Plant Archives Vol. 19, Supplement 2, 2019 pp. 1569-1571 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

EFFECT OF PHYSICAL AND CHEMICAL MUTAGENS ON GROWTH PERFORMANCE OF PIGEON PEA *(CAJANUS CAJAN L.)* IN M_3 GENERATION

Mohamed Baqer Hussine Almosawi*
College of Education for pure science, AL-Muthanna University, Iraq
Corresponding author: mohbaq2121@gmail.com

Abstract

This experiment was conducted at Department of botany Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, India. During the warm season from 2017. The experiment aimed to study the effect of Gamma rays as a physical mutagens and Sodium azide (SA) and Ethyl methane sulphonate (EMS) as a chemical mutagen on Growth performance (early flowering, number of branch and height) of Pigeon pea in M_3 generation. Dry seed was divided into 10 treatments T1 Control treatment, T2, T3 ,T4 seed was treated with 0.5, 0.10 and 0.15 % EMS T5, T6, T7 seed was treated with d 0.10, 0.15, 0.20 % SA and T8 , T9 and T10 seeds were irradiated with 5, 10 and 15 KR respectively and were sown in the filed by following randomized block design. (RCBD) in farm. The results of the statistical analysis showed that chemical mutagens (EMS and SA) affected on pigeon pea and decreases flowering days. The flowering in Control treatment was 103.3 days and decreases ($P \leq 0.01$) 0.01 to 99.1, 99.1 and 96.5 days in T2, T4 and T5 also the chemical and physical mutagens decreased the number of branch and height of Pigeon pea.

***Keyword*:** physical mutagens, chemical mutagens, Growth performance, Pigeon pea.

Introduction

Pigeon pea is one of the major pulse crops of the tropics and sub tropics, and It is a favorite crop of small holder dry land farmers because it can grow well under subsistence level of agriculture and provides nutritive food (FAOSTAT, 2013) pigeon pea contains high levels of proteins and important amino acids lysine, methionine and tryptophan. Dry pigeonpea seeds contain protein (20-22%), carbohydrate (57.3%), fat (1.5%) and ash (8.1%) (Saxena *et al.* 2010), and It provides vitamin B, calcium and phosphorus and the foliage are used as fodder and milling by-products form an excellent feed for domestic animals . The green leaves and tops of plants provide excellent fodder and are also utilized as a green manure. The dried stalks are used as fuel, for making baskets and thatching material, and it also improves soil by fixing atmospheric nitrogen (Upadhyay *et al*., 2010: Gowda *et al*., 2011).

Genetic variability is fundamental to successful breeding programs in vegetatively and plants. This variation can occur naturally or can be induced through mutations, using physical, biological or chemical mutagens and has attracted the interest of plant breeders for many decades. Mutations have been used to produce many cultivars with improved economic value (TURKAN *et al.* 2006). Such as Pigeon pea (Ariraman *et al*., 2016). Ethyl methane sulphonate (EMS), a chemical mutagen of the alkylating group has been reported to be the most effective and powerful mutagen and usually causes high frequency of gene mutations and low frequency of chromosome aberrations in plants (Khatri *et al*., 2005). Sodium azide (SA), is known to be highly mutagenic in several organisms, including plants and animals. Sodium azide is a potent mutagen in microorganisms and a very efficient mutagen in barley as well as in some other crop species, and it is metabolized in vivo to a powerful chemical mutagen in many plant species, including barley, rice, maize and soybean (Gruszka *et al*., 2014). Gamma rays, an energetic form of electromagnetic radiations are known to be the most popular mutagens for their simple application, good penetration, reproducibility, high mutation frequency and less disposal problems (Ambavane *et al*., 2015). The study examined mutagenic effects of Ethyl methane sulphonate (EMS), Sodium azide (NaN3) and Gamma rays on the production performance of the Pigeon pea in M3 generation.

