physiological studies on water requriments of wheat plants

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The present investigation was carried out to study the effect of growth regulators and antitranspirants incombination with three soil moisture levels on actual evapotranspiration , potential evapotranspiration andcrop coefficient at different stages of wheat growth aswell as their response on plant growth , yield andchemical composition. Therefore, a pot trial was conductedin Agricultural Research Center, Giza during the two seasons 1980 /1981 and 1981 /1982 using wheatvariety Giza 157 • The design of the experiment was completely factorial randomized design with 10 replications.The experiment consisted of 39 treatments andinclUdes two growth promoting SUbstances i.e. NAA andGA3 at the rate of 50 and 100 ppm. , two growth retardantsi.e. Alar and Ethrel at the rate of 500 and 1000ppm. and two antitranspirants5 x 10-5M and 1 x 10-4M andthe rate of I x 10-2M and 5 xi.e. PMA at the rate ofnces were combined factorially With three soil moisturelevels i.e. 30, 60 and 90 % depletion in availablewater • Plants were Sprayed three times When aged 35days after SOWing at tWo-week intervals with the usedchemicals SUlphonate atThese substafollows:The main trend of results can be summarized asI - Actual Evapotranspiration1- Seasonal evapotranspiration vary widely between394.9 and 555.2 under the various treatments.2- Evapotrauspiration values were increased as soilmoisture stress decreased. The least water consumption~lS brought about under dry conditions,whereas, the highest water use was attained undervery wet level , while under medium water supply,the values falls in between.3- The relative increase in water consumption by wheatwas founc. to be 28.7 and 16.3 % respectively forwet and medium soil moisture stresses over the drytreatment •4- Evapotranspiration rates by wheat was increased bythe application of either NAA or GA3 (growthpromoters) •5- Growth retardants (Alar or Ethrel) did result ina decr-ea.asin ET. with about 5 % • Higher concentrationsdid not cause any more decrease inseasonal gT.6- Antitranspirants (PMA or Sulphonate) decreasedwater conaumpt t on , also the decrease in ET. rateswas more pronounced by higher concentrations. Itcan be noted that seasonal water use by wheat wasrelatively lower by using PMA than sulphonate.7- The effect of such substances on ET. rates was morepronounced under wet conditions rather than underdry soil moisture •8- Daily evapotranspiration rates were lower early inthe growing season and increased as wheat plantsdeveloped till it reached its maximum during March.A decline in evapotranspiration rates occured atthe end of the season as expected with matureplants •9- Daily water use by wheat can be represented as acontinous function in the form :y = a + b X + c X 2whereY = daily evapotranspiration of wheat in mm.X = relative growth period as percentagea , b ,c are the parameters of the function.This function predicts daily ET. at any period ofwheat growth. The parameters in this function differaccording to the variables included such as growthregulators , antitranspirants and soil moisturestress •11- Potential Evapotranspiration1- Potential evapotranspiration values estimated byradiation, Jensen and Haise , class A pan , Turcand Blaney and Criddle methods were underestimatingthe mean values of ETp., while Buchet andPenman estimates were overestimating the mean.2- Methods using radiation (Penman , Radiation ,Jensen and Haise , and Turc) as the main variableprovide adequate and reliable estimates of ETp.either on short or long period determination.However, those depend on temperature as the mainparameter (Blaney & Criddle and Bouchet) werefound to be inconsistence when calculated as shortor long period basis •3- Comparing the different formula, it was found

