Effect of Gamma Rays Irradiation and Its Effect on Early Growth Stage of True Shallot Seed (*Allium cepa* (L.) Bauji Variety)

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**Abstract:** Bauji variety onion plants are able to produce fertile TSS and have 80% growth capacity, but the strength of Bauji TSS seeds is only 60% alive. This study with Gamma Cobalt 60 ray aims to determine the effect of gamma cobalt 60 rays at the right dose of Lethal values 50% dosage (LD50) to improve seed vigor (growing strength) and have the potential to get superior mutants. The research method used was a single Randomized Complete Design (CRD), with 6 treatments and was repeated 3 times, while the treatments used were, R0: seed without radiation, R1: seed resulting from Co-60 gamma ray radiation with a radiation dose of 5Gy; R2: seeds resulting from Co-60 gamma radiation with a radiation dose of 15Gy; R3 = seed resulting from Co-60 gamma radiation with a radiation dose of 25Gy; R4: seeds of Co-60 gamma radiation results with a radiation dose of 35Gy and R5 = seeds of Co-60 gamma radiation results with a radiation dose of 45Gy.

The parameters observed were the percentage of germination, TSS growth rate, plant growth rate, the results obtained that gamma ray cobalt-60 doses of 5 Gy and 15 Gy have radiosensitivity of LD50 values are doses that can be recommended in improving seed quality. The LD50 value of this TSS Seed is a linear Curve with \( r = 0.42777807 \) LD 50 = 24.6982 Gy, LD 20 = 116.619 Gy

**Keywords:** Shallot (*Allium ascalonicum* L.), Radiation, Growth, Yield

I. INTRODUCTION

Red onions (*Allium ascalonicum* L.), currently can be cultivated generatively or with seeds or what is known as TSS (true shallot seed), cultivation with TSS is still very rare because the quality of the seeds is still low, but planting with seeds has several advantages. among others, the need for seeds does not need special storage space, plants are resistant to pests and diseases.

The use of True Shallot Seed TSS in Indonesia has not yet developed the cause, among others, because its availability as a source of healthy seeds and high yielding power is still scarce (limited) because not many are producing it. Likewise, good and efficient seed production techniques and tuber production techniques from seed origin are still not fully understood. This is because the quality of TSS seeds is still low

Retno's research (2014) states that the local Nganjuk variety Bauji can produce tss fertile seeds, meaning that the seeds can germinate up to 80% but their vigor is still low, therefore mutation induction with gamma cobalt 60 radiation can create new diversity as a basis for selection.

Mutation breeding is very effective in increasing genetic diversity in plants that have characteristics such as shallots. This method is able to create a large genetic diversity in a shorter time than hybridization. Mutation induction can be done by using the vegetative or generative parts of the plant. In addition to being an effective way to increase genetic diversity, plant breeding with...
induced mutations can also enrich existing germplasm and improve the characteristics of local varieties (Mugiono, et al. 2009) Plants have different responses to gamma ray irradiation. high doses cause death, whereas low doses cause reversible phenotypic changes. Mutants resulting from gamma ray irradiation will produce the highest diversity around LD 20 and LD 50 (Human, 2012).

Research with the use of gamma ray radiation doses will provide a very important contribution to determine these effects, namely about changes in plant structure and metabolism, therefore it is very necessary what the optimum or correct dose is for the treatment of TSS seeds. Treatment with gamma rays can have a positive effect on plants, according to Jain (2010), it is used to improve biotic and abiotic stress.

This study aims to determine the dose of gamma cobalt 60 radiation on the morphological and physiological characters of TSS Bauji onion in the M1 generation.

II. MATERIALS AND METHODS

This research was conducted in the village of Ketindan Lawang, Malang Regency, with an altitude of 700 above sea level. This study used a single plant method, namely planting all planting material on the same land without any replications with the resulting dosage of LD50, namely 15 and 25 krad. The materials used were Bauji variety TSS seeds, soil, husk husk, manure for soil media, poly bag manure, NPK Mutiara 16:16:16, soil block media (soil: husk charcoal: compost) with a ratio of 1: 1: 1, and tapioca flour.

