Plant Archives Vol. 19, Supplement 2, 2019 pp. 1572-1574 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

EFFECT OF ETHYL METHANE SULFONATE, SODIUM AZIDE AND GAMMA RAYS ON YIELD PERFORMANCE OF PIGEON PEA *(CAJANUS CAJAN L.)* IN M_3 GENERATION

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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 sulfonate (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 the chemical and physical mutagens affect the pigeon pea and increased number of pods per plant and Number of seed per pods. In control (T1), the number of pods was 438 .20 pods and increased significantly ($P \leq 0.01$) to 533.10 pods in T3 treatment (highest value) and 520.40, 521.70 and 442.85 pods in T8, T9 and T10 respectively. Furthermore, the highest asset value of the number of seed per pods was recorded in T10, T2 and T7 treatments and reached 4.73, 4.48 and 4.37 seed respectively compared with 4.24 seed in T1 and of Ethyl Methane Sulfonate, Sodium Azide and Gamma rays did not effect on length of pods.

***Keyword*:** Ethyl Methane Sulfonate, Sodium Azide, Gamma rays, Yield performance, Pigeon pea.

Introduction

Pigeon pea is wide-ranging in the world, and its name differs giving the country such as in India is called Toor Dal or Arhar Dal, Congo pea or Gungo pea (In Jamaica), and Cytisus Cajan (Odeny, 2007), and it is plays an important role in food and nutritional security because it is a rich source of protein, minerals and vitamins. Pigeon pea seeds are mainly consumed as pea soups and also eaten as green pea vegetable and as whole-grain preparations (Saxena *et al.,* 2010). The mutation breeding has become a proven way since the beginning of this century as one of the driving force for evolution besides creating genetic variation within the crop variety (TURKAN *et al.,* 2006) Induced mutagenesis has been recognized as the most efficient method for induction of morphological and genetical variability in plants, especially in those with limited genetic variability (Ariraman *et al.,* 2016). Genetic mutations in Pigeon pea can be stimulated by using physical and chemical methods (Oladosu *et al.*, 2016; Chen *et al.*, 2013) Ethyl Methane Sulfonate (EMS) and Sodium Azide (AS) a chemical mutagen, EMS is a powerful mutagen and usually causes high frequency of gene mutations and low frequency of chromosome aberrations in plants and has been successfully used to develop fenugreek mutants with the ability to produce early maturing mutants with a determinate growth habit, high seed yield, seed quality and adaptation to a short growing season (Khatri *et al.*, 2005; Espina *et al.,* 2018) " and AS is 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 are one of the most useful and widely used physical mutagen. During the past few decades, gamma rays had been successfully used to develop the useful varieties in cereals, pulses, oilseed and ornamental crops and can induce useful as well as harmful mutation in plants" (Gaur *et al.*, 2018) . The study aimed at determining the potential of Ethyl methane sulphonate, sodium azide and gamma irradiation in generating genetic variability that may be used in developing an improved pigeon pea with high-yield potential.

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 plants growth, The number and length of pods for 10 plants were measured randomly for each mutagenic treatment and For the observation number of seed per pod, the 100 pods of each mutagenic treatment were selected randomly, and pods were opened and number of seeds were counted for each pod and were selected the plants from each treatment randomly from the field. Statistical analysis was based on randomized complete block Design (RCBD) and using SPSS (2011) , Post hoc tests were performed using Duncan's multiple range tests (1955).

Results and Discussion

Table 1. Showed the effects of Ethyl Methane Sulfonate, Sodium Azide and Gamma rays as a mutagen on the number of pods in Pigeon pea during the M3 generation and shows a significant effect ($P \leq 0.01$) of the treatments on the number of pods. In control (T1), the number of pods was 438.20 pods and increased significantly ($P \leq 0.01$) to 533.10 pods in T3 treatment (highest value) and 520.40, 521.70 and 442.85 pods in T8, T9 and T10 respectively. As for treatments, T5, T4 and T7 Recorded lower values and reached 378.50, 267.50 and 381.40 pods respectively.

