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The role of potassium humate in the formation of symbiotic apparatus of cow peas and nitratreduktase activity in clay-sandy soils

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Abstract

Influence of potassium humate on symbiosis between cow pea (*Vigna unguiculata* (L) Walp) plant and *Rhizobium leguminosarium* bacterium and activity of nitratreductase in plant organs in clay-sandy soils of the Turkan settlement of Absheron peninsula of Azerbaijan is learned. It is concluded that in saline clay-sandy soils the growth of cow pea can be improved by positively influencingthe formation of effective symbiosis between potassium humate and *Rhizobium leguminosarium* bacterium and activity of nitratreductase enzyme.

Keywords: Clay –sandy soils, Cow pea, Symbiosis, Nitratereductase, Potassium humate.

Introduction

The global climate change and the risks associated in future development of human civilization worried UNO and the world's leading nations [1]. One of the important facts accompanying global warming is the change precipitation rates and distribution patterns by surface area and time [2]. According to some estimates, soil moisture in many regions of the world will be reduced in 2070-2100, compared to the 1960-1990 years. (in light of the differences in precipitation rates between different regions) This increases the frequency and intensity of stressors such as aridity. The combined effect of high temperatures with this inconvenient factors may stimulate another severe stress, such as salinity in areas with unstable climates, including moderate environments [3].

Most of soils which suitable for cultivation have become salted and this process is continuing. These areas include the "Mil-Mughan", the "Kur-Araz" lowland and the Caspian Sea. The total lanf fund of our Republic is 8 million 641 thousands and 500 hectares. About 4,5 million hectares are suitable for agriculture. And most part of these areas are mowing, winter and pasture areas. 600 thousand hectares of arable land have been occupied by Armenians. Currently, only 30 % or 1 million 583 thousand hectares of our total land fund is used [4]. This fact actualize the cultivation of food crops in saline clay-sandy soils.

The efficiency of nitrogen fixation of the symbiotic association of the root overly is determined by the presence of complex symptoms in the root nodule bacteria. The completeness of these symptoms depends on the environmental impact as well as on the salt stress. Effective symbiosis between plants and microorganisms can play a positive role in the enzymatic activity and productivity of leguminous plants in saline soils. Although much research has been devoted to this area, there is very little information about the role of potassium humate in these processes [5,6,7]. That's why the article explores the role of potassium humate in the formation of a symbiotic system between cow pea and *Rhizobium leguminosarum* in saline clay-sandy soils.

Materials and Methods

The sort of cow peas is used (*Vigna unguiculata (L) Walp*) "Ayla". The seeds of the plant were inoculated with the Rhizobium leguminosarum (ştamm 163) bacteria. After the seeds were germinated at 22^0 C in a thermostat, they were planted in 9 kilos of vegetation containers filled with soil. The surface area of the plant was prepared with 0.002% potassium humat solution. Activity of the enzyme nitratreductase was determined with *in vivo* with a optical density of 548 nm on a spectrophotometer [8].

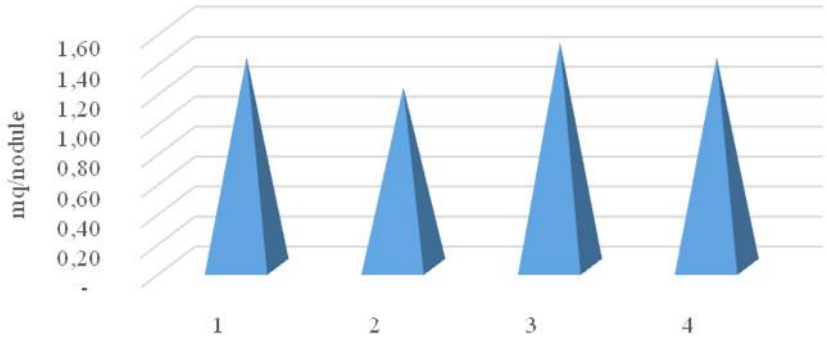
The soil samples required for the experiments were taken from the 1200-m area of the Caspian Sea in the Turkan settlement of Absher on and some agrochemical indicators were identified. So, pH of soil is 8,3, mixed salinity is observed but it's high carbonated- 29,41% , total humus content is 1.65% and total nitrogen is 0.128%. Soil salinity in the control variants is 0.23%, total humus is 1,91%, and total nitrogen is 0.211%.

Results and Discussion

Changes in the environmental situation surrounding us show this fact that we are developing and effectively using environmentally friendly and safe drugs in various areas of our activities. One of these drugs is potassium humat. Potassium humat is a natural stimulant which has high effection. It was assimilated easily by the root and surface organs of plant. Except it there is a molybdenum (2mg/l) here, which combines nitrogenesis and nitratreductase of higher plants in itself. Being an environmentally friendly product it increases the resistance of plants to stress factors (salt, water, temperature) [9,10,11]. Having such qualities potassium humat can regulate hormonal induction of nitratreductase and nitrogenesis.