Preparation of seeds from research in year 1

The TSS selected from the research results of the first year must be prepared in advance. The condition of the seeds must be healthy, healthy, not wrinkled or scarred by insects or pests, free from disease or pathogens carried by the seeds. The seeds must be clean, not mixed with grass (weeds) or dirt and seeds of other plants. Then the selected seeds were directly planted on M1, namely the seeds of the LD50 value of 15 Gy were planted all and 30 Gy were all planted.

Planting shallot seeds / nursery

After all the planting media are ready, the nursery is used with a soil block, the planting medium is doused / saturated with water so that the media is moist. After the planting medium was saturated, each planting medium was divided into 3 rows, then each row was filled with 15 TSS seeds. After all the rows are filled with shallot seeds, cover them again with sterile sand, then cover them with black plastic to keep the soil moist and speed up the germination process.

Transplanting

The planting medium for transplanting is sterile sand, soil in the Singosari area (Alfisol) and compost. The three planting materials are mixed in equal proportions; Then the planting medium mixture is put into a poly bag measuring 40 x 40 cm which has been provided and labeled according to the treatment. The transplanting process is the process carried out when the seeds are 6 MST old. Before transplanting, planting holes are made with a spacing of 20 cm x 20 cm. The shallot seeds are then transferred to the land by taking the seeds and the soil block, then inserting them into the planting hole according to the treatment label. Each planting medium is filled with 2-3 TSS seeds according to the size of the polybag.
Maintenance

Maintenance of shallot plants includes watering which is done every morning and evening and is done more than once a week. Fertilization using NPK pearl 16: 16: 16 as much as 5 grams / plant once a week, and weeding is done. Spraying of insecticides and fungicides is done once a week.

Harvest

Harvesting is done when the plants are aged 65-70 DAS with the characteristics of the leaf base plants that have weakened, the leaves are yellow, the tubers are compact and stick out to the surface of the soil, the tubers are dark red-purple, and most of the plants have fallen.

III. RESULTS AND DISCUSSION

Germination Test (LD50 Value)

Based on the results of statistical analysis, the provision of Cobalt-60 gamma radiation had a significant effect on the percentage of TSS germination. From these results (table 2) it can be seen that the treatment without radiation (R0) was significantly different from treatment R1 (dose 5Gy) and R4 (dose 35Gy), but not significantly different from treatment R2 (dose 15Gy), R3 (dose 25Gy) and R5 (dose 45Gy).

Table 1. Percentage of TSS Bauji Sprouts

<table>
<thead>
<tr>
<th>Germination</th>
<th>Average Germination Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>R₀</td>
<td>24.25 a</td>
</tr>
<tr>
<td>R₁</td>
<td>56.81 b</td>
</tr>
<tr>
<td>R₂</td>
<td>45.15 a</td>
</tr>
<tr>
<td>R₃26,71 a</td>
<td></td>
</tr>
<tr>
<td>R₄33,93 b</td>
<td></td>
</tr>
<tr>
<td>R₅</td>
<td>23.99 a</td>
</tr>
<tr>
<td>BNJ 5 %</td>
<td>8.31</td>
</tr>
</tbody>
</table>

