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Meteorological factors associated with grasshopper outbreak at Vagholi village (Solapur district, Maharashtra) in 1975

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सार — विभिन्न नाशकारी जीवों के प्रकोप पर मौसम की दशाओं के प्रभाव की जांच की गई है । नाशकारी कीटों की वृद्धि के सन्दर्भ में तापमान व वर्षण के परस्पर सम्बन्ध को ज्ञात किया गया है ।

इस विश्लेषण से इस विश्वास की पुष्टि होती है कि कीटों पर मौसम का प्रभाव प्रायः अल्प कालीन ही होता है ।

ABSTRACT. Influence of weather conditions on an outbreak of a sporadic pest are examined. Temperature and precipitation relationship to the abundance of an insect pest are outlined.

The analysis supports the belief that weather effects on insects often act over a short period.

1. Introduction

During the month of September 1975 public attention was drawn by press reports to locusts sighted in Mohol tehsil of Solapur district. They were reported to have destroyed kharif crops. Although locusts and their close relations grasshoppers have caused concern to mankind since the beginning of recorded history, its incidence in the State of Maharashtra is a rare phenomenon. However, on examination of the infested fields the pest was found to be grasshoppers. In view of the huge insect population and its potential danger to rabi crops the present study was undertaken. Fig. 1 shows the damage to various crops by the pest.

2. Meteorolgical factors and their importance in pest outbreak

Climate affects the distribution and number of insects in a given area directly through its influence on the speed of their development, their longevity and indirectly through its influence on the availability of food. The effect of climatic factors on insect production have been studied by various scientists. Parker (1952) has pointed out that "Weather conditions during and following the hatching period may start or end outbreaks". If it is warm and dry, the death rate may decline below the 60% average and allow grasshoppers to develop in outbreak numbers. If it is cold and wet, mortality may increase to such an extent that few survive.

The relationship between temperature, rate of growth and distribution of insects is demonstrated by Shotwell (1952). He found that a sample of eggs of the two stripped grasshopper hatched in an average of 8.6 days at 77° F, while a sample of differential grasshopper eggs hatched in 22.5 days at the same temperature.

Temperature and moisture often act together to limit the number of distribution of insects. High temperatures and high humidities encourage the spread of a fungus disease that attacks many species of grasshoppers for instance, and disease may decimate whole population nearly to the exclusion of other limiting factors. This was pointed out by Mills.

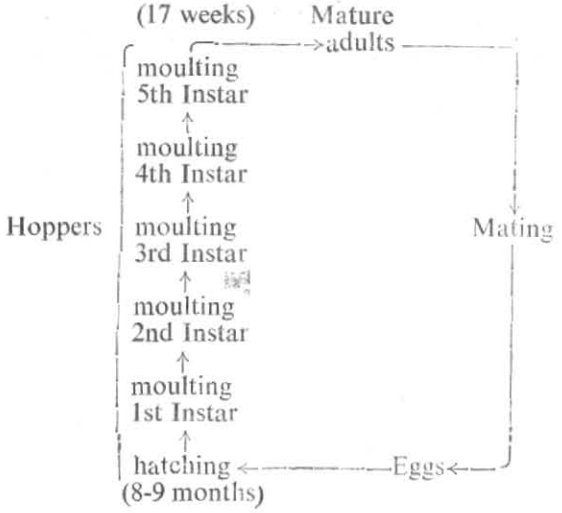
Effects of temperature and humidity on hopper development have been shown by Parker whose extensive experiments with several American grasshoppers clearly indicate a shortening of the hopper period and an accelerated rate of development with rising temperature.

Temperature and precipitation relationships to the distribution and abundance of an insect is given by Pepper (1938).

Wind also in certain instances plays an important role in the dispersal of insects to new areas (Rainy 1951).

