

Induced mutagenesis in *Cicer arietinum*

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ABSTRACTS

The traditional varieties of chick pea have low potentiality and restricted variability with respect to economic characters. Broadening the genetic base for crop improvement can be quickly achieved through induced mutagenesis. The present study was undertaken in order to comparing the effectiveness and efficiency of mutagens on *Cicer arietinum*. In this regard, Co – 4 variety of chick pea was subjected to different dose/concentration of Gamma rays (20, 30, 40, 50 and 60 kR) and Ethyl Methane Sulphonate (10, 20, 30, 40 and 50 mM) for inducing mutation. Mutagenic effectiveness and efficiency was calculated based on biological damage in M_1 and chlorophyll mutations in M_2 . The results indicated that, mutagenic effectiveness increased with the increase in dose/concentration of mutagen. Intermediate treatments in general were found more efficient in causing less biological damage and inducing maximum amount of mutations. It shows that the chemical mutagens are more effective and efficient than physical mutagen for inducing mutation in Chick pea.

Keywords: *Cicer arietinum*; Mutagenic effectiveness; Mutagenic efficiency

1. INTRODUCTION

After the discoveries of Muller and Stadler eighty years ago, a large amount of genetic variability has been induced by various mutagens and contributed to modern plant breeding. The use of induced mutation had played a major role in the development of superior plant variety for the past five decades, among them majority of the mutant varieties food crops especially cereals and pulses.

Among the pulses, Chick pea is the second largest grown food legume of the world (Gaur et al., 2008). It ranks third among pulses, fifth among grain legumes and 19th among grain crops of the world. It occupies 30 per cent of area with 38 per cent of annual production in India. Apart from the highest protein content, Chick pea has been considered for having essential elements such as calcium phosphorous, iron and vitamins such as niacin and riboflavin (Morno and Cubero, 1998; Gaur et al., 2008)

In order to induced variability and utilize useful mutation for efficient plant breeding, the systematic and comparative study of induced mutagenic effectiveness and efficiency in a

variety of crop plants and cultivars is essential. The success of any mutation breeding programmes depends on developing screening techniques to identify the desirable mutations, which occur with a very low frequency, among a large number of other mutations with little breeding value (Solanki and Sharma, 2002). A study of induced variability for chlorophyll and viable morphological mutations in the M_2 generation was the most dependable tool to utilize useful mutations for efficient crop improvement (Kumar et al., 2007). The present study was an attempt to study the response of induced mutagenesis in Chick pea (Photo 1).



Photo 1. *Cicer arietinum*.

2. MATERIALS AND METHODS

Mutagenic treatment: Seeds of Chick pea variety 'CO-4' variety from Tamil Nadu Agricultural University, Coimbatore was used present study. For EMS treatment, hundred healthy seeds of both species, presoaked in distilled water six hour and were treated with different concentrations (10, 20, 30, 40 and 50 m) of freshly prepared aqueous solution of EMS in phosphate buffer (pH 7.5) for six hour. And another set of seed were irradiated with different doses (20, 30, 40, 50 and 60 kR) of gamma rays from ^{60}Co gamma cell in Indhira Gandhi Atomic Research Center, Kalpakkam. Another hundred seeds were soaked in distilled water and used as control. The treated seeds were sown immediately after the treatment along with control. M_1 plant was harvested individually and M_2 progeny rose in separate row.

Chlorophyll and viable mutations were scored in the field. Both mutagenic effectiveness and efficiency were determined using the following formulae,

$$\text{Mutagenic effectiveness} = \mathbf{Mf/tc}$$

$$\text{Mutagenic efficiency} = \mathbf{Mf/l}$$

Mf = Percentage of families segregating for chlorophyll mutations.

t - period of treatment with chemical mutagen.

c - Concentration of chemical mutagen in terms of percentage.

l - percentage of lethality in M_1 .

3. RESULTS

The data presented in Table 1. Indicate the effectiveness and efficiency of various dose/concentrations of mutagens. Mutagenic effectiveness reflects rate of mutation in relation to mutagen dose, where as mutagenic efficiency is the mutation rate in relation to EMS and irradiation dose. Lethality or biological injury based on germination, increased with increasing dose/concentration of gamma rays and EMS. The highest lethality was observed in 50 kR of gamma rays and 40 mM of EMS.

3. 1. Mutagenic Effectiveness and Efficiency

Data on effectiveness and efficiency of various mutagenic treatments calculated on the basis of the frequency of chlorophyll mutations are given in Table 1. It was found that effectiveness and efficiency were higher at the moderate doses of gamma rays and EMS. The estimates of effectiveness ranged from 0.037 to 0.065 in gamma rays treatment, where as the effectiveness of EMS treatments ranged from 0.062 to 0.087.

The mutagenic efficiency increased dose of both gamma rays and EMS treatments. The mutagenic efficiency varies on different dose or concentration of mutagen. The highest mutagenic efficiency was observed in 20 kR of gamma rays and 20 mM and 30 mM of EMS.

Table 1. Mutagenic effectiveness and efficiency of physical and chemical mutagens in Chick pea.

Treatments	% Lethality	% Mutated families	Mutagenic effectiveness	Mutagenic efficiency
Gamma rays 30 kR	40	1.30	0.065	0.361
40 kR	44	3.54	0.051	0.334
50 kR	56	2.56	0.037	0.251
EMS 20 mM	36	2.63	0.087	0.657
30 mM	46	4.87	0.071	0.652
40 mM	62	3.10	0.062	0.055

4. DISCUSSIONS

Mutagenic effectiveness means the frequency of mutations induced by unit of a mutagen, while efficiency means undesirable biological effects like lethality and sterility caused by the mutagen (Konzak et al., 1965). The utility of a particular mutagen depends not only on its effectiveness and inducing mutation but also on its efficiency. The efficiency of a mutagenic agent is of complex nature as it does not only depend on the reactivity of the agent with the material and on its applicability to the biological system but also to the degree to which physiological damage, chromosomal aberrations and sterility are induced in addition to mutations. Higher efficiency at lower concentration of the mutagen appears mainly due to the fact that injury, lethality and sterility are induced in addition to mutations. Higher efficiency at lower concentrations of the mutagen appears mainly due to the fact that injury, lethality and sterility increased with an increase in the mutagen concentration (Khakwal, 1998 and Cheema et al., 2003). In the present study the treatment with low concentration of mutagens were found to be more effective and efficient as measured on the basis of lethality and injury than the treatments with higher concentrations. The maximum effectiveness and efficiency was observed at 30 kR of gamma rays and 20 mM EMS. When compared to physical mutagen, the chemical mutagen induces more effectiveness and efficiency.

5. CONCLUSION

Estimates of mutagenic effectiveness and efficiency for different mutagenic treatments based on the mutation frequency on M_2 plant basis. The effectiveness of mutagens indicated that 30 kR in gamma rays and 20 mM in EMS were most effective mutagen for production of morphological mutations.

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