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Effect of Humic Acid on Seed Germination of *Raphanus sativus* L.

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Abstract: In the present study, we have tested the effect of humic acid on seed germination of Radish (*Raphanus sativus*). Seeds were soaked in various concentrations (0.1%, 0.25%, 0.5%, 0.75% and 1%) of humic acid at different time periods (10, 60, 120, 180 and 240 minutes). After 7 days, the seeds were analysed for their germination capacity, root and shoot length. The study infers that humic acid with the concentration of 0.25% showed maximum seed germination (100%) and the optimum shoot and root length was recorded as 6.175cm and 11.46cm respectively after 60 minutes soaking.
Key words: Humic acid, *Raphanus sativus*, seed germination, plant growth studies.

Introduction

Raphanus sativus belong to the brassicaceae family and is distributed all over the world. They vary in their size (10-15cm), colour (ranging from white or red) and in cultivation duration. It grows best in sandy loams and full sun light with pH 6.5-7.0. It is rich in ascorbic acid, folic acid and potassium. The root of *R. sativus* has several polyphenolics like vanillic acid, phenyl pyruic, syringic acid, p-coumaric, o-coumaric and caffeic[1,2]. Wild radish seed has 48% of oil content and used as biofuel. Radish are rich in potassium, which helps in maintaining the blood pressure and have benefits in certain ailments like jaundice, piles, urinary disorder, weight loss, constipation, cancer, skin disorder and insect bites[3]. In this study, effect of humic acid on seed germination of radish was evaluated. Humic acid are the component of humus, consist of humic, fulvic and hymatomelonic acid[4], which are formed by organic decomposition of organic matter like lignites, peat, as well as from abiotic organic matter like soil and water ecosystem. Structure of humic acid complex found to be organic containing polyphenolic backbone with carbohydrate and peptide side chain. So, they have high molecular weight [5&6]. In general, humic acid supplies both macro and micro nutrients to growing plants, increases soil fertility and productivity, increases water holding capacity and enhance seed germination. Humic acid also reduces the other chemical fertilizer requirements, increases aeration of the soil, increases the protein and mineral contents of most crops[7]. Hence the objective of this present study is to gain information on humic acid and its effect on seed germination of *Raphanus sativus* L.

Materials and Methods

Radish seeds were purchased from local market and healthy seeds were selected for this study. The seeds (10 Nos) were soaked in sterile distilled water and treated with various concentration of humic acid (0.1%, 0.25%, 0.5%, 0.75% and 1.0%) for various time intervals (10 min, 60 min, 120 min, 180 min and 240 min). All the treated seeds were placed in sterile petridishes containing a thin layer of wet cotton and covered with wet filter paper. Seed germinated in distilled water was served as a control. The percentage of seed germination, root length and shoot length were recorded after 7 days of sowing and tabulated.

Results and Discussion

Table 1: Effect of Humic acid on seed germination (%)

Seed soaking time (minutes)	Humic acid concentration (%)	Seed germination (%)
10	0.1	90
	0.25	90
	0.5	80
	0.75	90
	1.0	90
60	0.1	100
	0.25	100
	0.5	90
	0.75	80
	1.0	90
120	0.1	70
	0.25	90
	0.5	90
	0.75	90
	1.0	90
180	0.1	90
	0.25	90
	0.5	90
	0.75	90
	1.0	90
240	0.1	90
	0.25	80
	0.5	80
	0.75	80
	1.0	80
Control	Soaked in Water	80

In the present study, effect of humic acid treated radish seeds showed significant results over untreated seeds and are presented. (Table- 1) shows the percentage of seed germination over control in different concentrations of humic acid. Among the treatments, maximum seed germination was observed in 0.1% and 0.25%. Similarly Patil *et al*[8] reported that the application of 1% of potassium humate with deproteinized leaf extract increased the seed germination of soybean and black gram up to 100%. Volenec *et al*[9] stated that deproteinized juice (DPJ) consists of many free aminoacids, vitamins, hormones, and the foliar application of deproteinized juice significantly increased the growth and yield of crop plants. Radish seeds after germination were observed for their growth in terms of shoot and root length between 24 and 168 hrs and the results obtained were showing significant improvements than control seeds (Table- 2 & 3). The maximum shoot length was recorded as 6.175cm at 168 hrs in 0.25% of humic acid. The same trend was observed in root length i.e. 11.4cm at 168 hrs in 0.25% of humic acid with 60 minutes treatment. Xue *et al*[10] observed better performance when humic acid was applied along with chemical fertilizer in maize, wheat, cotton, rapeseed and sesame production as compared to Di-ammonium phosphate and other fertilizers. Humic acid increases resistance of

