Scheduling irrigation of maize using the evaporation pan method under different fertilization regimes and their effect on soil characteristics

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Field experiments were carried out at Giza agricultural research station, Agricultural Research Center, Egypt, during 1992 and 1993 seasons to study scheduling irrigation of maize crop using the evaporation pan method under different fertilization regimes and their effects on soil physical analysis, water relations, growth parameters, yield and yield components and chemical analysis for grains, for S.C.10 maize cultivar.The experiments were laid down in a randomised complet block factorial design with four replicates. The experiment included 27 treatment which were the combinations of 3 irrigations regimes according to daily evaporation pan records, 3 nitrogen levels and 3 potassium levels. Thus theexperiment consisted of 108 plot.Sowing dates were May 16th and 26th in 1992 and 1993, respectively. While, harvesting of plants was 2nd and 12th of September in the samerespective years.The description of the experimental factors and treatments was as follows:A. Irrigation regime: (evaporation pan coefficients)1.0.6 evaporation pan coefficient.2.1.0 evaporation pan coefficient.3 1.4 evaporation pan coefficient.137B. Nitrogen fertilization:1 . 100 kgN/fad.2 . 120 kgN/fad.3 . 140 kgN/fad.C. Potassium fertilization:1. 00 kgK/fad. 2 . 50 kgK/fad.3. 70 kgK/fad.The nitrogen fertilizer was applied in the form of ammonium nitrate (33.5%N) in two equal portions, the first portion was added before the life irrigation and the other one was before the third irrigation. The potassium fertilizer was used in the form of potassium sulphate (48%K20) and was added in two portions at the same time of nitrogen addition. Phosphorus fertilizer (in the form of calcium super phosphate, 15.5%P205) at the rate of 100 kg/fad. was added together with the second portion of N and K.The proceeding crops to maize were Faba bean and fallow in the first and second seasons, respectively.Character studied :I- SOIL PHYSICAL ANALYSIS1. Soil aggregation (%).2. Pore size distribution.II. Soil water relations:1.Water consumptive use.2.Actual evapotranspiration.3.Daily water use.4.Monthly water use.5.Crop coefficient.6.Potential evapotranspiration by some formulae (i.e. Penman, Doorenbose-Pruitt and Pan evaporation)7.Comparison between actual and potential evapotranspiration, estimatedby some ET formulae.8.Pattern of moisture extraction in root-zone.9.Water use efficiency.III- GROWTH PARAMETERS 1. plant height (cm.).3. Number of green leaves/plant.IV-Yield and yield components: 1. Ear length (cm.)3. Number of grains/ear. 5. Ear yield, kg/fad.2. Stem diameter (cm. 4. Leaf area index 2. Ear diameter (cm.)4. 100- grain weight (gm). 6. Grain yield, kg/fad.V. Chemical analysis:1. Nitrogen, phosphorus, potassium and crude protein percentage in grains.The important results of this study can be summarized as follows:I- SOIL PHYSICAL ANALYSIS1. Wet sieving stable aggregates and distribution of aggregate size fractionswere affected by irrigation treatments. The aggregates percentages after sowing were reduced compared with the aggregates before sowing. The maximum reduction was obtained for 1.4 accumulative pan evaporation treatment compared with the other irrigation treatments.Pore size distribution was affected by number of irrigations, being more reduced after sowing for the irrigation at 1.4 accumulative pan evaporation compared with the other irrigation treatments.II. WATER RELATIONS1.Seasonal water consumptive

