SOME PHYSIOLOGICAL STUDIES ON THE EFFECT OF LEAF DEFOLIATION ON LATE OPENING OF COTTON BOLLS

NAME : M

TITLE : S

By

MOHAMED SAID ESMAIL
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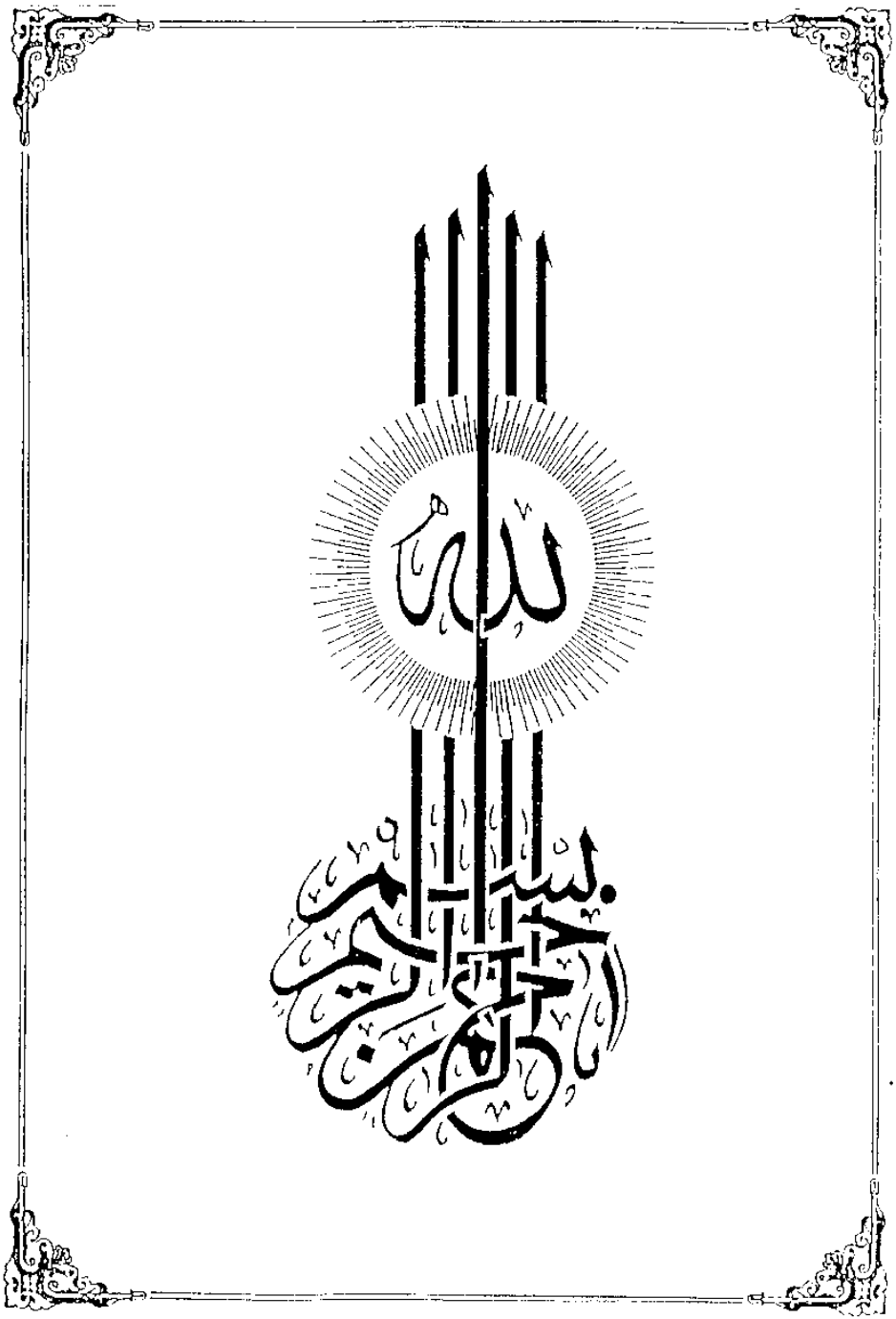

TABLE OF CONTENTS

INTRODUCTION

The cotton plant is one of the major fiber crops which-owing to their economic imprtance-have been the object of throughgoing botanical and chemical studies by physiologists. The Egyptian cotton varieties which belong to G. barbadense are considered to have the finest and longest lint quality in the world.

On fertile soils with a high humus content, cotton plants tend to grow vegetatively specially when the climatic conditions are suitable for such growth, and a growth disorder commonly referred to as late boll opening occurs.

