



Short Note

## Effect of Potassium Humate on Seed Germination, Seedling Growth and Chlorophyll Contents of *Glycine max* (L.) Merrill and *Phaseolus mungo* L.

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A laboratory experiment was conducted to study the effect of potassium humate on seed germination and seedling growth (root length and shoot length) of *Glycine max* (L.) Merrill (Soybean) and *Phaseolus mungo* L. (Black gram). The seeds of *Glycine max* and *Phaseolus mungo* were treated with potassium humate at ten different concentrations (from 0.1 to 1.0%) and water as control. The seeds were then sown on moist blotter papers to record percent seed germination, root length and shoot length of *Glycine max* and *Phaseolus mungo*. The effect of potassium humate (1.0%) on chlorophyll content of *Glycine max* (L.) Merrill and *Phaseolus mungo* L. was visualized using systronic spectrophotometer (Type 106) method. At the end of tenth day, potassium humate treated seeds showed positive correlation between concentration of potassium humate and percent seed germination with root length and shoot length of *Glycine max* and *Phaseolus mungo* against water (control). The experiment revealed that, Potassium humate treated plants showed higher chlorophyll a and -b contents than control.

**Key words:** Humic acid, Potassium humate, Percent seed germination, Seedling growth and Chlorophyll contents

Soil organic matter includes the remains of all plants and animals bodies that fell on earth surface. The final residue obtained from microbial decomposition of organic matter is called as humus and process of formation of humus is called as humification. Humic substances are component of humus and are widely distributed over earth surface. Humic substances can be classified into three general categories like humic acid, fulvic acid and humin (Solange and Rezende, 2008). Potassium humate is the salt of humic acid and dark colored, water soluble but alkali insoluble.

In a review of published reports, it is found that the application of humic acid extracts to wheat and soybean crops increased water absorption, respiration and seed germination rate (Smidova (1962), Ishwaran and Chonkar (1971)). Applied humic acids to sand culture of soybean increases shoot length, root length and nodule dry weight in response to treatment up to 400 to 800 mg/kg soil (Tan and Tantiwiramannond 1983). Humic acid stimulate shoot growth of various plants when applied either as foliar spray or in nutrient solutions (Chen and Aviad, 1990).

The various functional groups of humic acid such as acidic (e.g. carboxylic acid and phenol), alkaline (e.g. amine, imines) or neutral groups (e.g. alcohol,

aldehyde, ketone, ether, ester and amide) stimulated enzymatic activities in several metabolic pathways (Jackson, 1993). Humic acids extracted from peat and Leonardite stimulated plant growth (Adani *et al.*, 1998). Effect of seed soaking with plant growth regulators (IAA, GA, humic acid) on wheat seedling growth under normal (4 ds / cm) and saline (15 ds / cm) conditions and results showed that seed soaking with growth regulators increased root length, shoot length, and fresh and dry weight of seedling (Irfan *et al.* 2005). Lignite humic acid showed stimulatory effects on growth and yield of turmeric in Afisol (Baskar, 2006).

Humic acid application (2.5 kg per plot) on yield component of wheat at four sowing times (St<sub>1</sub>, St<sub>2</sub>, St<sub>3</sub> and St<sub>4</sub>) on clay soil of central Anatolian field conditions in a randomized complete block design with four replications in 1999 and 2001 and results showed that treated plants showed more plant height, spike number, grain number and 100 grain weight as compared to untreated plants (Ulukan, 2008). Similar results were also reported by Bama *et al.* (2004) and Salman (2005).

