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Research Article

EFFECT OF PHOTONS RADIATIONS AND NICKEL ON THE GROWTH AND GERMINATION OF *HORDEUM VULGARE*

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ABSTRACT
In this study, the effects of photons radiations and nickel on the growth and germination of *Hordeum vulgare* were investigated. Firstly, the seeds were exposed to radiations and then nickel was applied on seedling stage. Three groups were made, of which one group was controlled group. Second group contained a large amount of Nickel exposure. Third group was also treated with nickel metal. The results obtained in this study indicate that photons radiations affect seeds in dormancy stage more than state of germination. Germination rate was affected under the specified exposure conditions, but root growth decreased more due to possible effects oxidative stress in dormancy state.

Keywords: *Photons, Nickel, Biological Effects, Hordeum Vulgare*

INTRODUCTION
Photons belong to ionizing radiation and are the most energetic form of such electromagnetic radiation, having the energy level from around 10 kilo electron volts (keV) to several hundred keV. Therefore, they are more penetrating than other types of radiation such as alpha and beta rays (Kova´cs & Keresztes, 2002).

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, 2003). Ionizing radiations are also used to sterilize some agricultural products in order to increase their conservation time or to reduce pathogen propagation when trading these products within the same country or from country to country (Melki & Salami, 2008).

A number of radiobiological parameters are commonly used in early assessment of effectiveness of radiation to induce mutations. Methods based on physiological changes such as inhibition of seed germination and shoot and root elongation have been reported for detection of irradiated cereal grains and legumes.

Chaudhuri, (2002) reported that the irradiation of barley seeds reduced shoot and root lengths upon germination. Gamma radiation can be useful for the alteration of physiological characters (Kiong *et al*., 2008).

The biological effect of gamma-rays is based on the interaction with atoms or molecules in the cell, particularly water, to produce free radicals (Kova´cs & Keresztes, 2002).

These radicals can damage or modify important components of plant cells and have been reported to affect differentially the morphology, anatomy, biochemistry and physiology of plants depending on the radiation dose (Ashraf *et al*., 2003).

These effects include changes in the plant cellular structure and metabolism e.g., dilation of thylakoid membranes, alteration in photosynthesis, modulation of the anti-oxidative system, and accumulation of phenolic compounds (Kova´cs & Keresztes, 2002; Kim *et al*., 2004; Wi *et al*., 2007; Ashraf, 2009).

From the ultra-structural observations of the irradiated plant cells, the prominent structural changes of chloroplasts after radiation with 50 Gy revealed that chloroplasts were more sensitive to a high dose of gamma rays than the other cell organelles.

Similar results have been reported to be induced by other environmental stress factors such as UV, heavy metals, acidic rain and high light (Molas, 2002; Barbara *et al.,* 2003; Quaggiotti *et al.,* 2004).

However, the low-dose irradiation did not cause these changes in the ultra-structure of chloroplasts. 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 (Hammed *et al*., 2008).

Due to limited genetic variability among the existing wheat genotypes, Irfaq & Nawab (2001) opened a new era for crop improvement and now mutation induction has become an established tool in plant breeding that can supplement the existing germplasm and can improve cultivars in certain specific traits as well.

Considering the effects of radiation on plants, the present study was conducted to determine the effects of radiation on wheat germination and some key physiological and biochemical characteristics of wheat seedlings.

MATERIALS AND METHODS

Plant Material

Seeds of Barley were selected for irradiation. Moisture content of the seeds was adjusted at 13% before irradiation. Barley crop grown in pots and gave different concentrations of nickel i.e. 3ppm, 6ppm and 9ppm.

Spring barley was grown in pots and effect of nickel on shoot and root in barley crop was investigated. In these experiment plants were plotted supplemented with different concentrations of nickel i.e. 3ppm, 6ppm and 9ppm.

Few pots were taken as control pots. After applying the Ni four readings were taken in 4 consecutive days with following parameters - root length, shoot length in cm, whereas no of leaves, leaf area index in cm^2, and leaf biomass, root biomass, shoot biomass in g. Which indicated that the Ni enhances the root and shoot growth of barley.

Statistical Analysis

Statistical analysis was performed using Mstat-c software.

