STUDIES ON THE EFFECT OF SOME GROWTH REGULATORS, MACRO AND MICRO NUTRIENTS ON SOME BIOCHEMICAL CONSTITUENTS OF SOYBEAN UNDER THE CONDITION OF RECLAIMED SOILS

BY

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A thesis submitted in partial fulfilment

of

the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

Agricultural Science

(Agricultural Biochemistry)

Soils Department

Faculty of Agriculture

Ain Shams University

1990

APPROVAL SHEET

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ABSTRACT

A field experiment was carried out at Mariut Research Station of the Desert Institute for two years 1986-1887 to study the individual as well as the combined effects of P, Mn and Fe with and without GA3 on yield parameters, nutrient contents and some biochemical constituents of soybean (*Glycin max* L. *var* Clark) under the conditions of a reclaimed desert calcareous soil at Mariut area.

All nutrient treatments resulted in significantly higher yield of dry weight of leaves, stems, straw and seeds of soybean in both experimental years. P treatments whether individually or in combination with the other two elements were superior to all other treatments as far as yield parameters were concerned. Soaking soybean in gibberillic acid was generally depressive of soybean yield.

The applied nutrient treatments had marked effects on the respective content in the vegetative parts of soybean

during growth. All treatments resulted in a significant increase in plant P content. The results showed markedly effects on antagonism between Fe and Mn. This effect was reflected on both Fe and Mn contents as well as yield parameters.

The individual application of P was the most effective treatment in enhancing crude protein content in leaves, stems and seeds. Combined treatments of P+Fe+Mn and P+Mn were almost as effective as P treatment. Application of GA3 in general reduced crude protein in seeds.

Most nutrient treatments increased soluble protein fractions without GA3 application, while with it, iron application was superior to other treatments especially when applied with P.

The phosphorus treatments were superior as far as oil production in soybean seeds was concerned. Application of GA3 increased oil content of soybean seeds. All nutrient treatments without GA3 retarded the production of saturated fatty acids (palmitic and stearic). On the other hand, GA3 application increased unsaturated fatty acids (oleic, linolenic and arachidonic). All treatments decreased acid and peroxide values of seed oil. Most treatments increased iodine balue and decreased saponification value. GA3 increased acid and peroxide values, but decreased iodine and saponification value.

The effects of the applied treatments on amino acids content did not have a consistent trend. However, the P and Fe treatments resulted in higher amounts of essential amino acids. All treatments with GA3 decreased the magnitude of all amino acids except for arginine.

In conclusion, the results clearly showed the significance of certain nutrient treatments for better growth yield, and the biochemical constituents of soybean grown on reclaimed calcareous soils. P and Fe and, in certain cases, Mn had profound effects on the parameters studied.

ACKNOWLEDGMENTS

The author wishes to express his deepest gratitude and sincere appreciation to Dr. A.R. Nassar, Professor of Biochemistry, Faculty of Agriculture, Ain Shams University, for his supervision, guidance and criticism through the course of study.

Grateful acknowledgment is also estended to Dr. F.Abd El-Naeim, Professor of Biochemistry, Faculty of Agriculture, Ain Shams University, for his supervision, guidance and sincere help.

The author also expresses his gratefulness to Dr. N.E. Ali, Professor of Biochemistry, Faculty of Agriculture, Ain Shams University, for his kind help, valuable advices and fruitful efforts in revising this work.

Thanks are to Dr. I.H. El-Bagouri, Head of Soil Conservation Department, Desert Research Institute, for his appreciable ideas and fruitful cooperation in the preparation of manuscript.

Profound gratitude is to Dr. M.A. Wassif, Professor of Soil Science, Desert Research Institute, for his valuable advices, continuous support, guidance, many valuable suggestions and deep interest during this work.

Wholehearted gratitude and appreciation are recorded to Dr. M. Shams Eldin, Associate Professor of Biochemistry, Faculty of Agriculture, Ain Shams University, for his help and encouragement during the lately stage of this work.

LIST OF TABLES

* **

LIST OF FIGURES

No. Page

* * *

1. INTRODUCTION

Soybean seeds represent a highly nutritious source of food for man and animals. Soybean seeds contain up to 40% of protein and 20 % oil by weight. Soybean plant has a short growing season. With these advantages, soybean is considered to be among the promising cash crops in Egypt. The area planted with soybean (*Glycine max L.*) in Egypt has been increased from 624 feddans in 1966 to 3,318 feddans in 1977. The total seed yield in the same period of time increased from 359 to 26,496 tons. In 1987, the planted area of soybean was increased to 150,000 feddans (Ministry of Agriculture).

Soybean seed yield, as well as, its chemical composition are controlled by many integrated factors including mineral nutrition. Nutrient elements can be applied to soybean through the soil or via plant foliage. Soil application is faced with decreased availability of applied nutrients; partially or completely. On the other hand, foliar application is believed to be more effective than soil application of certain elements as was reported by many research workers. Phosphorus, an essential macronutrient to plants, plays an important role in plant metabolism. Many scientists related low crop yield to phosphorus deficiency, since it affects the formation of nucleoprotein, phospholipids, phosphoproteins and energy compounds. It also plays an imoportant role in mitocondria's function and in the assimilation of fats and carbohydrates in plant systems. Phosphorus acts as coenzyme of Zymase. It is also essential for root development and seed formation.

