Morphological Response Of Wheat Genotypes At Different Altitudes In Karo Highland Sumatera Utara

Dafni Mawar Tarigan, Rosmayati, Chairani Hanum, Lollie A.P. Putri

Abstract: Grain growth is strongly influenced by climate where the plants grow. One of the parameters that affect the climate of the plant growth is temperature. Air temperature difference at one place to place depending on the altitude and latitude location. Climate change and the limitations of specific wheat varieties into one obstacle wheat development in the country. Then carried out research that aims to get the wheat genotypes corresponding to climatic conditions (especially temperature) of a specific location through morphological response every kind of wheat used. The research was conducted in two Karo highland locations namely Berastagi (1400 meters above the sea level) and Tiga Panah (1100 meters above the sea level) during the rainy season by using the twelve wheat varieties are two varieties of wheat namely (Selayar/K and Dewata /L) and ten genotypes (A = OASIS/SKAUZ//4*BCN); (B = HP1744); (C = LAJ3302/2*MO88); (D = RABE/2*MO88); (E = H-21); (F = G-21); (G = G-18); (H = MENEMEN); (I = BASRIBEY); (J = ALIBEY). This research aimed to obtain the appropriate type of wheat planted in each location based on morphological characters such as plant height, number of grain/spike and grain weight/spike. The design used is non factorial randomized block design. The result showed significant difference for all types of wheat on plant height, number of grain/spike and grain weight/spike.

Index Terms: altitude, highland, morphological characters, wheat genotypes

1. Introduction

Wheat needs in Indonesia almost entirely from imports, thus greatly deplete foreign exchange. With a great need and limited ability to import increasingly demanding immediate development of wheat in the country. Efforts to develop the wheat crop in Indonesia has been done by the government by introducing strains or varieties of wheat from other countries. Subtropical wheat development in Indonesia is concentrated only in the highlands are also a limited extent. Therefore, the wheat breeding program in Indonesia aimed at assembling tropical varieties that can adapt some altitude [4]. Environmental factors (climate) that most affects the grain growth is temperature, duration of exposure and rainfall. Temperature affects the rate of metabolic processes, germination, leaf growth, reproductive organ initiation. When the temperature is too high at the anthesis phase then plant reproduction will be impaired, which in turn will affect crop yield [18], [13], [10], [8]. Similarly the opinion of [16] and [5] which states that the temperature is an important factor for the quality of production, especially during grain filling. This study was to obtain morphological characters of wheat genotypes in different altitude.

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- *Many studies have been reported on the use of growth regulators or mycorrhizal fungi in decreasing harmful effects of environmental stress. Mycorrhiza fungi increase growth, photosynthetic pigments and photosynthesis of host plants by better mineral nutrition. They cause chlorophyll organs of plant to grow by absorbing required carbon, giving nutriments to plant and increasing efficiency of photosynthesis (Enteshari,and Hajbagheri, 2011).*

2 MATERIALS AND METODS

The study was conducted at two locations namely Karo highlands Berastagi (1400 meters above sea level) and Tigapanah (1100 meters above the sea level) from July to November 2012. Wheat seed used comes from Cereal Crops Research Institute Maros South Sulawesi twelve types of two varieties (Selayar/K and Dewata/L), while ten types of wheat is still shaped genotypes / strains, namely (A=OASIS / SKAUZ // 4 * BCN); (B = HP1744); (C = LAJ3302 / 2 * MO88); (D = RABE / 2 * MO88); (E= H-21); (F = G-21); (G = G-18); (H = MENEMEN); (I = BASRIBEY); (J = ALIBEY).Planting twelve types of wheat was repeated three times for each location using a system where the distance between the array is an array of 25 cm. The study was conducted using a single factor, namely 12 genotypes of wheat, while fertilizer as recommended Cereal Crops Research Institute Maros, South Sulawesi. This study uses a randomized block design non factorial complete for each location. If the results of the study showed significant differences, it will be followed by Duncan's multiple range test. Wheat plant morphological characters observed were plant height, number of grains/spike and grain weight/spike.

