EFFICIENCY OF PHOSPHATE AND MANGANESE UTILIZATION IN RELATION TO THE YIELD OF SNAP BEANS

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INTRODUCTION

Unquestionably, the great attention given to the crop of snap bean is possibly due to the outstanding increase in awareness to human nutrition. Climatic conditions play a vital role in encouraging farmers to grow this crop almost around the whole year.

Realizing these facts, investigations have been focused on the study of various growth factors and practices required for development and improvement of snap bean production particularly in the developed countries such as Egypt.

Since snap beans is considered one of the short-season crops, fertilization plan should be expected to be of great importance. As this crop is one of the legumes, phosphate nutrition along with requirements to microelements should be basic in any design for fertilizer application. The problems of microelements could be, in fact, imposing their importance under our present conditions created by the building up of the High dam which might result in an unbalance in all nutritional elements particularly those of minor elements. Therefore, the current investigation was conducted in order to find out the possibility of improving the production of snap bean crop by means of application of phosphatic fertilizers along with manganese which represents of the most needed microelement for such crop. Efficiency of plants to utilize both phosphorus and manganese under various nutritional conditions were also investigated.

REVIEW OF LITERATURE

For clarity, the literature will be reviewed in the following sections:

I- Growth of bean plants.

II- Chemical contents of bean plants.

III- Yield of bean plants.

Each section was further subdevided into the following subheadings:

A- Effect of nitrogen, potassium and phosphorus fertilization.

B- Effect of inoculation by root nodule bacteria.

C- Effect of manganese application.

I- Growth Studies

(A) Effect of nitrogenous, phosphatic, and potassic fertilizers on the growth of snap bean plants.

Bean plants, being a vegetable crop that requires a short period of time for its complete growth, needs relatively abundant amounts of the different nutrients.

The major elements that have been recognised to be important for the growth of bean plants are nitrogen, phosphorus and potassium. Since 1940, tremendous data have been conducted to study the effect of various chemical fertilizers on the growth of this crop along with other legumes.

a) Nitrogen:

Kenneth (1940) studied the effects of nutrient deficiencies and excess upon the vegetative growth and flowering of peas. He reported that greatest stem length was produced when an intermediate amount of nitrogenous materials was present in the nutrient solution during the major portion of the early growing period. He added that branching of peas was less where nitrogen was lacking, and that the most vigorous growth occurred where nitrogen was intermediate in concentration.

Kenneth (1943) pointed out that high levels of nitrate ranging from 75 to 100 parts per million in the soil solution during the vegetative growth stage resulted in an increase in the stem length of peas. In field experiments with peas there was a clear response to combined nitrogen, as noticed by Mulder (1948).

Marth et al. (1953) indicated that ammonium fertilizer induced the plant to develop shorter internodes, thicker stems and darker green leaves beside a delayed maturity.

In a study on the effect of nutrient deficiencies on growth and fruiting characteristics of peanuts, Reid and York (1958) found that pod formation was reduced by nitrogen, calcium and sulfur deficiencies. He added that pod formation was prevented by deficiencies of nitrogen, calcium and boron.

Hollis (1959) demonstrated that growth was directly related to the total amounts of nitrogen present in the root zone throughout the season. If the available nitrogen was limited just before harvest, growth was maintained by an accelerated redistribution of nitrogen from other plant parts, and this resulted in faster maturation. He added, however, that the vegetative growth increased as the nitrogen content of a mixed fertilizer was increased.

Meyer and Anderson (1959), working on temperature and symbiotic nitrogen fixation, reported that the uninoculated plants normally responded to nitrogen treatment at both tested temperatures.

In an investigation on dwarf beans, Riempa et al. (1960) demonstrated that increasing the rate of nitrogen application delayed ripening and drying.

In a study on the number of pods per plant, Klacan (1962) found that very low nitrogen concentrations encouraged plants to produce fewer pods and fewer peas per pod than plants supplied with adequate nitrogen. Reducing the nitrogen supply at any stage before pod swelling greatly reduced seed development; vegetative growth was lower when the nitrogen supply was reduced at the swelled pod stage than when plants received a continuously high supply of nitrogen.

