

## 6. SUMMARY

The present work was carried out to study the effect of soil moisture levels in combination with some growth regulators on growth, yield and its components, evapotranspiration, crop coefficient, and chemical composition of soybean plant. Therefore, field plot trials were conducted in Agricultural Research Center, Giza farm during the two successive seasons 1988 and 1989 using crowford soybean variety. The design of the experiment was complete randomized block design with four replications. The experiment consisted of 18 treatments and included three soil moisture levels i.e. 85, 70, and 55 % of field capacity. These three moisture levels were combined factorially with two growth regulators i.e.  $GA_3$  as a promoter at the rate of 0, 100 and 200 ppm and Alar as a retardant at three concentrations i.e., 0, 1000 and 2000 ppm. Plants were sprayed twice when aged 20 and 30 days with the previous chemicals.

The main trend of results can be summarized as follows:-

### I. Growth behaviour :

1. Stem length increased by time from emergence up to 100 days after sowing, then it seemed to be constant after that. Water deficit had a significant effect on stem length at all tested periods. The use of  $GA_3$  at both levels increased stem length significantly. However, Alar application reduced stem length especially by increasing its concentration. It is worthy to mention that the effect of water deficit is more effective than any other hormonal influence.

2. Leaf area/plant started with lower values at earlier period of growth and increased gradually to reach a maximum when plants aged 100 days. The wet treatment gave the highest values of leaf area/plant followed by the medium level. Prolonged irrigation intervals produced the lowest leaf area/plant. The application of  $GA_3$  did result in a significant increase in total leaf area/plant compared with the control. Such increase was found to be obvious at higher  $GA_3$  rate (200 ppm). On the contrary, the use of Alar caused a depressive effect on leaf area/plant. The enhancing effect of  $GA_3$  was more pronounced under wet conditions while the retarding effect of Alar seemed to be obvious under waterdeficit.

3. The highest rate of dry matter accumulation in roots was found 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 significant increase in dry matter of roots.  $GA_3$  application enhanced dry matter accumulation and the lower rate (100 ppm) is the most pronounced level. However, the use of Alar depressed such values. The reduction was clear with the higher concentration. The enhancing effect of  $GA_3$  seemed to be obvious under wet conditions while the reverse trend was found to be true with Alar.

4. Stem dry matter showed higher values under wet conditions. The use of  $GA_3$  enhanced such values. Using Alar with low concentration enhanced the accumulation of dry matter of stem, while higher rate (2000 ppm) reduced it. The promoting effect of  $GA_3$  seemed to be clear under wet soil moisture, however, Alar needs dry conditions

to insure its effect.

5. The period from 50-75 days seemed to be the greatest stage of dry matter accumulation in leaf petiol and blade. The effect of different treatments on dry matter of both petiols and blades are similar to that observed with stem.

6. The values of pods dry matter/plant were higher under wet soil moisture level and decreased by increasing water deficit.  $GA_3$  application stimulated the dry matter of pods/plant and that was more pronounced at 100 ppm rate. The use of Alar resulted in a retarding effect on pod dry matter which was increased by high level. The effect of growth regulators was controlled by the level of soil moisture.

7. Dry matter content of whole plant increased continuously from emergence till the last sample. The highest dry matter was produced from wet level followed by the medium and the least values were gained from the dry treatments. The lower rate of  $GA_3$  (100 ppm) enhanced dry matter production either over the control or the higher rate. 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 through the first 50 days followed by stem while root ranked the third in this respect. When plants aged 75 days, stem dry weight was superior followed by leaf blade, pods and petiols while root value was the lowest one. At 100 days, stem and pods dry matter were the dominant organs.

## II. Soybean yield and its components :

1. Soil moisture stress has a significant effect on different yield components of soybean plant. Such characters were decreased by water deficit. The application of  $GA_3$  stimulated the tested yield components while Alar retarded them.
2. Maximum seed yield was obtained from the wet level followed by the medium soil moisture and the least yield was produced from the dry treatment. Foliar application of  $GA_3$  did result in a significant increase in seed production.  
On the contrary Alar application decreased seed yield and this was obvious by high concentration. The enhancing effect of  $GA_3$  seemed to be clear under wet and medium soil moisture level. However, in case of Alar, the retarding effect increased by water deficit.
3. The trend of straw yield is identical to that observed with seed yield.
4. Statistical analysis showed that either water deficit or growth substances had a significant effect on oil content of soybean seeds.
5. Oil production increased by high soil moisture level and decreased by water deficit.  $GA_3$  application increased oil production and that was found to be more by low level. The use of Alar decreased oil yield and such decrease was greater by higher rate.

### III. Evapotranspiration :

1. Seasonal evapotranspiration by soybean varies widely between 49.57 and 84.09 cm. under the various treatments.
2. Evapotranspiration rates were increased as soil moisture stress decreased.
3. Growth promoting substance i.e.  $GA_3$  increased seasonal ET. values while retardant (Alar) decreased such values and that was greater by high concentration.
4. Daily water use by soybean started with lower amounts increased gradually to a maximum when plants complete 70 % of its growth cycle then declined after that.
5. Daily water use by soybean can be represented as a continuous function in the form :

$$y = a + bx + cx^2$$

where :

y = daily evapotranspiration mm/day

x = relative growth period as a percentage.

Such function predict daily ET. at any specific period of soybean growth.

6. Crop coefficient ( $K_c$ ) for soybean was very low at earlier stages, then increased gradually to exceed the unit when soybean complete 70-80 % of its growth period. Thereafter,  $K_c$  values redecreased again.  $GA_3$  application increased such values while Alar decreased it.

- 7.. Water use efficiency was lower in the first period (from emergence to 50 days) then reached a maximum through the period from (50 & 75 days). Thereafter, water use efficiency values red decreased again to reach a minimum at the end of the seasons (from 100-130 days).
- 8 . Water use efficiency expressed as Kg. dry matter/m<sup>3</sup> of water consumed, was higher under high soil moisture level and decreased by water deficit.
- 9.. The use of GA<sub>3</sub> improved water use efficiency values under high soil moisture level. However, under prolonged irrigation intervals, no clear trend was observed. The use of retardant i.e. Alar, slightly decreased the values of water use efficiency.
10. Water use efficiency expressed as Kg. seeds/m<sup>3</sup> of water consumed was higher under wet conditions and decreased by increasing soil moisture stress. The use of GA<sub>3</sub> at 100 ppm improved the efficiency of water utilization while Alar depressed such values.

#### IV. Water and Soybean Yield Relationships :

1. Statistical analysis showed that the relationship between soybean yield and soil moisture level or seasonal water consumption is a first clear relation. The regression line has the form :

$$y = a + bx$$

2. The relation between the two factors i.e. actual evapotranspiration and soil moisture level, and soybean yields demonstrates that

both factors affect the productivity of such crop. These relationships have the form :

$$y = a + bx_1 + cx_2$$

3. Results indicate that any environmental factor affecting seasonal water consumption of soybean had a great response on its production.

#### V. Chemical Composition :

1. The level of soil moisture is an important factor controlling soybean protein. It was found that increasing soil moisture stress resulted in increasing soybean protein. The use of growth promoting substances ( $GA_3$ ) seemed to decrease the amount of soybean protein while Alar increased such values.
2. The total content of different macronutrients i.e. NP K increased with advancing age. Soil moisture levels and growth regulators affected the total amount of tested nutrients in different plant parts as well as the whole plant which decreased with increasing soil moisture stress.
3. The total content of Fe, Mn and Zn seemed to be decreased with 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 effect as well as to regulate the balance between micro and macro-nutrients.