Table 1 : Effect of Ethyl Methane Sulfonate, Sodium Azide and Gamma rays on the number of pods in Pigeon pea

Treatment	Mutagen	Dose	Number of Pods
T1	Control	-	438.20 e
T2	EMS	0.05%	420.90 f
T3	EMS	0.10%	523.10 a
T4	EMS	0.15%	378.50 h
T5	SA	0.10%	267.50 i
T6	SA	0.15%	460.30 d
T7	SA	0.20%	381.40 g
T8	Gamma Rays	5 KR	520.40 b
T9	Gamma Rays	10 KR	521.70 ab
T10	Gamma Rays	15 KR	442.85 c
SEM			8.45
Sig .			**

- **T1 Control treatment, T2 , T3 ,T4 seeds was treated with 0.5 , 0.10 and 0.15 % EMS T5, T6, T7 seeds 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.**
- **SEM mean Stander Error om Means.**
- ****significant at P ≤0.01 levels.**
- **Means with different letters significantly different at P≤0.01.**

The number of seed per pod in Pigeon pea was shown in Table 2. And there were significant differences in the number of seed per pod ($P \leq 0.01$). The highest asset value was recorded in T10, T2 and T7 treatments and reached 4.73, 4.48 and 4.37 seed respectively compared with 4.24 seed in T1 and number of seed per pod decreased significantly ($P \leq 0.01$) to 4.03, 4.21, 4.11 and 4.00 seed in T3, T4, T5, T6 and T9 respectively and There was no significant difference between these treatments and T1 in the number of seed per pod Pigeon pea plants.

Table 2 : Effect of Ethyl Methane Sulfonate, Sodium Azide and Gamma rays on the number of seed per pod in Pigeon pea

Treatment	Mutagen	Dose	Number of seed per pod
T1	Control	-	4.24 cd
T2	EMS	0.05%	4.48 ab
T3	EMS	0.10%	4.03 d
T4	EMS	0.15%	4.21 cd
T5	SA	0.10%	4.11 cd
T6	SA	0.15%	4.00 d
T7	SA	0.20%	4.37 b
T8	Gamma Rays	5 KR	4.18 cd
T9	Gamma Rays	10 KR	4.28 c
T10	Gamma Rays	15 KR	4.73 a
SEM			0.25
Sig .			**

- **T1 Control treatment, T2, T3, T4 seeds was treated with 0.5, 0.10 and 0.15 % EMS T5, T6, T7 seeds 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.**
- **SEM mean Stander Error om Means.**
- ****significant at P ≤0.01 levels.**
- **Means with different letters significantly different at P≤0.01.**

Yield is a very important parameter in mutation breeding, because ultimately the plant breeder wants to improve the yield along with other beneficial traits, Number of pods per plant and Number of seed per pods is of the most important yield contributing traits, which is closely and constantly correlated with the yield per plant. Number of pods per plant and Number of seed per pods due to treatments of mutagens can be considered as evolutionary conversion of the plant habit genes carrying substantial polygenic significance stimulated by the mutagens (Barshille *et al.*, 2009) " and The enhancing effect may be due to sudden increase in the metabolic status of seedlings and increase in the activity of growth promoters (Patil, 2009)

Table 3. It showed there was no significant effect of Ethyl Methane Sulfonate, Sodium Azide and Gamma rays as a mutagen on length of pods in Pigeon pea. The length of pods reached 5.95, 5.43, 5.66, 5.69, 5.74, 5.65, 5.74, 5.78, 5.67 and 5.78 cm in T1, T2, T3, T4, T5, T6, T7, T8, T9 and T10 respectively.

Table 3 : Effect of Ethyl Methane Sulfonate, Sodium Azide and Gamma rays on length of pods in Pigeon pea

Treatment	Mutagen	Dose	Length of Pods (cm)
T1	Control	-	5.59
T2	EMS	0.05%	5.43
T3	EMS	0.10%	5.66
T4	EMS	0.15%	5.96
T5	SA	0.10%	5.74
T6	SA	0.15%	5.65
T7	SA	0.20%	5.74
T8	Gamma Rays	5 KR	5.78
T9	Gamma Rays	10 KR	5.67
T10	Gamma Rays	15 KR	5.78
SEM			0.27
Sig .			NS

- **T1 Control treatment, T2, T3, T4 seeds was treated with 0.5, 0.10 and 0.15 % EMS T5, T6, T7 seeds 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.**
- **SEM mean Stander Error om Means.**
- **NS non significant at P ≤0.05 levels.**

Conclusions

The chemical and physical mutagens affect the pigeon pea and increased Number of pods per plant and Number of seed per pods and did not affected on length of pods.

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