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Distribution of moisture in the soil profile in terms of two soil types

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Abstract. *A field study was conducted in the experimental field of Agricultural Institute, Stara Zagora. Examined the distribution of irrigation water in the soil profile in irrigation in furrow, maize grain. Experience is based on two soil types- Eutric Vertisol and Gleyic Chromic Luvisol. Humidity profiles before and after irrigation showed trends of distribution and redistribution of irrigation water in furrow irrigation, without irrigation and ridge between them. Due to the lateral filtration in both soil types it can be applied in furrow irrigation. The contours of wetting show that during the irrigation period readily available moisture in the active layer does not fall below wilting point. Soil moisture is accumulated in deep layers, which creates conditions for developing a strong root system of plants. Furrow irrigation for maize in the grain increases the productivity of irrigation water and effective use of precipitation fell during the irrigation season of maize grain.*

Keywords: irrigation, humidity profile, irrigation through furrow, soil moisture distribution

Introduction

Global climate change and depletion of water resources requires a review of technologies for irrigation of agricultural crops. Crop production is oriented towards the search for water-saving technologies, particularly in cultures where it relies on repeated irrigation. The regulated water deficit of soil moisture during certain periods of growth could save irrigation water without reducing yield. Experiments have shown that yields decreased disproportionately to the reduction of irrigation water. Efficient use of water resources is possible only when having knowledge of the requirements of the crop soil moisture and soil type.

One strategy that can be applied to optimize water deficit and stabilize the yield is the submission of irrigation water in furrows to reduce surface evaporation from the soil and increasing the efficiency of irrigation water used. (Eneva, 1990; Eneva and Todorova, 2001; Kang et al., 2000; Dospatliev et al., 2007; Stoyanova et al., 2010; Moteva et al., 2010). Better food, water balance and higher productivity of irrigation water can be obtained if you know what is the distribution of water brought into the soil profile. (Moteva, 1987). Controlled soil moisture deficit in order to prevent humidity to fall below the zavyahvane and throughout growing season crop have enough readily available moisture in the soil (Kang et al.,2000; Sepaskhah et al., 2002)

Purpose of this study was to determine the humidity profile of furrow irrigation on irrigated and ridge between them after the submission of irrigation water through a groove, the effective use of limited water resource.

Material and methods

The field study was conducted in the experimental field of Agricultural Institute, Stara Zagora. Examined the distribution of irrigation water in the soil profile in the irrigation of maize grain in groove. In the first year (2006) the field experiment is displayed in Eutric Vertisols and during in the second year (2009) the test area is located on the Gleyic Hromic Luvisols. Vertisols are characterized with medium clay soils with good water holding capacity, deep humus surface horizon, which reaches 100 cm. Soil type is characterized also with significant lateral filtration 1.0 - 1.5 m, WP- wilting point is 19-20%. Marginal water supply for the layer 0-100 cm is 452 mm. The level of groundwater in wet years is from 2.5 to 3.0 m and from 6,0 to 8,0 m in dry years. Gleyic Chromic Luvisol is characterized with humus surface horizon - 80 cm, the layer from 0 to 20 cm has a loose structure and the bottom part is thicker. Soil structure creates conditions for reducing the speed of vertical infiltration and increases the radius of the lateral spread of water, a fact which is of great importance in irrigation furrows. WP- wilting point is 18-19%, and infiltration is also 1.0-1.5 m. Groundwater level falls during the winter and in late August and September up to 2.5-3m. Marginal water supply in this soil type is within the 405 mm.

Corn is planted in the optimum for crop cultivation period - late April and early May. The study was conducted in three irrigations in both years. Soil moisture is determined periodically gravimetrically. The contours of the moisture in the soil profile were made from soil samples taken in the vertical groove moistened in dry ridge and furrow between them. The samples taken were processed by the weight-thermostatic method.

