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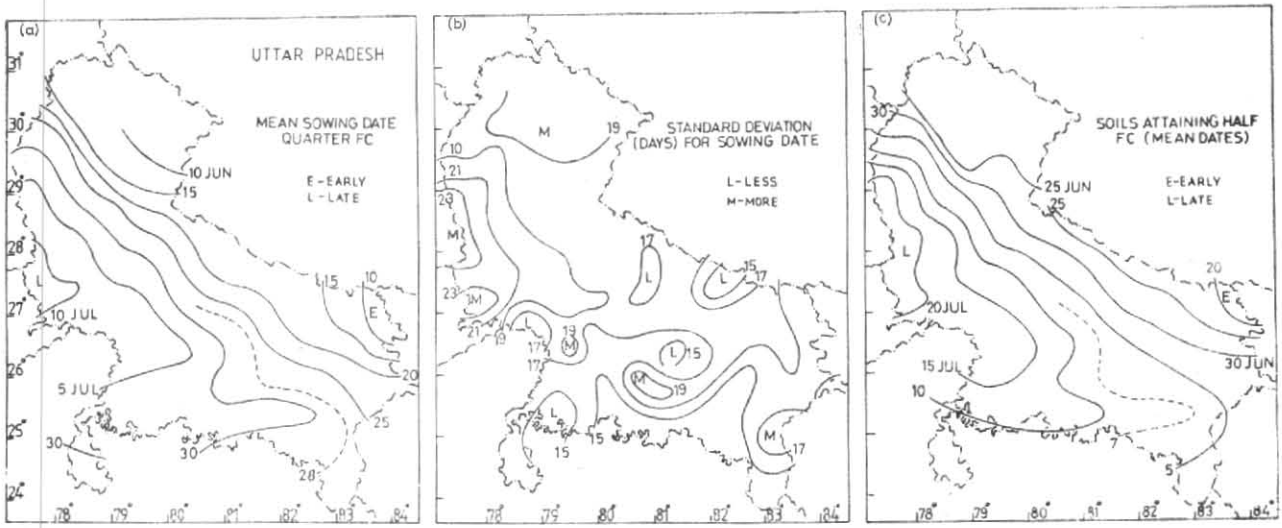
SOWING DATES FROM SOIL MOISTURES

Sowing is probably the most crucial phase of crop growth. Earlier the sowing dates were determined based on a specified amount of rainfall during a specified period for Maharashtra State (Raman 1974). Similar work has been done for several other States [I.M.D. 1986, (a & b), 1989, 1991] and for selected locations Rao *et al.* 1978, 1983, Gopalaswamy *et al.* 1988).

It is useful to have the sowing date determined using a more rational method. With this objective in view in the present study, these dates are determined based on the soil moisture criterion, by using the water balance technique of Thornthwaite and Mather (1955). The dates thus obtained are more consistent, as the determination of sowing dates with a given quantity of rainfall, in a given period, is likely to be very much influenced by the initial pre-monsoon thundershowers which on several occasions are sufficiently heavy to satisfy the rainfall requirement, in an individual case itself. A methodology, therefore, has been developed from which the sowing dates for different crops in different areas can be determined by deciding the initial requirements of soil moisture storages.

2. *Scope of study*—The water balance is studied for over 300 stations spread over Uttar Pradesh State, on a day to day basis. Daily rainfall values for the period 1901-80 are used in the study. Stations with less than 20 years rainfall data are not considered. The hilly



Figs. 1 (a-c). Soil moisture attainments for different stages

districts of the State are not included as sufficient rainfall data are not available and the orography of this area is not suitable for uniform analysis. The dates for sowing are determined on a yearly basis and the average value of the sowing dates for all the 80 years from 1901 to 1980 is taken as the normal sowing date. The study is limited to the kharif season alone.

3. *Scheme of study*—For studying the water balance the requirements are : (*i*) initial moisture storage in the soil, (*ii*) rainfall, and (*iii*) potential evapotranspiration (PE) on a daily basis. Normal values of daily PE values are derived from the normal values (Rao *et al.* 1971) for all the stations after suitable extrapolation and derivation. The parameters used in the calculations of PE values lend themselves for spatial interpolation. Daily values of PE are not available for the long period, considered. Using normal daily values of PE instead of the actual values does not affect the calculations as the deficiencies of rainfall against PE are accumulated till a desired storage is reached. The build up of soil moisture is gradual and, therefore, no abrupt fluctuations occur.

As most of the State area under analysis is covered by alluvial soil, the field capacity (FC) is taken to be 150 mm for all locations. The water balance is studied from 1st May of each year, assuming the initial soil moisture storage as zero. This is acceptable as the soil will have been practically dry after a sufficiently long rainfree period, and, as the requirements of evapotranspiration in the dry months would have depleted the storage present in the soil after the rainy season. Also, in this study, rainfall is taken as the only source of moisture.