Iron, an essential nutrient, contributes to the structure of of heme and non-heme proteins which are critical in oxidation-reduction reactions of photosynthesis, respiration, nitrate reduction and protein metabolism. In the newly reclaimed areas, available iron is too low to satisfy plant requirements, so the addition of such element is required.

Manganese, an essential micronutrient, is critical for various metabolic activities in plant systems. It contributes to chlorophyll synthesis, photosynthesis, nitrate reduction, amino acids and protein synthesis and other activities.

Recently, several growth regulators have been used at a large scale for increasing the yield of different crops through controlling their grwoth. One of these compounds is gibberellic acid (GA3) which affects plant grwoth particularly the stem elongation, number of tillers, fresh and dry matter accumulation.

There are few available data concerning the combined effect of GA3 and nutrients application on the magnitude and quality of soybean yield. Therefore, the aim of the current investigation is to evaluate the effect of mineral fertilization with P, Fe and Mn combined with gibberellic acid treatment on the plant content of those elements, as well as, on the biochemical content of crude protein and oil in soybean grown on a newly reclaimed calcareous soil.

2. REVIEW OF LITERATURE

2.1. Biochemical constituents of soybean:

2.1.1. Protein and amino acids:

Krober and Cartter (1962) showed that during the development of soybean seed, the percentage of non-protein nitrogen decreased with a concomitant rise in the percentage of total nitrogen.

Bae and Yu (1967) studied the changes of protein content in various organs of soybean during germination. They found that protein content increased in the differentiating parts of the seed on the account of carbohydrates of cotyledons.

Pliskova (1967) observed that soybean seeds contain aspartic, asparagine, glutamine, serine, and alanine acids, and stated that the amino nitrogen at the first weeks of seed development was greater than at the flowering.

Kakade et al. (1972) pointed out that the ratios of the two amino acids; methionine and cystine, to the total nitrogen content of soybean were 1.6-3.5 and 0.9-1.2 g/16 g N, respectively.

Caviness (1973) found, in three years experiments, that protein content of soybean seeds ranged from 38.3 to 44.1 % and oil content from 21.2 to 24.9 % and the sum of both components ranged from 59.5 to 69.0%.

In a report on soybean nutritive value, Coppock (1974) illustrated that the seed stored 40 % protein. He also found that stored defatted soya flour included the essential amino acids; isoleucine 119, leucine 181, lysine 161, phenylalanine 117, tyrosine 91, cystine 37, methionine 37, threonine 101, tryptophan 30 and valine 126 mg/g total essential amino acids.

Mattil (1974), from the analysis of three soybean varieties, showed that the percentages of lysine in soybean varied between 5.1 and 5.8, threonine from 3.7 and 3.8, valine from 4.7 and 4.8.

Kaizuma _et al_. (1974) studied the amounts of seed protein and sulphur-containing amino acids of soybean cultivars and found that protein percentage varied from 34.8 to 49.1 while methionine content varied from 0.67 to 0.96, cystine from 0.62 to 1.22 and total S-containing amino acids from 1.29 to 2.15 g/16 g N, which were negatively correlated with maturity.

Pak and Barja (1975) found that protein in five varieties of soybean ranged from 33.5 to 36.0 %. Stanilova (1975) found that amino acids composition of soybean depends on the cultivar and applied nitrogen and phosphorus.

2.1.2. Oil and fatty acids content:

Bils and Howell (1963) reported that both lipids and protein compounds in cotyledons of maturing seeds became packed with lipids, protein and starch, however, the starch bodies disappeared from the seed just proir to their maturation. Rubel _et al_. (1972) showed that during development, soybean seeds contain 5 % oil at 25 days after flowering, and the percentage of oil content increased slightly to 20 % at 40 days after flowering and remained constant during the rest of seed development. Privett _et al_. (1973) studied the lipid composition of developing soybean and showed that the percentage of fatty acids increased to its highest concentration during early developmental stages, and then gradually decreased.

Joshi _et al_.(1972) stated that the content of saturated fatty acids and that of both linoleic and linolenic acids as well as their correlation in soybean oil varied according to different varieties. Similar observations were reported by Moulton _et al_.(1972) and Robertson _et al_.(1972). Chinnadurai _et al_.(1973) indicated that the oil content of soybean seed ranged from 14.76 to 28.06 %. Kurink and Jaky (1975) followed the changes of oil content and fatty acids in soybean and found that there were marked increases between 16 and 20 % in oil content in 16 cultivars of soybean.

Lal _et al_. (1973) investigated the protein and oil content of soybean in different cultivars and found that protein content was 41.03 % and oil content of soybean was 21.33 - 26.98%. They showed that protein and oil contents were negatively correlated.

Filet and Williamson (1974) showed that the oil content of 25 soybean cultivars ranged from 20.25 to 21 % and the seed protein ranged from 36.83 to 40.57%. Rinne _et al_. (1975) determined the protein and oil content in 45 samples