Results and discussion

The quantity and distribution of rainfall during May to August is presented in Figure 1. Studied period is characterized by uneven distribution of rainfall during the active growth of plants. With regard to irrigation period July-August both years are defined as average dry - 2006. (60.4% probability) and 2009. as moderately wet (34.5%). In 2006. first irrigation was made during phase "tasseling" (74 days from sowing). The second irrigation was realized in phase

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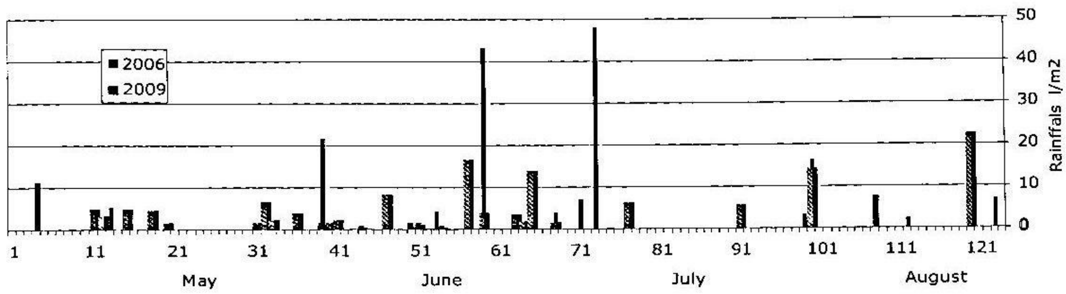

Figure 1. Quantity and distribution of rainfall in 2006 and 2009

"silk darkening" (86 days from sowing). During the period between irrigation there was rainfall amounting to 5.8 mm (the quantity is negligible and is equal to the daily evapotranspiration of maize). In the second year of the field study the time of rainfall between irrigations were not reported. The first irrigation was made during the phase "silk darkening" (84 days from sowing) and the second during the 'milk-wax ripeness" corn grain (96 days from sowing).

Achieved irrigation rates are consistent with the depth of active layer and before irrigation soil moisture. The Figures 2, 3, 4, 5, 6 and 7 present the trend of the depletion of productive water supply. Figure 2 gives curves of distribution of moisture in the soil profile 0-100cm, measured before first irrigation in phenophase "tasseling", (2006). Soil samples to detect moisture before irrigation taken a day before the implementation of irrigation. The figure shows that the soil horizon at a depth of 60 cm is not enough stocks readily available moisture. The water supply of 20 cm depth with the lowest values. In phase "tasseling "maize was developed its root system and the active layer comprises greater depth. This allows the crop to use the available moisture in these layers. To fail to produce significant drying of the soil, leading to stress in the plants watering was applied .

Two days after the implementation of irrigation soil samples

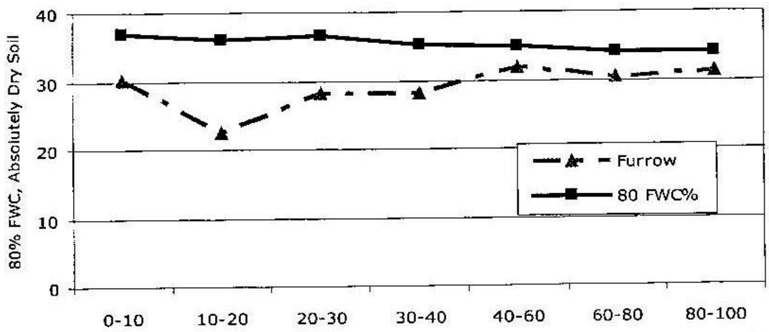

Figure 2. Soil moisture distribution of in the soil profile 0-100cm, measured before first irrigation in phenophase "tasseling", in 2006

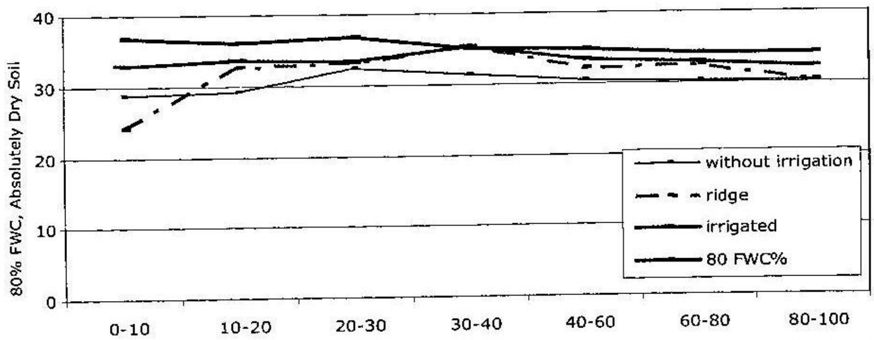

Figure 3. Soil moisture distribution in the soil profile 0-100cm, measured after the first irrigation in phenophase "tasseling", in 2006

