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# Test and Selection of Adaptive M6 Wheat Mutants Lines in the Jeneponto Lowland

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**Abstract.** The study aimed to test the lines of mutant 6 populations (M6), the formation of populations for a subsequent generation to M8 mutants, family formation through adaptive genotype (mutant) selection at low altitudes at high temperatures in the dry and rainy seasons, adaptation tests, stability, and multi-location. The benefits of the study are obtaining potential lines from wheat mutants that are adaptive at high temperatures in the lowlands. This research was carried out in Jeneponto Regency, South Sulawesi from July to October 2018. The study was in the form of a trial using a randomized block design with three replications. The treatment consisted of twenty wheat genotypes, namely: g1 (M 1.7.1), g2 (N.350 3.6.2), g3 (N.250 4.2.1), g4 (N.350 3.1.3), g5 (N.350 3. 2.2), g6 (N.250 45.2), g7 (N.350 3.1.4), g8 (N.250 4.6.2), g9 (N.350 3.8.9), g10 (N. 250 4.4.2), g11 (N.350 3.5.10), g13 (N.200 2.4.B.6), g12 (S. 8.4.2), g14 (N.200 2.5.2), g15 (N. 200 2.3.3), and g16 (N.300 4.3.6), and 4 comparison varieties, namely g17 (Dewata), g18 (Selayar), g19 (Nias), and g20 (Munal). Parameters observed for plant height, length of panicle, number of seeds, seed weight per panicle and production. The results showed that the M6 wheat mutant lines genotypes adaptive to lowland and had production > 1.6 g.clump-1 namely genotype N.200 2.4.B.6 (2.12 g.clump-1), N.250 4.2.1 (1.87 g.clump-1), N.350 3.1.3 (1.73 g.clump-1) and g7 (N.350 3.1.4) (1.72 g.clump-1). Characters with broad genetic diversity coefficient and high heritability were the number of seeds per panicle, seed weight per panicle, and production.

## 1. Introduction

Wheat plants are classified as cereal crops which have an economic significance which is very important in maintaining the stability of food diversification as a source of protein. As a source of protein, wheat is classified according to the texture and color of the seeds. Hard wheat type of protein content is 11-17% suitable for making bread, and soft wheat 6-11% protein content and gluten is weak (wheat gluten) so it is suitable for making cakes, cookies, and biscuits. Durum wheat is suitable for making macaroni, spaghetti, and other forms of pasta.

Domestic flour demand is met from imports in the form of wheat seeds which are then processed into wheat flour. The volume of imported wheat seeds is predicted to continue to increase in the coming years, mainly in line with the increasing population and the changing diet of the Indonesian people. Before 2010, Indonesia was the fifth largest wheat importer with a total import of 4.5 million tons/year at a rate of 2.6% per year [1].

Grain imports to Indonesia in 2010 amounted to 5.2 million tons, in 2011 of 6.3 million tons, in 2012 amounting to 7.4 million tons, even in 2013 in the period January to September reached 5.1 million tons [2]. Indonesia's dependence on wheat imports that are significant enough to be used as



food will dim the effort to develop wheat cultivation, whereas agronomically wheat can now be cultivated in the tropics with higher production and shorter harvest times [3]. Agronomically, Indonesia is an area that has a very large prospect for the development of wheat, starting from the lowlands with a faster shelf life (35-51 days) compared to highland wheat (55-60 days) [4].

The challenge faced in the development of local wheat is not easy because farmers and field workers have not fully controlled wheat technology from upstream to downstream, there is no market that can accommodate farmers' harvest, lack of farmers' facilities and capital and lack of government support because wheat is not a commodity priority. However, based on the opportunities mentioned above, then it is proper for wheat to be developed based on the region's potential by finding varieties of wheat that are by Indonesia's agro climate.