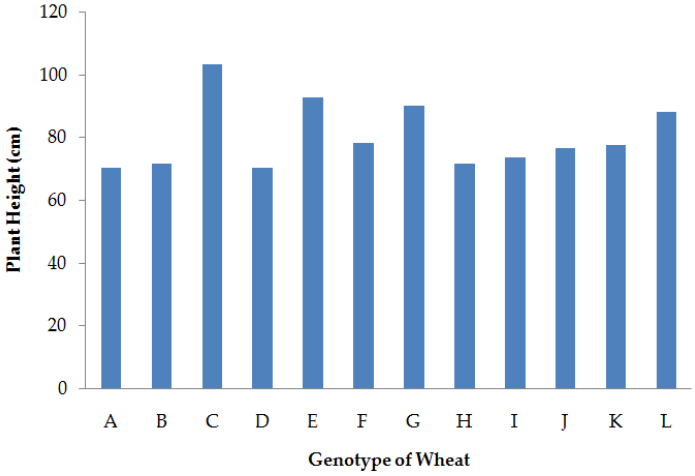
3 RESULTS AND DISCUSSION

Important morphological characters in a plant adaptation to environmental changes grow that can occur naturally or be conditioned on a certain environment. Morphological characters associated with changes in the phases of growth, development, flowering to ripening seeds / fruit crops. The course of these phases is strongly influenced by the state of the environment, such as altitude, duration of exposure, temperature and humidity [7]. It can be seen that the lower

altitude, the temperature variation is increasing and this has a direct influence on the growth and development of the wheat crop. Similarly with the [6] states that any increase in height of 100 meters where there will be a decrease in temperature of about 0.6 °C.

Plant height

Results of analysis of variance showed that each wheat genotypes were significantly different for plant height in Berastagi and Tigapanah (Table 1, Figure 1, 2). The highest wheat crop in Berastagi is the genotype C is 103.93 cm higher than varieties of Selayar (K) and Dewata (L) and three genotypes of wheat that had high above plants 90 cm are varieties of Dewata (L) 102.46 cm; E genotype 97.79 cm; G genotype 96.91 cm. While at Tigapanah of the highest wheat crop is C genotype 103.32 cm which also higher than comparable varieties of Selayar (K) and Dewata (L), the other two wheat genotypes have a minimum plant height 90 cm that is genotypes E and G each have plant height 92.67 cm and 90 cm.



This is caused by the difference in altitude that affect the temperature at which wheat is grown (Figure 7, 8). This can be seen a decrease in plant height in Tigapanah compared with Berastagi. From the research [11] there was a decrease in wheat plant height in Bogor (hot air) compared to the wheat crop in the area Cipanas (cold air) and a change in the environment is very large variations cause changes in plant morphological characters.

Table 1. *Average Plant Height (cm) in Berastagi and Tigapanah*

Genotype	Berastagi (1400 meters above sea level)	Tigapanah (1100 meters above sea level)
A	74.29l	70.32k
B	78.19j	71.59j
C	103.93a	103.32a
D	83.81e	70.20l
E	97.79c	92.67b
F	78.45i	78.01e
G	96.91d	90.00c
H	82.28g	71.67i
I	83.66f	73.66h
J	76.52k	76.41g
K	78.81h	77.59f
L	102.46b	88.01d

Note : Mean values by the same letter do not significantly differ based on DMRT (F = 0.05)

It also shows significant differences in the response of each genotype were adapted. Similarly with the research [2], [3], [9] and [17] reported that positive correlation and significant between genotypes with productive tillers, plant height, spike length, number of spikelet/spike, number of grain/spike and grain yield.

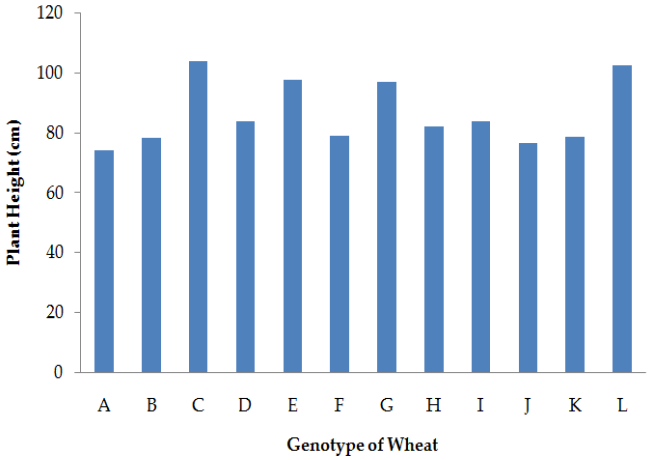


Figure 1 *(Berastagi) and Figure 2 (Tigapanah) show histogram between each wheat genotype with a plant height.*

