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Conference Paper

Characterization of Shallot (*Allium ascalonicum*) Plants Affected by Armyworm Pest (*Spodoptera exigua*)

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ABSTRACT

Shallots are susceptible to Spodoptera exigua attack, causing crop failure of 45-57% for low attack and high attack can cause up to 100% crop failure. One way to increase plant resistance is to use resistant varieties. In previous studies, shallot mutants have been produced through radiation techniques in the M3-M5 generation resistant to armyworm pests with cobalt gamma radiation doses of 3 Gy and 4 Gy. This study aimed to obtain M5 shallot mutant strains that are resistant/tolerant to armyworm pests. The experiment used a Randomized Group Design (RAK) with 20 test samples of 17 M5 mutant strains. The second stage was a preliminary test to see the stability of the radiation mutant strains. The experiment was conducted using a Randomized Block Design (RAK) with a total of 25 strains consisting of 22 tested M5 mutant strains and three released comparison varieties. The test was conducted in four replications with the number of individual plants observed per plot of 11 plants. Quantitative data were analyzed using the analysis of variance (ANOVA) test. Morphological characters between combinations of generations and bulb forms in shallots show differences, namely the character of crown behavior, leaf green color intensity, leaf length,and pseudo-stem length.

Keywords: Gamma Rays, Shallot, Spodoptera exigua

Introduction

Shallots are one of the vegetable commodities that have high economic value and are widely cultivated by farmers in the lowlands. Currently, shallot productivity is decreasing and prices are fluctuating, because shallot farmers cannot store the bulbs as seeds properly due to erratic weather conditions, resulting in shallot bulbs often rotting during storage and many leafworm attacks on shallot plants, therefore farmers always use consumption bulb seeds so that the quality of onions is not good.

The low productivity is partly due to pest attacks. Pests that often attack shallot plants are caterpillars (*Spodopetra exigua*). This pest is found in almost all shallot production centers. The onion caterpillar (exigua) is the main pest that commonly damages shallot plants. This pest attack can cause a decrease in shallot production or loss of yield if no prevention and control efforts are made. This is one of the problems of pests in shallot plants until now and is the main factor that inhibits production because the attack can reduce yields by up to 100% (Asadi, 2013).

Until now, controlling this pest is still difficult. Control is generally carried out indirectly, including by reducing the source of the attack by uprooting plants that have shown symptoms of an attack, performing crop rotation, eradicating weeds that can become alternative hosts, and controlling the development of vector insects using pesticides (Sukada et al. 2014).

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These control methods are sometimes ineffective because the transmission process can occur quickly considering that leaf caterpillars can transmit to healthy plants in just minutes to hours (Basri, 2011). In addition to requiring high costs, the use of pesticides can also leave residues on bulbs that are harmful and pollute the environment. Mutation breeding is a solution in reducing caterpillar pest attacks on shallots, with radiation mutation will create new genetic diversity so as to provide more opportunities for selection. The radiation mutation technique can expand genetic diversity so as to increase the chances of successful selection and selection of hopeful strains in accordance with plant breeding objectives. The mutant strains of shallots of early age and pest resistance can increase the productivity of shallots. The specific objective of the research is to obtain a generation of shallot mutant strains (M5) that are resistant/tolerant to leaf caterpillar pests in the field, the importance of this research is to obtain varieties that are resistant to pests in as an effort to prevent control with pesticides that can affect health and the environment.

This pest resistance test is to prove the strains of hope strains that have been obtained in previous studies with this mutation technique in generations M0 to M4 which obtained pest-resistant hope strains at doses of 3 Gy and 4 Gy. In generation M5 is said to be a strain because the plant until now shows resistance to pests, this resistance test is carried out by transmitting pests to plants, after which it can be tested for stability in the next generation. The assembly of resistant varieties can help solve food security problems in Indonesia and can contribute to efforts to increase farmers' income by reducing the risk of yield loss.