Under local conditions of Egypt, Badawi (1965) showed that adding ammonium sulphate to soyabean plants tended to increase the height of plant. He added that nitrogenous fertilizers enhanced the production of different parts of soyabean plants. The dry matter content of the whole plant and its different parts became great by addition of ammonium sulphate up to the highest level, i.e., 250 Kg. per feddan. Moreover, ammonium sulphate tended to increase the dry matter content of roots.

No statistical significant effect was obtained, however, by Behairy (1965) for the calcium nitrate on the height of peas plants although it tended to be increased very slightly. She noted that applying calcium nitrate enlarged the number and the dry matter content of the different parts of pea plants.

Cartwright ([illegible]) showed that growth of the roots was not affected by the level of combined nitrogen. Nitrate in the mineral salt solution markedly reduced nodule numbers. This was confirmed by Stephens (1968) who reported that bean roots were weakly nodulated.

Ellis (1969) noticed that high rates of nitrogen fertilizer resulted in greener foliage and, to a lesser extent, greater vigour.

b) Phosphorus:

Regarding the phosphatic fertilizer, Reid and York (1958) reported that dry weight and flower production of peanuts, were reduced by phosphorus deficiency.

Robert (1959) pointed out that an increase in the phosphorus level in nutrient solution from 2 to 10 ppm., resulted in taller and heavier plants in Soyabeans. A little or no effect was found, however, for the phosphorus level on the number of days needed for blooming.

Results were confirmed by Lunin and Gallatin (1966) who showed a growth response for snap beans only where phosphorus was added. On the growth of root nodules Mickovski and Mickovska (1966) observed that humus and soluble phosphorus in the soil had a favourable influence on nodulation.

Osawa and Lorenz (1968) found that low phosphorus levels produced small plants with dull green leaves.

In field trials carried out by Muravin and Sumilin (1969), combined applications of phosphate and molybdinum produced increases in green matter of peas.

c) Potassium:

Regarding the potassic fertilizers, Ozbum et al. (1965) stated that fully developed, mature leaves were much less sensitive to potassium deficiency than were growing leaves. Although incipient potassium deficiency accelerated the respiratory rate of mature leaves both in darkness and in light, only under severe potassium deficiency was photosynthesis decreased. This depression was associated with chlorophyll degradation as well as with potassium loss from the tissues.

Shea et al. (1968) reported that a high capacity for growing at low levels was not related to greater seed size or to greater size and competitive ability of the root system.

d) Combined nitrogen, phosphorus and potassium:

Several investigations were reported in the literature dealing with the effects of combinations of various fertilizers on the growth of bean plants. Delver (1953) grew dwarf beans in pots filled with poor sand and peat mixtures. He showed that this crop was in need for much nitrogen and phosphorus but comparatively little potassium. Nitrogen and phosphorus were found to promote fruiting. Plants grown without nitrogen supply showed a lower rate of fruiting than plants supplied with small amounts of nitrogen; higher quantities of nitrogen increased the rate of fruiting. Phosphorus increased flower formation and consequently a larger number of pods were produced.

A foliar fertilization was applied by Cervato (1958) for bean plants. Nitrogen and potassium were present in different ratios. Only the ratios of 2:1 $N:K_{20}$ were found to increase the dry weight of plant.

Similar results were obtained by [illegible] and Sawyer (1959). They declared that Fordhook Lima beans responded to 200 pounds per acre of phosphate with a phosphorus reading averaging 30 pounds per acre. He added that in one year out of two, this response occurred in the presence of high potash resulting from application of 100 pounds per acre of K_2O. No benefit was obtained from 100 pounds of nitrogen as compared to a 50 pound application.

Seed size in the bean variety Soluggia was increased by nitrogen application particularly when applied in the basal fertilizer mixture containing 70 lb.N, 50 lb. P_2O_5, and no potassium per acre. Mitchell (1964). Fontes et al. (1965) pointed out that French bean responded to phosphorus application. He added that nitrogen and potassium had no effect. Lime, at 2 localities, evoked a response in which both it and phosphate had some residual effects.

Generally a high level of soil fertility produced more pods per acre for Field beans owing to better plant survival and increased branching and podding, Soper (1952).

Under conditions favouring the vegetative growth there appeared to be some competition between stem production and pod production.