Response of soybean to some growth regulators under water deficit conditions

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SUMMARYThe present work was carried out to study the effect of soilmoisture levels in combination with some growth regulators on growth,yield and its components, evapotranspiration, crop coefficient, andchemical composition of soybean plant. Therefore, field plot trialswere conducted in Agricultural Research Center, Giza farm duringthe two successive seasons 1988 and 1989 using crawford soybean variety.The design of the experiment was complete randomized block designwith four replications. The experiment consisted of 18 treatmentsand included three soil moisture levels i.e. 85, 70, and 55 % of fieldcapacity. These three moisture levels were combined factorially withtwo growth regulators i.e, GA) asa promoter at the rate of 0, 100and 200 ppm and Alar as a retardant at three concentrations i.e.,0, 1000 and 2000 ppm. Plants were sprayed twice when aged 20 and30 days with the previous chemicals.The main trend of results can be summarized as follows:-L Gcowth behaviour :1. Stem length increased by time from emergence up to 100days after sowing, then it seemed to be constant after that. Waterdeficit had a significant effect on stem length at all tested periods.The use of GA3 at both levels increased stem length significantly.However, Alar application reduced stem length especially by increasingits concentration. It is worthy to mention that the effect of waterdeficit is more effective than any other hormonal influence.2. Leaf area/plant started with lower values at earlier periodof growth' and increased gradually to reach a maximum when plantsaged 100 days. The wet treatment gave the highest values of leafarea/plant followed by the medium level. Prolonged irrigation intervalsproduced the lowest leaf area/plant. The application of GA3 did resultin a significant increase in total leaf area/plant compared with the.control. Such increase was found to be obvious at higher GA3 rate(200 ppm). On the contrary, the use of Alar caused a depressive effecton leaf area/plant. The enhancing effect of GA3 was more pronouncedunder wet conditions while the retarding effect of Alar seemed tobe o-bvious under waterdeficit.3. The highest rate of dry matter accumulation in. roots wasfound to be from 50 up to 75 days after sowing, while at later stages,the rate was declined. High soil moisture level resulted in a significantincrease in dry matter of roots. GA3 application enhanced dry matteraccumulation and the lower rate (roo ppm) is the most pronouncedlevel. However, the use of Alar depressed such values. The reductionwas clear with the higher concentration. The enhancing effect of GA3seemed to be Obvious under wet conditions while the reverse trendwas found to be true with Alar.4. Stem dry matter showed higher values under wet conditions.The use of GA~ enhanced such values. Using Alar with low concentrationenhanced the accumulation of dry matter of stem, while higher rate(2000 ppm) reduced' it. The promoting effect of GA3 seemed to beclear under wet soil moisture, however, Alar needs dry conditionsto insure its effect.5. The period from 50-75 days seemed to be the greatest stageof dry matter accumulation in leaf petiol and blade. The effect ofdifferent treatments' on dry matter of both petiols and blades are similarto that observed with stem.6. The values of pods dry matter/plant were higher under wetsoil moisture level and decreased by increasing water deficit. GA 3application stimulated the dry matter of pods/plant and that was morepronounced at lOO ppm rate. The use of Alar resulted in a retardingeffect on pod dry matter which was increased by high level. The effectof growth regulators was controlled by the level of soil moisture.7. Dry matter content of whole plant increased continously fromemergence till the last sample. The highest dry matter was producedfrom wet level followed by the medium and the least values weregained from

