SOME PHYSIOLOGICAL RESPONSES OF COTTON PLANT TO WATER SUPPLY

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A C K N O W L E D G E M E N T

This investigation was carried out under the supervision of Dr. A. Raafat, Dr. M. El-Kadi, Associate Professors of Plant Physiology, Dr. A.I. Gabr, Lecturer of Plant Physiology, Faculty of Agric., Ain Shams University and Dr. M.T. El-Saidi, Researcher in the National Research Center, Cairo.

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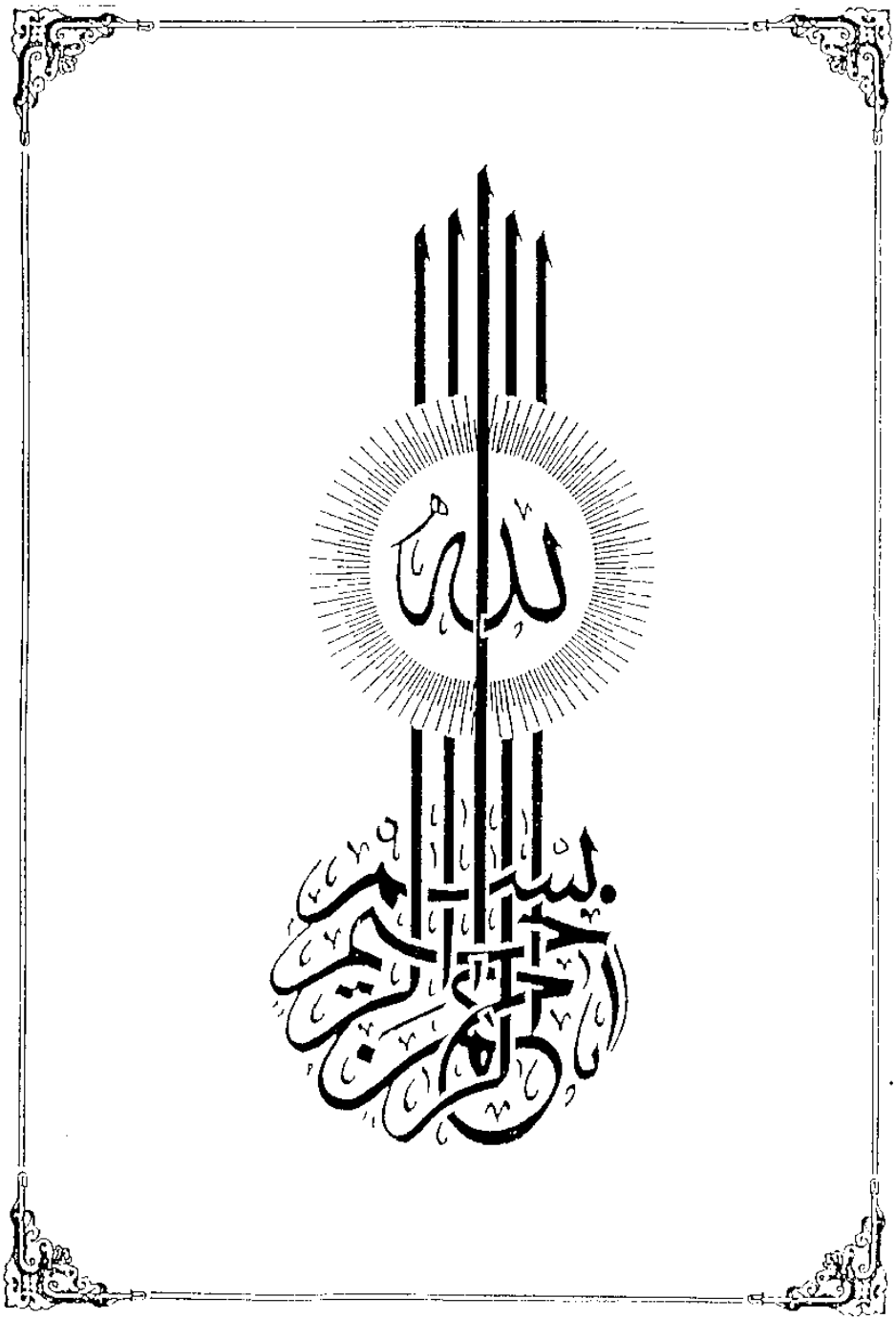