The introduction section should be written in a way that is accessible to researchers without specialist knowledge in that area. The introduction should contain the background and research objective. The section should end with a brief statement of what is being reported in the article.

Standard Abbreviations (SA) should be spelled out first. Units of measurements should be spelled out except even preceded by a numeral e.g., 3 cm, not three centimeters. If no metric measurement units are used the metric equivalent should be mentioned. The complete scientific name of every organism must be mentioned in the text e.g., *Macaca fascicularis* not *M. fascicularis* (for first its appearance). The use of common names must be accompanied by the correct scientific names must be accompanied by the correct scientific name e.g Sourgrass (*Paspalum conjugatum*).

Material and Methods

This research was conducted in Lawang-Singosari, East Java (land area of 1,000 m2). The tools used were a PCR machine, electrophoresis, autoclave, vacuum trainer, micro-pipette, pipette tip, disposable glove, centrifuge, vortex, glass cup, magnetic stirrer, eppendorf tube, thermocycler, UV lamp, and Gel Doc. The research materials were 17 strains of M5 shallot mutants from the previous selection of one variety as control (Bauji variety) and 2 comparison varieties (Varuetas Tajuk and Super Philip), water, soil, compost, NPK fertilizer, and seedling plastic.

This study was a one-factor experiment arranged based on a Randomized Group Design (RAK), consisting of 11 mutants, 1 unirradiated plant (control), and 2 comparison varieties (Table 1). Each was repeated 3 times. The number of plants in each genotype in one replication was 4 plants, resulting in a total of 240 plants. Observation parameters included the percentage of infested plants, percentage of uninfested plants, plant length, tuber wet weight, and tuber dry weight.

Observations of incidence and intensity of attack were made 5-40 days after planting. The level of disease attack was assessed based on the incidence and intensity of attack that occurred in the experimental plots with the following formula:

$$Incident\ (\%) = \frac{a}{A} \times 100\%$$

Description:

a = Number of symptomatic plants
A = Number of plants observed

While the formula for calculating the intensity of pest symptoms, namely:

$$I = \frac{\Sigma(n \times v)}{Z \times N} \times 100\%$$

Description:

I = Attack intensity
n = Number of plants in each category attack (1 – 4)
v = Scale value of each category
Z = Scale value of the attack category highest
N = Number of plants observed

Criteria for shallot resistance to caterpillar pests according to Moekasan et al. (2012) are as follows.

0 = Immune
0 x ≤ 10 = Resistant
10 < x ≤ 20 = Moderate resistant
20 < x ≤ 30 = Moderate susceptible
30 < x ≤ 50 = Susceptible
x > 50 = Highly Susceptible

Results and Discussion

Percentage of plants affected and percentage of plants not affected

The assembly of pest-resistant varieties can help solve food security problems in Indonesia and can contribute to efforts to increase farmers' income by reducing the risk of yield loss. In the assembly of onion pest resistance, the source of pest resistance genes is absolutely necessary as a source of elders that can be used for the formation of pest and high-yielding varieties.

Table 1. Criteria for onion plant resistance to caterpillar pests

Shallot	Attack Intensity	Resistance level
B (0Gy)	0	Immune
Mutant Bauji 3 Gy	20 < x ≤ 30	Moderate Susceptible
Mutant Bauji 4 Gy	20 < x ≤ 30	Moderate Susceptible

Table 1 shows that control plants without radiation suffer attacks above 50% and cause damage to shallot plants so that they are unable to produce, Bauji mutants at doses of 3 Gy and 4 Gy are hopeful mutants that experience damage between 20-30% of the resistance rating in the susceptible criteria (Susceptible).

