Effect of Major Nutrients and Water Levels on the Biochemical Constituents of Guar Plant (*Cyamoposis tetragonoloba*)

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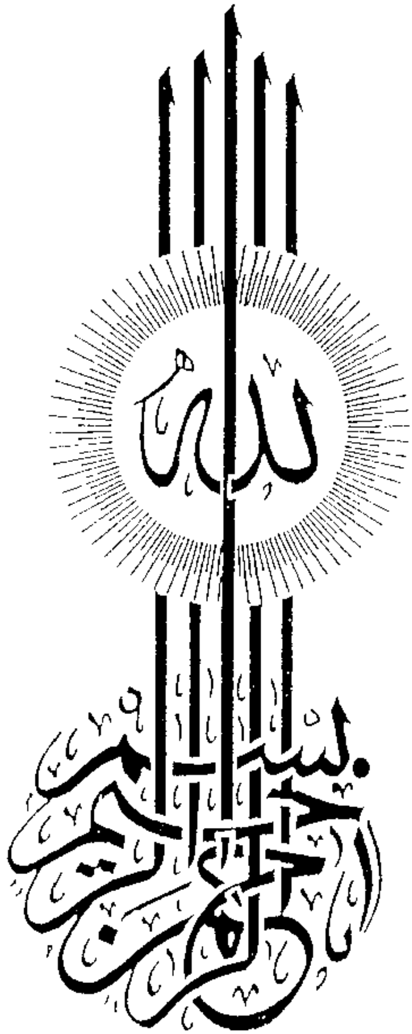
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C O N T E N T S

1. INTRODUCTION

Guar plants produce mucilage which is one of the outstanding representatives of the new generation of plant mucilages.

Its source is an annual pod-bearing drought-resistant plant, called guar, or cluster bean (Cyamoposis tetragonoloba) belonging to the family Leguminosae. It has been grown for several thousands of years in India and Pakistan as a vegetable and forage crop. It is interesting to know that some guar seeds have been found recently in excavated Pharaoh Zoser's tomb in Sakkarah.

The plant had been used by the Ancient Egyptians for embaling the dead and for glueing together strips of clothing for binding mummies.

Besides the uses of guar plant as a cattle food and green manure, guar seeds are considered as an important source of guar mucilage which has several industrial and pharmaceutical uses.

Now, guar mucilage is a big business in the United States and Europe.

The success of this plant as an important source of mucilage and the increasing demand have naturally attracted the attention to cultivate the plant in Egypt.

Guar is grown successfully in Sinia and the environmental conditions prevailing in Egypt are most suitable for its cultivation.

The present work is concerned with a phytochemical investigation of the growth and mucilage production of the seeds. It will be of great interest to study the effect of some fertilizers and irrigation treatments upon the growth and other important constituents of guar plant.

2. REVIEW OF LITERATURE

Ahmed *et al.* (1956), Haksar and Kendurkar (1959) reported that guar plant is an annual legume which for generation, has been grown to be used as food and cattle feed. They also reported that the plant is used in the United States as green manure. The same authors added that some of the major markets for guar gum are set with in paper industry, explosive industry, textile industry, petroleum drilling, mining industry and cosmotic industry.

Haksar and Kendurkar (1959) stated that the endosperm of the seed contains a mannogalactan with a small amount of protein, fibre and contains fats and sugars. The mannogalactan portion of seeds is used in obtaining gum which possesses enormous swelling property in contact with water, on account of which it has found many useful applications in industry.

Synthelabo (1969) found that guar gums are used with other compounds for treating gastrointestinal disorders.

Stewart (1921) has founnd in cacti a transformation in many cell contents in the growing regions into mucilage, which by absorbing water may stimulate true growth and may be of importance in conserving and regulating the supply of water for the growing cells.

Little work has been reported on the effect of irrigation on the yield of guar plant, but with the help of other researches conducted on different leguminous crops, such as peas, beans and soyabean, a clear trend could be obtained.

Widtsoe and Stewart (1920) showed a relation between the amount of irrigation water and protein content in bean plant. It is generally agreed that excess moisture tends to lower protein content.

Ayres et al. (1934) mentioned that the growth of bean plants was inhibited as the soil moisture tension at the time of irrigation increased.

Whitt (1945) reported that in unirrigated plots both seed weight and yield were reduced about one third as compared to irrigated soyabean.

Ahmed et al. (1956) reported that the guar plant was found to be in need of frequent irrigation only during the early stages of growth particularly under hot weather conditions. It was found that 3 to 4 irrigations were sufficient under these conditions and that the number of irrigations could be reduced under colder weather conditions. In general, the plant was found to resist drought to a considerable extent.

Hanway (1957) stated that the highest yield of soyabean was obtained by keeping the top 4.6 feet of soil wet at sowing and maintaining a high moisture level throughout the season. He also found that six irrigations without adding nitrogen fertilizers increased soyabean yield.

Gabelman and Williams (1960) stated that the most critical water stress for snapbeans was during blossoming and immediately following the time of this stage, although drought periods at earlier stages of growth obviously would reduce vegetative growth and yield. They also reported that although irrigation increased the percentage of blossoms which developed into pods, but it did not always insure a heavy crop of beans.

