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Relationship Between Ambient Temperature and Soil Temperature at Different Moisture Levels

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In dryland agriculture the establishment of the crop is important. It is dependent on germination and seedling growth which are affected by ambient temperature, soil temperature and soil moisture. A simple correlation between these factors have been worked out. There was hardly any difference between the ambient and soil temperature during the *kharif* (monsoon season). In *rabi* (winter season) the soil temperature was lower than the ambient temperature by several degrees. Soil moisture influenced this relationship. During summer season the ambient temperature and soil temperature correlated strongly.

In dryland agriculture seed germination and crop stand are important pre-requisite for a good crop. Quick moisture loss after germination leads to water stress in plants which can be accentuated by high soil temperature (Kailasa Nathan *et al*, 1976). In India sowing is done immediately after the onset of monsoon rains (*kharif* season) when the ambient temperature is relatively high. A break in the monsoon rains causes a large change in the ambient temperature. These days multiple cropping is being practised in several parts of North India and in this cropping pattern, summer crops are grown after the harvest of wheat. During this period the ambient temperature is generally very high but its relationship with soil temperature and soil moisture is not clearly understood.

During the winter season the ambient temperature goes down considerably, particulary in the northern parts of India. The soil temperature in this period can cause an adverse effect on the root growth of plants. Since the moisture content of the soil also influences the soil temperature, an attempt has been made to study the relation between soil temperature, ambient temperature and soil moisture.

MATERIAL AND METHODS

The study on the relationship between ambient temperature and soil temperature under different moisture levels (mainly three levels) was carried out in the farm area of Water Technology Centre, IARI, New Delhi. Nine plots of 3m x 2m size were prepared in the sandy loamy soil. The first three plots were treated as control plots i.e. no irrigation was given during the entire period of the experiment. Three plots were irrigated to half the field capacity and the remaining three plots were irrigated to full field capacity. Irrigation was given every fortnight and the observations on soil moisture and soil temperature were taken just 24 hours after irrigation.

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TABLE I. Soil temperature observations under different moisture levels in the crop seasons

Year 1975 76 season	Full field capacity		Half field capacity		Control		
	Soil moist. %	Soil temp. °C	Soil moist. %	Soil temp. °C	Soil moist %	Soil temp. °C	Ambient temperature °C
	(Average value of 105 observations)		(Average value of 105 observation))		(Average value 105 observations)		Average value of 105 observations)
Kharif (July-Oct.)	15.3	26.3	14.4	26.4	14.0	26.7	28.1
Rabi (Nov.-April)	14.5	12.9	14.2	13.1	12.95	7.8	16.4
Summer (May-June)	12.2	24.5	10.9	24.8	6.9	27.9	31.1

The soil moisture determination was carried out by standard gravimetric method. The soil temperature was measured by ordinary soil thermometers. Both the above parameters were measured at 15 cm. depth at various points in the plots. The ambient temperature was recorded by thermograph enclosed in a stevenson screen near the experimental site. This experiment was conducted from July 1975 to November 1976.

A simple correlation technique was used to study the relationship between ambient temperature, soil temperature and soil moisture. Their values tested for significance both at 5 per cent 1 per cent levels.

RESULTS AND DISCUSSION

Soil temperature, soil moisture and ambient temperature for *kharif*, *rabi* and summer seasons are given in Table I. The soil temperature decreased by 2°C as compared to ambient temperature during *kharif* irrespective of the soil moisture. In *rabi* there was only a little difference in moisture content at 15 cms depth among the treatments and control. However, the temperature in control plots was lower by 8.6°C whereas in irrigated plots it decreased by only 2.2°C to 2.5°C. Thus, it appears that at the time of decreasing ambient temperature, irrigation can help in maintaining better temperature conditions for root activity in the soil. In summer season the soil temperature in control plots was 3.2°C lower than the ambient temperature. However, irrigating the land to half field capacity or full field capacity reduced temperature by another 3°C. Thus, it was lower by 6.3°C than the ambient temperature. This was of significant difference. In the same period if mung beans are grown in pots containing sand where the ambient temperature and the root medium remaining the same, the roots are damaged and plants fail to grow (Sinha unpublished). Thus, frequent irrigations even though of low quantity can help in maintaining more favourable root environment.

Correlation srudies shows that the air temperature and soil temperature have very strong and significant posi-

TABLE II. Correlation coefficient values between ambient temperature, soil temperature and soil moisture under different moisture regimes

	Control	Half field capacity	Full field capacity
Correlation coefficient 'r' between ambient temperature and soil temperature	+0.97**	+0.94**	+0.91**
Correlation coefficient 'r' between ambient temperature and soil moisture	+0.03	—0.25	—0.44*
Correlation coefficient 'r' between soil temperature and soil moisture	+0.13	—0.14	—0.26
Regression equation of air temperature with soil temperature	Y=1.14X —0.49	Y=1.18X +0.06	Y=1.20X —0.34

** 5% level of significance * Level of significance

ive 'r' value. (Table II) However, ambient or soil temperature has a negative correlation with soil moisture. This is understandable on the basis of the above data.

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