Note: the numbers followed by the same letter are not significantly different

Mutations / radiation are random, so the results can be positive (superior traits, expected traits) and some are negative (undesirable traits) (Mugiono, 2001). These properties will be obtained from the radiation results and will be seen after planting. According to Piri et al., (2011); Iglesias-Andreu et al., (2012), in relation to improving the quality of seeds and seedlings, gamma ray radiation has been widely applied to plant breeding activities that aim to get a change to produce new superior varieties, namely by obtaining sources of diversity through techniques this mutation.
In Retno's (2012) study, it was found that the TSS fertility rate of Bauji variety without radiation treatment was 30-50%. However, if seen from the diagram above, it is known that the percentage of TSS germination of Bauji variety in R0 treatment (without radiation) is still low, namely 24.25% compared to TSS with R1 treatment (5Gy dose) of 36.81%, R2 (15Gy dose) amounted to 25.15%, R3 (dose 25Gy) was 26.71%, and R4 (dose 35Gy) was 33.93%. However, it was higher when compared to R5 radiation (dose 45Gy) of 23.99%. This proves that low doses of radiation can increase the germination percentage of shallot seeds. The success of mutations to increase plant diversity is largely determined by the sensitivity of plants to the mutagens used. Sensitivity is measured based on the LD50 value (lethal dose 50), which is the dose that causes 50% of the deaths of the irradiated plant population and is considered the optimum dose to increase plant diversity (Shu et al. 2010). The LD 50 value is to see the expected dose for planting. then can be seen in Figure 1.
Figure 1 shows that the LD50 (Lethal dose 50%) value seen from the germination power means that the Bauji variety can survive at doses (R1 and R2). This mutation is able to change the original shallot seedlings and has a good vigor even though the increase is very small.

**TSS Growth Rate**

Table 2. Bauji Variety TSS Growth

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Σ sown seeds</th>
<th>Σ dead seeds</th>
<th>Σ growth seeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>R0</td>
<td>120</td>
<td>94</td>
<td>26</td>
</tr>
<tr>
<td>R1</td>
<td>120</td>
<td>70</td>
<td>60</td>
</tr>
<tr>
<td>R2</td>
<td>120</td>
<td>65</td>
<td>55</td>
</tr>
</tbody>
</table>
### Table 3. Shallot Plant Growth Rate

<table>
<thead>
<tr>
<th>Treatment</th>
<th>$\Sigma$ Tan. Tansplanted</th>
<th>$\Sigma$ Tan. Life-Harvest (80 HST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R0</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>R1</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>R2</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>R3</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>R4</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>R5</td>
<td>18</td>
<td>18</td>
</tr>
</tbody>
</table>

**Jumlah** 108 108

In table 2 it can be seen that more TSS died than those that grew. Nearly 80% of TSS experienced death and approximately 20% grew. However, it turns out that the number of seeds that grow the number of alive is up to 100%, this shows that radiation is able to change the genetic makeup by looking at the 50% mortality rate meaning that the seeds that are alive and can survive are 100%. (Table 3).

Mutation is a technique that has been developed widely in an effort to increase plant genetic diversity in order to acquire new traits as a means of plant genetic improvement. Based on statistical analysis that TSS Bauji is able to survive at radiation doses of 5 Gy and 15 Gy, this indicates that TSS Bauji is sensitive to gamma rays. This radiation dose will not be the same as other TSS due to different genetic effects in each variety. In accordance with the opinion of Aisyah (2015), that a plant is one of the factors that influence the determination of plant sensitivity to gamma ray radiation, which can be seen from the LD 50 value. The results of the LD50 calculation on the survival rate of
sprouts increased, this is in accordance with the opinion of Akbari et al. The ability to survive is to
determine the quality of the seeds, where the quality of the seeds will produce better tubers.

IV. CONCLUSIONS

1. In the study of the Effect of Gamma Ray Radiation (Cobalt-60) on TSS (True Shallot Seed)
   Seeds on Growth and Yield of Shallots (Allium ascalonicum L.) Bauji variety can be
   concluded as follows:
2. Gamma ray radiation (Cobalt-60) is able to increase the growth power of TSS
3. Treatment R1 (dose 5Gy) is the best dose to increase growth and production of Bauji varieties
   of shallots.
4. Low radiation dose can increase TSS growth and production, and higher radiation dose can
   reduce TSS growth and production of Bauji variety.

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