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COMBINED USE OF (^{60}COBALT) GAMMA IRRADIATED SEEDS AND NURSERY FERTILIZERS IN THE CONTROL OF ROOT ROT FUNGI OF CROP PLANTS

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ABSTRACT

Experiment was conducted to investigate the combined effect of seeds treated with ^{60}Co emmiting gamma rays for 2, 8 and 16 minutes and soil amended with nursery fertilizers like frutan, DAP and urea at 0.01 % and 0.1 dosages for the control of root infecting fungi such as *Fusarium* spp, *Macrophomina phaseolina* (Tassi) Goid and *Rhizoctonia solani* Kühn in mungbean (*Vigna radiata* L.) and sunflower (*Helianthus annus* L.) plants. Both crops showed significant increase in growth parameters like shoot length, shoot weight, root length, root weight, leaf area and germination as compared to control. Complete reduction of root rot fungi of sunflower and mung bean was observed when seeds were treated with gamma rays for 2 minutes and soil was amended with urea, DAP and frutan at 0.1 and 0.01 % w/w.

Key words: ^{60}Co Gamma radiation, nursery fertilizers, root infecting fungi, mung bean, sunflower.

INTRODUCTION

The soil borne pathogens like *Macrophomina phaseolina* (Tassi) Goid, *Rhizoctonia solani* (Kühn) and *Fusarium* spp., are most severe pathogens which attack roots, limiting nutritional uptake and produce root rot disease complex resulting in the death of plants. The genus *Fusarium* contains a number of species, which have been recognized for long time as important plant pathogens (Booth, 1971; Nelson *et al*., 1983). Similarly, *M. phasoelina* is reported to produce charcoal rot of over 500 species of plants (Sinclair, 1982), where at least 72 hosts have been reported from Pakistan (Mirza and Qureshi, 1978; Shahzad *et al*., 1988). *R. solani* is reported to cause disease on atleast 63 host plants from Pakistan (Mirza and Qureshi, 1978).

Use of fertilizers for growth improvement of crop plants is a common practice. Major portion of applied fertilizer is phosphorus (P) which is attributed to high P fixing capacity, high pH and activity of $CaCO_3$. Therefore, in view of low soil fertility status, nutrient management based on utilization of various resources viz., soil, organic, biological and mineral fertilizer with particular references to arid conditions is necessary, not only in sustaining productivity and soil health but also in meeting fertilizer requirement of different crops (Hedge and Dwived, 1993). Nitrogen present in the fertilizer is absorbed by the plant which is utilized in protein synthesis and seed production whereas potassium is involved in many cellular functions including photosynthesis, phosphorylation, water maintenance, reduction of nitrates and reproduction. Potassium is also known to reduce *F. oxysporum* infection on tomato (Ellet, 1973) and *R. solani* infection on hemp (Pal and Choudhary, 1980). Urea beside improvement of plant growth also controls soil borne root-infecting fungi on mungbean (Dawar and Ghaffar, 2003).

Gamma rays are known to influence plant growth and development by inducing cytological, genetical, biochemical, physiological and morphogenetic changes in cells and tissues (Gunckel and Sparrow, 1961). Several workers have studied effect of gamma rays on seed germination of Gymnosperms. The higher exposures were usually inhibitory (Bora, 1961, Kumari and Singh 1996), whereas lower exposures were sometimes stimulatory (Torne and Desai, 1964, Taylor 1968, Sparrow 1966, Mujeeb 1974, Mathew and Gaur 1975, Mujeeb and Greig 1976, Thapa, 1999).

Irradiation is helpful process in various agricultural and in the control and reduction of insect pests. Radiation has been used in food sterilization, food preservation and different food engineering processes, which gives benefit for the human society (Hyun-Pa *et al*., 2006; Sameh *et al*., 2006; Dus˘an, 2004; Ivanov *et al*., 2001). Irradiation with gamma radiation considered as a method of disinfesting stored foods, including cereal grains and legumes, has opened a new field for irradiation application in which considerable work has to be done (Urbain, 1986). Present studies have been conducted to investigate the combine effect of fertilizers and gamma irradiated seeds of sunflower and mung bean on plant growth and control of root rot diseases.