RESULTS AND DISCUSSION

Effect of Gamma Radiation on the Germination

Seed germination test after Photons radiation revealed that mean germination time was decreased with increasing irradiation dose for both genotypes. Gamma radiation had no significant effect on final germination percentage.

The effect of Cu on wheat somatic callus was seen drastically. $CuSO_4$ dramatically increased shoot regeneration over a wide range of concentration.

On medium lacking $CuSO_4$ the regeneration frequency was only 13%, whereas on MS medium containing the original concentration of $CuSO_4$ produced shoots. A more than twofold further increase occurred at higher $CuSO_4$ concentration.

At the optimal concentration of 6 ppm $CuSO_4$, there was also a large change in the number of shoots/regenerating callus.

Thus a three-fold further increase was achieved by using Cu. On $CuSO_4$ free medium, the mean shoot number / regenerating callus were only 1.1. While at the optimal $CuSO_4$ concentration (9 ppm) 3.6 shoots/regenerating callus were produced.

$CuSO_4$ also stimulated root formation from wheat callus. The root length, number of roots per callus, and the total dry root and shoot mass.

Table 1: Effect of Nickel Toxicity on Growth of *Hordeum Vulgare*

Mean	Root Length cm	Shoot Length cm	No. Leaves	Leaf Area cm²	No. Tillers	Leaf Biomass G	Root Biomass G	Shoot Biomass G	Total Biomass G
Control	0.43	22.11	4	3.07	4	0.70	0.54	0.77	2.01
3PPM	4.93	23.38	4	5.44	4	0.73	0.60	0.81	2.14
6PPM	5.77	25.24	4	6.14	4	0.76	0.67	0.89	2.35
9PPM	6.78	28.89	4	7.25	4	0.79	0.73	0.95	2.47
Mean	11.13	99.62	4	21.9	4	2.98	2.44	3.42	8.97

Table 2: Effect of Nickel Toxicity on Growth of *Hordeum Vulgare*

Means	Root Length cm	Shoot Length cm	No. Leaves	Leaf Area cm²	No. Tillers	Leaf Biomass G	Root Biomass G	Shoot Biomass G	Total Biomass G
Control	0.46	22.13	4	3.09	4	0.72	0.56	0.78	2.06
3PPM	4.95	23.39	4	5.46	4	0.75	0.61	0.83	2.19
6PPM	5.78	25.26	4	6.16	4	0.77	0.68	0.91	2.36
9PPM	6.80	28.91	4	7.27	4	0.80	0.74	0.96	2.50
Mean	17.99	99.69	4	21.98	4	3.04	2.59	3.48	9.11

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3rd Day's Reading After Applying Metals

Means	Root Length cm	Shoot Length cm	No. Leaves	Leaf Area cm^2	No. Tillers	Leaf Biomass G	Root Biomass G	Shoot Biomass G	Total Biomass G
Control	0.47	22.15	4	3.11	4	0.73	0.57	0.79	2.09
3PPM	4.97	23.41	4	5.47	4	0.77	0.63	0.85	2.15
6PPM	5.80	25.27	4	6.18	4	0.78	0.69	0.93	2.40
9PPM	6.81	28.93	4	7.28	4	0.81	0.76	0.97	2.54
Mean	18.05	99.76	4	22.04	4	3.09	2.65	3.54	9.18

4th Day's Reading After Applying Metals

Means	Root Length cm	Shoot Length cm	No. Leaves	Leaf Area cm^2	No. Tillers	Leaf Biomass G	Root Biomass G	Shoot Biomass G	Total Biomass G
Control	0.49	22.17	4	3.13	4	0.75	0.59	0.81	2.15
3PPM	4.98	23.43	4	5.49	4	0.78	0.65	0.86	2.19
6PPM	5.81	25.28	4	6.19	4	0.80	0.71	0.95	2.46
9PPM	6.83	28.95	4	7.30	4	0.83	0.77	0.98	2.58
Mean	18.11	99.83	4	22.11	4	3.16	2.72	3.60	9.38

REFERENCE

Abdel-Hady MS, Okasha EM, Soliman SSA and Talaat M (2008). Effect of Gamma radiation and gibberellic acid on germination and alkaloid production in *Atropa belladonna*. *Australian Journal of Basic and Applied Sciences* **2**(3) 401-405.

