

# THE RELATIONSHIP BETWEEN NUTRIENTS UPTAKE AND MOISTURE LEVELS

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#### ARABIC SUMMARY

## I. IRRIGATION

As a factor limiting plant growth, water probably is foremost in importance. Vast areas produce only limited yields of crops because of water deficiency. For this reason the behaviour of water in soils and the response of plant to the various moisture conditions are of particular - practical importance.

Other important factor that affects, to a large extent, the growth is the nutrients availability as well as their physiological behaviour towards the available water, that part of soil water ranging between the two critical limits of field capacity and permanent wilting point.

For a relatively long period of time, the question of available soil moisture has been a subject of controversy. One group of investigators argues that, as long as the available water content of the soil is in excess of the permanent wilting point, the effect of water on nutrients uptake is unimportant. Another group of investigators argues that the transition from the available to unavailable state is gradual and that the plant response may be affected to a measurable degree by this transition before reaching the permanent wilting point.

The effect on the availability of nutrients exerted by a decrease in soil moisture content to or below the wilting coefficient is pertinent to plant growth. Under field conditions, however, it is a common occurrence for the crop roots in the surface soil to be submitted to a moisture content at a level considerably below the wilting coefficient while the lower portions of the root system are in contact with soil containing available moisture. Several investigators have reported that, under such conditions, moisture absorbed from the lower soil depths may be given off by the roots in the drier surface soil. They showed some evidence that this translocated moisture may lead to the absorption of potassium from the drier soil and possibly of nitrates, but there is a question as to the intake of phosphorus.

Therefore, fertilizer response depends on a number of factors concerned with both of moisture and nutritional status of the soil. Consequently, any plan aimed to providing advisory informations for fertilization and irrigation should take both factors into account.

The aim of this work is to study the effect of soil moisture regime expressed by available moisture level pre-irrigation on yield and nutrients uptake by wheat crop at the successive stages of growth developed under

different levels of nitrogen applications. The intention of this study is to suit the Egyptian environmental and soil conditions for better development of wheat which is one of the major economical crops. In other words, the utilization of the complex interaction between soils, crop, fertilizer and water as to obtain the best and economical yield of plants.

## II. REVIEW OF LITERATURE

According to the voluminous literature previously cited, it was thought advisable to be reported through presentation of influences of moisture and fertilization on the growth, yield and nutritional status of plants.

### II.1. Effect of Soil Moisture Regimes on Behaviour of Plants.

Several investigations were carried out, using several crops, to study the effect of soil moisture on the growth, yield and mineral constituents of plants.

#### II.1.1. Growth and yield.

The effect of soil moisture regimes on plant growth is an important point of research which had received considerable attention from many investigators.

Neidig and Snyder (1924), Singleton et al. (1950) Veihmeyer and Hendrickson (1950) and Stanhill (1957) found that plant growth was diminished as the available water was depleted. This relationship was found more frequently with annuals than with perennials crops.

Hendrickson and Veihmeyer (1941) noted that any attempt to wet the soil mass in a container to less than

field capacity will simply result in a part being wetted to field capacity while the remainder is left unwatered.

Robins and Domingo (1953) showed that soil moisture depletion to the wilting percentage resulted in decreasing the grain yield of corn. Such deficits for periods of one to two days during the tasseling or pollination stage, resulted in 22 % reduction for corn yield, and a period of six to eight days gave a yield reduction of about 50 %. Following maturity, the depletion in the available soil moisture had no effect either on the yield or on the water content of grains. These results were also confirmed by Peters (1957).

Baver (1956), Hagan et al (1957) and Smittle and Bradley (1966) indicated that irrigation intervals which are based upon the application of water<sup>when</sup> 50 % percent of the available soil moisture has been removed will gave the optimal growth and yields of sunflower, cotton, sugarcane and ladino clover. In this respect, Gupta and Dorgan (1972) found that the optimum regime to schedule irrigation for wheat was 50 % of the available moisture. It was reduced to 10 % of the available moisture when the climate was wet and cool. The peak period of water was at the earing and grain filling stages. Simirov (1958) & Power et al (1961 a&b) explained the favourable effects of soil moisture to be attributed to an increase in the root growth

which resulted in a corresponding increase in the absorption of both fertilizer and soil nitrogen which generally increased the yield. Simirov (1958) also reported that when the soil moisture decreased, mobility of nutrients in the soil is lowered and the rate of nutrient flow to the absorbing zone of the root decreases. Therefore plants can only absorb the nutrients which are in contact with the absorbing surface of the root, i.e. from a considerable small volume of soil.