C O N T E N T S

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I. INTRODUCTION

Cotton is one of the most important crops in U.A.R. It occupies about one third of the total cultivated area every year. The Agricultural Egyptian Economy largely depends on cotton crop and thus serious attempts must be paid to increase cotton production. At present, it is rather difficult to increase the yield of cotton in U.A.R. by increasing its cultivated area due to many reasons. Therefore, it seems rather obvious that the principal approach to overcome such problem rests in raising the yield per feddan.

The literature concerned with the effect of different conditions of water supply on cotton as well as other agricultural crops are plenty. Most of the available literature show the effect of water supply on growth and yield of plants. However, studies covering the effect of different conditions of water supply on the physiological processes and chemical constituents in plants are somewhat rare.

The present investigation aimed to study the effect of different conditions of water supply during different developmental stages of cotton plants on some

physiological and chemical aspects in the plant as well as on the yield. It is hoped that this investigation may throw some light on the favourable conditions of irrigation and may also indicate the critical period or periods of excess or shortage of water supply on cotton.

II. REVIEW OF LITERATURE

Literature dealing with the effect of water supply on growth and development of different crops are voluminous. Those dealing with cotton will be reviewed under the following titles :

Effect of soil moisture on growth and development :

King (1922) found some correlation between water content of soil and stem growth by measuring the height of Pima cotton plants. He indicated also that the plant to which he applied the most water, produced the greatest number of flowers.

Crowther (1934) indicated that, plant height, number of nodes, and internode length increased by increasing the amount of irrigation water. He reported that the amount of irrigation water was responsible for a considerable variation in the total number of flowers produced by the plant and the number of flowers per plant increased with heavier application of water. In 1936, he stated that heavier irrigation had no effect on total bolls picked per plant.

Adams et al. (1942) concluded that, excessive water was objectionable, as it encouraged too rapid and luxuriant vegetative growth at the expense of fruiting.

Harris and Howkins (1942) reported that, with holding water during the fruiting period might decrease the vegetative growth and stimulate fruiting.

Bert et al. (1955) indicated that, later irrigation usually causes undesirable vegetative growth.

Christides and Harrison (1955) reported that, the number of flowers and bolls picked were higher with an increased amount of irrigation.

Brown and Ware (1958) pointed out that, an ample supply of moisture might result in a rapid vegetative growth but on the other hand, insufficient water supply checked the growth. They indicated that adequate water with other factors in balance usually stimulated fruiting-branch growth along with other plant growth.

Abdel-Raheem (1960) indicated that, increasing the amount of irrigation water increased significantly the plant height at the end of the season, number of nodes,

length of internode, length of sympodium, number of flowers and number of open bolls per plant.

Stockton et al. (1961) irrigated cotton plants with three frequencies : i) weekly, no sign of moisture stress, ii) at first sign of moisture stress and iii) after several days of wilting. They found that the plant height, in inch, was 45, 39 and 32; number of flowers per 0.001 ac. was 627, 495 and 378; number of bolls per 0.001 ac. was 201, 197 and 153 for the same respective treatments.

Kramer (1963), in his classical study related to water stress and plant growth, noticed that plant growth is directly controlled by plant water and indirectly by soil water stress. He suggested that plant water stress should be measured directly, through the effect of water supply on plant growth and allied processes.

Demol (1964), while studying the effect of water regime on different yield components, noticed that plant height and branch development increased linearly with the increase in water supply, but dry matter production was not related likewise. He concluded that half

saturation was the most proper moisture regime for dry matter production.

Doss et al. (1964) found that, the rate of moisture used by cotton plant increasing with increasing soil moisture and gradually increased with progressing plant development to the period of blooming and boll development.

