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Original Article

EFFECT OF RADIATION STRESS ON SOME PHYSIOLOGICAL AND CHEMICAL INDICATORS OF FENUGREEK (TRIGONELLA FOENUM GRAECUM L.)PLANT

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Abstract:-

Research into the effects of gamma rays and their ability to cause metabolic changes in fenugreek plants was the primary goal of the study. Before being sown in soil-filled plastic containers with 200 grammes of fenugreek seeds per pot, the seeds were subjected to four doses of gamma irradiation: 25, 50, 75, and 100 Gy. The pots were subsequently placed in a greenhouse. The seeds germinated after around 8 days, and the plants were left alone until they reached full maturity. Several components, including protein and proline, were tested in the leaves after about 45 days. Studies have shown that low-dose gamma irradiation increases soluble protein content in leaves and significantly increases proline content across the board, especially at 100 Gy dosages. All gamma radiation dosages reduce P+ and K+ levels.

Keywords: Fenugreek, Gamma ray, proline, protine, elements.

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INTRODUCTION

One safe and effective way to change plants' biochemical and physiological processes is with gamma radiation. It is an essential physical component that many plants rely on to improve their traits and yields. Genomic studies and plant breeding initiatives that sought to increase productivity and produce desirable traits in a wide variety of crops under both typical and extreme conditions relied heavily on gamma radiation technology (Borzouei et al., 2013). An annual herb, fenugreek belongs to the Fabaceae family of leguminous plants. One of the first medicinal herbs to be acknowledged in traditional medicine for its ability to lower blood sugar and cholesterol levels and inhibit the growth of cancer cells is fenugreek (suboh et al., 2004). Physiological and biochemical characteristics of fenugreek (Trigonella foenum-graecum L.) plants were examined in relation to the effects of gamma irradiation at various dosages in order to identify potential parameters that should be considered when assigning an appropriate radiation dose to plants.

MATERIALS AND METHODS

Fenugreek seeds collection

We measured the efficacy and germination rate of the seeds by collecting them from local markets in Babylon province, washing them, and then placing them in Petri plates with filter paper that had been wet with water. After approximately four to six days, we found that the germination rate was around 90%.

Protein content in plant

The method (Bishop et al., 1985) was used to extract and calculate total proteins. To estimate the protein content laboratory, a cold mortar and pestle was used to grind 0.5 g of fresh plant leaves with 6 ml of phosphate buffer solution (pH = 5.6) experimentally. Then, we added 2 ml of the protein extract to 8 ml of laboratory biuret reagent, and then a weight analysis of the samples was performed. A spectrophotometer was used experimentally to measure the absorbance of the studied protein samples at 555 nm. Apply a standard curve based on bovine albumin. A standard curve was used to determine total protein content.

Proline content in plant

Laboratory free proline content in leaves was measured using the method described by Bates et al. (1973). During this method, 0.5 grams of leaves used in the study were ground with 5 mL of 3% sulfosalicylic acid using a mortar and pestle method. After this procedure, 2 ml of the extract used in the experiment, 2 ml of glacial acetic acid, and 2 ml of ninhydrin reagent have already been combined. The mixture was then treated until boiling in a water bath at 100°C for 30 minutes. After cooling the samples, 6 mL of toluene was added. After that, the mixture was separated in the laboratory, and the absorbance was measured at 520 nm using an Aga spectrophotometer. Standard curve used for the purpose of measuring proline concentration.

Phosphorus (P+)

The amount of phosphorus ammonium molybdate was determined by following the steps outlined by Al-Sahaf (1989): mixing 2.5 ml of an indigestible sample with 2.5 ml of ammonium molybdate solution and 20 ml of distil water. After 30 minutes, the mixture was allowed to sit for 30 minutes, and the colour intensity was measured spectrophotometrically at 430 nm.

Potassium (K+)

In order to determine the potassium content of indigestible materials, Hornbeck and Hanson (1998) utilised a Flame Photometer.