Materials and Methods

This experiment was being conducted during the warm season from 2017. The seeds of the pigeon pea were obtained from the Department of botany Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, India. Dry seed was divided into 10 treatments:

- T1 Control treatment.
- T2, T3 and T4 seeds were soaked in distilled water for 6 hr and was treated with different concentration of EMS 0.5, 0.10 and 0.15 % respectively.
- T5, T6 and T7 seeds were soaked in distilled water for 6 hr and was treated with different concentration of SA 0.10, 0.15 and 0.20 % respectively.
- T8, T9 and T10 seeds were irradiated with doses of 5, 10 and 15 KR gamma derived from Cobalt-60 (60CO) source with a measured dose rate of 124.5Gy/min.

After the mutagenic treatments, seeds were thoroughly washed in running water for 10 to 15 times to leach out the residual of chemicals and were sown in the filed by following randomized block design. (RCBD) In farm and After the growth of plants was measured early flowering, height of plants from base to the apex of the plant in centimeters by measuring tape and number of branch and primary branches in plant from base to apex and were selected 10 plants from each treatment randomly from the field. Each treatment was replicated 10 times, and statistical analysis was based on randomized complete block Design and using SPSS (2011), Post hoc tests were performed using Duncan's multiple range tests (1955).

Results and Discussion

Fig 1 showed the effects of Ethyl Methane Sulfonate, Sodium Azide and Gamma rays on early flowering in Pigeon pea during the M3 generation. The flowering in T1 was 103.3

days and decreases (P≤0.01) to 99.1, 99.1, 96.5 and 100.5 days in T2, T4, T5 and T6 respectively Compared with 111.0, 109.5, 107.1, 113.8 and 108.4 days in T3, T7, T9, T9 and T10 respectively.

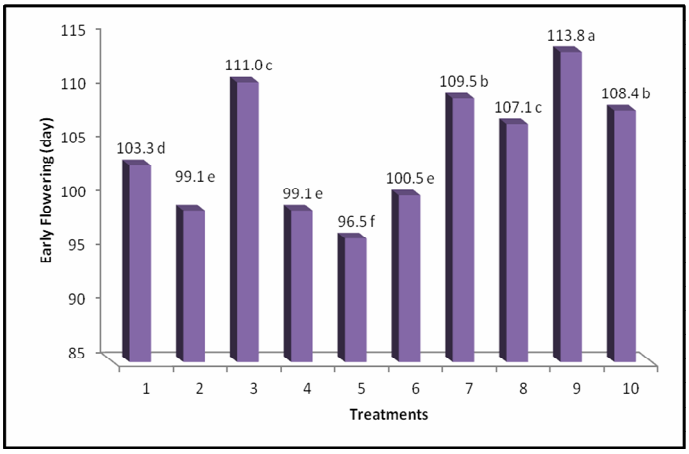

Fig. 1 : Effects of physical and chemical mutagens on early flowering in Pigeon pea (Mean ± SE)

- 1 Control treatment, 2, 3, 4 seeds was treated with 0.5, 0.10 and 0.15 % EMS 5, 6, 7 seeds were treated with d 0.10, 0.15 , 0.20 % SA and 8, 9 and 10 seeds were irradiated with 5, 10 and 15 KR respectively.
- Means with different letters significantly different at P≤0.01.

The early flowering in Pigeon pea in EMS and SA mutagens treatments consistently shifted towards earliness. It is valuable in obtaining varieties associated with escape from pests, drought and other stress injuries that occur in late growing season and caused by difference in the effects of mutagens, which interfered with seed metabolism and onset of DNA synthesis (Tambe, 2009).

The mean number of branch in Pigeon pea shown in Fig. 3 and there were significant differences in the number of branches (P ≤ 0.01). The highest value was recorded in T10 treatment (39.3 branches) Compared with 35.4 branches in T1, and the number of branches decreased significantly (P ≤ 0.01) to 24.3 and 26.9 branches in T5 and T6 respectively and There was no significant difference between the treatments T2, T3, T4, T7, T8 and T10 in the number of branches in Pigeon pea plants.