the crop against drought, cold and diseases, resulting in overall improvement of crop yield and accumulation of availability to the plant nutrients. It induces and increases plant growth sustainably by releasing its nutrients slowly to the plants and microflora associated with it and expressed its effect on root enzymes and rhizosphere soil[11&12]. *Trichoderma viride* has effectively converted humic acid from Lignite and similar effect was obtained on *Sorghum* and *Stevia rebaudiana* and the same author also reported that 60% of potassium humate enhances the mushroom growth, 4% enhances *Morus alba* and 0.2% of humic acid enhancing the growth of *Spirulina plantensis*[13-17]. Kazuhiro Sugimoto[18] reported that wild radish seeds A were capable of tolerating NaCl at 25 °C, with tolerance of 10 mM $MgCl_2$ and 100 mM MgSO4, but was sensitive to NaCl and CaSO4. The growth response of the humic acid are due its hormonal effect and rich in macro and micro nutrients Atiyeh *et al*.[19]. Similar effect was found in this study and can be used effectively for seed treatment and high crop yield.

Conclusion

Thus the present study reveals the required concentration of 0.25% of potassium humate for seed germination and seedling growth with effective root length and shoots length. This can be used for both seed treatment and growth regulator.

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	Table 2: Average root length after treatment of different concentration of Humic acid Root length (mm)											Total root length (mm)	Average root length (mm)
Soaking Time (minutes)		1	2	3	4	5	6	7	8	9	10		
	Control	16.5	12.2	7.8	1.4	10.5	6.1	4.8	2.1	7	0	68.4	6.84
10	0.1	13.9	13.7	14.3	6.6	7.1	7.9	14	6.1	4	0	87.6	8.76
	0.25	9.8	5.4	6.1	4.2	2.1	2.4	2.1	3.4	9.5	0	45	4.5
	0.5	10	4.7	15.9	5.1	6.7	11.9	9.1	5	0	0	68.4	6.84
	0.75	12.4	8.6	11	0.5	1.8	11.6	6.7	15	9.6	0	77.2	7.72
	1	10.3	12.5	14.6	4.1	7.5	4.3	0.5	3.2	10.5	0	67.5	6.75
60	0.1	7.5	7	9.5	13	11	6	9	15	2.5	7	87.5	8.75
	0.25	11.3	14.8	16.5	12.8	13.3	8.1	12	13.2	2.3	10	114.55	11.46
	0.5	8.9	9	10.8	8.6	9.1	12	4.2	6	5	0	73.6	7.36
	0.75	2	9.2	5.3	4.2	7.4	9.4	1	4.1	4	0	46.6	4.66
	1	7.4	9.5	3.1	15.2	9.9	12.1	9	9.8	8.9	0	84.9	8.49
120	0.1	11.2	14.2	12.5	10	2	9.2	11	5	7	0	82.1	8.21
	0.25	11	10.5	11	7.5	6.7	6.2	11.6	9.7	2.9	0	77.1	7.71
	0.5	15	9	15	15.2	8.4	5.5	5.4	10.6	9.4	0	93.5	9.35
	0.75	14.5	14	7	4.2	6.5	10	8.5	2.5	4	0	71.2	7.12
	1	15.5	10.5	7	11.2	11.9	10.6	9.8	9	9.8	0	95.3	9.53
180	0.1	8.5	13.2	10.5	10.5	6	7.2	9	1.2	2.5	0	68.6	6.86
	0.25	6	8.3	10.9	7	11.2	11.5	7.8	1.2	9.3	0	73.2	7.32
	0.5	6.5	10.4	1.5	5.9	9.7	8.6	9.4	10.6	13.2	0	75.8	7.58
	0.75	0.7	1.2	10	14.4	12.2	5.4	5.1	12.2	3	0	64.2	6.42
	1	8.2	16.3	9.9	13.1	9	6.8	9.2	10	15.5	0	98	9.8
240	0.1	10.5	8	15	10.1	10	6.8	5.6	13.2	7.6	0	86.8	8.68
	0.25	13	11.5	9.5	7.9	5.8	5	9.1	11.3	0	0	73.1	7.31
	0.5	14	8.7	15	14.7	9.5	15.7	15	8.6	0	0	101.2	10.12
	0.75	14	12.5	14.5	3.7	14.3	8.9	6	12.3	0	0	86.2	8.62
	1	15	9.5	6	6.7	14.6	7.7	6.8	9.9	0	0	76.2	7.62

