

EFFECTS OF MUTAGENS ON POLLEN FERTILITY IN MUNGBEAN (*Vigna radiata*) (L.) WILCZEK

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ABSTRACT

A study was carried out to see the effect of chemical mutagens i.e sodium azide, (SA), Hydrazine hydrate (HZ) and Ethyl methane sulphonate (EMS) in the two varieties of Mungbean viz., Asha and K-851 in M₁ generation. The pollen fertility was dose dependent as evident from a proportionate decrease in fertility with the increasing concentrations of mutagens in both the varieties. The highest percentage of reduction was recorded in EMS followed by HZ and SA. The Variety K-851 was found to be more sensitive than Asha.

KEYWORDS: Mutagens, K-851, Asha, pollen fertility, M₁ generation

Mungbean is a self-pollinated crop, mutation breeding is an important sources of creating genetic variability. Induced mutation provided a modern and fruitful tool in crop plants for creating genetic variability (Swaminathan, 1969; Gottschalk, 1972 and Khan, 1988.)

Success of plant breeding including chemo-mutagenesis is directly dependent on the genetic variability in the source population. The major break through in plant breeding was made when man realized that main source of genetic variability was gene mutation and recombination.

Most of the plant attributes of interest to a plant breeder are qualitative Characters which are controlled by polygenic interaction. In such situation the efficiency of selecting the desire mutant is generally lower than for specific characters which are controlled by a single gene. Micromutations produce genetic variability in qualitative characters of the crop plants. Hence, they deserve full attention of plant-breeders. Such mutation should be useful for improving qualitative inherited traits (e.g. grain yield) without disturbing the major part of the genotypic and phenotypic architecture of crop.

In the present study three different chemical mutagens and two varieties of mungbean were taken to see the effect on pollen fertility. The pollen fertility is one of the most important, stable and genetically controlled character which may be considered for hybridization as well as to study the cytological effects to assess the effectiveness and efficiency of mutagens.

MATERIALS AND METHODS

Variety Asha

This variety was released in 1991 for general cultivation in irrigated areas of Haryana state. The variety is especially suitable for kharief season and semi-erect in growth habit. The seeds are medium, smooth and shining in colour. It matures in 70-75 days. Average yield is 9-11 q/ha.

Variety K-851

The variety K-851 has been developed at Kanpur. It is erect and semi-tall. The seeds are medium bold, smooth and shining green. It matures in 65-70 days. Average yield is 10-12 q/ha.

Mutagens Used

i- Ethylmethane sulphonate (EMS) - CH₃SO₂OC₂H₅.

It is a monofunctional alkylating agent causes depurination, transition and formation of triesters in the backbone of DNA molecule.

ii- Sodium azide (SA) NaN₃.

It is used as respiratory inhibitor. During duplication of DNA by base transition mechanism, it cause point mutation.

iii- Hydrazine hydrate (HZ) NH₂ NH₂ H₂O.

It is base analogue of nucleic acid and thereby causing gene mutation in the DNA molecule.

M₁ Generation

Three replication of 100 seeds each, were sown for every treatment in each variety at the University Agriculture Farm (A.M.U). The distance between seeds in a row and between the rows was kept 30 x 60 cms respectively. The remaining lot of fifty seeds were used for determining basic

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characters such as seeds germination and seedling height i.e., root and shoot length.

Seeds of each treatment with their respective controls of both the varieties were spread over moist cotten in petriplates. Finally the petriplates were kept in the B.O.D. incubator at $25 \pm 2^\circ\text{C}$. Temperature with the relative humidity of 97%..

Pollen Fertility

The pollen fertility was determined by staining the pollen grains with 1% acetocarmine solution. For this purpose 10 or 15 plants at random were selected from each treatment including their controls for both the varieties and 5 young flower buds from each plant were used for microscopic analysis. Pollen grains which took a deep stain and had a regular outline were considered as fertile, while the shrunken, empty and unstained ones as sterile.

Percentage inhibition

$$\text{Percentage injury} = \frac{\text{Control} - \text{treated}}{\text{Control}} \times 100$$

Percentage reduction

The following formula was used to calculate the percentage of pollen inhibition or injury or reduction.

RESULTS

About 3.0% percent pollen sterility was also observed in control plants but pollen fertility was dose-dependent as evident from a proportionate decreases in fertility with the increasing concentrations of mutagens in both the varieties of mungbean in M_1 generation (Table - 1). The highest percentage of reduction was recorded in EMS followed by HZ and SA. The fertility was the lowest 65.59% and 62.95% in at 0.4% EMS in the varieties Asha and K-851 respectively. It ranged from 87.66% to 65.59% in variety Asha and 84.22% to 62.95% in variety K-851. The variety K-851 was found to be more Sensitive than Asha.

DISCUSSION

Mutagenic sensitivity is an important aspect of artificial induction of mutations. Species differ with respect to their sensitivity to the action of different physical as well as chemical mutagens. In the present study, the mutagenic

sensitivity has been assessed by measuring the effects of mutagenic treatments through pollen sterility in the two varieties viz., Asha and K-851 of mungbean with three different chemical mutagens.

It was observed during mutagenic studies that EMS, SA and HZ bring about a reduction in pollen fertility. Such reductions were found to be dose dependent. An immediate consequence of the various aberrations in pollen mother cells due to mutagens could be discerned in the microspores in the form of the pollen sterility. The pollen sterility count is a better way and a dependable parameter to find out the mutagenic effects in M_1 generation.

In the present State of study, varying degree of pollen sterility has been observed in different concentration of the mutagens, where as approximately same 3-4 percent pollen sterility also occurred in control is expected due to the environmental effect The order of the amount of pollen sterility induced by the three mutagens is EMS, HZ and SA. Since SA does not induce chromosomal aberrations, its effect on pollen sterility could be attributed to gene mutations expressed as genetic or Zygotic lethality. High pollen sterility is in EMS and HZ treatments indicating that these two chemical mutagens invite a high degree of meiotic abnormalities.

Table 1 : Effect of mutagens on pollen fertility in M_1 generation of Mungbean

Treatment	Var. Asha		Var. K 851	
	Pollen fertility	Percentage of reduction	Pollen fertility	Percentage of reduction
Control	98.05	-	96.65	-
0.1 % EMS	87.56	10.61	84.22	12.86
0.2 % EMS	79.80	18.61	75.99	21.37
0.3 % EMS	71.12	27.46	69.29	28.30
0.4 % EMS	65.59	33.10	62.95	34.86
0.01 %SA	89.96	9.25	87.36	9.61
0.02%SA	82.39	15.97	79.55	17.69
0.03%SA	76.69	23.09	73.61	23.83
0.04%SA	69.98	28.62	66.57	31.12
0.01%HZ	88.19	10.05	85.97	11.05
0.02%HZ	79.99	18.41	77.28	20.04
0.03%HZ	72.26	26.30	70.89	26.65
0.04%HZ	66.47	32.20	64.67	33.08

Dose dependent increase in pollen sterility and a positive and significant correlation between chromosomal abnormality and pollen Sterility was reported earlier and in conformity with the present work (Kallo and Das, 1971 ; Nerker ,1977 ; Ingacimuthu and Babu, 1988;Grover and Tejpaul, 1980 ; Khan and Siddiqui, 1988, Khan et al., 1994 ; Khan et al. ,1998.)

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