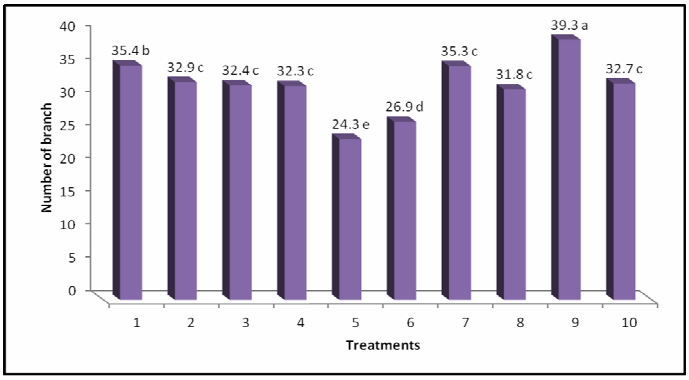

Fig. 2 : Effects of physical and chemical mutagens on the number of branch in Pigeon pea

- 1 Control treatment , 2, 3, 4 seeds were treated with 0.5 , 0.10 and 0.15 % EMS 5 , 6 , 7 seeds was treated with d 0.10 , 0.15 , 0.20 % SA and 8 , 9 and 10 seeds were irradiated with 5, 10 and 15 KR respectively.
- Means with different letters significantly different at P≤0.01.

Treatment of Pigeon pea with physical and chemical mutagens (EMS, SA and Gamma Rays) resulted a significant decrease in height of Pigeon pea was recorded 269.5 cm in T1 (Control treatment) Compared with 235.6, 215.7, 256.0, 230.1, 242.8, 255.5, 255.5, 256.5 and 244.7 cm in T2, T3, T4, T5, T6, T7, T8, T9 and T10 respectively.

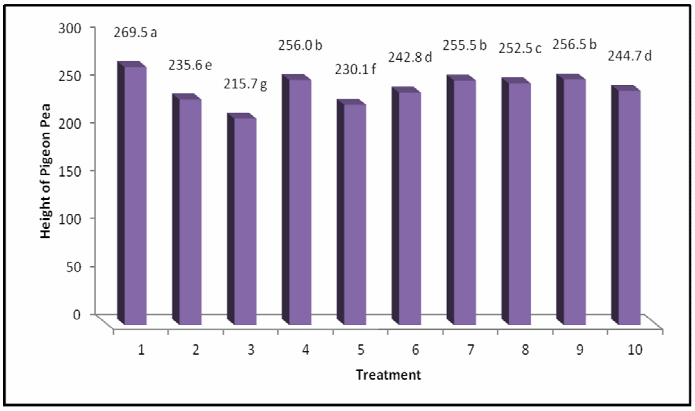

Fig. 3 : Effects of physical and chemical mutagens on height of Pigeon pea (Mean ± SE)

- 1 Control treatment, 2, 3, 4 seeds were treated with 0.5, 0.10 and 0.15 % EMS 5, 6, 7 seeds were treated with d 0.10, 0.15, 0.20 % SA and 8, 9 and 10 seeds were irradiated with 5, 10 and 15 KR respectively.
- Means with different letters significantly different at P≤0.01.

This reduction in the number of branch and height of Pigeon pea by chemical (EMS and SA) and physical (gamma rays) mutagens, which was attributed to gross injury caused at the cellular level (Markeen *et al.,* 2007). Gamma rays, being high energy ionizing radiations are known to cause extensive damage to DNA molecules by making strand breaks and disturbing sugar and bases such lethal effects of these mutagens can cause conversion of functional genes into nonfunctional ones (Gaur *et al.*, 2018) and also the decrease in on growth performance of Pigeon pea caused by Gamma Rays, EMS and SA could be attributed to physiological perturbations and partly to the chromosomal damages and according to Shukla and Dube (2016) plants height after treating with gamma rays and EMS mutagens showed lower plants height because they restricted the somatic cell division, reduced viability and increased growth abnormalities.