RESULTS

Protein content(mmol/g.fw)

The total protein content in leaves produced from irradiated seeds increased to 3.081 mmol/g at 50 Gy during the laboratory experiment with a clear decrease in gamma irradiation doses, indicating a significant effect of different gamma irradiation doses on total protein content.

The total protein levels were significantly lower in the treated seeds (2.014 mmol/g) compared to the untreated control seeds (1.738 mmol/g) after exposure to the maximum dosage of gamma radiation (100 Gy).

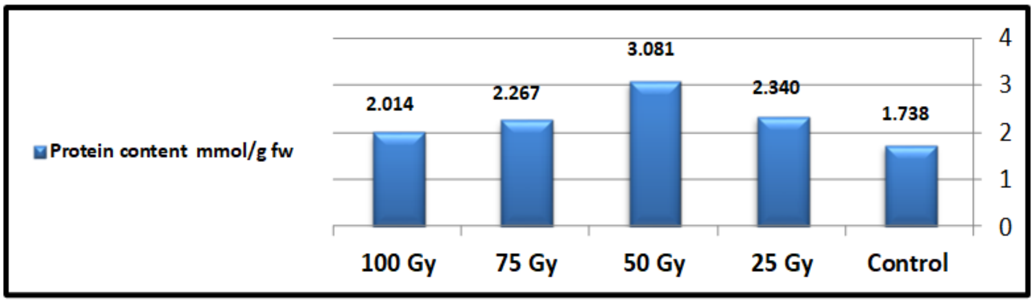

Figure 1. Effect of Gamma doses (25,50,75,100Gy) on the protein content mmol/g f.w. of Trigonella foenum-graecum L.

Proline content

Different levels of gamma radiation enhanced the proline content of fenugreek plants, resulting in a substantial rise in total proline contents (0.398 mmol/g) in 100 Gy but a decreased proline content in 25 Gy (0.218 mmol/g) when compared to untreated control plants (0.276 mmol/g).

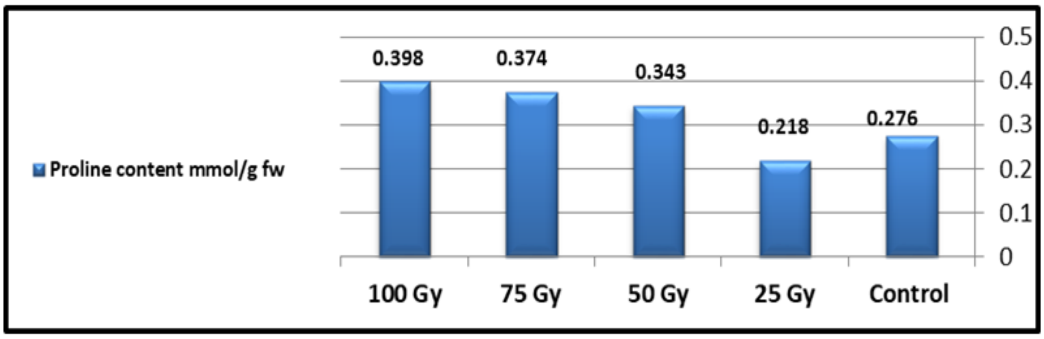

Figure 2. Effect of Gamma doses (25,50,75,100Gy) on the proline content mmol/g f.w. of Trigonella foenum-graecum L.

Phosphor content

Different levels of gamma radiation reduced the P+ concentration of fenugreek plants, with a considerable drop (0.1075 mmol/g) in 100 Gy and the greatest P+ content in untreated plants (0.2104 mmol/g).

