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Effect of Humic Acid Fertilizer on NPK uptake by Yield of Rapeseeds Grown in Sand Soil Due to the Exposure of Its Seeds to Gamma Rays Irradiation before Sowing.

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EFFECT of gamma rays (Gy) at different doses of (0, 50, 100 and 200 Gy) and fertilized by different levels of humic acid fertilizer (H) at (0%, 50%, 100% and 150%) on NPK uptake of rapeseeds (before sowing). P and K were supplemented in the form of normal super-phosphate and potassium sulphate as a basal to single dose. The experiment was laid out in randomized complete block design in three replicates. The combination of G50 + H50 was proved to be the best in terms of yield which was increased by 184.38% in leaves and 206.69% in roots compared to control. The highest nitrogen content uptake406.34 mg / pot^{-1} was observed in the leaves exposed to the same combition, followed by 262.95 mg N pot^{-1}. Also NPK uptake by leaves and roots of turnip plants as were observed in the pots received rates of (G50 + H 50%) and (G200 + H50%), respectively.

Keywords: Rapeseeds / Humic acid / Gamma ray irradiation/ Sand soil

Introduction

Turnip (*Brassica rapa L*) belongs to the family Brassicaceae. It is a very popular crop for its edible parts (roots, leaves, and seed), locally known in Egypt as Lifft or Shaljam. Turnip contains a variety of organic compounds with biological activity such as glucosinolates (Schonhof et. al, 2004), phenylpropanoids (Liang et. al, 2006), flavonoids (isorhamnetin, kaempferol and quercetin glycosides), phenolics ascorbic acid, vitamin A, niacin and riboflavin (Von Schonfeld et.al, 1997 and .Hassanzadeh 1991).

Miller et al., 2003, reported that nutrient supply to plants greatly affects their growth, production and plant constituents. The seed yield, total dry matter and harvested index in some genotypes of Brassica napus and B.juncea has been found to improve with higher level of N.

Lickfett et al., (1999), reported that the application of P significantly increases the seed yield, leaf area index and total dry matter as well as increases the P uptake in canola and some other Brassica species.

Many commercial products containing humic acid (HA), including K-humate (KH) have been promoted for use on various crops (Liu et al., 1998). Benefits ascribed to the use of humic acid, particularly in low organic matter, alkaline soil, include increased nutrient uptake, tolerance to drought and temperature extremes, activity of beneficial soil microorganisms and availability soil nutrients (Russo and Berlyn,1990). Humic materials may also increase root growth in a manner similar to auxins (Senn and Kingman 1973).

In gamma rays irradiation, there are several usages of nuclear techniques in agriculture. In plant improvement, the irradiation of seeds may cause genetic, variability that enable plant breeders to select new genotypes with improved characteristics such as precocity, salinity tolerance, grain yield and quality (Ashraf et. al, 2003). Furthermore, Hammed et al., 2008, reported that the irradiation of seeds with high doses of gamma rays disturbs the synthesis of protein, hormone balance, leaf gas-exchange, water exchange and enzyme activity.

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Chaudhuri (2002) found that a high dose of gamma rays reduces root and shoot length. Melki and Marouani's (2010),concluded that a low dose of 20 Gy gamma radiations enhances the root length and number by 18–32 %. Rashid and Daran's (2013), showed that increasing duration of gamma rays decreases the average germination rate in ginger (44 %), which was not as severe as that of the maximum exposure period of 150 s.

Therefore, the aim of this work is to study the effect of humic acid fertilizer on N, P and K - uptake by yield of turnip plants grown in sand soil due to the exposure of its seeds to gamma rays irradiation before sowing.

Materials and methods:

A field experiment was carried out at the Plant Nutrition and Fertilization Unit of Soil and Water Department, Nuclear Research Center, Atomic Energy Authority, Inshas, Egypt.