El-Saidi (1964) found that, water deficits in meristematic regions reduced growth in cotton. He indicated that plants which were subjected to only a slight moisture stress failed to attain the amount of growth of the control. In some cases if plants which suffer from water deficits were not in critical period (flowering and boll formation) they might surpass the control after receiving water. If plants in critical period were exposed to shortage conditions of water supply, the growth never approach to the control levels after recovering from drought.

Bruce and Rômkens (1965) cultivated cotton under several regimes of soil moisture stress imposed during three stages of growth. They found that square initiation was directly related to rate of plant height, increased

during the four weeks after first flowering which [illegible] was progressively reduced by increasing moisture stress during that period.

Talha (1966) stated that, plants subjected to soil drought except during the boll opening stage had a drop in the rate of flowering, which consequently not only decreased the total number of flowers, but the number of bolls too was greatly affected, especially when plants were subjected to drought at the peak of flowering. He reported that there exists a linear relationship between the water supply, and plant height and branch development.

Effect of soil moisture on date of first flower, opening of first boll and shedding :

Crowther (1934) indicated that, medium irrigation caused less damage from shedding than either light or heavy application. In 1936 he concluded that heavier irrigation had a slightly delaying effect on flowering.

Adams et al. (1942) indicated that, continuous but not excessive available moisture gave the lowest percentage of shedding.

Wakeley and Rigney (1947) showed that, water requirement of the plant should be available in the time

of square and flower formation to prevent the injurious effect of drought which was responsible for the shedding of flowers and bolls.

Christides and Harrison (1955) reported that, the percentage of shedding was higher with an increased amount of irrigation water.

Abdel-Raheem (1960) found that, the date of first flower and opening of first boll delayed significantly with increasing the amount of irrigation water.

Stockton et al. (1961) irrigated cotton plants with three frequencies : i) weekly, no sign of moisture stress, ii) at first sign of moisture stress and iii) after several days of wilting, and they found that the percentages of bolls shed were 67.5, 59.6 and 59.5 respectively.

Chlichlias, and Anastassiou-Lefcopoulou (1967),found that, irrigation was needed during boll formation and maturity was delayed when the number of irrigations was increased.

Effect of soil moisture on the yield :

Gregory et al. (1932) obtained an increase of 0,45 Kentar of seed cotton per feddan by watering heavily every two weeks as compared to light irrigation.

Crowther (1936) found that increased amount of water at each irrigation had, in most cases, no significant effect on the yield.

Sabit and Khalil (1949) reported that, if the quantity of water given was more than 2250 or less than 2100 cubic metres, the yield would decrease.

Shardakov (1953) studied the effect of different levels of soil moisture on cotton. He found that cotton plants which were grown at 60 % soil moisture gave the higher yield than other treatments which were grown at 40 % or 80 % soil moisture.

Borodollina and Sokolova (1957) obtained the higher yield of cotton, when soil moisture was raised from 65 % to 80 %. They indicated that in maximum flowering stage, when the soil moisture was raised to 80 %, the yield was higher than that when it was raised at the beginning of flowering.

Spooner et al. (1958) pointed out that irrigation increased the yield by approximately one bole/ac. They indicated that water applied before flowering did not cause a significant increase in the yield.

Yaroch (1959) concluded that the decline in the yield due to lack of moisture in the soil results not only from retardation of growth but also from rhythm disruption of individual biochemical processes.

Abdel-Raheem (1960) found that the yield of seed cotton per feddan increased significantly as the amount of irrigation water increased up to 215 cu.m. Any addition of irrigation water above this amount did not raise the yield of seed cotton.

Martin (1966) irrigated cotton (G. hirsutum)Cv. stoneville when the soil moisture content reached 80, 70, 60, 45, or 30 % of field capacity, in a preliminary field trial, and pointed out that the highest yield (3637 kg/ha) and the greatest advance in harvest date (20 days) were obtained by irrigating at 30 % level.

Petinov and Durdyev (1968) found that yields of seed cotton were reduced from 34.4 h kg/ha to 14.9 h kg under insufficient water supply, compared with the normal supply.

Yulev (1968) stated that in field trials, yield of cotton Cv. 2362 (a) and Cv. 3996 B were higher by 8 %