

EFFECTS OF SEED COATING WITH SODIUM HUMATE AND BIOFERTILIZATION ON GROWTH AND YIELD OF BEAN AND WHEAT

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ABSTRACT

Plants grown from seed coated with sodium humate and inoculated by certain biofertilizers bacteria, were investigated under greenhouse conditions. The nodulation status, nitrogen uptake and yield component of bean *Phaseolus vulgaris*, inoculated by specific rhizobia increased by application with sodium humate. The application of sodium humate alone without rhizobial inoculation had good growth stimulating effect. A fair increase in the yield and phosphorus uptake of wheat *Triticum aestivum* inoculated with *Azotobacter* and/or *Bacillus* spp. was also recorded with the addition of the humic material. The greatest effect was observed on the plants inoculated with *Azotobacter* and *Bacillus* spp. together.

Keywords: *Azotobacter*, *Phaseolus vulgaris*, *B. polymxa*, *B. megatherium*, biofertilization, humic acid, *Rhizobium tropici*, sodium humate, wheat.

INTRODUCTION

The decomposition of organic matter, wide in C/N ratio, in the soil and its beneficial effect on the N₂-fixation has been demonstrated and extensively studied (Abd-El-Malek, 1971, Heckman and Kluchinski, 1995; Janzen, and McGill, 1995 and Janzen *et al.*, 1995).

The magnitude of microbial activity, including N₂-fixation, in the rhizosphere depends not only on the plant and root microorganisms but also on the climatic and edifice conditions (Heckman and Kluchinski, 1995).

The studies on the role of specific humus in the growth and development of plants have received considerable studied. It has been reported that these substances extracted from soil, organic mature, peat, and even coal, exert favorable influence on the growth, nutrient uptake and health of plants (Burroni *et al.*, 1994; Adani *et al.*, 1995; Lulakis and Petsas, 1995; Valdighi *et al.*, 1995). Although there is no agreement as yet with regard to the mechanisms of action of humus substances on plants. The growth promoting effects are usually attributed to their being biologically active components of organic matter which play multisided role in the physiology of plants (Fernandeaz, 1968 and Adani, *et al.* 1995).

The present investigation was designed to study the communication deals with the influence of sodium humate on the growth and nutrient uptake of bean (*Phaseolus vulgaris*) and wheat (*Triticum aestivum*) inoculated with specific *Rhizobium*, *Azotobacter chroococcum* or mixed culture of phosphate solubilizing bacteria.

MATERIALS AND METHODS

Bacterial strains:

Rhizobium tropici UMR 1899 kindly obtained from the culture collection of Rhizobium Research Laboratory, Department of Soil Science, Univ. of Minnesota, USA. The media used and preparation of standard inoculant according to (Vincent, 1970). Modified Ashby's medium (Abd El-Malek and Ishac 1968) were used to preparation *Azotobacter chroococcum*. The strains of phosphate solubilizing bacteria which included *Bacillus megatherium* var. *phosphaticum*, *Bacillus circula* and *Bacillus polymxa* were kindly supplied by Unit of Biofertilizer, Faculty of Agriculture, Ain Shams University.

Humic acid extraction:

Humic acid was extracted from well decomposed farmyard manure by the method described by (Bhardwaj and Gaur, 1968). The purified humic acid gel was converted into sodium humate by neutralizing it with NaOH, dialyzed in cellophane bags and air dried.

Pot experiments:

Sandy loam soil was collected from a cultivated field and passed through 2-mm sieve. It was analyzed for carbon (0.35%), nitrogen (0.05%), available phosphorus (0.001%), humic acid (0.04%) and its pH (7.8) was determined. Pots 35 cm in diameter received 10 kg sandy loam soil were used. The soil used received the basal dressing of superphosphate at the rate of 90 kg P₂O₅ per hectare and rock phosphate at the rate of 70 kg per hectare, respectively.

RESULTS

The data presented in Table (1) show that the effectiveness of bacterial inoculants was appreciably increased in the presence of sodium humate. The modulation status and total nitrogen content were enhanced with the application of sodium humate.

Table 1: Effects of inoculation by *Rhizobium tropici* with sodium humate on nodulation and nitrogen fixation in bean plants .

Treatment	No. Of Nodules	D. Wt. of Nodules mg/plant	D. Wt. of Shoots g/plant	Total N content mg/plant
Control	5	15.8	1.2	28.9
Na-humane	7	21.4	2.4	30.0
Na-humane +N ₂ Fertilizer	3	10.6	2.8	72.3
<i>Rhizobium</i> inoculate	17	54.6	2.7	69.4
<i>Rhizobium</i> + Na-humate	25	85.3	2.9	72.5

D.Wt = Dry weight

Even when the humic acid material was applied to the soil (0.30% w/w) without seed bacterization there was a good increase in the dry matter yield and nitrogen uptake of the crop. Maximum effect of the sodium humate application was observed on the plants inoculated with *Rhizobium*. There was recorded the highest values in the all parameters tested.