use was increased by short irrigationintervals. The highest values of 63.4 and 62.6 cm. were obtained from 1.4 accumulative pan evaporation treatment in the first and secondseasons, respectively.2.Seasonal water consumptive use was increased by increasing nitrogen andpotassium levels up to 140 kg N/fad and 70 kg K/fad.. respectively.3.The monthly and daily water consumptive use varied according to thegrowth stages and irrigation regime.4.The monthly and daily water consumptive use started low at thebeginning of the growing season, then, increased gradually as plants grew up and reached maximum values on July and declined again duringmaturity stage.5.The crop coefficient (Kc) of maize was low at the beginning of thegrowing season, then increased gradually and reached its maximum value in July (mid season), after that it declined to reach lower value atmaturity.6.The crop coefficient (Kc) of maize in middle Egypt was 0.77 and 0.81 inthe first and second seasons, respectively.7.The most efficient method in calculating ET crop of S.C. 10 maizecultivar at Giza region was the Penman method.8.Evaporation pan method was superior in scheduling irrigation of maize in middle Egypt (i.e. Giza region) and then it can be used it on the level of application.9.The superiority of the irrigation treatments was obtained with the irrigation at 1.0 accumulative pan evaporation, and then it can be taken as the effective pan coefficient in middle Egypt .10.The highest value of soil moisture extracted from the first soil foot depth (72.2 %) was for irrigation at 0.6 accumulative pan evaporation treatment.11.The highest extraction percentages from the sub-surface 30 cm. layer(30.7 %) was obtained from 1.0 accumulative pan evaporation treatment.12.Water use efficiency was increased by decreasing available soil moisture at irrigation time (i.e. irrigation at 0.6 accumulative pan evaporation).13.Water use efficiency was increased by adding 100 kg N/fad. or 70 kg K/fad.III- GROWTH PARAMETERSA. Effect of irrigation regime:1.Irrigation regime had a significant effect on plant height, stem diameter,number of green leaves/plant and leaf area index , except leaf areaindex in the first season only.2.These characters were increased by increasing available soil moisture atirrigation time. While, number of green leaves/plant and leaf area index decreased by increasing available soil moisture at irrigation time, in the first season only.B. Effect of nitrogen levels:1.Nitrogen fertilizer level had a significant effect on plant height in the twoseasons2.Plant height, stem diameter, number of green leaves/plant and leaf areaindex were increased by increasing nitrogen level up to 140 or 120 kg N/fadC. Effect of potassium:1.Potassium fertilizer level had a significant effect on plant height, stemdiameter number of green leaves/plant and leaf area index in the twoseasons.2.The highest values of these characters were obtained from 70 kg K/fad.treatment.D. Effect of interactions:1.The interactions between h-ri x N and h-ri x K had a significant effect onplant height in the first season only. The highest values were recorded under 1.4 accumulative pan evaporation with 140 kg N/fad and 1.4 accumulative pan evaporation with 70 kg K/fad.2.The interaction between Irri x N had a significant effect on leaf area index in the first season only. The superiority of this character was resulted under 1.0 accumulative pan evaporation with 140 kg N/fad.IV- YIELD AND YIELD COMPONENTS:A. Effect of irrigation regime:1.Irrigation regime had a significant effect on ear length , number ofgrains/ear, 100- grain weight, ear yield/fad., and grain yield/fad., in thetwo seasons.2.Ear length, number of grains/ear, ear yield/fad and grain yield/fad.. weresignificantly increased under irrigation at 1.0 or 1.4 accumulative pan evaporation. While, 100- grain weight was significantly increased under irrigation at 0.6 accumulative pan evaporation. Ear diameter increased with irrigation at 1.0 accumulative pan evaporation.B. Effect of nitrogen :1.Nitrogen levels had a significant effect on ear length in the two seasons,while, it had a significant effect on number of grains/ear, ear yield/fad. andgrain yield/fad. in the first season only.2.Ear length, ear diameter, number of grains/ear, 100-grain weight, ear yieldand grain yield/fad. were increased by increasing nitrogen level up to 140 or 120 kg N/fad.C. Effect of potassium:1.Potassium levels had a significant effect on ear length in the first season.ear diameter, ear yield/fad. and grain yield/fad.2.Ear length, ear diameter, ear yield and grain yield/fad were significantlyincreased by increasing potassium level up to 70 kg K/fad., in the two seasons. Number of grains/ear and 100- grain weight tended to increase by increasing potassium level up to 70 kg K/fad. in the first season only.D.Effect of interactions:1.The interactions between Irri x N, Irri x K and N x K had a significanteffect on ear length and number of grains/ear in the first season only. Also, Irri x K had a significant effect on ear length in the second season.2.The interaction between Uri x N x K had a significant effect on ear length in the second season and 100-

grain weight in the two seasons. V. Chemical analysis : A. Effect of irrigation regime : 1.Nitrogen, phosphorus, potassium and crude protein percentage in maizegrains were significantly affected by irrigation regime.2.The highest values of these characters were obtained from irrigation at the moderate soil moisture content (i.e. irrigation at 1.0 accumulative pan evaporation treatment.)B. Effect of nitrogen :1. Nitrogen, phosphorus, potassium and crude protein percentage in maizegrains were significantly increased by increasing nitrogen levels up to 120 or 140 kg N/fad.C. Effect of potassium:1. Nitrogen, phosphorus potassium and crude protein percentages weresignificantly increased by increasing potassium level up to 70 kg K/fad.C. Effect of interactions:1.The interaction between Irri x N had a significant effect on nitrogen.phosphorus, potassium and crude protein percentages. Also, the interaction between h-ri x K was found significant in affecting phosphorus andpotassium percentages.2.The superiority of these characters were recorded under the interactionsbetween 1.0 accumulative pan evaporation with 140 kg N/fad., or 1.0 accumulative pan evaporation treatment with 70 kg K/fad.FINALLY 1. The effective evaporation pan coefficient which will be recommended for scheduling irrigation of maize (S.C.10 cv.) in middle Egypt (Giza region), is 1.0 accumulative pan evaporation and the equivalent potential effective evaporation equal the available soil moisture storage 113 mm.Actual water consumptive use for the recommended treatment of 57.4 and 56.4 cm in the first and second seasons. respectively. with an overall average of 56.9 cm and can be used in scheduling of irrigation.3.Penman formula can be used in potential evapotranspiration calculation as the superior method, followed by the other two formulae.4.Water use efficiency for the recommended treatment was 2.02 and 1.95 kg grains/m3 water used in the first and second seasons. respectively.5.The optimum nitrogen level was 120 kg N/fad.for maize.6.The optimum potassium level was 70 kg K/fad.for maize.In the same time, irrigation could be applied at 13-15. 12-14 and 15-17 days apart through the vegetative, flowering and grain filling periods, respectively.