The trouble of late boll opening is not prevalent throuout the cotton growing areas but is supposed to be one of the most serious troubles which affect both yield and quality. This trouble is considered to be a physiological one related to those factors which modify and disturb the normal well identified growth pattern of the cotton plant. The trouble of late boll opening is due to an over supply of water with abnormally excessive levels of nitrogen in fertile soils and or to subnormal temperature which throw the plant into a vegetative cycle that may retard fruit development and consequently boll maturation. In this case, the opening of most bolls occurs during a period of high humidity and relatively

low temperature. Under such conditions, mainly due to boll worm damage, the yield is highly reduced and the cotton produced is classified in lower grade than the early matured crop. Moreover the time available for seed bed preparation for winter crops following cotton is relatively short to handle the soil perfectly.

In Egypt, the trouble of late boll opening is increasing since there is a tendency among cotton growers to grow cotton late in the season (during April and beginning of May) after winter crops (Horse Bean, Bersim, etc.).However, most of these cotton growers believe in its relation to climatic factors since its severity and spread change from year to year and is mostly related to mild subnormal temperature of August (boll maturity period). Soil fertility, previous crop in the rotation and level of added fertilizers are also not neglected.

Accordingly to find out some means to control such a trouble and to help early opening of cotton bolls will be of great importance to the cotton growers and will serve to improve the yield and the quality of cotton. Among these possibilities is the creation of an appropriate balance between the vegetative and reproductive growth by means of reducing the leaf area of plant.

Thus it was the main objective of this investigation to study the efficiency of removing Giza 69 cotton leaves by some chemicals in forcing the plant bolls to earlier opening. The rate and time of application of these chemicals were also carefully investigated. In this study, late boll maturity was induced, as previously mentioned by the addition of high nitrogen level to cotton plants under investigation.

REVIEW OF LITERATURE

Several investigations have been carried out to study on one hand the factors affecting the efficiency of chemical defoliants applied in cotton fields and to elucidate on the other hand the effect of defoliation on the different aspects concerning cotton yield.

In reviewing the literature, references will be grouped under the following headings.

I- Factors affecting the efficiency of chemical defoliants applied for cotton plant :

Several factors were reported to influence the effect of defoliants on plant leaves. Hall (1951) stated that susceptibility of cotton plants to chemical defoliants was found to be greatly affected by high soil moisture content, low nitrogen level and moderate fruiting load.

Hall and Lane (1952) reported that Shed-A- Leaf showed promise in defoliating drought-stressed cotton at the late season in Texas. While Endothal (3, 6, endoxo-hexahydrophthalate.) gave the best defoliation when cotton had grown under moisture stress.

Lane and Hall (1952) studied the effect of applied sugars, light intensity and temperature upon chemical defoliation. The results obtained showed that there was a general increase in the defoliation percentage when sugars regardless of type was added to the defoliant over the defoliant alone. They also noticed that the defoliation percentage was increased in the case of high light intensity accompanied by high temperature conditions, and similar increase occurred by moderate light and temperature conditions.

Christidis and Harrison (1955) summarised the conditions favoring efficient defoliation in the following :
1- The plants should still be in an active state so that they can react to the chemical and allow cell multiplication for abscission. 2- Prolonged drought or cold weather might slow down activity and make defoliation very difficult.
3- Mature leaves had been found easy to remove but this was not the case with young leaves far from the state of senescence. 4- There was a high negative correlation between sensitivity to defoliation and starch content of the leaves.
5- Defoliants should be applied after most of the bolls are mature.

Addicott et al. (1959), Anonymous (1960), and Ray (1961) reported that the factors promoting defoliation were high temperature (70° to 100°F), high soil moisture, low level of nitrogen, stand with regular growth, complete coverage by the defoliant, large droplets and controlled insects and weeds.

II- Effect of chemical defoliants on leaf defoliation :

With regard to the influence of chemical defoliants on leaf defoliation, Thomas et al. (1951), sprayed potassium cyanate for cotton defoliation at September 22 and October 6. The percentage of defoliation was 81.9 % and 50.7 % at the two dates of spraying. The injury caused to the unremoved leaves was 10 %. The acre rates which were sufficient to initiate defoliation were 5 to 7 pounds. The same authors stated that high rates of potassium cyanate were harmfull to the plants. Thaxon et al. (1953) obtained similar results with potassium cyanate at the rate of 7 to 10 lbs. per acre. The percentage of defoliation obtained with both rates was 84 %.

Hall et al. (1954) tested Aminotriazole at various rates on cotton plants. Defoliation percentage obtained with the rates of 0.25, 0.50, 0.75, 1.0 and 1.5 lbs per

acre were 49.8, 87.6, 88.6, 90.6, and 80.0 % respectively.

Miller and Hall (1957) obtained excellent defoliation from an aerial application of Mg chlorate and Aminotriazole. The differences in defoliation percentage obtained with Aminotriazole were not significant in the field test for either / or 2 lbs.per acre.

Cook et al. (1958) tested the effect of Folex at different rates on cotton. The percentage of leaf defoliation obtained, 8 days after application, was 81 to 96 % in the early season by using 1.0 lb of Folex, while this defoliation percentage was obtained by using 2.0 lbs. at the late season. They recommended the rates of 1.0 to 1.5 lbs. per acre under favorable application conditions to obtain acceptable defoliation. Woodal (1959) obtained similar results with Folex at the rate of 1.5 and 2 pints per acre.