The results summarize in Table (2) also indicated that the inoculation of wheat with *Azotobacter* and *Bacillus spp.* alone or in combination is fairly influenced by the sodium humate application.

Table 2: Effects of inoculation by *Azotobacter* and *Bacillus spp.* with sodium humate application growth of wheat plants.

Treatment	Straw Dry wt. g/plant	Grain Dry wt. G/plant	P ₂ O ₅ in Straw (%)	P ₂ O ₅ in Grain (%)	N in Straw (%)	N in Grain (%)
Control	5.1	2.3	0.046	0.413	1.52	2.13
Na-humate	5.6	2.7	0.052	0.451	1.89	2.19
<i>Azotobacter</i> inoculation	5.5	2.6	0.046	0.439	2.16	2.43
<i>Azotobacter</i> + Na-humate	5.7	2.9	0.056	0.487	2.18	2.51
<i>Bacillus spp.</i> inoculation	5.6	2.8	0.073	0.539	1.92	2.31
<i>Bacillus spp.</i> +Na-humate	5.8	3.0	0.071	0.569	2.11	2.35
<i>Bacillus spp.</i> + <i>Azotobacter</i>	5.6	2.9	0.091	0.586	2.23	2.86
<i>Bacillus spp.</i> + <i>Azotobacter</i> +Na-humate	6.3	3.2	0.082	0.594	2.31	2.97

The greatest effect was observed in the inoculation of the crop with *Azotobacter* + *Bacillus spp.* plus Na-humate. There was 23.5 % and 39.1 % increase in the straw and grain dry weight. The same trend was also observed in case N₂ Fixed and P₂O₅ uptake than control.

DISCUSSION

Pot experiment carried out to study the effect of sodium humate on bean and wheat plants in association with bacterial inoculates, indicated that specific humus substances are among the stimulants of plant and microbial growth in the soil. The stimulation of growth and activities of native and introduced microflora of the rhizosphere of crop plants is of great importance from the agronomic point of view (Heckman and Kluchinski, 1995). The attention needs to be particularly focused on certain bacteria used as soil or seed inoculants for reaping the benefits of higher crop yields. It is interesting to note that the effectiveness of *Rhizobium* as legume inoculant was appreciably increased with the application of sodium humate (Table 1). The efficiency of rhizobial inoculations has found universal acceptance. As against this, the reports of higher yields obtained as a result of the inoculation of crops with *Azotobacter* and other useful bacteria are controversial. However, it has been indicated that a fair level of humus, calcium and phosphorus in soil makes *Azotobacter* inoculations effective (Janzen and McGill 1995 and Janzen *et al.*, 1995). Similar is the case with *Bacillus spp.* used as bacterial inoculants. It is encouraging to note that the favorable

effects of *Azotobacter* and phosphorus solubilizing bacteria, were much increased by the addition of sodium humate to the seeds (Table 2).

In this experiment, *Rhizobium* inoculation was compared with the application of inorganic nitrogen under the influence of sodium humate. The effectiveness of sodium humate plus nitrogen was more effective than that due to *Rhizobium* inoculation. This evidently shows that sodium humate enhanced the efficiency of nitrogen utilization by the plants.

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تأثير إضافة هيومات الصوديوم على نمو النباتات المسمدة تسميدا حيويا
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تم زراعة تجربة أصص في الصوبه لدراسة تأثير إضافة هيومات الصوديوم عن طريق تغليف البذور بها على نمو نباتات الفاصوليا الملقحة بالرايزوبيا المتخصصة لها وكذلك نباتات القمح الملقحة بكتريا الازوتوباكتر المثبتة للزوت الجوى وكتريا الياسيلس المذيبة للفوسفات . وأوضحت النتائج أن تغليف البذور بمادة هيومات الصوديوم أدى إلى زيادة كبيرة في كفاءة عملية تثبيت ازوت الهواء الجوى بواسطة الرايزوبيا في نباتات الفاصوليا . وأيضاً زيادة كبيرة في كمية كل من النيتروجين والفوسفور الممتص بواسطة نباتات القمح، وجد أيضاً إن إضافة مادة هيومات الصوديوم بدون تلقيح بكتيرى أدى إلى زيادة في كمية المحصول الناتج .