MATERIALS AND METHODS

Collection and irradiation of seeds

Different nursery fertilizers including urea, frutan and DAP purchased from the local market of Karachi. Seeds of sunflower and mung bean were surface sterilized using 1% $Ca(OCl)_2$ and dried aseptically under laminar flow hood. Seeds were irradiated with ^{60}Co gamma rays for 0, 2, 8 and 16 minutes and stored in jar for further use.

Experimental setup

The soil used was collected from the Experimental Field of Department of Botany, University of Karachi. Soil (300 g) was filled in 8 cm diameter plastic pot having sandy loam texture with pH of 7.9 and water holding capacity was 40 (Keen and Raczkowskii, 1922). Natural population of fungi in soil containing 5-7 sclerotia of *M. phaseolina* g^{-1} (Sheikh and Ghaffar, 1975), *R. solani* 6-9 % (Wilhem, 1955) and *Fusarium* spp., 3500 cfu g^{-1} (Nash and Snyder, 1962). The soil was amended with nursery fertilizers like frutan, DAP and urea separately with concentration of 0.01 and 0.1% w/w. 5 treated seeds of mung bean and sunflower with gamma rays for 0, 2, 8 and 16 minutes were sown in each pot. Soil without fertilizer and non irradiated seeds served as control. In this experiment, three replicates of each treatment were used and pots were kept randomized on screen house of Department of Botany, University of Karachi. The pots were maintained at 550% MMHC. Experiment was terminated after thirty days of germination of seeds and the data on shoot length (cm), shoot weight (g), root length (cm), root weight (g), leaf area (cm^2) and infection % of root infecting fungi were recorded.

Statistical analysis

Data were analyzed and subjected to one way analysis of variance (ANOVA) including least significant difference (LSD) (Gomez and Gomez, 1984).

RESULTS

The combination of seeds treated with gamma rays and amended soil with nursery fertilizers showed better results in enhancement of growth parameters. Maximum germination of sunflower seeds were observed when seeds were treated with gamma rays for 2 and 16 minutes in combination with 0.1 % urea and frutan while gamma rays irradiated seeds in combination with urea, frutan at 0.01 % and DAP at 0.1 % showed maximum increment in germination of mung bean seeds (Fig 1). Plant length of sunflower were significantly ($P<0.001$) increased when 0.01 % frutan used in combination with seed treated for 2 minutes while 8 minutes of seed treatment in combination of 0.1 % urea showed greater plant length of mung bean. Similarly seed treatment for 2 and 8 minutes in combination with 0.01 % frutan and 0.1 % DAP significantly ($P<0.001$) increased plant weight of sunflower and mung bean (Fig 1). Root length of sunflower was observed to be increased significantly ($P<0.001$) when 0.01 % urea used in combination with seed treated for 8 minutes while root weight enhanced with combination of seeds treated for 2 minutes and 0.1 % frutan. However, seed treated for 2 and 8 minutes with gamma radiations used in combination with 0.01 % DAP and urea caused significant increased in root length and weight of mung bean. 16 minutes irradiation of mung bean and sunflower seeds in combination with 0.1 % DAP showed increase in leaf area followed by 16, 2 minutes seed treated in combination with 0.1 % urea and 0.01 % frutan (Fig 2).

Combined application of nursery fertilizer with gamma irradiated seeds caused greater reduction of root infecting fungi like *M, phaseolina, R. solani* and *Fusarium* spp. Complete suppression of *Fusarium* spp., was observed when urea and DAP at 0.1, 0.01 % used in combination with sunflower seeds irradiated for 2 and 16 minutes while 2 minutes gamma rays exposure of mung bean in combination of 0.1 % frutan significantly ($P<0.001$) suppressed *Fusarium* spp., and 2 and 8 minutes irradiation of sunflower seeds significantly ($P<0.001$) reduced *R. solani* infection when used in combination with 0.1, 0.01 % urea, frutan and DAP. However complete suppression of *R. solani* was observed when seeds of sunflower and mung bean treated for 16 and 8 minutes gamma rays exposure in combination with 0.1 % DAP and 0.01 % frutan. Sunflower seeds treated with gamma rays for 2, 8 and 16 minutes significantly ($P<0.001$) suppressed the infection of *M. phaseolina* when used in combination with 0.1, 0.01 % urea, frutan and DAP. However, 2 minutes irradiation of mung bean seeds in combination with 0.01, 0.1 % urea and DAP (Fig 3).