3. Life history of a grasshoppers

Most of the grasshoppers deposit their eggs in the ground in late September or early October. The common injurious species spend 6 to 8 months of the year as eggs in the top 3 inches or so of the soil. These eggs hatch after the first heavy rains and the small active insects emerge. They undergo the usual five moults and become mature in August or September. The life history is passed in rice fields and occupies seventeen weeks. After mating, eggs are laid in the soil (Maxwell-Lefroy 1906).



4. Purpose of the present investigation

As weather has an intimate relationship with the life history of an insect, the purpose of this study is to examine the weather conditions prevailing in the Vagholi area during the years 1973, 1974 and 1975 with a view to find out how far the meteorological factors would have contributed to the outbreak of the pest in the year 1975.

4.1. *Meteorological conditions at Solapur during the years 1973 and 1974 when no grasshopper outbreak was reported*

As no meteorological data for Vagholi are available, meteorological data of Solapur (nearest observatory to Vagholi) was examined. Table 1 shows the rainfall week by week for the months May to September for the year 1973 and 1974 along with normal rainfall during the same period based on 25 years data.

It will be seen that rainfall were of 32% in excess of the normal in 23rd week, of more than 615% and 117% in the excess of the normal in the successive 2 weeks (26th and 27th) in the year 1973.

Assuming that hatching has taken place after the first monsoon showers in week No. 23 followed by a dry spell in 24th and 25th weeks, the heavy downpour in 2 successive weeks (26th and 27th) along with low minimum temperature (Table 2) right from 27th week to 39th week would have caused severe unfavourable weather conditions for moulting of the newly hatched insects resulting in greater mortality of the hoppers.

TABLE 1

Rainfall at the Agricultural Meteorological Observatory at Solapur

Weeks	Normal rainfall (mm)	Actual rainfall (mm)		
		1973	1974	1975
18 (Apr 30-May 6)	5.9	0	0	5.0
19 (May 7-13)	4.4	0	0	0.0
20 (May 14-20)	6.3	0	16.3	0.0
21 (May 21-27)	17.3	0	16.2	0.0
22 (May 28-Jun 3)	13.7	0	9.5	2.8
23 (June 4-10)	31.7	41.8	7.0	15.7
24 (Jun 11 -17)	23.4	0	9.2	0.0
25 (Jun 18-24)	22.3	0	16.5	4.0
26 (Jun 23-Jul 1)	24.6	175.8	20.3	10.1
27 (Jul 2-8)	17.1	37.1	2.3	29.4
28 (Jul 9-15)	18.0	14.1	11.3	28.1
29 (Jul 16-22)	38.0	17.9	5.3	76.2
30 (Jul 23-29)	41.4	4.6	67.7	56.5
31 (Jul 30-Aug 5)	26.2	77.1	195.8	89.6
32 (Aug 6-12)	26.3	39.5	15.8	90.8
33 (Aug 13-19)	35.0	68.3	00.0	20.0
34 (Aug 20-26)	32.3	14.5	10.5	12.8
35 (Aug 27 Sep 2)	48.4	6.7	15.0	80.3

Again the heavy spells during 3 consecutive weeks (31st to 33rd) would have contributed to further mortality of the surviving insects.

In contrast to this, the rainfall pattern in the year 1974 was entirely different. The rainfall for most of the period was below normal, the maximum and minimum temperatures immediately after hatching were also below normal from 20th to 23rd week which may have adversely affected the insect population.

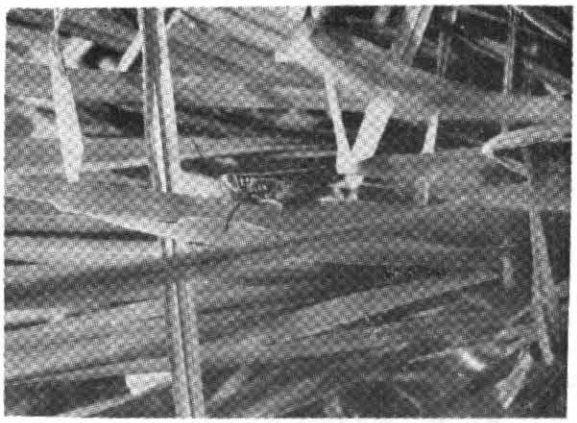
Again heavy rains during weeks 30th and 31st (when the rainfall was 63% and 647% in excess) would have caused further mortality of the insects.