the dry treatments. The lower rate of GA3(loa ppm)enhanced dry matter production either over the control or the higherrate. The use of the lower Alar rate increased dry matter content,while the higher rate reduced dry matter accumulation.8. Leaves comprise the main dry matter component throughtthe first 50 days followed by stem while root ranked the third in thisrespect. When plants aged 75 days, stem dry weight was superior followedby leaf blade, pods and petiols while root value was the lowest one.At 100 days, stem and pods dry matter were the domenant organs.IL Soybean yield and its components:1. Soil rnoistu re stress has a significant effect on different yieldcomponents of soybean plant. Such characters were decreasedby water deficit. The application of GA3 stimulated the testedyield components while Alar retarted them.2. Maximum seed yield was obtained from the wet level followedby the medium soil moisture and the least yield was producedfrom the dry treatment. Foliar application of GA) did resultin a significant increase in seed production.On the contrary Alar application decreased seed yield andthis was obvious by high concentration. The enhancing effectof GA3 seemed to be clear under wet and medium soil moisturelevel. However, in case of Alar, the retarding effect increasedby water deficit.4. Statistical analysis showed that either water deficit or growthsubstances had a significant effect on oil content of soybeanseeds.5. Oil production increased by high soil moisture level and decreas-. ed by water deficit. GA3 application increased oil productionand that was found to- be more by low level. The use of Alardecreased oil yield and such decrease was greater by. higherrate.iIL i Evapotranspiration1. Seasonal evapotranspiration by soybean varies widely between49.57 and 84.09 ern. under the various treatments.2. Evapotranspiration rates were increased as soil moisturestress decreased.:3. Growth promoting substance i.e, GA3increased seasonal ET.values while retardant (Alar) decreased such values and thatwas greater by high concentration.iii. Daily water use by soybean started with lower amounts increasedgradually to a maximum when plants complete 70 % of itsgrowth cycle then declined after that. >ii5,· Daily water use by soybean can be represented as -a continousfunction in- the formy = a + bx + cx2wherey = daily evapotranspiration mm/dayx = relative growth period as a percentage.Such function predict daily ET. at any specific period of soybeangrowth.6 c. Crop coefficient (Kc) for soybean was very low at earlierstages, then increased graduaJ1y to exceed the unit when soybean.cornplete 70-80 % of its growth period. Thereafter, Kc valuesredecreased again. GA3 application increased such valueswhile Ajar decreased it.7” Water use efficiency was lower in the first period (from emergenceto 50 days) then reached a maximum through the periodfrom (50 & 75 days). Thereafter, water use efficiency valuesredecreased again to reach a minimum at the end of the seasons(f rom 100-1 30 days).8. Water use efficiency expressed as Kg. dry matter/m 3 of waterconsumed, was higher under high soil moisture level and decreasedby water deficit.9,. The use of GA3 improved water use efficiency values underhigh soil moisture level. However f under prolonged irr iga tionintervals, no clear trend was observed. The use of retardantLe, Alar, slightly decreased the values of water use efficiency.10. Water use efficiency expressed as Kg. seeds/rn ’ of waterconsumed was higher under wet conditions and decreasedby increasing soil moisture stress. The use of GA 3 at 100 ppmimproved the efficiency of water utilization while Alar depressedsuch values.IV. Water and Soybean Yield Relationships:1. Statistical analysis showed that the relationship between soybeanyield and soil moisture level or seasonal water consumptionIS a first clear relation. The regression line has the form :y = a + bx2. The relation between the two factors i.e, actual evapotranspirationand soil moisture level, and soybean yields demonstr-ates thatboth factors affect the productivity of such crop. These relationshipshave the form :3. Results indicate that any environmental factor affecting seasonalwater consumption of soybean had a great response on itsproduction.V. ~hemica1 Compositon::1. The level of soil moisture is an important factor controlingsoybean protein. It was found that increasing soil moisturestress resulted in increasing soybean protein. The use of growthpromoting substances (GA3) seemed to decrease the amountof soybean protein while Alar increased such values.The total content of different macronutrients i,e. NP K increasedwith advancing age. Soil moisture levels and growth regulatorsaffected the total amount of tested nutrients in differentplant parts as well as the whole plant which decreased withincreasing soil moisture stress.3. The total content of Fe, Mn and Zn seemed to be decreasedwith the use of growth substances as well as water deficit.It can be concluded that when

growth substances were applied,such micro-nutrients should be added to ensure their effectas well as to regulate the balance between micro and macronutrients,