DISCUSSION

Present study describes the combined application of seeds treatment with gamma rays and fertilizers for the control of root infecting fungi viz., *Fusarium* spp, *M. phaseolina* and *R. solani* on mung bean and sunflower plants. Our main purpose for controlling plant pathogen is to improve growth quality and yield. In the present study treatment of mungbean and sunflower seeds with gamma rays for 2, 4, 8 and 16 minutes showed significant increase

in plant height and weight as compared to control. Our results supported by Gunckel and Sparrow (1961) who observed that gamma rays are known to influence plant growth and development by inducing cytological, genetical, biochemical, physiological and morphogenetic changes in cells and tissues.

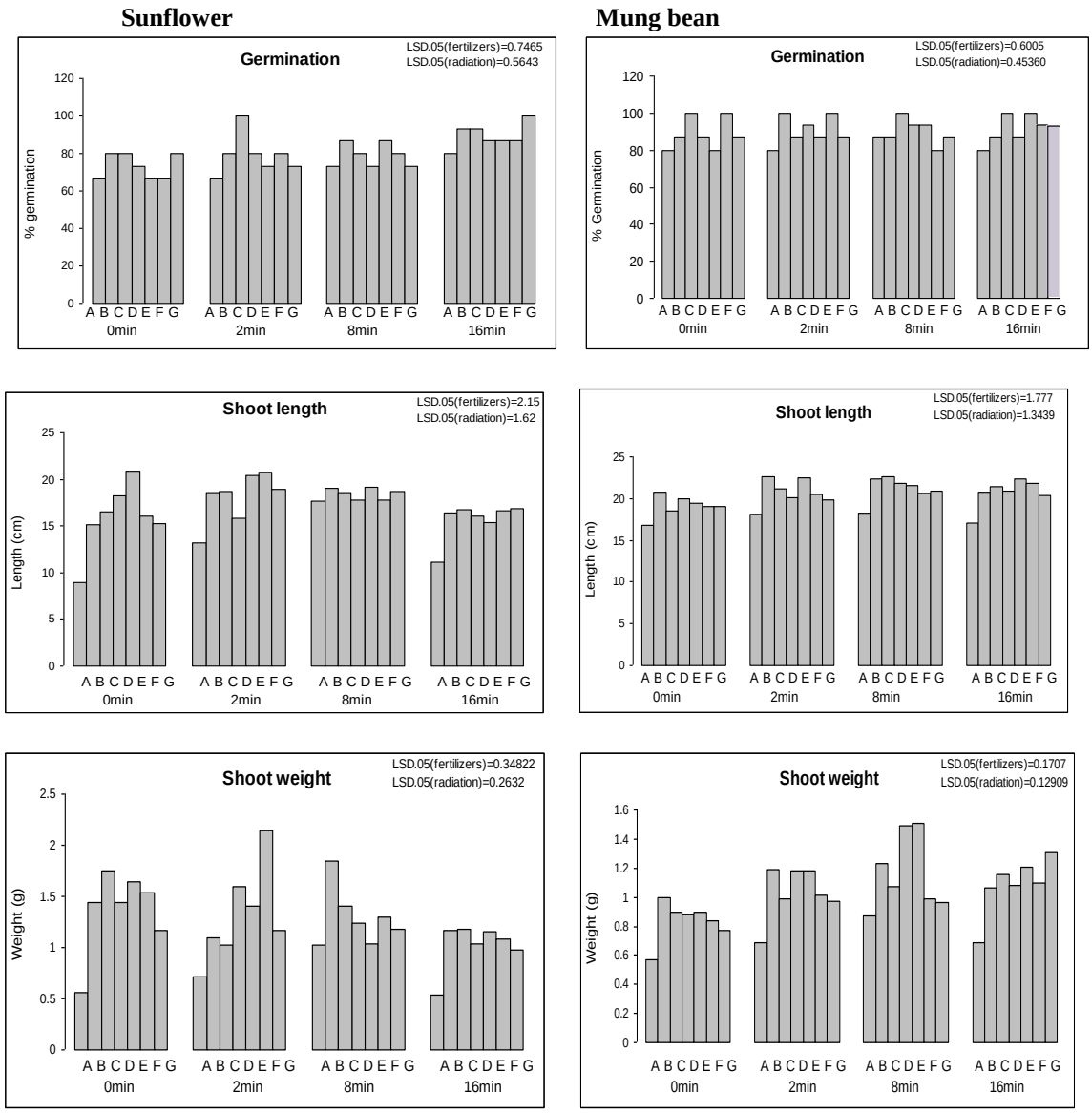

Fig. 1. Effect of different dosage of fertilizers on germination, shoot length and shoot weight of sunflower and mung bean seedlings arising from seeds irradiated with gamma rays for varying time.
A = Control, B = 0.01% urea, C = 0.1% urea, D = 0.01%DAP, E = 0.1% DAP, F= 0.01% Frutan, G = 0.1% Frutan.

Several workers have studied effect of gamma rays on seed germination of gymnosperms. Irshad *et al.* (2006) observed different local fertilizers and it was concluded that flourish, frutan, NPK, urea and fish meal enhanced the growth parameters of mung bean and okra plants. The higher exposures were usually inhibitory (Bora 1961, Radhadevi and Nayar 1996, Kumari and Singh, 1996). The higher exposures are usually inhibitor on seed germination of gymnosperm and angiosperm (Saric *et al.,* 