Fernandez and Laird (1959) and Cannell et al (1960) concluded that a minimum available moisture percentage of about 30 % of the available moisture must be maintained in loamy and silty loam soils for the production of maximum grain yields .

Abdel Salam et al (1960) showed that raising soil moisture level in Ras-El-Hekma highly calcareous soil from 7 % to 11 % of the available moisture had progressively increased the total yield for barley and corn. It was found also that the total plant yield increased progressively corresponding with increasing the moisture level in clay soil.

Denmand and show (1960) pointed out that decreasing the available soil moisture below 50 % before, during or two days after silking reduced the grain yield of corn by 25, 50 and 21 % respectively. It means that high

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moisture stress imposed at the silking stage was the most effective in decreasing corn yield.

Peters (1960) explained the growth of corn on the basis of relative humidity. When plants were subjected to high evaporative demand, i.e. low relative humidity, growth was found to be profoundly influenced by both soil moisture tension and moisture content. However at low evaporative demand, other factors being held constant, growth influenced by moisture content is only a minor way.

Jackowska (1961) noticed that repeated decrease of soil moisture to 20 % of the total holding capacity even for a short time reduced grain yields. Increasing soil moisture up to 85 % of total holding capacity for short duration, did not affect grain yields. Straw yields increased with increasing the soil moisture and decreased with decreasing the soil moisture only if these changes occurred during the formation of reproductive organs.

Abdel Salam and Hashish (1962) mentioned that raising soil moisture levels from 11 % to about 24 % in desert soils in Egypt caused transient increase in vegetative growth of corn while in case of barley plants no detectable increase in vegetative growth was observed. Further increase in soil moisture to about 28 % resulted in a remarkable increase in vegetative growth for both corn

and barley plants.

Lehane and Staple (1962) using wheat and Singh and Alderfer (1966) using vegetable crops concluded that plants yielded well on all soils tested where moisture stress was applied early, but when moisture stress was applied late in the season, yields were very poor.

Robins and Domingo (1962) advised that severe soil moisture stress must be avoided from the boot stage to maturity for maximum wheat yields. The most critical periods for water was during the heading stage.

Borchmann (1963) using fodder crops grown on soil mixtures of different moisture treatments found that, at 30 % moisture capacity, fresh and dry weights varied directly with increasing water supply but dry-matter percentages decreased.

Kramer (1963) found that soil moisture stress decreased root penetration and prevented normal plant growth of wheat.

Ligon and Benoit (1966) using barley and tobacco found that maintaining the moisture levels in soil at 100 %, 75 %, 25 % and 5 % of field capacity, the total dry weight of leaves decreased by increasing soil moisture tension. Also Fin and Mack (1964) , Olsen (1964), Smittle

and Bradley (1966) and Gupta and Dogan (1970) obtained similar results.

Yacoub (1969) using three levels of soil moisture up to 45 % of the water holding capacity concluded that the yield of dry matter, shoots and roots of wheat plants and nutrients uptake as well significantly increased by increasing soil moisture level.

Brengle et al (1970) using wheat and beans as test crops found that yields were significantly greater on plots with available water down to 3 and 5 feet than on plots with less water. Sharma et al (1972) found, however, that increasing soil moisture in a clay soil from 0.3 atm. to near the permanent wilting point (about 12 % moisture ) increased dry matter and grain yields of wheat.

Day and Sunhawatr (1970) indicated that the critical period for moisture in the growth of wheat was the jointing stage. However, optimum irrigation must be provided throughout the entire growing season for maximum yields of high quality grain.

Potocanac (1970) reported that the optimum yields of wheat were obtained when maintaining with 70-85 % of the soil moisture during the period from shooting to ripening. At high levels of denesity and soil moisture,