Ibrahim (1961) sprayed Aminotriazole, potassium cyanate and Folex on cotton plants at a rate of 2 and , 7.5 pounds and 1.7 l and their double values for the different chemical defoliants at plant age of 146, 156 and 166 days. The higher rates of the different chemical defoliants tended to increase the defoliation percentage as compared to the lower rates.

Green and Kalogeris (1965), in Tanzania, reported that 80 to 90 % defoliation was obtained with Folex at 2.8 lbs. per acre, DEF at 1.35 lb. per acre, Prep (Sodium cis-3-chloroacrylate) at 1.5 lb. per acre and Deflo at 6 lb. per acre.

Zakirov and Vasilevskii (1966) sprayed cotton plants at different dates with Free cyanamide, magnesium chloride and Butifos (S, S, S- tributyltrithiophosphate). The maximum defoliation (up to 85 %) was obtained from applying 1.5 - 2 Kg Butifos/ha. when 2 - 3 of the lower bolls were open.

Zakirov and Sadykov (1967) stated that the application of cyanamide at 20 - 25 Kg/ha. or Butifos at 1.5 - 3.5 Kg/ha. increased leaf shedding to 82 - 91 % and 83 - 95 % respectively compared with 21 % in the control.

Deshkova (1968) sprayed calcium cyanamide at the doses of 20, 40 and 60 Kg/ha. The best defoliation was obtained when 40 Kg/ha. were dissolved in 880 L of water when 2 bolls per plant on the mean were open.

Zakirov (1968) found that magnesium chlorate and calcium chlorate when used as cotton defoliants in 0.3 % solu-

tions were more effective when applied in mixtures than alone. The ratio of 1 : 1 produced the best results and gave 84 % defoliation, compared with 77 and 70 % for the two defoliants respectively, when applied alone.

Lobato et al. (1970) tested DEF and Folex at 0.75 , 1.00 and 1.50 Kg/ha. when 50 % of the cotton bolls were formed. The defoliants at 1.00 and 1.50 Kg/ha. gave the best defoliation.

Abdurkhmanov (1971) reported that spraying 50 Kg calcium cyanamide, 12 Kg magnesium chlorate or 2.5 Kg. Butifos /ha. on cotton plants when 1 - 2 bolls were opened on most of the plants gave about 60 % defoliation. A second spray of 8 - 16 Kg magnesium chlorate or 1.5 - 4.0 Kg Butifos/ha. applied 6 days later gave 100 % defoliation.

Burban and Gleadle (1973) used the defoliants DEF, Folex and cyanofol and the desicants, Reglone and Gramoxone singly or in mixtures, at several dosages. They reported that the phosphate defoliants DEF and Folex gave adequate defoliation when used alone at the rate of 1.5 pints per acre, but the addition of 0.75 pints of Gramaxone to either slightly increased both the final leaf loss and the rate of defoliation. Satisfactory defoliation was obtained within

two weeks of spraying with the greatest rate of leaf loss occurring between the fourth and eleventh day.

Topalov (1973) stated that the best defoliation of cotton for mechanical harvesting was obtained by foliar sprays of 1 L Folex, 5 - 10 Kg magnesium chlorate, 1 L Gramoxone (Paraquate), 50 - 60 Kg calcium cyanamide or magnesium chlorate + 0.5 1 L Gramoxone/ha. when about 100 bolls on 100 plants had opened.

Musaev and Krobotov (1973) stated that foliar application of 10 Kg magnesium chlorate/ha to cotton when 35 % of the bolls were opened gave satisfactory defoliation. The application when 25 % of the bolls were opened was less effective.

Sarkisyan and Butkova (1973) found that the application of 3 Kg Butifos or 10 Kg magnesium chlorate/ha. when 2 - 3 bolls per plant were opened gave 85.7 - 78.6 % defoliation resulted from chemicals applied when 1 - 2 bolls were opened.

III- Effect of chemical defoliants on the chemical composition of cotton leaves :

1- Carbohydrates and nitrogen content :

In connection with the influence of chemical defoliants on the chemical composition of cotton leaves , Hall (1951) found that there was a high degree of negative convariance between sensitivety to defoliation and the starch content of the leaves. This increase relationship between defoliation and the starch content of the leaves suggestes that carbohydrate depletion is an important factor in the effectiveness of chemical defoliation. Although there appeared to be a significant positive effect between defoliation and the total nitrogen content of the leaves, it was found that the influence of nitrogen upon defoliation was largely due to an interrelation between starch and total nitrogen.

Hall *et al*. (1954) reported that cotton plants sprayed with Aminotriazole showed a compositional changes following application. The aerial organs lost approximately half of the original reducing sugars and sucrose, meanwhile a slight increase in starch was essentially balanced by an equivalent loss in hemicellulose fraction. The net result