Humate treatment enhanced overall metabolism of crop plants, thus chlorophyll contents were also increased. Increased contents of chlorophylls enhanced overall photosynthetic rate there by yield

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**Table 1. Effect of potassium humate on seed germination, root length and shoot length of *Glycine max* (L.) Merrill and *Phaseolus mungo* L.**

Potassium humate (%)	<i>Glycine max</i>			<i>Phaseolus mungo</i>		
	Seed Germination (%)	Root length (cm)	Shoot length (cm)	Seed Germination (%)	Root length (cm)	Shoot length (cm)
0.1	80.00	16.5	16.8	83.33	2.0	4.7
0.2	83.33	16.8	17.2	86.66	2.3	4.8
0.3	86.66	16.9	17.4	90.00	2.6	4.9
0.4	90.00	17.5	17.5	93.33	2.7	5.0
0.5	93.33	17.6	17.7	96.66	2.8	5.2
0.6	96.66	18.0	17.8	100.00	3.0	5.8
0.7	96.66	18.1	17.9	100.00	3.3	6.1
0.8	96.66	18.2	18.0	100.00	3.8	6.4
0.9	96.66	18.3	18.3	100.00	4.0	6.6
1.0	96.66	18.9	18.4	100.00	4.1	6.8
<b>Control</b>	73.33	13.8	14.9	76.66	2.0	3.8
<b>C.D. at 5%</b>	1.62	1.6	1.6	1.44	1.2	1.2

in general. (Sladky 1959 in Tomato, Kui Zeng 2002 in Wheat) In the present paper, an attempt was made to discuss the importance of potassium humate on seed germination and seedling growth (root length and shoot length) and chlorophyll contents (chlorophyll-a and chlorophyll-b) of *Glycine max* and *Phaseolus mungo*.

#### Materials and Methods

The effect of ten different concentrations of potassium humate (0.1 to 1.0% ) against control (tap water) in three replications for each crop were tested for seed germination and seedling growth (root length and shoot length) of *Glycine max* and *Phaseolus mango*. Seeds of *Glycine max* (L.) Merrill cv. Mahamendal and *Phaseolus mungo* (L.) cv. Local were collected from field during year 2007. Seeds of each crop (4kg) were stored in small gunny bags at  $27\pm 2^{\circ}\text{C}$  for six month in laboratory for the experiment. The seeds were tested on moist blotter methods following ISTA (1966) procedure. The observation recorded after ten days included percent seed germination (%), root length (cm) and shoot length (cm).

#### Potassium humate formulation (Stock solution)

The commercial product of potassium humate is black, crystalline and water soluble. The stock solution of potassium humate of various concentrations like 0.1%, 0.2%, 0.3%, 0.4%, 0.5%, 0.6%, 0.7%, 0.8%, 0.9%, and 1.0% were prepared by dissolving 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1.0 gm of potassium humate in 100 ml water. The effects of ten different concentrations (0.1 to 1.0 %) of potassium humate were tested on percent seed germination, root length and shoot length of crop plants as these concentrations gave better results.

#### Blotter Method

A laboratory experiment to screen the percent

seed germination for potassium humate was conducted in the Petri dishes of size 10 cm in diameter. The Petri dishes well sterilized by using 0.1 percent  $\text{HCl}$  solution. A thin layer of cotton was placed at the bottom of Petri dishes and it was covered with filter paper. In each Petri dish 10 seeds were sown and regularly watered with potassium humate solution. Final value was taken as mean (average) of three replicates for treatment and control. Seed germinated in tap water was served as control for comparison. The percent seed germination, root length and shoot length was recorded 10 days after sowing.

#### Chlorophyll content

In order to see the effect of potassium humate on content of chlorophylls, pot experiment was conducted. The amount of chlorophyll-a and chlorophyll-b in leaf extracts was determined by using systronic spectrophotometer (Type 106). Crop plants were raised in pots and irrigated as per requirements with 1.0% potassium humate and with water as control. Fresh leaves were collected from crops for determination of amount of chlorophylls on 45<sup>th</sup> day (*Glycine max*) and 32<sup>nd</sup> day (*Phaseolus mungo*).

