-33	58.7	32	8	5	8/12(32.0)	30/1(29.8)	20.0(7/1)	30.0(14/1)	g 24.2(14/1); a 31.3(7/1).
1933-34	59.9	34	14	6	14/12(31.0)	8/2(31.0)	20.0(2/2)	30.3(20/1)	g 20.9(20/1); a 32.3(2/2).
1934-35	59.2	27	7	5	20/11(31.9)	27/1(32.0)	19.0(18/1)	27.8(18/1)	

The different data incorporated in this communication will probably remain incomplete if I do not also give a list of all those days in Lahore since 1st January 1879, on which the minimum shade temperature of air went below 30° F. There have not been very many such days during the last half century (to be accurate the last 57 years) and these are set down in Table III.

TABLE III

(showing the days in Lahore since 1879 when the minimum air temperatures went below 30° F.)

Year	Date	Minimum Air Temperature	Grass minimum on the same day
1889	Jan. 19	29.2	18.8
1910	Dec. 23	29.4	17.9
1929	Jan. 31	29.0	14.7
1935	Jan. 15	29.1	21.3
"	" 17	28.1	20.2
"	" 18	27.8	19.0
"	" 19	28.3	20.2

A study of the data included in this paper leads one to the conclusion that very low

air temperatures are not of too common occurrence in the plains of the Punjab whereas quite low ground temperatures are not so uncommon. Really low temperatures seem to result only from actual cold waves; severe ground frosts, on the other hand, do not necessarily mean the incidence or passage of a cold wave.

Low ground temperatures would result from the combined influence of an extremely clear sky and an almost total absence of water vapour in the atmosphere. If the water vapour present is not negligible the ground temperatures may not reach very low figures even though there be a clear sky and, due to a cold wave, below freezing air temperatures. This was perhaps what happened during the last cold wave. On the other hand, absence of any air currents near the ground may be responsible for very low ground temperatures not being accompanied by low air temperatures, there being a difference in level of about 4 feet between the thermometers registering air and grass temperatures.

Another remarkable fact stands out from Table III. During the 50 years preceding

1928, air temperatures (in shade) went below 30° F. only on two occasions, once in 1889 and once again in 1910; whereas during the seven years that have followed 1928, there have been two cold waves resulting in lower than 30° temperatures on one day in 1929 and four days in 1935. One must not really generalise from such meagre premises but it would appear as though we were in for a period of more frequent cold waves!

In the end I must thank the Indian Me-

teorological Department for giving general permission, several years ago, to their officer-in-charge of the local observatory to allow me access to the records, etc., kept in Lahore. And I cannot close without also thanking the local officer, Mr. Dina Nath Chopra without whose active help and co-operation, I would not have been able to maintain my interest in matters meteorological, nor able to give all the facts and figures incorporated herein.

Stigmas and Awns—Their Homology.

By G. N. Rangaswami Ayyangar, B.A., I.A.S.,
Millets Specialist, Agricultural Research Institute,
and

V. Panduranga Rao, M.A.,
Assistant, Millets Breeding Station, Coimbatore.

THE existence in certain varieties of sorghum of fertile pedicelled spikelets has been noted (G. N. Rangaswami Ayyangar, and V. P. Rao, 1935).¹ One of these varieties, M. S. 1644, is awned. It is well known that in awned varieties the sessile spikelets bear awns and the pedicelled ones do not have them. The occurrence of grain-bearing fertile pedicelled spikelets raised the question whether such fertility resulted in the stimulation and manifestation of the otherwise absent awn in the pedicelled spikelets. An examination of these fertile pedicelled spikelets showed that they did develop the awn concurrent with this fertility—only the expression of the presence of awn was a bit feeble. In Fig. 1 the top picture shows

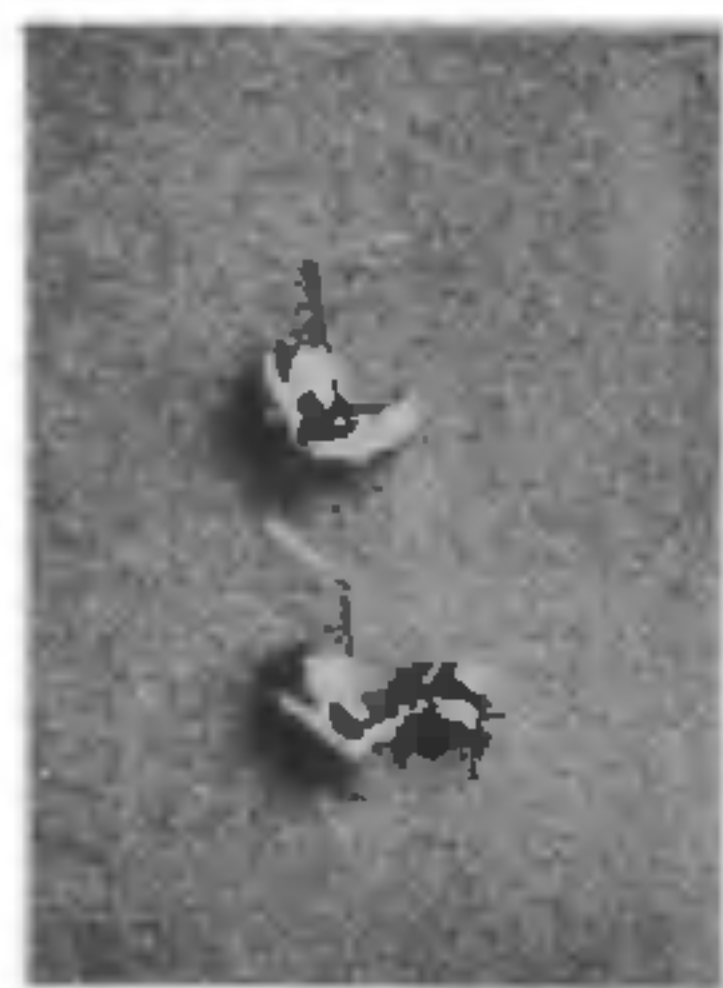


Fig. 1.

the pedicelled sterile spikelet without awn and in the bottom one the same pedicelled

spikelet when it bears a grain also develops the awn. Where awns did occur, measurements show that they were about half the length of the normal awn; normal—6 mm.; pedicelled—2.9 mm.—(average of 100 readings.) Pedicelled spikelets without awns have occasionally anthers. This activation into a manifestation of the awn concurrent with the appearance of the ovary with the stigma raised the probable homology between awns and stigmas. Looking up literature it was noted that Harlan (1931)² working in Barley “had felt for some years” that the barbs on the awns and the hairs on the stigma arise from the same basic tissue. In 1915 he noticed a high positive correlation between the number of teeth on the awns and the number of hairs on the stigmas. The experience recorded above in which the awn as an organ manifested itself concurrently with the stigma, gives unmistakable proof of their inter-relationship.

Next to this concurrent presence of stigmas and awns in awned varieties is the parallel that exists in their general morphology. In Fig. 2. are given two stigmas (a) that of *Sorghum Durra*, Stapf, the Grain Sorghum, and (b) that of *Sorghum Nervosum*, Bess, the fodder type, *Irungu Cholam*. It will be noted that in *S. Durra*, the stigmatic feathers cover half the style, and in *S. Nervosum* a little less than a third. Fig. 3 gives the photographs of the respective

¹ *Curr. Sci.*, 1935, 3, 433-34.

² *Jour. Hered.*, 1931, 22, 271.