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## Chlorophyll and morphological mutants of Pearl millet (*Pennisetum typhoides* (Burn.) stapf. Var. CO(cu)9

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### ABSTRACT

Chlorophyll and morphological mutants play an important role to assess the dose/concentration of mutagens. *Pennisetum typhoides* variety CO (cu)9 were treated with Gamma rays and EMS. The seeds were treated with different concentration of gamma rays such as 10, 20, 30kR and 20, 30, 40mM of EMS. In the present investigation, three chlorophyll mutant and twenty morphological mutants were observed in M<sub>2</sub> generation. The mutants are Albino, Xantha, Viridis, Tall, Dwarf, Bushy, Brittle stalk, Barren stalk, Tillers, Narrow leaf, Lazy, Zebra striped, Brevis, Male sterile, Nana dwarf, Crinkly leaf, Brachytic, Early maturity plants, Late maturity plants, Long panicle, Small panicle, Bold seeded and Small seeded. EMS provided more number of chlorophyll and morphological mutants followed by gamma rays in the investigation.

**Keywords:** Chlorophyll mutants, Morphological mutants, EMS and Gamma rays.

### INTRODUCTION

Pearl millet (*Pennisetum typhoides*) is the most widely grown type of millet. Because of its tolerance to difficult growing conditions such as drought, low soil fertility and high temperature. The physical and chemical mutagens induce different mutation spectra (1). Environmental conditions may markedly affect the expression of chlorophyll deficient mutants (2).

The induction of mutations as a technique for crop improvement occupies a significant place among modern methods of plant breeding. The induced mutations are of considerable value for comprehension, evaluation and accelerating the process of plant improvement. Chemical mutagens are the most widely used as compared to ionizing radiations, as they induced more viable mutants (3).

Chlorophyll mutations are considered as the most dependable indices for evaluating the efficiency of different mutagens in indicating the genetic variability for crop improvement and are also used as genetic markers in basic and applied research. The occurrence of chlorophyll mutations after treatments with physical and chemical mutagens have been reported in several crops (4, 5, 6, 7, 8, 9, 10).

In general any mutational event may bring large or small changes in the phenotype the changes in macro mutants have highest significance in plant breeding because they may sometimes give a desired phenotype. Thus a number

of new commercial varieties have been originated from induced macro mutants. The present study has been made to see the frequency and spectrum of viable mutants in M<sub>2</sub> generation of Pearl millet (*Pennisetum typhoides*) Var.CO(cu) 9.

### MATERIALS AND METHODS

In this research, the seeds of (*Pennisetum typhoides* (Burn.)Stapf. Var.Co(Cu)-9 have been selected to induce chlorophyll and morphological mutation. The seeds of Co (Cu)-9 Variety from Tamilnadu Agricultural University, Coimbatore was used for the present study. The seeds irradiated with different doses (10, 20 and 30kR) of gamma rays from <sup>60</sup>CO from The Sugarcane Breeding Institute, Coimbatore. For EMS treatment, healthy seeds were treated with different concentrations of ( 20, 30 and 40mM). The treated seeds were carefully removed from the solution and they were thoroughly washed in tap water for two to three times. The field experiment was carried out in the Botanical garden of Botany Department, Annamalai University, Annamalai nagar in a complete Randomized Block Design (CRBD) with three replication. The spacing was maintained at 30cm (Between the rows in a row) and 15cm (between plant to plant ) in the field. The M<sub>1</sub> plants were harvested separately and the plant progenies were raised in M<sub>2</sub> generation. The control and treated progenies were screened several times for morphological mutations throughout the crop duration. Chlorophyll mutants were scored at seedling stage of 8-15 days old. They were identified and classified according (11).

### RESULTS AND DISCUSSION

In present investigation various types of chlorophyll and morphological mutants such as Albina, Xantha, Viridis, Tall, Dwarf, Bushy, Brittle stalk, Barren stalk, Tillers, Narrow leaf, Lazy, Zebra striped, Brevis, Male sterile, Nana dwarf, Crinkly leaf, Brachytic, Early maturity plants, Late maturity plants, Long panicle, Small panicle, Bold seed and Small seed could be detected at seedling stage in M<sub>2</sub> generation. The data pertaining to the mutation frequency and spectrum of chlorophyll and morphological mutant was recorded in all the treatments (Table1).

#### Chlorophyll mutant

##### Albino

Albino- white, lethal, no chlorophyll (or) carotenoides is found. Albina seedlings are smaller in height and survive to a maximum of 20 days after germination and they die.

##### Xantha

Carotenoid pigment predominantly found. But chlorophylls are not formed. These mutants survived for 30-35 days and become stunted growth.

##### Viridis

The seedlings are dark green in the early stages of development and turn normal green in the later stages.

#### Morphological mutant

##### Tall

Plant was very height more than the control.

##### Dwarf

Plant was very short with broad thick leaves compared to the control plant.

##### Bushy

Dwarf with higher number of tillers per plant.

##### Brittle stalk

Stalks and leaves easily broken under pressure.

##### Tillers

Plant was very height more than 8 to 12 tillers per plant.

**Barren stalk**

No panicle develops. These plants are female sterile. Stalks lack concave depression at ear node.

