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EFFECTS OF GAMMA IRRADIATION ON GERMINATION, GROWTH OF SUNFLOWER AND CONTROL OF CHARCOAL ROT FUNGUS *MACROPHOMINA PHASEOLINA* (TASSI) GOID.

Muhammad Anis[1], M. Javed Zaki[1] and Zeeshan Abbas[2]

[1]*Department of Botany, University of Karachi, Karachi-75270, Pakistan*
[2]*Department of Physics, University of Karachi, Karachi-75270, Pakistan*

ABSTRACT

Effects of gamma irradiation on germination, growth and charcoal rot disease of sunflower was investigated under greenhouse conditions. The sunflower seeds exposed to gamma rays showed slight reduction in germination as compared to un-exposed (non treated control). Maximum germination was observed in non treated control followed by seeds treated with gamma rays at the dose of 6 KGy. Seeds exposed to 9 KGy showed significant ($P<0.05$) increase in plant length, fresh plant weight and vigour index. Minimum colonization or maximum control of root infection by charcoal rot fungus *Macrophomina phaseolina* was observed with 9 KGy followed by seeds exposed with 6 KGy whereas maximum colonization of roots by *M. phaselina* was recorded in non treated control. The effect of gamma irradiation on germination, plant growth and colonization of *M. phaseolina* was seemed to be dose dependent.

INTRODUCTION

Gamma rays are the most energetic form of electromagnetic radiation, having 10 to 100s kiloelectron volts energy level and greater penetrating ability as compared to other radiations (Kovacs & Keresztes, 2002). Gamma rays effects growth and development of plants by inducing changes in cell physiology and morphology (Gunckel & Sparrow, 1961). In some reports gamma rays at higher exposures showed inhibitory effect for plants (Bora, 1961; Kumari & Singh, 1996), and at lower exposures the effects were stimulatory (Torne & Desai 1965; Raghava & Raghava, 1989; Thapa, 1999). The main objective of the present study was to treat sunflower seeds with gamma rays (^{60}Cobalt) at different doses on germination, growth of sunflower and control of charcoal rot fungus, *Macrophomina phaseolina*.

MATERIALS AND METHODS

Experimental setup: Sunflower seeds var. Aussie gold 61 were obtained from Federal Seed Certification Department, Karachi and surface sterilized with 1% $Ca(OCl)_2$ (bleech) rinsed thoroughly with water and dried aseptically under laminar hood. The seeds were then exposed to radiation with ^{60}Co emitting gamma rays with different doses @ 6, 9, 12 KGay in the Department of Physics, University of Karachi. Irradiated and non-irradiated seeds were sown separately in plastic pots (8 cm diam.) containing sandy loam soil (sand, silt, caly, 60, 22 & 18% respectively, pH 7.1-7.5 with moisture holding capacity 29%) @ 300 g /pot. The soil had 3-5 sclerotia/g soil as assessed by wet sieving and dilution technique (Sheikh & Ghaffar, 1975). The control pots contained non-treated seeds. There replicates were taken for each treatment and all pots were kept in a randomized design. 50% MHC was maintained in pots during the study. After one month of seed germination, plant length, fresh plant weight and vigour index were recorded. The root rot incidence by *M. phaseolina* was recorded by cutting one cm long root pieces after washing in running tap water were surface sterilized with 1% bleech (Ca $(OCl)_2$) and transferred on PDA plates supplemented with Penicillin @ 200 mg/liter and streptomycin @ 200 mg/liter at 5 pieces per plate. Petri dishes were incubated at room temperature (25-30°C).

Statistical analysis: Data was subjected to analysis of variance (ANOVA) followed by the least significant difference (LSD) using statistica software according to Sokal & Rohlf (1995).

RESULTS AND DISCUSSION

The sunflower seeds exposed to gamma rays (^{60}Co) showed slight reduction in germination as compared to un-treated control. Maximum germination was observed in the non treated control followed by seeds treated with gamma rays at the dose of 6 KGay. The reduction in germination was dose dependent. Seeds exposed to 9 KGay showed significant ($p<0.05$) increase in plant length followed by seeds exposed to 6 KGay. Significant ($p<0.05$) increase in plant weight was observed in seeds exposed to 9 KGy followed by seeds exposed to 6 KGy and minimum increase in plant weight was observed in un-treated control (un-exposed). Maximum vigour index was recorded in seeds exposed to gamma rays at 9 KGy followed by seeds treated with 6 KGy. Minimum colonization or maximum control of root infection by *M. phaseolina* was observed with 9 KGy followed by seeds exposed with 6 KGy whereas maximum colonization of roots by *M. phaseolina* was recorded in non treated control (Fig. 1).