## 2. Research Method

This research was carried out in Maros Regency, South Sulawesi from July to October 2018. The study was in the form of a trial using a randomized block design with three replications. The treatment consisted of twenty wheat genotypes, namely: g1 (M 1.7.1), g2 (N.350 3.6.2), g3 (N.250 4.2.1), g4 (N.350 3.1.3), g5 (N.350 3.2.2), g6 (N.250 4.5.2), g7 (N.350 3.1.4), g8 (N.250 4.6.2), g9 (N.350 3.8.9), g10 (N.250 4.4.2), g11 (N.350 3.5.10), g13 (N.200 2.4.B.6), g12 (S. 8.4.2), g14 (N.200 2.5.2), g15 (N.200 2.3.3), and g16 (N.300 4.3.6), and 4 comparison varieties, namely g17 (Dewata), g18 (Selayar), g19 (Nias), and g20 (Munal). Spacing between rows 25 cm and area of plot 5 m x 1 m. Plant fertilized at a dose of 150 kg.ha<sup>-1</sup> Urea, 200 kg.ha<sup>-1</sup> SP36 and KCl 100 kg.ha<sup>-1</sup>. At 10 days after planting (DAP) and second fertilization with doses of Urea 150 kg.ha<sup>-1</sup> at 30 DAP. Parameters observed were plant height, length of panicle, number of seeds per panicle, seed weight per panicle and production per clump. The data analysis used variance analysis followed by Least Significance Difference (LSD) test ( $p > 0.05$ ). Heritability was calculated [5] formula:

$$KKG = \frac{\sqrt{\sigma^2 g}}{\bar{x}} \times 100\%$$

Heritability values are grouped according to [6] with value  $< 0.2$  categorized as low,  $0.2 - 0.5$  as moderate, and value  $> 0.5$  as high.

## 3. Results and Discussion

Growth and production of M6 wheat mutant lines varied between genotypes. Results show that some mutant genotypes showed higher growth and yield compared to the comparison varieties indicated by parameters of plant height, length of panicle, number of seeds per panicle, seeds weight per panicle, and production per clump (table 1).

Table 1 shows that Genotype N.200 2.4.B.6 (g12) gave the highest plant height (61.55 cm) and was significantly different from all comparison varieties. The higher the appearance of plant morphology, the higher the potential for receiving and absorbing light and inversely proportional to shorter plants. Plant growth is strongly influenced by the surrounding environment because an environment that has a high temperature will cause cell death so that the process of growth and development of cells is inhibited. Several environmental factors that can affect the growth of wheat crops include water, temperature, light intensity and humidity [7]. According to [8], very high temperatures can damage or cause cell death within minutes after plants are exposed to high temperatures.

**Table 1.** Mean of plant height (cm), length of panicle, number of seed and seed weight per panicle, production of M6 mutant lines planted in the lowland of Jeneponto.

Genotypes	Observation				
	Plant height (cm)	Length of panicle (cm)	Number of seeds per panicle	Seeds weight per panicle (g)	Production (g.clump <sup>-1</sup> )
g1 (M.200 1.7.1)	45.73	7.33	15.87	0.21	0.95
g2 (N.350 3.1.4)	48.64	7.26	21.13	0.25	1.28
g3 (N.250 4.2.1)	58.53 abcd	8.21 D	21.40 bd	0.38 abcd	1.87 d
g4 (N.350 3.1.3)	57.91 d	8.33 D	23.67 abcd	0.35 abcd	1.73 b
g5 (N.350 3.2.2)	49.52	7.93	22.47 bcd	0.27	1.27
g6 N.250 4.5.2)	53.03 d	8.50 Cd	22.63 bcd	0.35 abcd	1.51
g7 (N.350 3.1.4)	59.00 abcd	8.28 D	16.90	0.31 bc	1.72 b
g8 (N.250 4.6.2)	56.13 d	7.77	21.40 bd	0.21	0.93
g9 (N.350 3.8.9)	59.66 abcd	8.86 abcd	22.00 bcd	0.23	1.51
g10 (N.250 4.4.2)	52.91 d	7.57	21.33 bd	0.31 bc	1.34
g11 (N.350 3.5.10)	49.83	7.37	18.53	0.26	0.58
g12 (N.200 2.4.B.6)	61.55 abcd	8.29 D	18.97	0.34 abcd	2.12 d
g13 (S. 8.4.2)	51.84 d	7.38	16.13	0.18	0.78
g14 (N.200 2.5.2)	53.91	7.52	16.87	0.14	0.80
g15 (N.200 2.3.3)	49.97	7.88	15.27	0.18	0.60
g16 (N.300 4.3.6)	54.15 d	7.62	16.90	0.25	0.95
g17 (Dewata) (a)	49.64	8.00	19.97	0.27	1.38
g18 (Selayar) (b)	50.17	7.70	16.70	0.20	1.07
g19(Nias) (c)	48.16	7.64	18.87	0.24	1.27
g20 (Munal) (d)	43.19	7.35	17.13	0.27	1.30
LSD <sub>(0.05)</sub>	8.08	0.80	3.17	0.06	0.48