Soil Physical and Chemical Analysis

The soil sample was collected, air dry granules (0 – 15cm deep) and sieved to pass through 2 mm sieve then subjected to some physical and chemical analyses whose results are presented as follows: A- Particle size distribution, coarse sand % 64.1, fine sand % 26.4, silt% 2.7, clay% 6.8, Textural class sand, B - Soluble cations and anions (m mol L^{-1}) in soil paste extract are, Ca2+ 1.25, Mg2+ 1.00, Na+ 0.32, K+ 0.09, CO3 (0), HCO3 (0.88), Cl^- (1.25), SO4 $^{-2}$ (0.53), pH (1:2.5 soil suspension) 7.97, EC (paste extract) 0.27, organic matter 0.3 g kg^{-1} (OM). Total Nitrogen 0.07 g kg^{-1} (TN), C: N ratio 2.43, and CaCO3 10.0 g kg^{-1}.

Plant materials:

A homogenous lot of rapeseeds), was obtained from the Crop Institute, Agricultural Research Center, Giza, Egypt.

Gamma ray irradiation process:

Dry turnip seeds were exposed to different doses of gamma irradiation at (0 , 50, 100 and 200 Gy) using gamma rays were generated from the Cobalt-60 source in the Irradiation Laboratory at Cyclotron Project, Nuclear Research Center, Atomic Energy Authority, Egypt.

The experiment layout:

An experiment was carried out in plastic pots (30cm in diameter, 45cm in depth) filled with 30kg of air dried sand soil and the experimental treatments were arranged in a randomized complete block design with three replicates . Experimental pots received different rates of humic acid contained of (90% potassium hamates) applied (500gm fed^{-1}) in recommended dose at three levels (0, 250 (50%), 500 (100%) and 750 (150%) gm Humic fed^{-1}) were applied at three doses, one dose after 14 days from sowing , two dose, after 14 days from one dose and the other dose applied after 14 days from the second dose . A basal dose of P and K was applied according to recommended rate as a source of single super phosphate and potassium sulphate.

The experiment design include 48 treatments, four doses of humic acid (H) applied and four doses of gamma rays in grey (D) treatments which were as follows:

1- $D_0 + H_0$ (as a control).
2- $D_{50} + H_0$
3- $D_{100} + H_0$
4- $D_{200} + H_0$
5- D_0 + 250 gm H fed^{-1} (50%)
6- D_0 + 500 gm H fed^{-1}(100%).
7- D_0 + 750 gm H fed^{-1} (150%).
8- D_{50}+ 250gm H fed^{-1} (50%).
9- D_{50}+ 500gm H fed^{-1} (100%).
10 - D_{50}+ 750 gm H fed^{-1} (150%).
11 - D_{100}+ 250gm H fed^{-1} (50%).
12 - D_{100} + 500 gm H fed^{-1} (100%).
13 - D_{100}+ 750 gm H fed^{-1} (150%).
14 - D_{200} + 250 gm H fed^{-1} (50%).
15 - D_{200} + 500 gm H fed^{-1} (100%).
16 - D_{200} + 750gm H fed^{-1} (150%).

Methods of analysis:

Chemical and physical analyses of tested soil samples was determined according to *Page et al. (1982) and Black (1965).*

2-6. Statistical analysis:

The analysis of variance for the final data was statistically assayed using the system ANOVA and the values L.S.D from the controls were calculated at 0.05 levels according to **SAS (1987).**

Results and discussion

leaves and roots of turnip plants.

Dry weights of leaves and roots showed in Table (1) were significantly ($p<0.05$) increased in turnip plants, but had no clear trend due to utilization of humic acid fertilizer at different levels which was exposed its seeds previously to various doses of gamma rays irradiation before sowing among all treatments. Furthermore, in leaves, the highest values were 28.58 g $plot^{-1}$ followed by 18.36 g pot^{-1} as observed in the pot received rate of (D 50 + H50) and (D 100 +H150), which reached to184.38% and 62.48% over control treatments which recorded 10.05 g pot^{-1} and 11.30 g pot^{-1} at (D 0) respectively. In roots, the high value was, 131.66 g pot^{-1} , followed by 96.52 g pot^{-1} as observed in the pot received (D 50+ H_{50}) and (D200+H150), relatively increased by 206.69% and 1.17% over control treatment which recorded 42.93 g pot^{-1} and 95.40 g pot^{-1} at (D 0), respectively.