Based on the results that have been obtained, show that the shallot mutants are resistant/tolerant to caterpillar pests in the field (Figure 1). The criteria for the level of resistance of onion plants to leafworm pests fall into the Moderate resistant category at a percentage of 20%-30%. However, some plants are attacked by pests but not damaged, this happens because of the effect of gamma rays that cause plants to be resistant to pest attacks. Kogan and Ortman (1978) suggested that the mechanism of plant resistance to pest attacks is divided into three, namely the mechanism of antixenosis, antibiosis, and tolerance. The antixenosis mechanism is a mechanism characterized by the presence of physical and chemical properties of plants that are not preferred by insects such as texture, color, and taste of plants that can make it difficult for pests to take refuge to lay eggs.

Figure 1 Shallot Plants of Bauji Variety Irradiated with 60 C Gamma Rays Attacked by Pests without Damage

Quantitative character observation

Table 2. Quantitative Character Observation Results

Treatment	Number of Leaves	Leaf Length (cm)	Leaf Diameter (mm)	False Stem Length (cm)	False Steam Diameter (mm)	Leaf Chlorophyll Content
3GyU$_1$tan3	4,5	32,1b	4,2	6,4ab	4,5	62,8
3GyU$_1$tan4	4,2	38,0bc	4,0	6,0bc	4,8	62,4
3GyU$_1$tan8	4,7	29,8d	4,1	6,3c	4,1	69,1
3GyU$_1$tan1	4,0	34,9cd	4,3	5,2c	4,8	67,7
3GyU$_3$tan6	4,6	35,2b	4,5	7,4a	4,2	64,5
3GyU$_2$tan1	4,7	35,8a	4,2	7,3a	5,0	63,9
3GyU$_4$tan6	4,8	34,2ab	4,5	6,4ab	4,3	65,9

Note: Numbers followed by the same letter in the same column are not significantly different in the DMRT further test at 5% level

There were 6 quantitative characters observed on the crown, 2 of which showed differences, namely leaf length and apparent stem length. Generation five shallots tended to produce shorter leaves and false stems than the other two generations. Within the same generation, there were no significant differences between these two characters, except in generation two. The large-round shallots in generation two had shorter leaves than the small-round shallots, but neither the large-round nor small-round shallots produced significantly different leaf lengths from the oblong shallots. Based on Table 2, there is no decrease in shallot crown performance with the use of bulbs up to generation two as planting material.

Qualitative character observation

There are 4 qualitative characteristics observed, namely crown behavior, crown curvature, crown green color intensity, and the shape of the bulb splitting. The green color on the shallot crown can be divided into two intensities, namely light (generation zero), and dark (generation one and two). The intensity of the green color in the crown looks darker with increasing chlorophyll content of the leaves (Table 2). The zero-generation tubers had semi-erect crowns while the other generations had erect crowns. The curvature of the crown can be seen from the degree of breakage in the shallot leaves.

Generation one shallots have weak crown curvature, while generation one and two have moderate curvature. Within the same generation, there is no significant difference in a character's Crown length and curvature, except in generation 5. Large round shallots in generation two have shorter leaves than small round shallots, but large or small round shallots do not produce significantly different leaf lengths from oval shallots.

Table 3. Observation Results of Qualitative Characters of Shallot Heads and Bulbs

Treatment	Crown Behaviour	Crown Curvature	Crown Green Colour Intensity	Bulb Shape
$3GyU_1tan3$	Semi-upright	Medium	Light	round
$3GyU_1tan4$	Semi-upright	Medium	Slightly dark	round
$3GyU_1tan8$	Upright	Medium	Light	round
$3GyU_1tan1$	Upright	Medium	Light	round
$3GyU_3tan6$	Upright	Medium	Light	round
$3GyU_2tan1$	Upright	Medium	Light	round
$3GyU_4tan6$	Upright	Medium	Slightly Dark	round

Conclusion

Morphological characters between combinations of generations and bulb forms in shallots show differences, namely the character of crown behavior, leaf green color intensity, leaf length, and pseudo-stem length. A decline in onion bulb performance does not occur with the use of bulbs up to the second generation as planting material. Oval-shaped bulbs produced fewer tillers than round bulbs in every generation.

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