**Male sterile**

One of several genes which causes pollen to abort. Anthers are shriveled and may or may not exert.

**Nana dwarf**

Plants are one-fourth to one-third normal height. Leaves are short, stiff and twisted.

**Crinkly leaf**

Plants somewhat shorter than normal. Leaves have characteristic crinkled appearance at the base.

**Brachytic**

Silk internodes and shortened.

**Narrow leaf**

Plants have narrow leaf blades. They are generally weaker than normal. Leaves tend to be striated longitudinally.

**Lazy**

Plants develop normally except they tend to grow earthward rather than upright. Stalks of “lazy” plants are as strong as normal, upright plants.

**Zebra striped**

Leaves of almost mature plants have chlorotic cross bands.

**Brevis**

Plants about one half normal height due primarily to shortened internodes in the region of distillate inflorescence.

**Early maturity plant**

This mutant line was early matured. 10 days earlier in comparison to the control plant.

**Late maturity plant**

Late maturity as well as late flowering.

**Long panicle**

Long panicle and high yielding.

**Short panicle**

Short panicle and low yielding.

**Bold seeded**

Seeds are big in size. High seed weight and high yielding.

**Small seeded**

Seeds are small in size and low seed weight.

**Frequency of chlorophyll and morphological mutants**

Micro and macro mutants play an important role to assess the dose/concentration of mutagens. Almost all the mutagenic treatments showed different degree of mutants with respective dose. In the present investigation, the maximum mutation frequency was observed in 20kR (20.71%) of gamma rays and 30mM (23.39%) of EMS. The minimum mutation frequency was observed in 10kR (16.41%) of gamma rays and 20mM (17.46%) of EMS (Table-1). Among all the mutagens tested EMS induced maximum frequency of chlorophyll mutations indicating their greater effectiveness (12). This is an agreement with earlier report (13) in *Pennisetum typhoides*. Higher mutation frequency and a wider spectrum of chlorophyll mutants in chemical mutagen have been reported by (14, 15, 16, 17) and respectively. The highest mutation frequency was noted in EMS (30mM) than other dose of mutagens. Bushy,

tall, dwarf, early maturity and sterile mutants were more in EMS than SA treatments in Lentil on M<sub>2</sub> generation (10 and 18). Albino, Xantha, Viridis, Dwarf, Tall, Bushy, Male sterility, Early maturity were more in EMS than Gamma rays in Black gram (19). EMS was to be higher superior to gamma rays including a higher frequency and wider spectrum of chlorophyll mutations in M<sub>2</sub> generation (20).

**Table-1** Frequency of chlorophyll and viable mutants in M<sub>2</sub> generation

Mutagen	Gamma rays			EMS		
Dose/Concentration	10kR	20kR	30kR	20mM	30mM	40mM
No. of plants studied/mutants	390	362	354	378	342	336
Albino	2	3	5	3	4	7
Xantha	4	5	5	5	5	6
Viridis	5	6	5	6	6	7
Tall	2	4	3	3	6	2
Dwarf	2	2	4	2	2	3
Bushy	3	5	2	3	4	2
Brittle stalk	1	2	3	2	1	3
Tillers	3	4	1	4	3	1
Narrow leaf	2	4	3	2	4	2
Lazy	3	2	3	2	3	4
Zebra striped	2	3	2	4	4	3
Brevis	4	2	3	2	3	2
Barren stalk	3	6	2	2	4	-
Male sterile	3	2	3	4	1	3
Nana dwarf	2	1	3	2	2	3
Crinkly leaf	2	2	2	2	2	2
Brachytic	2	2	-	3	3	1
Early maturity plants	3	4	2	2	5	2
Late maturity plants	4	2	3	2	2	3
Short panicle	3	2	3	4	2	3
Long panicle	2	5	2	2	6	3
Bold seed	4	5	2	2	5	2
Small seed	3	2	4	3	3	3
Total	64	75	65	66	80	67
Percentage of mutation frequency	16.41	20.71	18.36	17.46	23.39	19.94



**BRITTLE STALK (40mM)**



**LONG PANICLE (20kR)**



**TALL (20kR)**



BUSHY (30mM)



LAZY (10kR)



STERILE (40mM)



TRILLERS (20kR)



ALBINO (10mM)



XANTHA ( 20mM)

#### Photo-Chlorophyll and morphological mutants of Pearl millet

In the present investigation, EMS was found to be more effective and efficient mutagen. It may be due to differential action of EMS on DNA. Similar results have been reported by (21) in *sorghum bicolor*. EMS has been also reported as the most effective and efficient mutagen in comparison to DES and Gamma rays in rice (22).

#### CONCLUSION

The frequency of chlorophyll mutants was concentration/doses dependant. The increase in chlorophyll and morphological mutation frequency was recorded with increase concentration/doses of all mutagens. In the present study it can be concluded that chemical mutagens are more effective in including maximum frequencies of chlorophyll and morphological mutant was observed in pearl millet. Morphological mutants are viable and useful to breeding approach to obtain suitable ideotype in pearl millet. Hence, mutant and its derivatives when used in cross breeding have found to be more productive in the development of improved varieties of pearl millet.

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