S U M M A R Y

The present investigation was carried out at El-Qanater Horticultural Research Station, Kalubia Governorate, during the two successive seasons 1989/1990 and 1990/1991. The main objective of this work is to study the effect of water regime and growth regulators on growth, yield, water use and chemical composition of potato plant (Solanum tuberosum). For such target two field experiments were carried out. The treatments of the first experiment were as follows :

A: Irrigated according to the local farmer practice.

B: Irrigated at 0.5 bar.

C: Irrigated at 1.0 bar.

D: Irrigated at 1.5 bars.

E: Irrigated when 50% of the available soil moisture is depleted as estimated by modified Penman method.

The treatments of the second trial were as the following:

A: Control.

B: Sprayed with GA_3 at a concentration of 100 ppm.

C: Sprayed with GA_3 at a concentration of 200 ppm.

D: Sprayed with CCC at a concentration of 1000 ppm.

E: Sprayed with CCC at a concentration of 2000 ppm.

Growth regulators were sprayed when plants aged 45 and 60 days. A complete randomized block design was used for both experiments, in the two seasons, and in fall and summer plantations. Agricultural practices were carried out according to the usual methods being adopted for such crop. The variety Konder was used in the 8 experiments.

The most important results induced from this investigtation could be summarized as follows :

A. EFFECT OF WATER REGIME

1. Increasing water stress resulted in decreasing plant height significantly.

2. Potato plant directed its growth in fall plantation for producing shorter plants with higher number of branches, while in summer the plants are taller with less number of branches. Also, it can be noted that maximum values of branches/plant were produced from the wet treatment (0.5 bar).

3. Leaf area/plant increased gradually from emergence to the last sampling date (80 days after planting) in summer plantation, while a slight decrease in leaf/area was observed at the age of 80 days. The wet treatment has the highest

value of leaf area per plant.

4. Maximum period of dry matter accumulation by leaves was from emergence up to 50 days in fall, while in summer it was from 50 to 65 days. In both plantations the grand period of dry matter accumulated in stems was found to be from emergence up to 50 days. The highest proportion of dry matter accumulation in tubers falls in the period from 50 up to 80 days after planting. Dry matter of the whole plant increased gradually from planting to the last sample. It was noticed that prolonged irrigation intervals decreased the accumulation of dry matter. This may prove the importance of maintaining a high level of soil moisture for better growth.

5. The highest values of either length or width of tubers were obtained from treatments irrigated freqently. Thus, it can be noted that maintaining high soil moisture level produces larger tubers.

6. Tuber index or the ratio between length and width was not affected significantly by water deficit. However, results indicate that low or moderate stress increased the values of tuber index. On the contrary, severe soil moisture stress resulted in decreasing such value. These results indicate that potato tubers are somewhat spherical in shape when

grown under low soil water, while under high soil moisture level, the tuber length was much more than its width.

7. Results have shown that number of tuber/plant is mainly controlled by genetics and to less extent by environmental conditions.

8. Maximum tuber yield/plant was scored from the wet level (0.5 bar) followed by medium soil moisture regime (1.0 bar and farmer practice). However, the lowest value was attained from dry treatments (1.5 bars and 50% modified Penman). It is worthy to mention that tuber yield/plant was found to be greater in fall plantation than that obtained from summer season.

9. Average tuber weight data showed that it was higher in fall compared with summer plantation. Regarding the effect of water regime, similar results were obtained as those of tuber yield/plant.

10. Potato plants imposed to severe water stress, had a higher tuber dry matter percentage compared with those plants irrigated frequently.

11. Water deficit has no obvious effect on tuber

specific weight and/or total soluble solids either in fall or summer plantation and the values were about the same.

12. The data indicate that for maximum tuber yield of potato, irrigation water should be applied at 0.5 bar soil moisture tension. However, more than that level, the yield decreased significantly. It is worthy to mention that the values obtained from the medium soil moisture stress and the farmer practice are about the same. This means that the Egyptian farmers irrigate their fields at moderate stress which affects the final tuber production.