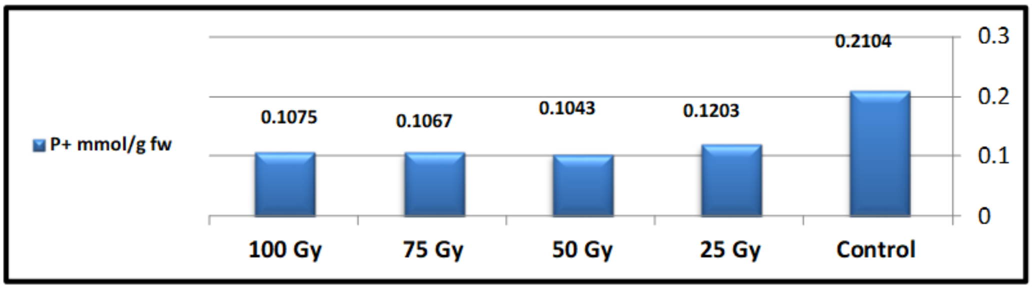

Figure 3. Effect of Gamma doses (25,50,75,100Gy) on the phosphorus content mmol/g f.w. of Trigonella foenum-graecum L.

Potassium content

Different doses of gamma radiation decreased K+ content of fenugreek plants caused significant decreased in the K+ contents (1.017 mmol/g) in 50 Gy ,but highest K+ content in untreated (2.750 mmol/g).

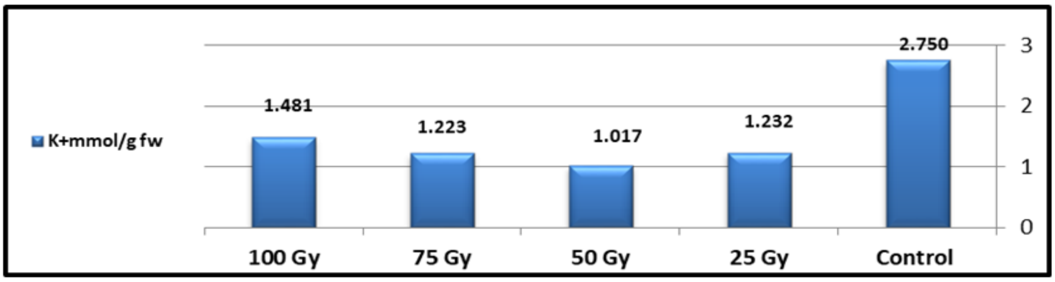

Figure 4. Effect of Gamma doses (25,50,75,100Gy) on the potassium content mmol/g f.w. of Trigonella foenum-graecum L.

Gamma radiation is a powerful agent that, depending on the dose, can alter the biochemical and physiological characteristics of plants. Protein synthesis and RNA activation can stimulate plant growth during In response to gamma radiation stress, plant cells have several defence mechanisms, one of which is the creation of defence systems (Jan et al, 2012). A protective mechanism against gamma irradiation damage that plants employ is an increase in their soluble protein content (Al-Rumaih, 2008). In reaction to dryness and external salt, plants acquire free protein. According to research conducted by Garg et al. in 2010. One of proline's main roles is to help the proteasome fix broken proteins so they may be recycled back into cellular metabolism. The results are in agreement with those of Madloom (2016), Hamad (2010), and Palmeat et al. (2009), all of which examined calluses of different plants. Many physiological processes in plants are maintained by the ion K+ (Cakmak, 2005). Enzymes rely on the cell membrane to enhance their effectiveness and the cell's turgor is a result of the membrane's role in organising ion transport proteins (Britto and Kronzucker, 2008). The maintenance of mineral content, including calcium and potassium, which are critical for enzyme function, protein synthesis, and the integrity of cell membranes and cell walls (Taiz & Zeiger, 2006). Ionic imbalances, nutritional shortages, and specific ion toxicity are symptoms that plants experience when they are under stress during development (Ashraf, 1994; Munns, 2005).

CONCLUSION

Lastly, the results show that fenugreek plants benefit from gamma radiation, even at modest levels, which improves a number of biochemical components. These parameters were most improved by 25 Gy gamma irradiation as compared to 100 Gy high dose gamma irradiation, which reduced these contents while boosting proline concentrations.

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