4. *Analysis*—Starting with a zero storage on 1st May of a year, the changes in storage, daily from the water balance are studied. The day the storage reaches or exceeds the 25% FC value is taken as the sowing date (Singh 1989). The average of these yearly dates is taken as the normal sowing date for a station. This has been done for all the stations and the corresponding dates obtained. The standard deviations of the 25% FC dates are also calculated. The number of days required to achieve 50% FC from 25% FC and 75% FC from 50% FC are also obtained. The isolines showing the sowing dates (25% FC), with the standard deviations are presented in Figs. 1 (a & b). Further stages of storage (*i.e.*, 50% FC & 75% FC) and the periods required for attaining those are given in Figs. 1(c-f).

5. *Discussion*—From the analyses it is seen that :

(a) Mean sowing date varied from 10th June in the northern parts of the extreme east of the State to 10th July in the extreme west. These are the dates on which quarter FC storage value is reached [Fig. 1(a)].

(b) The standard deviation of the mean sowing dates as seen in (a) is varying from minimum of less than 17 days in the east of the State to about 23 days in the extreme west of the State. It is mostly less than 17 days over most of the southern parts of the State [Fig. 1(b)].

(c) Dates of attaining half FC values varied from 20th June to 20th July in a similar way as in (a) [Fig. 1(c)].

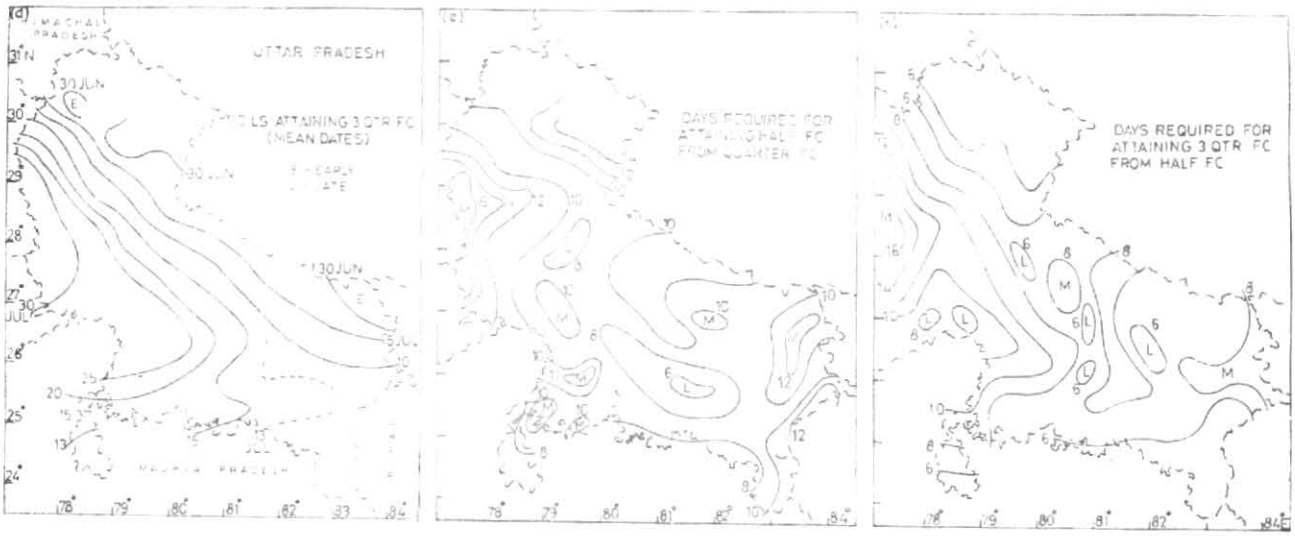
(d) The dates of attaining three quarter FC values varied from 30th June to 30th July similar to (c) [Fig. 1(d)].

It is thus seen that the duration of time required for the specified required conditions of soil moisture storages to occur, all over the State from east to west, for all the three levels of the storage values, is nearly a month.

(e) The number of days required to attain half FC from quarter FC values vary from 10 days to 16 days from east to west. However, it is less than 10 days over most of the eastern parts of the State [Fig. 1(e)].

(f) The number of days required to attain 3 quarter FC from half FC values vary from 8 days to 14 days from east to west. However, it is less than 8 days over most of the eastern parts of the State [Fig. 1(f)].

After the southwest monsoon is established over the country, the monsoon trough is more or less permanent feature of the lower half of the troposphere. This



Figs. 1 (d-f). (d) Soil moisture attainments, (e & f) days for inter stages soil moisture attainment

trough lies roughly along the middle parts of the southern half of the State. These parts thus lie within the monsoon trough. Depressions originating over the Head Bay of Bengal and moving westnorthwestwards along the trough are a common feature of the season, maintaining the rainfall which accounts for the lower number of days seen over the southern half of the State in (e) and (f), above [Figs. 1 (e & f)].

6. *Utility*—With agriculture becoming more technologically oriented with inputs of fertilizers, modern methodology, it is very necessary that water reasources be utilised optimally. To this end a knowledge of the soil moisture conditions is very useful. The climatological conditions obtained in the study can be used meaningfully, comparing them with the actual conditions prevalent and deficiencies, if any, can be rectified by supplementary irrigation if possible. Alternate cropping can be tried if conditions warrant it.

As the values for the various epochs in the study are based on soil moisture situations which are varying gradually and systematically, the results of utilisation of these dates will be more beneficial than the traditional methods. This can be further improved if actual PE values are available on a day to day basis for computing the water balance.

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