Conclusions

- The two chemical mutagens (EMS and SA) affected the pigeon pea and decrease flowering days.
- The chemical and physical mutagens decrease the number of branch and height of Pigeon pea.

References

Ambavane, A.R.; Sawardekar, S.V.; Sawantdesai, S.A. and Gokhale, N.B. (2015). Studies on mutagenic effectiveness and efficiency of gamma rays and its effect on quantitative traits in finger millet (*Eleusine coracana* L. Gaertn). Journal of Radiation Research and Applied Sciences. 8: 120-125.

Ariraman, M.; Bharathi, T. and Dhanavel, D. (2016). Studies on the effects of mutagens on cytotoxicity behaviour

in Pigeon pea (*Cajanus cajan* (L.) Millsp) Var. CO-7., J. of Applied and Advanced Res. 1(1): 25–28.

Duncan, D.B. (1955). Multiple range and multiple F. test. Biometerics, 11: 1- 42.

FAOSTAT (2013). Food and Agriculture Organization of the United Nations. FAOSTAT. http://faostat3.fao.org/home/index.html.

Gaur, A.K.; Singh, I.; Singh, S. and Reddy, K.S. (2018). Studies on effects of gamma ray doses on germination in pigeonpea [*Cajanus cajan* (L.) Millspaugh] under laboratory and field conditions. International Journal of Chemical. 6(4): 1975-1977.

Gowda, C.L.L.; Saxena, K.B.; Srivastava, R.K.; Upadhyaya, H.D. and Silim, S.N. (2011). Pigeonpea: From an orphan to leader in food legumes. In Biodiversity in Agriculture: Domestication, Evolution and Sustainability (Gepts P, Bettinger RL, Brush SB, Famula TR, McGuire PE, Qualset CO and Damania AB eds.). Pp 361-373. Cambridge University Press. University of California, Davis, USA.

Gruszka, D.; Szarejko, I. and Maluszynski, M. (2014). Sodium Azide as a Mutagen https://www.researchgate.net/publication/226668425

Khatri, A.; Khan, I.A.; Siddiqui, M.A.; Raza, S. (2005). Evaluation of high yielding mutants of *Brassica juncea* cv. S-9 developed through gamma rays and EMS. Pakistan Journal of Botany, 37(2): 279-284.

Markeen, K.G.; Suresh, B. and Lavanya, G.R. (2007). Effect of mutagenesis on M1 population in urdbean; Journal of Food Legumes, 20(1): 109-110.

Saxena, K.B.; Kumar, R.V. and Sultana, R. (2010). Quality nutrition through pigeon pea–a review. Health 11:1335–1344.

Shukla, M.S. and Dube, K.G. (2016). Gamma Rays and EMS Induced Morphological Parameters in *Hibiscus sabdariffa*. International Journal of Science and Research. 5(11): 1318-1324.

SPSS (2011). Statistical Package for Social Science version 20 for window LEAD Technologies. Inc. USA.

Tambe, A.B. (2009). Induction of Genetic Variability in Soybean [Glycine max (L.) Merrill.] For yield Contributing Traits. Ph.D. Thesis, University of Pune.

TÜRKAN, A.D.; Khawar, K.M.; Çiftci, C.Y. and ÖZCAN, S. (2006). Effects of Mutagenic Sodium Azide (NaN3) on In Vitro Development of Four Pea (*Pisum sativum* L.) Cultivars. Int. J. of Agri. Biol. 8(3): 349–351.

Upadhyay, B.; Dhaker, A.K. and Kumar, A. (2010). Ethnomedicinal and ethnopharmaco-statistical studies of Eastern Rajasthan, India. Journal of Ethnopharmacology. 129:64–86.