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FREQUENCY OF COTYLEDONARY AND LEAF ABNORMALITIES IN M_1 GENERATION OF MUNGBEAN

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ABSTRACT

Present investigation was carried out to see the effect of chemical mutagens viz., Ethyl methane sulphonate (EMS), Sodium azide (SA) and hydrazine hydrate (HZ) on the frequency of cotyledonary and leaf abnormalities in M1 generation of mungbean. These abnormalities were recorded in the population of both the varieties treated with EMS and HZ. The frequency of abnormalities in both the varieties was found to increase with the increase in concentration of mutagens. It was the highest in variety K-851 followed by the variety Asha. In variety Asha, it ranged from 0.33 to 2.66% with EMS, while in case of HZ, a range of 0.33 to 1.66% was recorded. Where as in Sodium azide (SA), treatments did not induce leaf abnormalites in variety Asha, but in variety K-851 0.04%, SA showed leaf abnormalities.

KEYWORDS : Chemical Mutagens, Leaf Abnormalities, Mungbean

Mungbean is self-pollinated crop; mutation breeding is an important source of creating genetic variability. Induced mutation provided a modern and fruitful tool in crop plants for creating genetic variability Success of plant breeding including chemo-mutagenesis is directly dependent on the genetic variability in the source population. The major breakthrough in plant breeding was made when man realized that main source of genetic variability was genetic 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 character 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 architedure of crop. In the present study three different chemical mutagens and two varieties of mungbean were taken to see the effect on cotyledonary and leaf abnormalities in M_1 generation of Mungbean to assess the effectiveness and efficiency of mutagen.

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 kharif 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 9-11q/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 shinning green. It matures in 65-70 Days. Average yield is 10-12q/ha.

Mutagen used

i-Ethylmethane sulphonate (EMS) $Ch_3\ So_2O\ C_2H_5$-

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

ii Sodium azide (SA) NAN_3

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

iii- Hydrazine hydrate (HZ) $NH_2\ NH_2\ H_2O$

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

M_1 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 30x60 cms respectively. The remaining lot of fifty seeds was used for determining basic character such as seed germination and seedling height i.e. roots and shoots length.

Seeds of each treatment with their respective controls of both the varieties were spread moist cotton in petriplates. Finally the petripates were kept in the B.O.D

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incubator at 25 +-2`C. Temperature with the relative humidity of 97%.

Morphological abnormalities

The plates showing abnormalities in cotyledons and leaves were recorded in the field. The frequency of cotyledonary abnormalities and of the abnormalities in size and shape of leaves in various treatments was calculated by the formula given blow-

$$\text{Cotyledonary abnormality Or Leaf abnormality} = \frac{\text{No. of seedling showing cotyledonary abnormality Or No. of seedling showing leaf abnormality}}{\text{Total No of } M_1 \text{ Seedlings}} \times 100$$

RESULTS

The frequency of cotyledonary abnormalities such as seedlings with one cotyledonary leaf, three and four cotyledonary leaves were recorded in M_1 generation. (Plate 1)

These abnormalities were recorded in the population of both the varieties treated with EMS and HZ. The frequency of abnormalities in both the varieties was found to increase with the increase in concentrations of mutagens. In variety Asha, it ranged from 0.33 to 2.66% with EMS treatment, while in case of HZ, a range of 0.33 to 1.66% was recorded from 0.02 to 0.04% respectively. No such abnormalities in cotyledons were recorded for SA treatments except in the variety Asha at 0.04% SA. The cotyledons in other treatments were as normal as those of control, where as various kind of leaf abnormalities such s damage in shape, size and number (uni-,bi-,tetra and pentfoliate) were also observed in treated plants. However the frequency of these abnormalities was greater at higher concentrations of mutagens in both the varieties. (Table 1)

It was the highest in Variety K-851 followed by the variety Asha. Sodium azide (SA) treatments did not induce leaf abnormaly in Variety Asha, where as in variety K-851 0.04% SA showed leaf abnormalities. A brief account for each type is given below:

a) Narrow leaflets

Few plants with narrow leaflets were encountered in the EMS and HZ treated population in both the varieties.