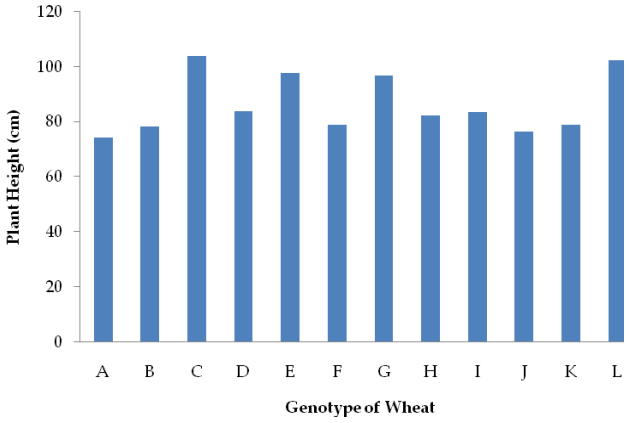


Figure 1. Histogram Wheat Genotypes with Plant Height in Berastagi

Figure 2. Histogram Wheat Genotypes with Plant Height in Tigapanah

Number of grain/spike

Results of analysis of variance showed that each wheat genotypes were significantly different for number of grain/spike in Berastagi and Tigapanah (Table 2, Figure 3, 4).Number of grain/spike highest in Berastagi are varieties of Dewata (L) is 77.28 seeds and seven genotypes of wheat that has the number of grain/spike ≥ 50 namely E genotype 54.86 seeds; G genotype 53.92 seeds; varieties of Selayar (K) 53.37 seeds; I

genotype 51.87 seeds; A genotype 51.07 seeds; genotype D and H is 50.46 seeds, 50.31 seeds. Each wheat genotypes have the number of grain/spike significantly different with varieties of Selayar (K) and Dewata (L). While at Tigapanah highest number of grain/spike are varieties of Dewata (L) 60.59 seeds, three other wheat genotypes have the number of grains/spike ≥ 50 seeds, namely E genotype 55.03 seeds; varieties of Selayar (K) 53.34 and A genotype 51.71 seeds, genotype F and genotype G showed no difference in the number of grain/spike. Furthermore, each genotype of wheat in Tigapanah showed significant differences in the number of grain/spike to the varieties of Selayar (K) and Dewata (L). Differences in the number of grain/spike in Berastagi and Tigapanah allegedly because of differences in the response of each genotype of wheat against the environment, among other differences in temperature. It is known that temperature affects (Figure 7, 8) the rate of metabolic processes, the development of plants, germination, leaf growth, reproductive organ initiation. Besides the temperature also affects the date of flowering and harvesting crops [14]. Age flowering and harvesting will be shorter if the subtropical crop planting is done in a lower location and this will result in the accumulation of biomass is not perfect. This is similarly with the opinion of [11] which states that the longer the life of the plant, the greater production of biomass and crop yields. The plants are sensitive to temperature changes, such as wheat, very sharp decline in the harvest if the crop is planted at lower altitudes with higher temperatures [12] also stated that rising temperatures caused grain crops are maturing early, reducing the number and size of the seeds and reduce yields.

Table 2. *Average Number of grain/spike of Wheat in Berastagi and Tigapanah*

Genotype	Berastagi (1400 meters above sea level)	Tigapanah (1100 meters above sea level)
A	46.34k	51.71d
B	49.60i	45.01i
C	45.81l	44.81j
D	50.46g	49.79e
E	54.86b	55.03b
F	48.47j	46.87h
G	53.92c	48.67f
H	50.31h	48.66f
I	51.87e	46.91g
J	51.07f	43.67k
K	53.37d	53.34c
L	77.28a	60.59a

Note : Mean values by the same letter do not significantly differ based on DMRT (F = 0.05)

Figure 3 (Berastagi) and Figure 4 (Tigapanah) show histogram between each wheat genotype with number of grain/spike.

