Identification Of Upland Red Rice Mutant Lines (ORYZA SATIVA L.) High Yield Potential

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Abstract : This study aimed is to determine the rice mutant lines that have high production potential when compared with the parent dan check. This research conducted in Kendari Southeast Sulawesi. This research consisted of one factor that were lines (G). There were 4 lines tested: SSJ33.203-34, SSJ31.6-21, SSJ31.104-36, SSJ31.104.35, Pae Loilo (check 1), Watanta (check 2) and three times replication, so there were 18 experimental units. The observation variables, included plant height (cm), productive tillers number per clump (tillers), panicle length (cm), neck panicle length (cm), grains number per panicle (grain), full grains number (grain), empty grains number (grain), and yields (g.clump^{-1}). The results showed that mutant lines had a higher yield potential indicated by characters productive tillers numbers, panicle length, length of neck panicle, full grain, and number of empty grains.

Index Terms— Upland red rice, Mutant, Superior lines, Pae lolo, Watanta

1 INTRODUCTION

Rice is the main staple food in Indonesia [1],[2],[3],[4],[5]. Rice demand continues to increase from year to year [6],[7]. On the other hand, the Indonesian government is targeting self-sufficiency in rice [8],[9]. One program that promises to achieve this target is an increase in rice production, especially upland rice which is planted on dry land [10],[11],[12].

Improvement of upland rice varieties continues to obtain superior upland rice through plant breeding. Plant breeding is a method that systematically assembles genetic diversity and selects it to become superior varieties. Conventional variety assembly requires a long time (more than 5 years) [13]. One alternative that is widely applied in improving varieties more briefly is through mutations [14],[15]. The mutation method is one of the methods to speed up to get of new superior varieties. Mutations are changes that occur suddenly and randomly on genetic material (genomes, chromosomes, genes). Mutation induction is to increase genetic diversity [16],[17] aimed at creating a basic population that has a high level of genetic diversity [15]. Mutation breeding can be used to obtain superior varieties by improving some of the traits without changing most of the good traits [18].

Induction mutation in upland rice plants aims to obtain upland rice mutant that have high production, short harvest, drought resistant and resistant to pests and diseases [14]. Induction mutation can also improve the age of harvest and productivity in soybean crop [19]. Identification is the activity in screening and selecting of individuals, families, or lines in wide range of populations [20] to get the expected superior line or individuals. Selection in plant breeding becomes a reference in producing new varieties. Identification method is an effective process to obtain traits that are considered very important and high success rate.

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2. MATERIAL AND METHODS

The study conducted at Agrotechnology Field Laboratory, Agriculture Faculty, Halu Oleo University. The research arranged in Randomized Block Design (RBD) with one factor were lines (G) namely: SSJ33.203-34, SSJ31.6-21, SSJ31.104-36, SSJ31.104.35, Pae Loilo (check 1), Watanta (check 2), with three replications so that there were 18 experimental units. Observation variables were plant height (cm), productive tillers number per clump (tillers), panicle length (cm), length of neck panicle (cm), grains number per panicle (grain), number of full grains (grain), number of empty grains (grain), and yields (g clump^{-1}).

3. RESULT AND DISCUSSION

3.1 Results

The upland rice development can be done through increasing plant genetic diversity using the mutation method. Mutation treatment in rice plants is expected to produce rice varieties that have higher production than their parents, are resistant to pests and diseases and tolerant of environmental stress. Mutation breeding has a significant role in plant improvement and has produced many superior plants [21]. For example, sorghum ZH-30 which is treated with gamma ray radiation, produces new strains that are different from its parent [22].

The results showed that the third-generation mutants had shorter plant height than check. Genotypes higher than the original cultivar (Pae Loilo / check) have been eliminated in the previous generation [22]. Research on wheat plants gave different results. Wheat plants treated with 1-4 Gy mutations give the same results as their parents for all observations including plant height [23]. High genotypes tend to fall easily so that they can reduce yields [22].

Table 1. Production character of upland rice mutant

Treatment	Plant Height (cm)	Productive Tillers (tiller)	Panicle Length (cm)	Leng of Neck Panicle Length (cm)	Full Grain (grain)	Empty Grain (grain)	Grain Number Per Panicle (grain)	Yield (g clump^{-1})
SSJ33.203-34	162.27	14.20	35.15	6.37	166.80	16.57	183.37	63.49
SSJ31.6-21	170.13	13.20	34.59	6.21	151.13	18.40	169.53	64.90
SSJ31.104-36	170.67	12.93	35.08	6.77	173.43	11.27	184.70	63.79
SSJ31.104.35	156.40	11.33	35.12	6.49	176.13	20.27	196.40	64.89
Pae Loilo (check 1)	187.67	12.07	29.52	3.77	158.87	53.60	212.47	37.73
Watanta (check 2)	180.73	7.13	32.98	6.00	127.77	32.57	160.33	31.42

DISCUSSION

Four mutant lines (SSJ33.203-34, SSJ31.6-21, SSJ31.104-36, SSJ31.104.35) have higher production than the check. The high production of mutant genotypes is supported by several production characters included productive tillers number, panicle length, length of neck panicle, number of full and empty grains. The number of productive tillers of mutant genotypes ranged from 11.33-14.20 tillers. This number is higher than the check (7.13-12.07) except genotype SSJ31.104.35. Productive tillers per clump are determinants to the panicle counts. Number of productive tillers have a direct effect on the high or low grain yield. The formation of productive tillers greatly determines the number of panicles from rice. The more productive tillers the more number of panicles. There is a correlation between the number of panicles and yields, because the more panicles the higher the yield of rice plants [24]. Productive tillers are one of the yield components that have a direct effect on the level of grain yield. Increasing rice plants productivity associated with the productive tillers number. Productive tiller directly will produce rice panicles that produce rice seeds or grain [25]. The SSJ31.104.35 mutant genotype showed lower number of tillers (11.33 tillers) compared to parent (12.07 tillers), while the SSJ31.104-36 mutants gave nearly the same number of productive tillers (12.93 tillers) but were still in the new type rice. The establishment of a new type of rice in Indonesia is directed at new type of rice which has a moderate number of tillers but all are productive (10-12 tillers) [26]. Panicle is one of the characters of production which has an effect on the high and low rice productivity. The longer the rice panicle, the more grain will be produced by the rice. The panicle length of mutant ranged from 34.59 to 35.15 cm, longer than the check ranged from 29.52-32.98 cm. The panicle lengths could be categorized based on their size [25]. It could be short panicles (<20 cm), medium panicles (20 cm - 30 cm) or long panicles (>30 cm) [25], [26]. The mutant plants founded could be categorized as long panicles, because they have a length above 30 cm and longer than checks. The panicle length will support grains number in every panicle. The longer panicle, the higher the ability to support the amount of grain. The number of filled grains increased between 166.80-76.13 grain compared to check 1 (158.87 grains) but SSJ31.6-21 mutant (151.13 grains). Nonetheless, the high production of SSJ31.6-21 mutant is supported by productive tillers number that higher than the check lines or variety. The number of empty grains decreased dramatically, ranging from 11.27-20.27 grains compared to check 1 (53.60 grains) and lower than check 2 (32.57 grains). One of the problems with local upland rice is the high number of empty grains that causes low production upland rice. This causes the decline in the number of empty grains to be one solution to increase rice production.

4 CONCLUSION

Mutant lines had a higher yield potential indicated by the characters of productive tillers number, panicle length, length of the neck panicle, and number of full and empty grains.

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