

Ethyl Methane Sulfonate (EMS) Effect on Mutagenesis in Balinese Red Rice (*Oryza sativa* cv. Barak Cenana)

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ABSTRACT

Background and Objectives: “Barak Cenana” is one of the local red rice (*Oryza sativa*) which has high economic value due to its nutrient content. Some of agronomic characters such as tall shoot, low number of tiller and late harvesting are a drawback to improve its production. Ethyl Methyl sulfonate (EMS) is a chemical mutagen widely used to improve rice characters by mutation breeding. The aims of present research are to investigate the EMS concentration that suitable to induce mutation in Barak Cenana, and observed the mutagenesis effect of EMS on some agronomic characters of Barak Cenana. **Materials and Methods:** For those purpose, mature seeds of Barak Cenana were treated with various concentrations of EMS (0.25, 0.5, 0.75, 1.0 and 1.0 %) for 24 hour. Seed germination, plant growth, some agronomic character related to productivity were compared to untreated rice. **Results:** EMS reduced and delayed seed germination and inhibit shoot and root growth in early vegetative stage. The ability of EMS to reduce and delay seed germination and inhibit shoot and root growth are doses dependent. EMS concentration more than 1.0% is lethal for Barak Cenana and EMS concentration at 0.75% was able to reduce rice productivity by increasing seed sterility. EMS concentration between 0.25 and 0.5% are suitable for induce mutagenesis in Barak cenana. **Conclusion:** Some mutants with distinct morphology such as sterile plant, semi-dwarf, and high chlorophyll contents were produced in this research.

Keywords: Barak Cenana, Balinese red rice, chemical mutation, EMS

Introduction

Barak Cenana is a Balinese red rice variety which is still cultivated in the Tabanan district of Bali-Indonesia. growth (180-190 days plant age before ready to harvest), low numbers of tillers Barak Cenana is rich in vitamin B and anti-oxidant in the form of anthocyanin, and for that reason, it has high market value. However, its slow and its height (> 170 cm) are major drawbacks in this variety.

Increasing the genetic variation by mutation has been used for crop improvement [1]. The benefit using mutation in plant breeding is able to introduce new traits which are not exist in nature before.

The optimum concentration of EMS used to induce mutation in rice has been found to vary from 0.1% to 2%, depending on the rice cultivar[2]. These findings suggest that the optimum EMS concentration must be determined for each specific rice cultivar. However, no study has yet examined the EMS concentration on Barak Cenana, despite its economic importance.

Objective

To study the effect of various concentration of EMS to phenotype changes of Barak Cenana red rice mutants, both in the vegetative and reproductive stage.

Methods

SEED TREATMENT by EMS (24 hours)

0% 0.25% 0.5% 0.75% 1.0%

germination

- Date of germination
- % germinate
- % survived mutant seedling

Vegetative growth of Red Rice

- Plant height
- Productive tillers
- Date of flowering

Reproductive growth of Red Rice

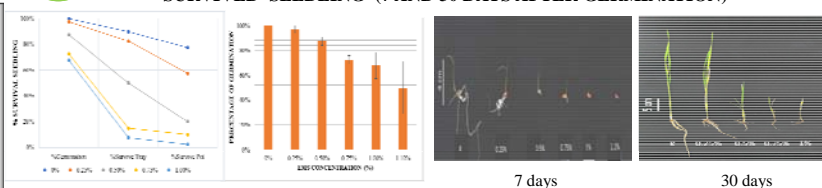
- Pollen viability test
- Number of grain
- % filled grain
- Weight of filled grain per clump
- 1000 grains weight

ACKNOWLEDGEMENT

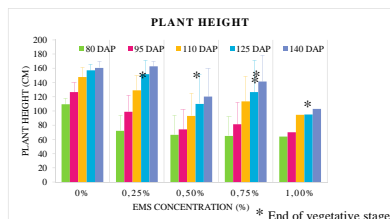
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Results

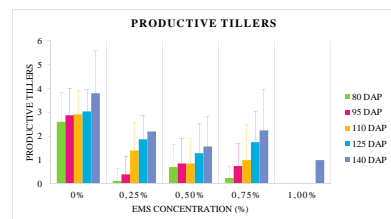
SURVIVED SEEDLING (7 AND 30 DAYS AFTER GERMINATION)



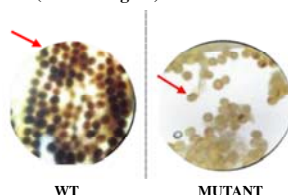
PLANT HEIGHT



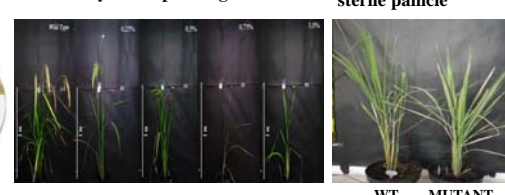
PRODUCTIVE TILLERS



POLLEN VIABILITY TEST (+I2KI reagent)



PLANT MORPHOLOGY at 140 days after planting



PUTATIVE MUTANT; semi-dwarf & sterile panicle

Conclusion

- EMS mutagen (0.25-1.00%) for 24 hours reduces the seed germination and inhibit rice growth at early vegetative stage.
- Some putative mutants produced in this research has a potential to be used to improve Barak cenana productivity, such as sterile panicle and semi-dwarf.

References

- Alodasu, Y., Rafi M.Y., Abdullah N, Hussin G., Ramli A., R H.A., Miah G., Usman M. 2016. Principle and application of plant mutagenesis in crop improvement: a review. Biotechnology and biotechnological equipment 30 (1): 1-16.
- Mohapatra T., Robin S., Sarla N., Sheshashayee M., Singh A.K., Singh K., Singh N.K., Mithra S.V.A., Sharma R.P. 2014. EMS Induced Mutants of Upland Rice Variety Nagina22: Generation and Characterization. Proc Indian Natn Sci Acad 80 (1): 163-172.