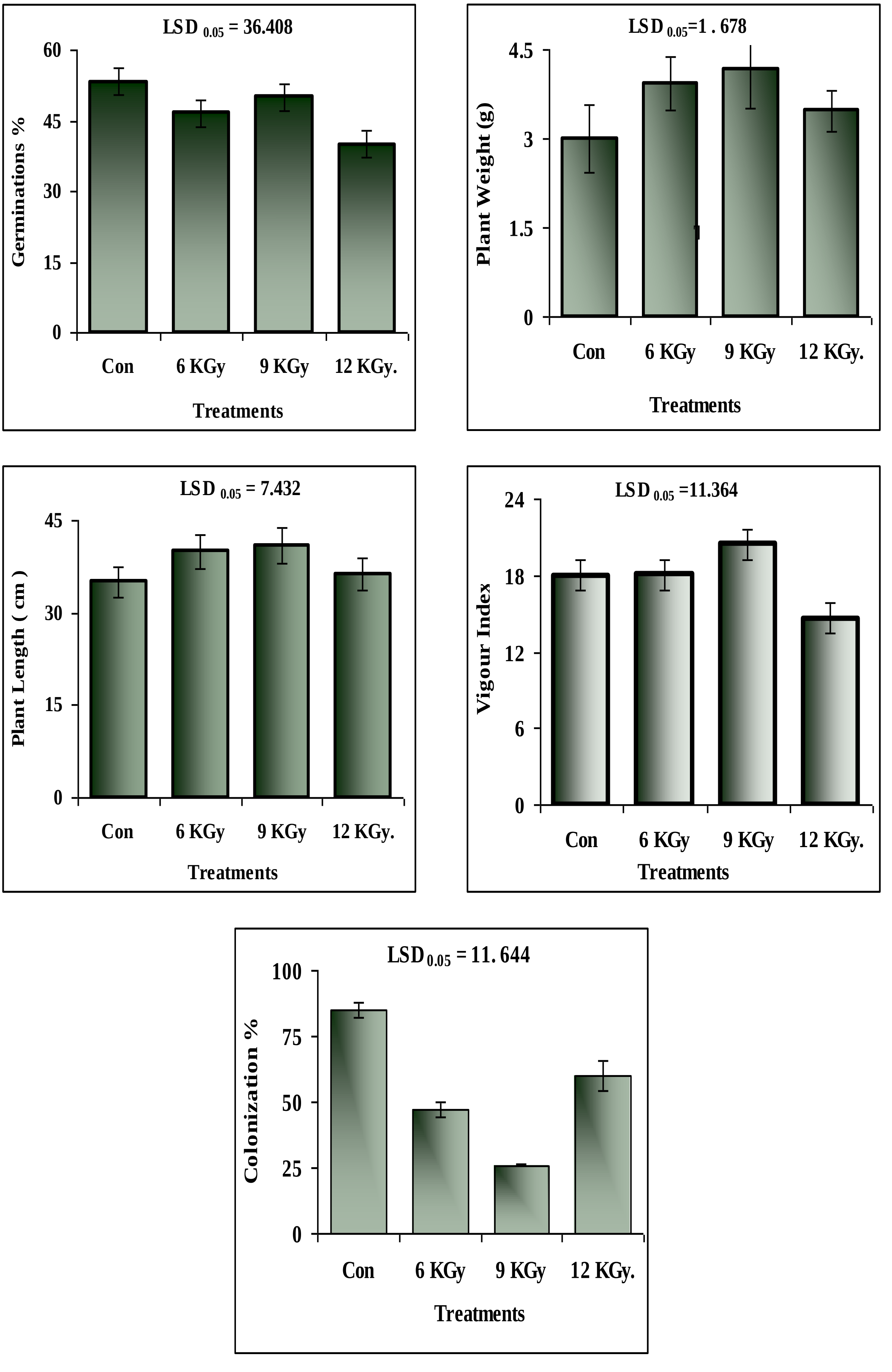

Fig. 1. Effect of sunflower seeds treated with different doses of ^{60}Co emiting gamma rays on seed germination, plant growth and root colonization by *M. phaseolina*. (Bars show standard error, SE ±).

Nedialkov *et al*., (1996) reported that magnetic field treatment of the seeds increased the number of germinated seeds and the growth rate for the maize, okra and groundnut seeds decreased with increase in the irradiation doses of ^{60}Co gamma rays i.e., 150, 300, 500, 700, 900, 1000 Gy. The reduction in germination was dose dependent. Our study also demonstrated that germination decreased with increase in dose of gamma irradiation.

In the present study, treatment of sunflower seeds with gamma rays (^{60}Cobalt) for 6 and 9 Gy showed significant increase in plant height, fresh weight and vigour index as compared to control and higher dose (12 Gy). According to Jaywardena & Peiris (1988) characters and productivity of plants like rice, maize, bean, cowpea and potato improved with the seed treatment with gamma rays. Sharma & Rana (2007) reported that the productivity and economic value of castor bean enhanced due to gamma radiation. The pre-sowing treatment with gamma rays showed an increase in yield of soybean (48%), peas (15%), okra (19%) and bean (21%). According to Dubey *et al*. (2007) treatment of okra seeds with different doses of gamma rays plant height and plant growth in term of branches and number of leaves per plant were increased. Present results suggested that seed treatment with gamma irradiations was effective for increment of plant weight and height and suppressed the root colonization by *M. phaseolina*.

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