1961; Akhaury and Singh, 1993; Thapa, 1999) whereas lower exposures are sometimes stimulatory (Taylor, 1968; Chauhan, 1978; Chauhan and Singh, 1980). Pre-sowing treatment with a magnetic field showed a positive impact on seeds of soybean, maize, peas, okra and beans leading to an increase of yield for soybean by 48%, for peas by 15%, 7% for okra by 19% and for bean by 21% (Nedialkov *et al.,*1996). Rizk and Moussa (2003) have also reported that gamma radiation doses of 2–4 kGy have been used to

successfully reduce the infection rate in sugar beet seeds. Seeds treated with gamma rays and soil amendment with nursery fertilizers significantly increases the plant height and weight as compared to control. Ikram *et al.* (2010) reported that all root infecting fungi were decreased significantly due to exposure to gamma rays on mung bean roots. Dawar and Ghaffar (2003) reported that urea showed the significant reduction in *M. phaseolina* infection on mung bean and okra. Pal and Choudhary (1980) also found that root rot disease caused by *Fusarium oxysporum* and *R. solani* reduced by the addition of mineral fertilizers. Huber (1980) observed that thicker cuticle and more schlerenchyma tissue with different nutrient regimes could be the reason of control of root infecting fungi by using of mineral fertilizers because of difficulty in penetration of pathogen.

Combined efficacy of fertilizers and gamma irradiated seeds observed to be better in increment in plant yield by increasing the growth parameters of crop and also controlled root infecting fungi upto a maximum level.