Because of this qualities, in different stressful environments, especially in saline soil, it is of interest to study the role of potassium humat in the formation of symbiosis between leguminous plants and rhizobium bacterias. The results show that in saline soils the number and weight of nodules is reduced. Under normal conditions, the weight of a root of carrots is 1,4± 0,6 mg, while the salinity of the nodules in the carbonate salts decreases by 1,2± 0,09mg. The splashing of surface of plants by potassium humat which grow in salty environment equalizes the weight of nodules to the nodules which are grown in a normal environment (Pic. 1).

Picture. 1. Effect of potassium humate on the weight of nodules in cow peas on clay-sandy soils



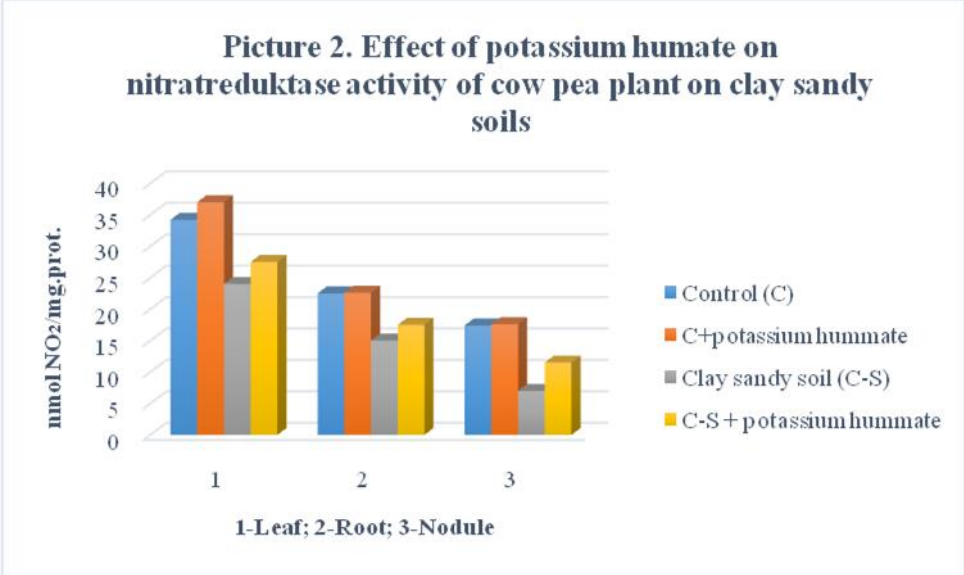
1-Control (C); 2-Clay-sandy soil (C-S); 3-C+Potassium humat; 4-C-S+Potassium humat

The analysis of the weight and number of the nodules shows that, in the sample version in the one plant the number of the nodules are 37± 2,01 and the total weight is 55,5 ± 3,35 mg. In saline soils, the total weight of the root is reduced by 21% and amount of the root is reduced by 61%. Although potassium humate's treatment with control plants does not change the average weight of nodules, it increases their total numbers by 49 units and this causes the increase of 32.4% of the total weight of nodules in a per plant, compared to the sample. It also eliminates the adverse effect of potassium humat salt on the formation of tuberculosis. Thus, the addition of potassium humate to the saline environment increases the number of nodules from 12 to 32, and the weight from 14.4 to 44.8 mg. (Table 1).

Table 1. Influence of potassium humate on the number and weight of nodules of cow peas in saline clay-sandy soil

Options	Control	Clay sandy soil	Control + potassium humate	Clay sandy soil + potassium humate
Number (piecemeal)	37± 2,01	12±0,92	49± 2,76	32±1,86
Weight (mg)	55,5 ± 3,35	14,4±0,98	73,5±4,29	44,8± 2,17

Determination of NR activity in organs of cow peas showed that enzyme activity changes both in normal and in saline soils. This is probably due to the formation of nodules in the plant and the activity of the nitrogenase enzyme. (Pic.2)



Apparently, salinity reduces nitratreductase activity mostly in nodules- 40%, later in roots. Leaves are less susceptible to the toxic effects of salts. The activity of the enzyme nitratreductase is almost invariant in the roots and roots of ordinary plants grown with potassium humat solution, but the activity of the enzyme is increased slightly. Potassium humat increases the activity of the enzyme in the organs of plants grown on saline soils. It shows itself more in the nodules- 64%.

The higher activity of the enzyme in the nodule is probably due to the active synthesis of the nitrogenase enzyme in the formed symbiotic apparatus. This causes the flow of molybdenum to the nodules. Molybdenum is one of the active centers of nitratereductase and its presence eliminates the toxic effects of salts on enzyme activity.

It can be concluded that in the saline clay-sandy soils the development of cow peas can be improved by positively influencing on the formation of effective symbiosis between the potassium humate and the *Rhizobium leguminosarum* bacterium and the activity of the enzyme nitratreductase.

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