4.2. *Meteorological conditions in 1975 — A year of grasshopper outbreak*

It will be seen that pre-monsoon showers in 1975 were received in the 18th week. After which dry conditions prevailed for 3 consecutive weeks (19th, 20th and 21st).

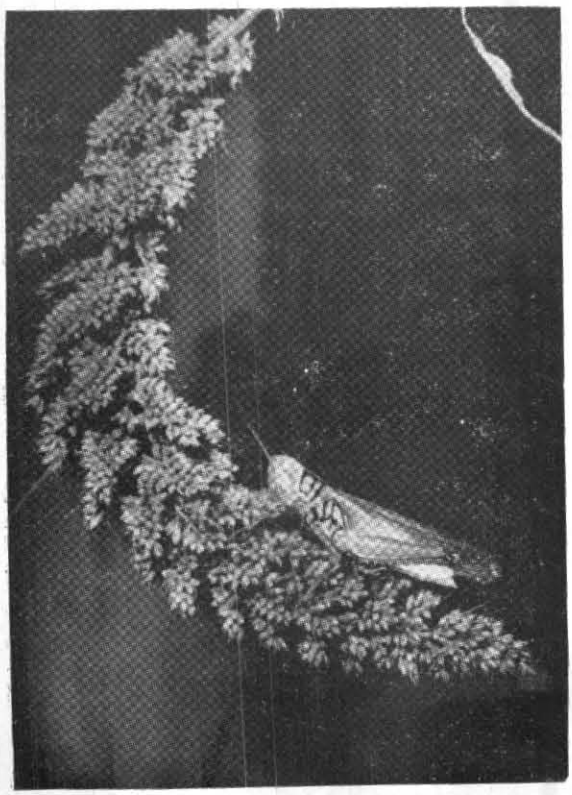
Mature adult grasshoppers were noticed for the first time in sugar cane field at the time of first earthing up of the crop on 1 Sep 75. As the life cycle of the insect takes about 17 weeks it is clear that hatching had taken place after the first showers in week No. 18. During the next 3 consecutive weeks, *i.e.*, 19th, 20th and 21st, there was no rainfall. Also the hours of bright sunshine were above normal (Table 3). It was dry and warm. Thus the weather conditions during these 3 weeks were quite favourable for the newly born insects to multiply in outbreak numbers. This analysis thus supports

(a) Italian milllet

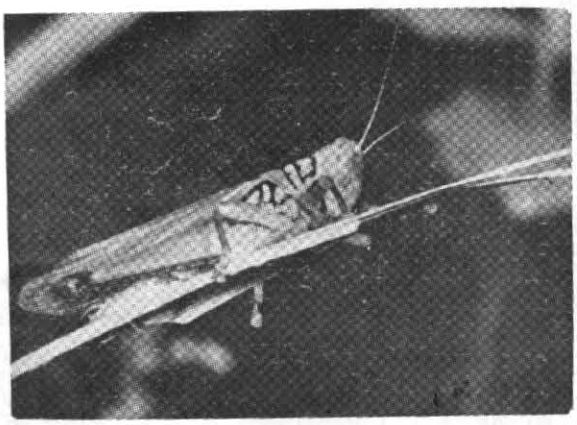


(b) Sugarcane

Figs. 1 (a & b). Damage to various crops by the insect pests



(c)



(d)