Genotype N.50 3.8.9 (g9) showed the longest panicle length (8.86 cm) and was significantly different from all comparison varieties (table 1). Higher radiation absorbed by the plant will trigger the maximum photosynthesis process to produce assimilate and energy for the development and growth of optimal plant reproductive organs. The development of the flower of wheat requires substantial assimilation supply for its length. This is in line with the opinion [9] which stated that water shortages and nutrient deficiencies greatly affect the growth and development of seeds, and will even reduce the number of seeds in a panicle, which consequently decreases yield. The transition time from vegetative to reproductive development is controlled by the environment such as photoperiod (long/short day length) and cold temperature (vernalization) [10].

Table 1 shows that genotype N.350 3.1.3 (g4) produced the highest number of seeds (23.67 seeds) and was significantly different from all comparison varieties. The environmental conditions of wheat crop strongly influence the failure of seed production in wheat plants during the process of cell division and gametogenesis. Plants that produce a large number of seeds can adjust the flowering time in environmental conditions gripped by extreme temperatures. The transition time from vegetative to reproductive development is controlled by the environment such as photoperiod (long/short day length) and cold temperature (vernalization) [10].

Genotype N.250 4.2.1 (g3) produced the highest seed weight per panicle (0.38 g) and was significantly different from all comparison varieties. Characters that have high seed weight are supported by two factors, namely the number and size of seeds. The size and amount are very much influenced by the process of gametogenesis, fertilization, and assimilation resulting from photosynthesis. This is in the opinion of [11], the wheat plant stage that is most critical of abiotic stress is the reproductive stage. Therefore, this stage needs to be considered to determine the tolerance mechanism of plants against abiotic stress.

**Table 2.** Heritability of M6 wheat lines adaptive to high temperature parameters.

No	Parameters	Heritability	Category
1	Plant height	40.55	Moderate
2	Length of panicle	34.63	Moderate
3	Number of seeds per panicle	60.90	High
4	Seeds weight per panicle	73.37	High
5	Production	63.26	High

$h^2 \leq 20$  (low),  $21 < h^2 \leq 50$  (moderate),  $50 < h^2 \leq 100$  (high)

Table 2 shows that the character of the wheat mutant seed weight has the highest heritability (73.37%) and the length of panicle characters was the lowest with heritability (34.63%). The results of heritability analysis show that almost all parameters have high heritability values. This can then be used as an assessment material for the selection of temperature stresses in the lowlands. For selection purposes, it should be used characters that have high heritability because these traits will be easily inherited and selection can be done in the early generations [12].

#### 4. Conclusion

1. The adaptive M6 mutant line genotypes that can grow and had production  $> 1.6$  g.clump<sup>-1</sup> were genotype N.200 2.4.B.6 (2.12 g.clump<sup>-1</sup>), N.250 4.2.1 (1.87 g.clump<sup>-1</sup>), N.350 3.1.3 (1.73 g.clump<sup>-1</sup>) and N.350 3.1.4 (1.72 g.clump<sup>-1</sup>)
2. Characters that had a large genetic diversity coefficient and high heritability were the number of seeds per panicle, seed weight per panicle and production.

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