b) Unifoliate

Different treatments of EMS and HZ caused leaves to form a single leaflet (the leaf appearing to be simple, instead of being trifoliate as in the control). The leaves were

Table 1 : Frequency of Cotyledonary and Leaf Abnormalities in M_1 Generation of Mungbean

Treatment	Cotyledonary abnormalities (%)		Leaf abnormalities(%)	
	Variety Asha	Variety K-851	Variety Asha	Variety K-851
Control	-	-	-	-
0.1%EMS	0.33	0.33	4.66	5.00
0.2%EMS	0.66	0.66	5.33	5.66
0.3%EMS	1.66	3.33	6.33	6.00
0.4%EMS	2.66	4.66	7.33	7.33
0.01%SA	-	-	-	-
0.02%SA	-	-	-	-
0.03%SA	-	-	-	-
0.04%SA	0.66	-	-	0.33
0.01%HZ	-	-	-	3.33
0.02%HZ	0.33	-	3.33	4.66
0.03%HZ	0.66	-	4.66	5.66
0.04%HZ	1.66	0.33	5.00	6.33

Leaves of Control and Treated Population of Mungabean with varied number of leaflets.
Figure 1 : Control (Trifoliate)
Figure 2 : Lobed Leaf
Figure 3 : Tetrafoliate
Figure 4 : Pentafoliate

broader, thicker and with wavy margins, compared to those of control.

c) Bifoliate

Bifoliate leaves were recorded with all the treatments of EMS and HZ and in both the varieties, their frequency showing a positive correlation with the mutagenic concentrations. All floral parts were modified into leafy structures.

d) Multifoliate

Plants with multifoliate (tetra and pentafoliate) leaves were more frequent in occurrence at higher concentrations of mutagens in both the varieties viz, Asha and K-851. Such plants were vigorous in growth.

DISCUSSION

In the current study the cotyledonary leaf abnormalities such as mono-, tri-, and tetracotyledons were observed in both the varieties of the mungbean are the common effects of mutagens, confirming the results obtained in various crops by several workers such as rice (Yamagata, 1966; Bose and Chowdhury, 1968), sorghum (Ramulu, 1970), lentil (Sharma and Kant, 1975) and mungbean (Chaturvedi and Singh, 1981).

Inhibition of ATP production, reduction in DNA synthesis and mitotic index due to chemical mutagens, as reported by (Kleinhofs et al., 1978), may also be partly responsible for seedling injury. Napp-Zinn, 1955) held a similar view that the growth, hormone in the treated materials mainly, may be responsible for these cotyledonary abnormalities, beside the other factors.

The presence of single cotyledonary leaf in some seedlings may be due to either cytochemical disturbances or to the acute chromosomal aberrations leading to the death of leaf primordial or of the embryonal cells responsible for leaf development. The formation of an extra cotyledonary leaf, on the other hand, indicates the formation and involvements of additional leaf primordia or the embryonal cell.

Leaf abnormalities such as mono-,tetra-, and pentafoliate was among the most common abnormalities noticed in almost all the treatments of EMS and HZ in the present investigation. Previously, the cause for these abnormalities were attributed to the mutagenic treatments to different crop plants such as *Brassica napus* (Fowler and Stefansson, 1972, *Vigna mungo* (Apparao and Jana, 1976), and *Vigna radiata* (Chaturvedi and Singh, 1978; Chandra et al., 1978; Grover and Virk, 1984).

Factors held responsible for the induction of leaf abnormalities are not clearly well known. But Rao, 1972 reported that the leaf abnormalities were due to several environmental factors such as fertility of soil, availability of water and degree of luxuriance during growth. However, Hagen and Gunkel, 1958 found that concomitant with the occurrence of leaf anomalies the free amino acid content of the leaves increased. (Blixt, 1972) state that leaf aberration seemed to be closely related to the actual mutation process

and these are most easily induced in leguminous plants. The altered metabolism as a result of cellular damage may also be one of the reason for leaf abnormalities.

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