Figs. 1 (c & d). Close view of insect pest on Italian millet and sugarcane leaf

TABLE 2

Station : Solapur

Week No.	Max. Temp. (°C) Normal	Max. Temp. (°C) Actual 1973	Max. Temp. (°C) Actual 1974	Max. Temp. (°C) Actual 1975	Min. Temp. (°C) Normal	Min. Temp. (°C) Actual 1973	Min. Temp. (°C) Actual 1974	Min. Temp. (°C) Actual 1975
18	40.3	43.5	42.1	40.7	25.0	27.3	25.2	25.7
19	40.8	42.8	42.5	39.7	24.9	24.8	26.1	24.1
20	40.5	41.5	37.2	39.8	25.1	24.8	23.3	24.8
21	39.3	41.7	36.2	40.1	24.5	26.4	22.2	24.6
22	38.7	41.5	36.0	38.5	24.3	26.3	21.9	24.3
23	36.6	37.6	36.1	37.3	23.4	23.9	22.1	22.8
24	35.4	35.9	37.6	35.9	23.0	24.0	23.1	24.4
25	34.2	36.9	34.6	33.6	22.7	23.7	22.9	23.0
26	33.3	33.3	32.4	31.2	22.5	22.4	21.7	22.3
27	32.7	29.5	33.3	32.0	22.4	21.9	21.9	22.0
28	32.6	31.1	32.7	31.3	22.3	21.7	22.5	21.7
29	31.5	32.0	32.9	32.5	22.0	22.0	22.5	22.0
30	30.0	33.6	33.4	31.4	22.0	21.8	22.3	21.9
31	30.6	31.7	30.6	29.8	21.9	22.0	21.7	21.2
32	31.7	29.1	29.6	29.9	21.8	21.3	21.7	22.1
33	31.7	29.5	32.1	31.5	21.6	21.3	21.3	21.1
34	31.5	29.6	32.2	31.9	21.5	20.6	20.5	21.0
35	31.5	29.6	32.5	30.9	21.4	20.6	20.1	21.1

TABLE 3

Bright hours of sunshine at Solapur

Week No.	Normal	Bright hours of sunshine (Actual) 1973	1974	1975
18	9.7	10.1	10.8	8.8
19	9.6	11.7	11.1	9.7
20	9.2	11.1	7·1	10.3
21	8.3	9.0	6.5	9.9
22	8.5	7.5	10.7	7.2
23	8.1	7.0	8.9	10.8
24	7.0	6.0	5.2	6.3
25	6.2	8.9	6.7	3.3
26	4.1	4.2	6.2	2.6
27	3.4	1.0	5.4	3.4
28	3.8	2.5	4.0	2.7
29	3.3	4.8	3.8	4.1
30	3.9	8.4	5.9	6.3
31	3.6	4.4	3.5	3.5
32	4.0	3.7	1.9	2.5
33	4.1	2.8	5.3	4.4
34	4.6	4.3	6.9	7.0
35	5.0	2.6	8.6	4.7

the belief that weather effects on insects often act over a short period. This factor of timeliness is, therefore, most important especially in such insects as chinch bugs and grasshoppers.

The rainfall during weeks 22nd to 26th was much below normal, thereby contributing favourable conditions for the moulting phase.

Though there were heavy spells during week nos. 29, 30, 31 and 32nd but this had no adverse effect on the insects as the moulting phase had almost completed by this time.

Added to the favourable weather conditions, there was plenty of food available in the form of sugarcane crop (planted in January 1975) and grass and weeds on the border of the fields.

Thirdly the natural ememies which are generally operative were not observed in the infested area, thereby allowing the insect pests to thrive in outbreak numbers.

5. Concluding remarks

(1) The study reveals that dry and warm weather during hatching and moulting phase favours the multiplication of the

insect pest in outbreak numbers. Thus forewarning of the pest attack from weather data, therefore, appears feasible.

(2) The analysis supports the findings of Parker (1952) that weather conditions during and following the hatching period may start or end outbreaks.

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