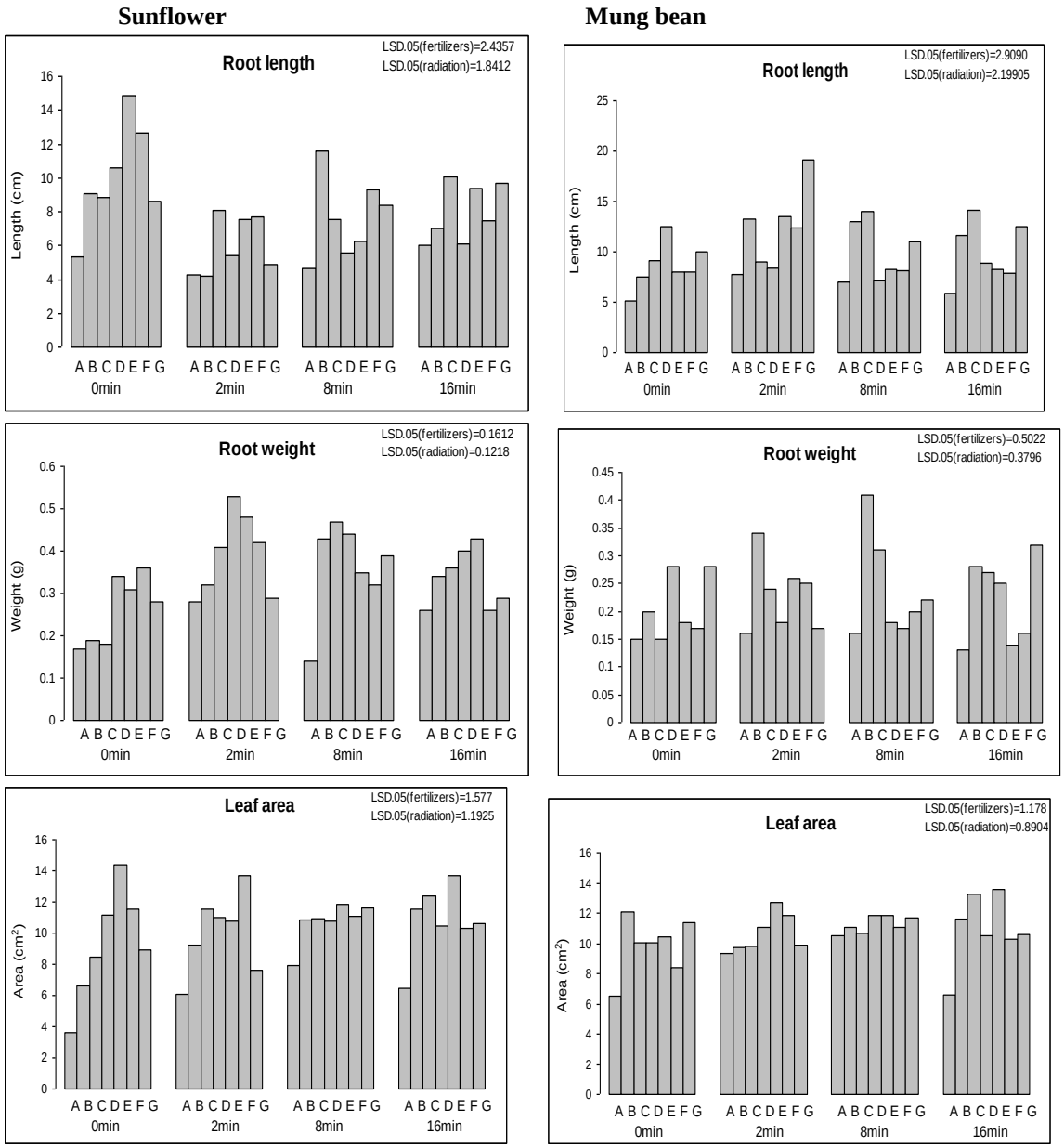

Fig. 2. Effect of different dosage of fertilizers on root length, root weight and leaf area of sunflower and mung bean seedlings arising from seeds irradiated with gamma rays for varying time.
A = Control, B = 0.01% urea, C = 0.1% urea, D = 0.01%DAP, E = 0.1% DAP, F= 0.01% Frutan, G = 0.1% Frutan.