13. Fall plantation was superior in producing larger tubers in size compared with those produced from summer plantation. With regards to the effect of water deficit on tuber size, data had shown that high and medium soil moisture level produced the highest percentage of larger tubers. On the contrary, severe water deficit did result in decreasing the percentage of medium and larger tubers, while increased the percentage of smaller tubers. These results mean that maintaining a high soil moisture level through the growth period of potato improved the production of tubers by producing larger tubers.

14. Seasonal water consumptive use by potato varies

between 300.4 mm and 419.3 mm for fall plantation, while for summer the values ranged from 443.4 mm to 626.9 mm. The variations are mainly due to climatic conditions and to the irrigation treatments. The highest water use value was attained under low water deficit. Increasing soil moisture stress by prolonged irrigation intervals resulted in decreasing water consumption.

15. Daily evapotranspiration rates reached its maximum value when potato plants aged 90 days in fall and 75 days in summer plantation. Such period is considered as the stage of tuberization, hence plant needs more water as the tubers increased in size and weight.

16. Crop coefficient was estimated using Penman formula and actual evapotranspiration rates. The values were low at the initial stage, then increased to reach its maximum value at mid season stage. Such period is considered the peack water demand by potato (the period of tuberization). A sharp decrease in crop coefficient was observed at the end of the season. Seasonal crop coefficient was found to be 0.75 and 0.77 for summer and fall plantations respectively.

17. Potato plant extracts about 80% of its moisture needs from the upper foot. This may prove that potato plant

is relatively sensitive to soil water deficit and has to be irrigated frequently.

18. Water use efficiency values experssed as kg. dry matter/feddan/one cubic meter of consumed water, were higher in fall plantation more than in summer one. It can be mentioned that fall plantation is preferable from stand point of either production or water use efficiency. Increasing soil moisture stress decreased the value of water use efficiency, this was true in both seasons, and in fall and summer plantations.

19. Efficiency of water use data, expressed as kg of tuber yield/feddan/m^3 of water consumed, revealed that the values of fall plantation were higher than those of summer cultivation. With regards to the effect of soil moisture stress on water use efficiency, data had shown that it decreased as water deficit increased. The reverse trend was found to be true.

20. It can be concluded that maintaining a high soil moisture level not only increases tuber production but also allows potato plant to use water more efficiently. The previous results may lead to the conclusion that potato plant is more sensitive to water deficit and this is more

pronounced in summer plantation than fall one.

21. Nitrogen content of potato leaves and stems increased gradually from the first sample up to 65 days, then decreased. As for nitrogen content of tubers, results showed that it decreased by time from the first sample to the last one. Nitrogen was decreased by increasing soil moisture stress. As for phosphorus concentration, data showed a similar trend to that observed with nitrogen. However, potassium concentration seemed to increase by water deficit.

22. A gradual increase in total sugars was observed from the first period (50 days) to the second stage (65 days), in leaves and stems. However, the tubers sugar content decreased gradually from the first sample to the last one. The values were higher in fall than in summer plantation, in leaves and stems.

23. Results showed a gradual increase in total carbohydrate from the first sample up to 65 days, then slightly decreased. This pattern is true in leaves and stems, while the reverse is clear in tubers. Water deficit has a negative response upon the accumulation of total carbohydrates.

24. Data indicate that different chloroplast pigments increased with advancing age. The rate of increase in chlorophyll exceeds the rate of carotenoides. Generally, chlorophyll (a + b) concentration is less under summer plantation compared with fall. However, carotenoides (c) is higher in summer than fall season. The ratio between a/b seemed to be similar under various irrigation treatments which indicates that any decrease in chlorophyll (a) by water deficit is accompanied by a similar decrease in chlorophyll (b). However, the ratio (a + b)/c was decreased by water deficit.