Howe and Rhoades (1951) found that under higher rainfall conditions an early irrigation was important, and a second irrigation applied at early pod filling time, was needed for high bean yield.

Salter (1962) reported that irrigation of peas at blossom time increased the number of marketable pods and the number of seeds per pod, whereas irrigation a few days prior to harvest increased the weight of both pods and seeds in the same year.

Miller and Beard (1967) found that soyabean yield increased by increasing the irrigation. The protein content increased also with irrigation.

Mulalic (1968) found that lack of available water during flowering and seed setting caused considerable decrease in soyabean yield.

El-Gibali et al. (1968) found that the higher yield of field beans resulted from six irrigations at intervals of 20 days. They also found that protein percentage was not affected by irrigation numbers.

El-Motaz Belah et al. (1970) found that in snapbeans, cowpeas, and peas, the plant height, number of branches and number of pods/plant were significantly increased with raising the water quantity in a successive way.

El-Nadi (1970) found that the decrease in the number of irrigations to Vicia faba decreased the number of pods per plant and the dry seeds.

On the other hand, Fageria and Bajpai (1970) found that increasing the irrigation numbers decreased the yield of seeds in peas.

Little work has been reported concerning the effect of fertilization on the growth and yield of guar plant.

Generally, plants belonging to Leguminosae family are known to be heavy feeders with demands upon phosphorus due to their production of ample protein containing materials of which the element is an important constituent. Phosphorus is reported to be essential for cell division and the most obvious effect is usually on the root system. Phosphorus is also essential for seed formation and its effect on the maturity of crops is pronounced.

Parr and Sen (1948) proved that phosphorus fertilizers improved the yield of legume crops in soils low in phosphorus.

Cook and Millar (1949) found that beans did not exhibit definite symptoms of phosphorus deficiency except that growth may be slow. The result was stunting of the plant and depression in yield.

Vayes and Desai (1953) reported that the beneficial effect of phosphate application on the peas plant growth was visible even after three weeks from seed sowing and effectiveness increased with the age of the plant. They also showed that the different doses of phosphates increased the yield of pea crop.

Howell (1954) studied the effect of different levels of phosphorus in the nutrient solution on the chemical characteristics of soyabean found that increases in the phosphorus level in the root media resulted in greater yields of all varieties used.

Ahmed et al. (1956) reported that the guar plant did not need any manuring for normal healthy growth. However, the use of 100 kg of superphosphate fertilizer proved to be profitable and increased the vegetative yield.

Panos (1959) reported that the application of phosphorus for legumes gave significant increase in the yield of broad beans which amounted to about 80% over the untreated plants.

Calzada and Chantez (1962) concluded that the highest average yield of dry beans was given by addition of nitrogen, phosphorus, and potassium fertilizers applied 10 cm. from the seed sowing, plus a top nitrogen dressing as ammonium sulphate applied to the base of the plants as a moulding up operation (hilling).

Fletcher and Kortz (1964) stated that high levels of superphosphate fertilizer caused toxic symptoms to soyabean plants.

Rewari et al. (1965) reported that there was a persistent increase of nitrogen in the soil as a result of growth of guar. The highest amounts of nitrogen, as well as phosphorus, were found in plants treated with superphosphate. A highly significant positive correlation was found between the amount of phosphorus contained in the plants and the amount of nitrogen fixed by them. The rate of increase of nitrogen fixation with phosphorus uptake was higher in poor soil than in rich one.

El-Sherif (1964) and Shekawat et al. (1966) found that the highest grain yield of bean and pea resulted from applying a high level of calcium superphosphate.

Mitrovic and Jelenic (1968) reported that increasing the application of phosphate fertilizer increased seed weight and the number of seeds per plant in soyabean.

Coastoache and Nica (1968) mentioned that phosphorus fertilizers increased the accumulation of protein and oil in soyabean to a certain degree, depending on the weather.

Oke (1969) reported that the application of sulfur, alone or in a combined form with phosphorus increased yield of guar and nitrogen content of root nodules of pigeon pea and guar. Sulfur applied at different levels in N-P-K increased the methionine content and yield of plants but had no effect on nitrogen content. Sulfur at 20 ppm. alone or combined with phosphorus increased the methionine content but the effect decreased at higher levels of sulfur. Higher methionine values were generally obtained in the presence of sulfur than when it was absent.

Anthony (1969) found that soyabean responded more to phosphorus fertilizer than to potassium. The yield increased with increasing rates of phosphorus and potassium fertilizers.

Bezljudnyj (1969) found that peas provided with phosphorus showed a high protein content with greater concentration of phosphorus nucleoprotein than phosphorus deficient plants.

Fageria and Bajapai (1973) concluded that phosphorus fertilizer application decreased the seed yield from peas. Plants receiving no superphosphate yielded higher amounts of seeds than those supplied with this fertilizer.

Abdou et al. (1971) concluded that the minute amount of phosphorus absorbed by barley seeds soaked in 0.25 M KH_2PO_4 and 0.25% superphosphate suspension stimulates the development of the root system which results in deeper rooting and increasing the absorbing surface of the roots and the points of contact with the soil and phosphorus fertilizer.