For this study, 1 gm of fresh leaves of experimental crop plant was taken into a clean mortar. 25 ml of 80% acetone was added in mortar and leaves were ground into fine pulp. The acetone extract was filtered first through muslin cloth and then through Whatman filter paper No.1. The acetone filtrate was collected in volumetric flask and volume was made up to 100 ml by adding distilled water. The optical density of chlorophyll-a and chlorophyll-b was measured with the help of systronic spectrophotometer (Type106) set at 645 nm and 663 nm. The amount of chlorophyll pigments (chlorophyll-a and chlorophyll-b) in the extract was expressed in mg chlorophyll per gram of fresh leaves by using following formula.

$$\text{Chlorophyll-a} = [12.7 (D 663) - 2.59 (D645)] \times \frac{V}{1000 \times W}$$

$$\text{Chlorophyll-b} = [22.9 (D 645) - 4.68 (D663)] \times \frac{V}{1000 \times W}$$

Total chlorophyll = chlorophyll- a + chlorophyll-b

Where, D = Optical density of wavelength indicated

V = Final volume of the 80% acetone chlorophyll extract

W = Fresh weight of leaves in gram

## Results and Discussion

It is clear from the results presented in Table-1 that with the increase in concentrations of potassium humate from 0.1 to 1.0% there was concomitant increase in seeds germination over control in *Glycine max* and *Phaseolus mungo*. 0.1% potassium humate treated seed of *Glycine max* showed 80% seed germination and seeds treated with 1.0% showed 96.66% germination as against 73.33% in water (control).

**Table 2. Effect of potassium humate (1.0%) on chlorophyll contents of *Glycine max* (L.) Merrill and *Phaseolus mungo* L.**

chlorophyll pigments	<i>Glycine max</i> (after 45 days)		<i>Phaseolus mungo</i> (after 32 days)	
	Potassium humate (1.0%)	Control (Water)	Potassium humate (1.0%)	Control (Water)
Chlorophyll –a(mg/gm of fresh leaves )	1.62	1.32	2.32	2.21
Chlorophyll –b(mg/ gm of fresh leaves)	1.38	1.21	1.76	1.48
Total Chlorophylls (a+b) (mg/gm of fresh leaves)	3.00	2.53	4.08	3.69

and chlorophyll-b in treated plants than control (water) in *Glycine max* and *Phaseolus mungo*. Potassium humate treated plants of *Glycine max* showed chlorophyll-a 1.62 mg / gm (control 1.32 mg / gm), chlorophyll-b 1.38 mg / gm (control 1.21 mg / gm) and total chlorophylls 3.00 mg / gm (control 2.53 mg / gm).

Similar trends were observed in *Phaseolus mungo*. Potassium humate treated plants of *Phaseolus mungo* showed chlorophyll-a 2.32 mg / gm (control 2.21 mg / gm), chlorophyll-b 1.76 mg / gm (control 1.48 mg / gm) and total chlorophylls 4.08 mg / gm (control 3.69 mg / gm). Thus optimum concentration of potassium humate as regards to seed germination and seedling growth i.e. root length and shoot length was found to be 0.6%.

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*Glycine max* seeds treated with 1.0% potassium humate showed maximum root length (18.9 cm against 13.8 cm in water-control) and shoot length (18.4 cm against 14.9 cm in water-control).

Potassium humate (1.0%) treated seeds of *Phaseolus mungo* showed similar trends. Seeds treated with 1.0% potassium humate solution in *Phaseolus mungo* showed 100% seed germination as against 76.66% in water (control). Similar results were recorded as regards to the root and shoot lengths. Seeds treated with 1.0% potassium humate showed maximum root length (4.1 cm against 2.0 cm in water-control) and shoot length (6.8 cm against 3.8 cm in water-control).

The results presented in Table 2 revealed that there was an increase in amount of chlorophyll-a

and dry matter accumulation of soybean in saline alkaline soil. In B. Novak *et al.* *Humus Planta.* pp. 613-615.

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