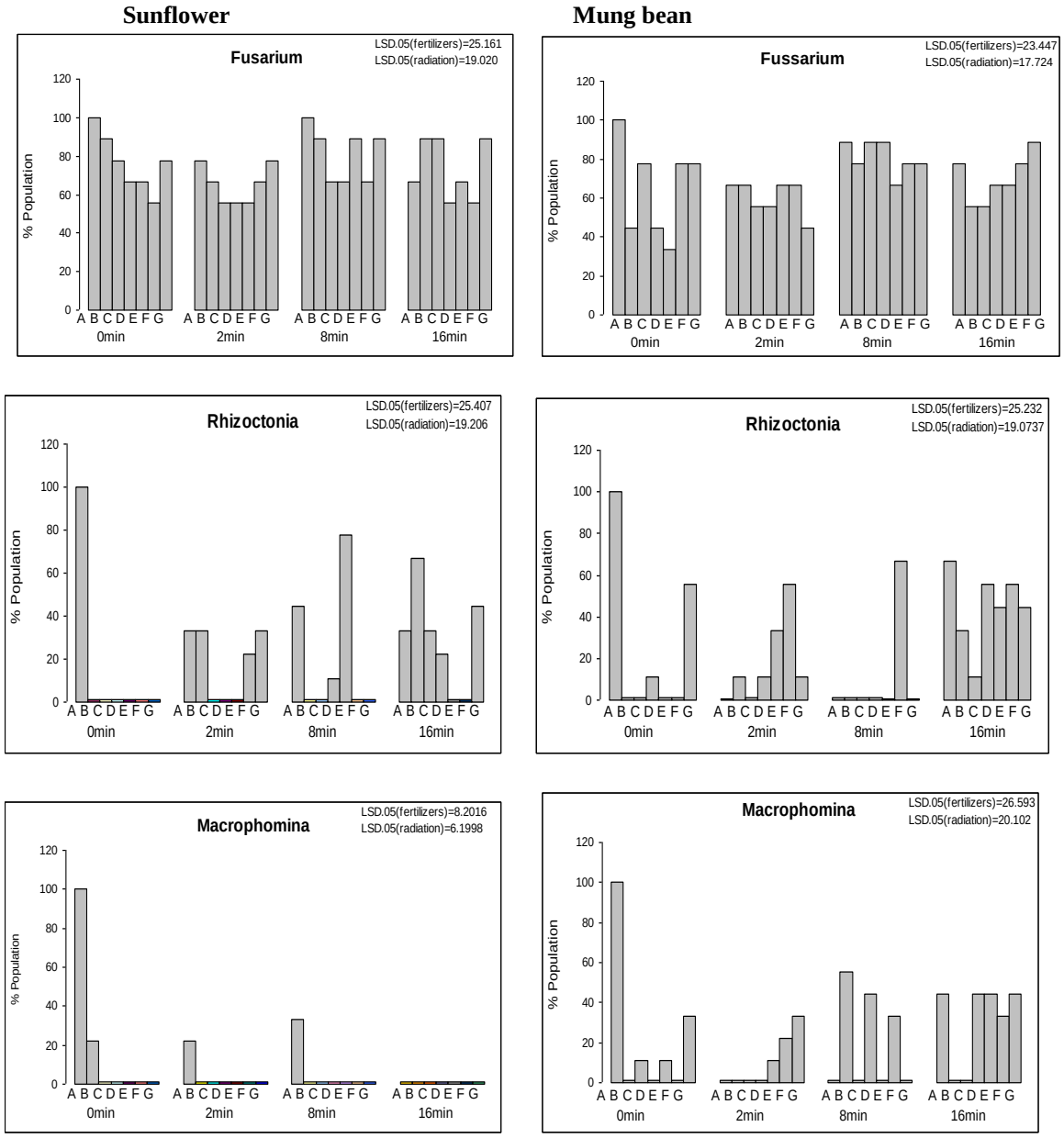

Fig. 3. Effect of different dosages of fertilizers on infection % of *Fusarium* spp., *M. phaseolina* and *R. solani* of sunflower and mung bean seedlings arising from seeds irradiated with gamma rays for varying time.
A = Control, B = 0.01% urea, C = 0.1% urea, D = 0.01%DAP, E = 0.1% DAP, F= 0.01% Frutan, G = 0.1% Frutan.

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