were taken on the basis of which is estimated layered distribution of soil moisture was estimated (Figure 3). As a result of lateral filtration the amount of readily available moisture approached the upper limit in the profile of furrow irrigation and ridge. Drying was observed only in the superficial layer of 0-20 cm. The determination of moisture layering shows that furrow irrigation moistened evenly across the active layer, but the amount of readily available moisture is limited.

Humidity profile before the second watering merger shows the contours of moisture and reported low levels of PPW in the layer at 0-60 cm (Figure 4). A trend of the depletion of productive water supply occurs in soil layers at a depth of 40-60 cm. In the deeper layers (below 60-80 cm) depletion of moisture is less. It is important to know, because drought and failure of irrigation can be expected to use an existing crop moisture from these layers.

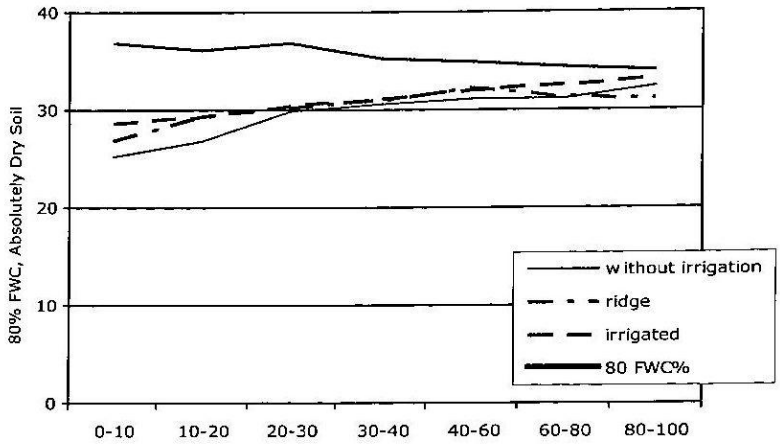

Figure 4. Soil moisture distribution in the soil profile 0-100cm, measured before the second irrigation in phenophase "silk darkening", in 2006

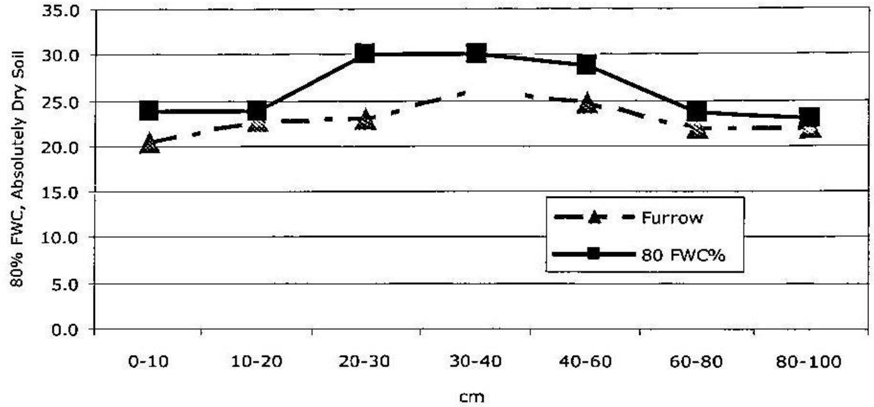

Figure 5. Soil moisture distribution in the soil profile 0-100cm, measured before first irrigation in phenophase "silk darkening", in 2009