Based on the previous findings, it can concluded that the second level of humic acid at dose of 50 Gy was sufficient to obtain the highest growth parameters or biomass represented by leaves and roots, but it can recommend humic acid as an organic fertilizer for producing organic products. In addition, the relatively lower dose of gamma irradiation (50 Gy) in this study induced more changes in leaves and roots of turnip plants than the other two higher doses.

These findings confirmed by Soheir. El-Sherbeny et.al, (2012) they revealed that the maximum increment for fresh and dry weights of leaves were recorded with medium humic acid level (HA2) which reached to 201.8% and 275%over the control treatment , followed by the highest mineral fertilizers (N200-P200- K100) and medium humic acid level for fresh and dry weight of leaves, respectively. Albayrak and Camas (2005) revealed that the highest root and dry matter yield were obtained from the 1200 ml- ha-1 humic acid level for turnip (Brassica rapa L.).

Chaudhuri (2002) found that a high dose of gamma rays reduces root and shoot length. Kim et al. (2004) determined that the low dose of gamma rays ranging 1–2 Gy when exposed on Arabidopsis seedlings slightly enhanced their growth, in comparison to seedlings exposed to high radiations of 50 Gy. Toker et al, (2005) findings showed that radiation up to 200 Gy increases shoot length, but further increase to 400 Gy causes despair in shoot length. Melki and Marouani’s (2010) also concluded that a low dose of 20 Gy gamma radiations enhances the root length and number by 18–32 %.

N – Uptake (mg N / Pot) by Leaves and roots yield of turnip plants

Data presented in Table (2) revealed that humic acid fertilizer treatments had no clear trend for their effects on N-uptake by leaves and roots of turnip plants which were exposed to different doses of gamma ray irradiation up to 200 Gy. In this respect, it can be noticed that treatment humic acid at a rate of 50 mg pot^{-1} with dose of 50 Gy had a pronounced effect compared with other treatments. Accordingly, the highest values of N-uptake by leaves were 406.34 mg N pot^{-1} followed by 262.95 mg Npot^{-1} achieved in the pots received rate of (D 50+ H50) and (D100 + H 150) , relatively .They were approximately increased by about 114.49% and 126.86% over control which recorded 189.10 mg Npot^{-1} and 115.91 mg pot^{-1}, respectively. By roots , the highest values of N-uptake of 3575.20 mg N pot^{-1} followed by 2865.26 mg N pot^{-1} which was observed in the pot received rate of (D50 + H50) and rate of (D100 +H150) , relatively increased by about 191.75% and 29.06% over control which recorded 1225.43 mg N pot^{-1} and 2220.13 mg N pot^{-1}, respectively.

It could be concluded that the second level of humic acid of 50 % was sufficient to obtain the highest values of N-uptake by leaves and roots with the a lower dose of gamma irradiation (50 Gy) and induced more changes than the other two higher doses.

In this respect, similar findings were recorded by Aisha, et. al, (2014) who found that the highest values of the growth characters, roots characters and the percentage of protein, N, P, K, carbohydrate and Fe content ppm in turnip root tissues were associated with plants received higher compost level (20 m3/fed.) with higher level of humic acid (6 L/fed.).

P-uptake (mg / pot) by Leaves and roots of turnip plants

Data presented in Table (3) revealed that humic acid fertilizer treatments had no clear trend for their effects on P-uptake by leaves and roots of turnip plants which were exposed to different doses of gamma ray irradiation up to 200 Gy. Accordingly, it can be noticed that treatment using humic acid at rate of 50 mg pot^{-1} with dose of 50 Gy had a pronounced effect compared with other treatments. Furthermore, the highest values of P-uptake by leaves of turnip plants were 21.48 mg P pot^{-1} followed by 20.70 mg Ppot^{-1} which was detected in the pots received rate of (D50+ H50) and (D100+ H150) levels, an increase of 18.03% and 3.92% over control which recorded 18.20 mg P pot^{-1} and 19.92 mg P pot^{-1}, respectively. By roots, the higher values of P-uptake were 28.14 mg P pot^{-1} followed by 19.51 mg P pot^{-1} as observed in the pot received rate of (D50+ H50) and rate of (D100 +H_0) levels, relatively increased by about 44.23% and 9.01% over control which recorded 19.51 mg P pot^{-1} and 21.08 mg P pot^{-1}, respectively. It could be concluded that the second level of humic acid fertilizer at 50 **%** was sufficient to obtain the highest values of P-uptake by leaves and roots under lower dose of gamma irradiation (50 Gy) which induced more changes than the other two higher doses.