Table 3: Average shoot length after treatment of different concentration of Humic acid

	Shoot length (mm)											Total shoot length (mm)	Average shoot length (mm)
No of Seeds	→	1	2	3	4	5	6	7	8	9	10		
time	control	7.6	6.9	5.6	4.5	4.1	2.4	1.9	2.6	3	0	38.6	3.86
10 min	0.1	6	4.7	6.6	2.3	6.3	5.4	5.2	3.4	3	0	43	4.3
	0.25	5	4.2	2.5	2.4	2.5	1.6	1.9	2	2.2	0	24.55	2.46
	0.5	4.5	5.4	8.4	4.2	4	4.7	6.2	3.1	4	0	45	4.5
	0.75	3.2	3.7	1.9	1.3	3.2	6.2	5.3	5.1	3.1	0	33.75	3.38
	1	6.4	4.1	3.9	3.8	5.3	3.2	1.5	3.4	5	0	37.6	3.76
60 min	0.1	4.1	4.5	2.8	4.5	3	2	1.5	4	4	5.2	35.7	3.57
	0.25	6.7	7	6.3	6	6	4.5	5	7	6	7	61.75	6.175
	0.5	3.2	4.1	5.3	3.8	3.7	3.8	3.6	4	4.1	0	36.1	3.61
	0.75	3.8	3.7	1	3.1	1.1	4.1	2.2	3	3.2	0	25.95	2.59
	1	5	4.2	4	5.9	5.5	5.3	5.8	5.5	6	0	48.2	4.82
120 min	0.1	3	3.2	5.5	1.2	1	3.5	3	4	3.3	0	27.8	2.78
	0.25	3.5	5.5	2	1.8	3.1	5.4	4.8	3.7	2.9	0	32.95	3.295
	0.5	5.2	3.9	5.7	4.3	4	4.2	3.2	3.8	1.5	0	36.3	3.63
	0.75	9.6	9.5	7.5	8.5	4	7	5.5	4.2	3.9	0	60.45	6.05
	1	4.5	5	6	4	6.5	3.7	6.2	4.2	5.5	0	46.6	4.66
180 min	0.1	2	4.5	5.5	1	2.5	5	1.7	2.5	2.4	0	27.2	2.72
	0.25	6.2	2	5	6	3.7	6.5	4.3	4.5	2.9	0	41.35	4.14
	0.5	3	2.5	1.4	2.8	2.1	2.8	1	4	3	0	23.1	2.31
	0.75	3.2	4.5	2.5	4.5	2.5	3	2.5	2.5	2	0	27.95	2.79
	1	1.5	5.4	4.6	5.4	3.9	4	3.2	4.1	3.9	0	37	3.7
240 min	0.1	5.5	5.5	5	4.1	3	4.9	4.7	4.8	3.3	0	40.9	4.09
	0.25	3.5	1.5	5.5	5.3	1.9	2.4	4	4.4	0	0	28.75	2.88
	0.5	6	5	4	3.7	4.7	3.6	5.1	7.1	0	0	39.7	3.97
	0.75	3	4.5	5	4.8	5.8	4	4.4	3.4	0	0	35.65	3.57
	1	5	4.2	4.4	4.2	5.1	3.6	4.9	2.8	0	0	35.2	3.52

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