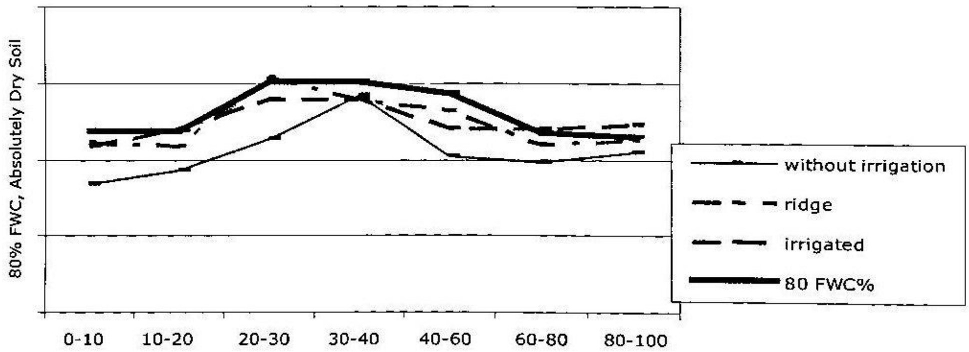

Figure 6. Soil moisture distribution in the soil profile 0-100cm, measured after the first irrigation in phenophase "silk darkening", in 2009

In the second year of study humidity profiles in Hromic Gleyic luvisols soil are different due to the different soil texture. Before first irrigation at 10-20 cm soil layer is moisture layer is close to the optimum (Figure 5). Productive water supply in the horizon of 20 to 80 cm is below the optimum, but is above the limit of wither. In phase "silk darkening" is realized irrigation. The allocation and reallocation of irrigation water shows the trend of movement of water in the soil horizon of this soil type (Figure 6). Humidity profile of the dry furrow indicates that in layers from 0 to 40 cm was observed accumulation draying significantly was observed while in the profile of furrow irrigation and ridge the soil moisture is higher. The distribution of irrigation water has been uneven. Due to the lateral seepage of soil moisture contours merge at a depth of 30-40cm and 80-100cm. These conditions favor the development of plants. Permanent drying was established before the second irrigation (Figure 7). The quantity of easily digestible moisture decreased significantly in the upper layers. Available moisture in deep soil layers provides the necessary moisture for corn.

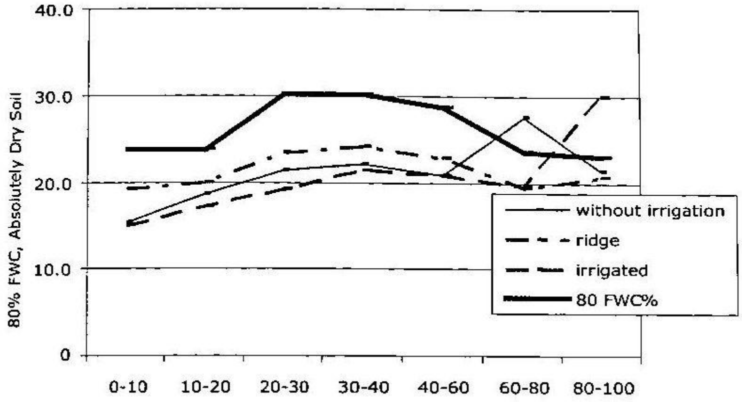

Figure 7. Soil moisture distribution in the soil profile 0-100cm, measured before the second irrigation in phenophase "milk-wax ripeness", in 2009

Between irrigation periods in both years of the field study there were 12 days. Distribution of moisture content in the soil after irrigation in irrigated, irrigated groove and ridge shows that the active layer is not evenly moistened. For both soil types humidity is around 70-80% of FWC for the entire layer. The distribution of irrigation water after watering (2 and 10 days after fulfilling the irrigation rate) shows that there was no water logging or soil saturation horizon for the entire FWC layer 0-100 cm. However, irrigation water as a result of lateral filtration has provided sufficient amounts of readily available moisture in the active layer of dry groove and ridge. Under the action of gravitational and permeable soil irrigation water is distributed and redistributed in the soil horizon. Humidity contours in the deeper layers show that the moisture stored in deeper layers and thanks to that culture is not experiencing a deficit of moisture. By submission of irrigation water in furrow reduced wetted surface and thus the rate of natural evaporation from the soil surface. This creates conditions for fruitful utilization of the water brought.

Conclusion

Due to the lateral filtration in both soil types Eutric Vertisols and Hromic Gleyic luvisols furrow irrigation can be applied. Soil moisture is accumulated in deep layers, which creates conditions for developing a strong root system of plants. Furrow irrigation for maize in the grain increases the productivity of irrigation water and the effective use of precipitation fell during the irrigation season of maize grain.

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