TABLE 1. Effect of humic acid fertilizer on on dry weights of leaves and roots (g plot^{-1}) yield of turnip plants exposure seeds to doses (Gy) of gamma ray irradiation.

Gamma Irradiation D (Gy)	Humic acid fertilizer (H)							
	Leaves (g/Pot)				Roots (g/Pot)			
	H_0	H_{50}	H_{100}	H_{150}	H_0	H_{50}	H_{100}	H_{150}
D_0	9.62	10.05	6.45	11.30	52.58	42,93	23.20	95.40
D_{50}	10.74	28.58	11.20	10.31	56.97	131.66	61.21	78.06
D_{100}	11.36	16.45	13.72	18.36	51.58	72.67	71.79	79.22
D_{200}	16.36	14.15	16.47	13.20	69.45	87.73	81.73	96.52

L.S.D at 0.05 : Leaves
D = 2.447
H = 2.447
D.H = 3.479

Roots
D = 20.95
H = 20.95
D.H = 12.90

TABLE 2. Effect of humic acid fertilizer on N- uptake by Leaves and roots (mg plot-1) of turnip plants exposure seeds to doses (Gy) of gamma ray irradiation.

Gamma Irradiation D (gry)	Humic acid fertilizer (H)							
	Leaves (g/Pot)				Roots (g/Pot)			
	H_0	H_{50}	H_{100}	H_{150}	H_0	H_{50}	H_{100}	H_{150}
D_0	98.77	189.10	69.27	115.91	502.14	1225.43	878.85	2220.13
D_{50}	111.17	406.34	164.83	135.76	630.47	3575.20	967.87	1846.00
D_{100}	202.97	184.65	170.92	262.95	842.48	2003.20	2104.11	2865.26
D_{200}	222.40	143.99	243.45	190.34	1078.93	2383.29	2524.39	2611.34

L.S.D at 0.05: N-uptake by Leaves
D = 39.57
H = 39.57
D.H = 56.26

N-uptake by Roots
D = 708.8
H = 708.8
D.H = 1008.8

TABLE 3. Effect of humic acid fertilizer on P- uptake by Leaves and roots (mg plot-1) of turnip plants exposure seeds to doses (Gy) of gamma ray irradiation.

Gamma Irradiation D (Gy)	Humic acid fertilizer (H)							
	Leaves (g/Pot)				Roots (g/Pot)			
	H_0	H_{50}	H_{100}	H_{150}	H_0	H_{50}	H_{100}	H_{150}
D_0	18.75	18.20	20.03	19.92	21.08	19.51	17.33	18.80
D_{50}	19.60	21.48	20.17	20.70	22.98	28.14	17.66	17.90
D_{100}	19.76	18.56	18.50	19.55	18.14	18.77	19.73	18.35
D_{200}	19.71	18.54	19.67	19.01	17.49	19.20	17.13	17.62