Al-Rumaih MM and Al-Rumaih MM (2008). Influence of ionizing radiation on antioxidant enzymes in three species of *Trigonella*. *American Journal of Environmental Sciences* **4**(2) 151-156.

Ashraf M (2009). Biotechnological approach of improving plant salt tolerance using antioxidants as markers. *Biotechnology Advances* **27** 84-93.

Ashraf M and Foolad MR (2007). Roles of glycine betaine and proline in improving plant abiotic stress resistance. *Environmental and Experimental Botany* **59**(2) 206-216.

Ashraf M, Cheema AA, Rashid M and Qamar Z (2003). Effect of gamma rays on M1 generation in Basmati rice. *Pakistan Journal of Botany* **35**(5) 791-795.

Barbara G, Maria S, Anna W, Slawa G and Magdalena G (2003). Changes in the ultra structure of chloroplasts and mitochondria and antioxidant enzyme Activity in *Lycopersicon esculentum* Mill. leaves prayed with acid rain. *Plant Science* **164** 507-516.

Bates LS (1973). Rapid determination of free proline for water-stress studies. *Plant Soil* **39** 205-207.

Chaudhuri KS (2002). A simple and reliable method to detect gamma irradiated lentil (*Lens culinaris* Medik.) seeds by germination efficiency and seedling growth test. *Radiation Physics and Chemistry* **64** 131-136.

Esfandiari E, Shakiba MR, Mahboob SA, Alyari H and Shahabivand S (2008). The effect of water stress on antioxidant content, protective enzyme activities, proline content and lipid per oxidation in seedling wheat. *Pakistan Journal of Biological Sciences* **11**(15) 1916-1922.

Falahati A, Kazemitabar SK, Bahrami AR, Lahouti M and Rahimi MF (2007). The study of gamma irradiation effects on drought tolerance in rice *(Oryza sativa* L.). *Indian Journal of Crop Science* **2**(1) 155-158.

Foyer CH, Lelandias M and Kunert KJ (1994). Photo-oxidative stress in plants. *Physiologia Plantarum* **92** 696-717.

Irfaq M and Nawab K (2001). Effects of gamma irradiation on some morphological characteristics of three wheat cultivars. *International Journal of Biological Sciences* **1**(10) 935-937.

Kavi Kishor PB, Sangam S, Amrutha RN *et al.*, (2005). Regulation of proline biosynthesis, degradation, uptake and transport in higher plants: Its implications in plant growth and a biotic stress tolerance. *Current Science* **88** 424-438.

Khajeh-Hosseini M, Powell AA and Bingham IJ (2003). The interaction between salinity stress and seed vigour during germination of soybean seeds. *Seed Science and Technology* **31** 715-725.

Kim JH, Baek MH, Chung BY, Wi SG and Kim JS (2004). Alterations in the photosynthesis pigments and antioxidant machineries of red pepper (*Capsicum annuum* L.) seedlings from gamma-irradiated seeds. *Journal of Plant Biotechnology* **47** 314-321.

Kim JS, Lee EK, Back MH, Kim DH and Lee YB (2000). Influence of Low dose *y* radiation on the physiology of germinative seed of vegetable crops. *Korean Journal of Environmental Agriculture* **19** 58-61.

Kiong A, Ling Pick A, Grace Lai SH and Harun AR (2008). Physiological responses of *Orthosiphon stamineus* plantlets to gamma irradiation. *American-Eurasian Journal of Sustainable Agriculture* **2**(2) 135-149.

Kovacs E and Keresztes A (2002). Effect of gamma and UV-B/C radiation on plant cell. *Micron* **33** 199-210.

Ling APK, Chia JY, Hussein S and Harun AR (2008). Physiological Responses of *Citrus sinensis* to Gamma Irradiation. *World Applied Sciences Journal* **5** 12-19.

Melki M and Marouani A (2009). Effects of gamma rays irradiation on seed germination and growth of hard wheat. *Environmental Chemistry Letters* **8**(4) 307-310 Doi: 10.1007/s10311-009-0222-1.

Melki M and Salami D (2008). Studies the effects of low dose of gamma rays on the behavior of *Chickpea* under various conditions. *Pakistan Journal of Biological Sciences* **11**(19) 2326-2330.