thatmodified Penman equation gave the most accurateresults, as its values are very close to actual ET.4- Measurements of ETp by a class A pan is the simplestmethod as it is easily operated. However, its valuesneed a correction factor , which was found to beunder Egyption condition (1.31).5- Jensen & Haise , and Turc formula provide adequateestimates after calibration. As for Jensen & Haise,the linear regression line was :y = 1.24 + 0.85 XwhereY = potential evapotranspiration mm./dayX = evapotranspiration values obtained fromthe formula of Jensen & Haise •However , in case of Turc a new constant wasderived and the modified equation was :ETp = 0.017T (Rs + 50) mm./dayETp = 0.017T + 15when RHTT + 15is greater than 50 ~(Rs + 50)(1+ 50 -RH)70mm/daywhen RH is less than 50 %ETp = potential evapotranspiration in mm!dayoT = mean air temperature in CRs = solar radiation in cal./cm2 I dayRH = relative humidity6- Seasonal crop coefficient (KC) for wheat was 0.89under normal conditions. whereas when wheat growthwas promGted by NAA or GA} , KC increased up to 0.95.On the other hand, retardation of growth reducedKC values to 0.85 •111- Plant Growth and Yield1- Increasing soil moisture stress resulted in a significantdecrease on plant height • Growth promptersincreased plant height , whereas growth retardantsand antitranspirants had the reverse trend.2- Dry matter accumulation started with low rates atearlier stages of growth then increased rapidlyduring shooting to early milk stage • Regardingthe distribution pattern of the different plantparts, it was found that leaf blades comprise themain plant dry matter component during tillering,while stem was found to be superior during floweringin this respect • However on dough stage ,wheat head., was found to be the domenant organfollowed by stem •3- The highest values of dry matter was gained fromthe wet treatment followed by the medium level andthe least values were obtained from dry soil moisturetreatment.4- The promoting effect of NAA or GA3 on dry matteraccumulation was directed mainly to the stem thanother plant organs • With regard to growth retardants, the dry matter production was reduced in theentire plant • As for antitranspirants, dry mattera«cumulation was reduced throughout the perioud oftheir use • The regulating effect of growth substancesor antitranspirants on dry matter productionseemed to be clear under wet conditions, whereasinhibited whe~ plants were imposed to severe moisturestress •5- Number of tillers /plant was not affected by growthregulators or antitranspirants while soil moisturestress had a pronounced effect on such character.As soil moisture stress increased , tiller productionwas decreased.6- Number of heads/plant was increased by growthpromoters under wet conditions, while under mediumor dry levels the effect was hindered. Alar bes noeffect on number of heads/plant , but Ethrel decreasedsuch number. In case of antitranspirant, thedata showed no obvious effect on that character •Concerning the effect of water regime, a similartrend to that found regarding number of tillers ,was observed •7- The weight of grains /head increased by using growthpromoting substances under wet conditions only.Using Alar has no effect on the weight of grains /head , while Ethre1 decreased such values • As forantitranspirants, no effect was observed. With regardto water regime, it was found that as soil moisturestress increased, grain weight/head decreased significantly•8- Number of grains /head was not affected by varioustreatments •9- The weight of 1000 grains showed a similar trend tothat obtained from weight of grains / head •10- Grain yield of wheat was increased by foliar spraywith NAA or GA3 till 50 ppm. , however, above thatconcentration no more increase in grain yield wasobserved • Spraying Alar slightly decreased grainyields, while Ethre1 sharply decreased such value •It is interesting to mention that PMA did not causeany significant decrease on grain yields and thevalues were similar to the control • However • adecline was observed in wheat grain yield fo11owe~the application of ol. -hydroxy sulphonate speciallyat higher concentrations • Concerning the effect ofwater regime , it was found that the wet levelproduced the highest values of grain yield followedby the medium treatment and the lowest yields wereobtained under high soil moisture stressII-Straw yield showed a nearly identical values tothose obtained from grain yields of wheat •IV-Water Use EfficiencyI-Water use efficiency was lower early in the seasonwhen the plant vegetation was not established yet,then increased gradually to reach a maximum valueduring the most rapid vegetative growth • Thereafter, the efficiency of water use falls down toa minimum when plants approach maturity.2-Under low or midum soil moisture stress, water useefficiency values were higher than those obtainedunder severe soil moisture stress. These resultsindicate the importance of maintaining high soilmoisture levels through shooting to early milkstage •3- Growth promoting

substances have no obvious effecton water use efficiency values at earlier stagesof growth (tillering to shooting) • However,lateron (from shooting to heading) growth promotersimproved such values. Under severe soil moisturestress , no clear trend was observed •4- Water use efficiency as affected by Alar showed asimilar trend to that observed from growth promoters.On the other hand , Ethrel reduced suchvalues.5- Film forming antitranspirant improved water useefficiency by decreasing transpiration more thanphotosynthesis •6- In general, such chemicals have improved wateruse efficiency expressed as dry matter producedper unit of water consumed under high soil moisturelevels but failed to cause any increaseunder lack of water •7- As for the marketable yield, water use efficiencyvalues were higher under wet treatment followedby the medium soil moisture with slight differencesbetween both treatments • However, undersevere soil moisture stress , the values weresharply decreased •8- With regard to the effect of different substanceson the marketable yield of wheat, it was found thatthe growth promoters and antitranspirant (PMA)had increased the values of water use efficiencyunder wet and medium soil moisture conditionsonly. Concerning the role of growth retardants ,results indicated that the use of Alar did notcause any increase in such values. However , theuse of Ethrel resulted in a great reduction insuch values •v- Chemical Composition1- Results had shown that the level of soil moistureis an important factor contro1ing protein contentof wheat grains. It was found that as water deficitincreased , wheat protein increased •2- The relation between water deficit and proteincontent is said to be a linear function with acorrelation coefficient of + 0.93 • The linearrepresentation of this relation is as follows :y = 90.06 + 0.41 XwhereY = protein content of wheat grains expressedas mg. / g.X = percentage of soil moisture depletion.3- Growth regulators and antitranspirant seemed todecrease total amount of protein •4- Data indicated that about 50 % of total amount ofgrain protein is insoluble , while ethanol solubleprotein comprises about 25 % .5- The increase in total protein by water deficit ismainly through non-soluble protein.