L.S.D at 0.05 : p-uptake by Leaves
D = 1.707
H = 1.707
D.H = 2.427

p-uptake by Roots
D = 1.094
H = 1.094
D.H = 1.796

K-uptake (mg / pot) by leaves and roots of turnip plants

Data 1 in Table (4) showed that humic acid fertilizer treatments had no clear trend for their effects on K-uptake by leaves and roots of turnip plants which were exposed to different doses of gamma ray irradiation up to 200 Gy. Furthermore, the highest values of K-uptake by leaves were 24.88 mg k pot^{-1} followed by 24.52 mg k pot^{-1} observed in the pots received rate of (D200 + H50) and (D200 + H100) levels, an increase of 6.32% and 25.23% over control which was recorded 23.40 mg k pot^{-1} and 19.58 mg k pot^{-1}, respectively. By roots, the higher values of K-uptake were 27.60 mg k pot^{-1} followed by 27.47 mg k pot^{-1} as observed in the pots received rate of (D200 + H150) and rate of (D50 +H100) levels, relatively increased by about 9.52% and 0.733% over control which recorded 25.20 mg k pot^{-1} and 27.27 mg k pot^{-1}, respectively.

TABLE 4. Effect of humic acid fertilizer on K- uptake by leaves and roots (mg plot-1) of turnip plants exposure seeds to doses (Gy) of gamma ray irradiation.

Gamma Irradiation D (gry)	*Humic acid fertilizer (H)*							
	Leaves (g/Pot)				Roots (g/Pot)			
	H_0	H_{50}	H_{100}	H_{150}	H_0	H_{50}	H_{100}	H_{150}
D_0	13.48	23.40	19.58	21.25	23.25	25.25	27.27	25.20
D_{50}	20.33	21.73	23.42	19.40	24.17	24.18	27.47	26.93
D_{100}	15.78	22.78	20.33	23.30	13.13	25.20	25.35	25.12
D_{200}	19.42	24.88	24.52	24.42	14.08	25.05	25.64	27.60

L.S.D at 0.05 k-uptakes by Shoots
D = 2.960
H = 2.960
D.H = 4.416

K-uptake by roots
D = 3.067
H = 3.067
D.H = 5.035

It could be concluded that the second level of humic acid fertilizer at 50 % was sufficient to obtain the highest values of K-uptake by leaves under the higher dose of gamma irradiation (200Gy), while, by roots observed at 150% under the same dose of (200Gy).

Conclusions

Based on the previous findings, it could be concluded that the second level of humic acid fertilizer at 50% was sufficient to obtain the highest growth parameters or biomass represented, N, and P-uptake by leaves and roots under the lower dose of gamma irradiation (50Gy) which induced more changes in leaves and roots of turnip plants than the other two higher doses. However, for K-uptake, it was observed that the second level of humic acid fertilizer at 50 % was sufficient to obtain the highest values by leaves under a higher dose of gamma irradiation (200Gy), while, by roots observed at 150% under the same dose of (200Gy).

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تأثير سماد حمض الهيوميك على النيتروجين, الفوسفور والبوتاسيوم الممتص محصول نبات اللفت النامى فى ارض رملية نتيجة تعرض بذوره لأشعة جاما قبل الزراعة.

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أجريت تجربة أصص بهدف دراسة تأثير تعرض بذور نبات اللفت النامى فى ارض رملية لأشعة جاما قبل الزراعة بمعدلات (صفر , 50 , 100, 200 جراى) على (الممتصNPK) بواسطة محصول اللفت المسمد بمعدلات (صفر , 50% , 100% , 150%) على صورة سماد حمض الهيوميك (KH 90%), رتبت معاملات التجربة فى توزيع كامل العشوائية مع ثلاث مكررات و أضيف السماد على ثلاث دفعات . أضيف الفوسفور والبوتاسيوم بالمعدل الموصى به فى صورة سوبر فوسفات و كبريتات البوتاسيوم.. أظهرت الدراسة النتائج التالية , تبين من الدراسة ان اعلى محصول من العرش وجذور نبات اللفت سجل مع المعاملة عند معدل (50% هيوميك + 50% جراى) بنسبة زيادة 184.38% , 206.69% فوق الكنترول بالنسبة للعرش والجذور على التوالى., اظهرت الدراسة ايضا ان المعاملات المختلفة لسماد حمض الهيوميك ليس لها اتجاه واضح فى تاثيرها على النيتروجين , الفوسفور والبوتاسيوم الممتص بواسطة عرش وجذور نبات اللفت التى سبق تشعيع بذوره بجرعات مختلفة من اشعة جاما قبل الزراعة.