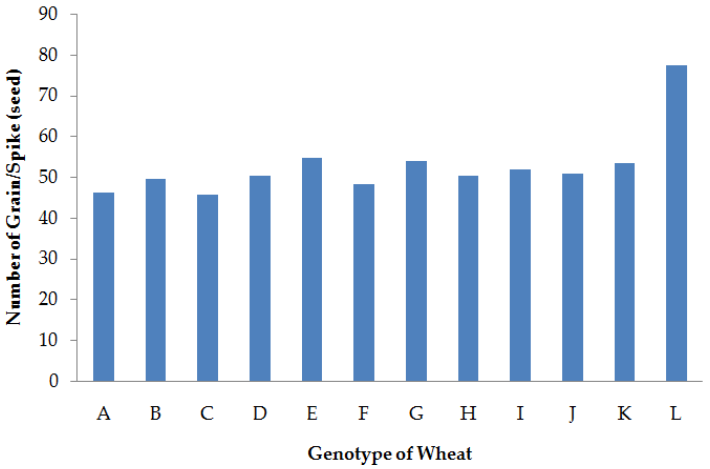


Figure 3. *Histogram Wheat Genotypes with the Number of grain/spike in Berastagi*

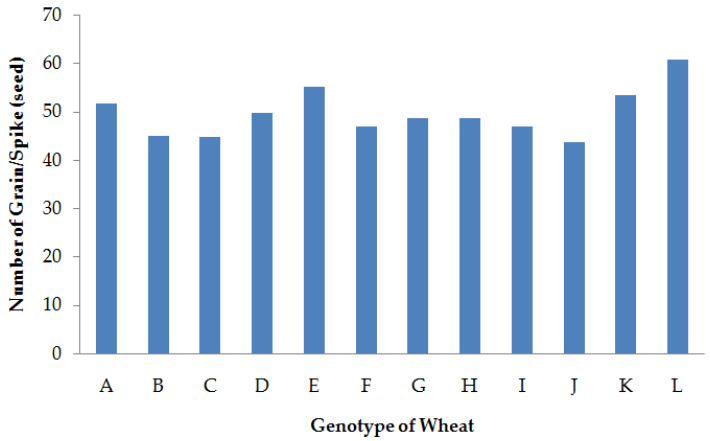


Figure 4. *Histogram Wheat Genotypes with the Number of grain/spike in Tigapanah*

Grain weight/spike (g)

Results of analysis of variance showed that each wheat genotypes were significantly different for grain weight/spike in Berastagi and Tigapanah (Table 3, Figure 5, 6). Grain weight/spike highest in Berastagi are varieties of Dewata (L) is 2.50 g and three genotypes of wheat which has grain weight/spike ≥ 1.90 g namely E genotype 1.96 g; I genotype 1.96 g; and A genotype 1.95 g. For each genotype of wheat in Berastagi have grain weight/spike were significantly different from the varieties of Selayar (K) and Dewata (L). While on location Tigapanah grain weight/spike highest is varieties of Dewata (L) is 1.96 g, the other genotypes have only grain weight/spike <1.90 g and each genotype of wheat in Tigapanah have grain weight/spike significantly different with varieties of Selayar (K) and Dewata (L).

Table 3. *Average grains weight/spike (g) in Berastagi and Tigapanah*

Genotype	Berastagi (1400 meters above sea level)	Tigapanah (1100 meters above sea level)
A	1.69d	1.51e
B	1.66e	1.33h

C	1.69d	1.31hi
D	1.69d	1.45f
E	1.96b	1.63c
F	1.61f	1.30i
G	1.86c	1.44fg
H	1.87c	1.42g
I	1.96b	1.54d
J	1.95b	1.44fg
K	1.87c	1.82b
L	2.50a	1.96a

Note : Mean values by the same letter do not significantly differ based on DMRT (F = 0.05)

Grain weight/spike differences between genotypes of wheat were planted in Berastagi and Tigapanah thought to be caused by the temperature difference of the two locations. From the research, wheat seeds were planted in higher areas (Berastagi) have seeds more pithy, dense and heavier than the lower areas (Tigapanah), this can be seen in Table 2 below. In line with these results [1] and [10] also stated that high temperatures severely limiting yield and yield components of wheat. High temperatures can accelerate the development of plants and specifically affecting the organs of flowers, fruit formation, seed number, seed weight and photosynthesis. Furthermore, according to [15] that the temperature increase will accelerate the rate of growth and development plant that result in reduced accumulation of biomass. In addition the high temperature affects the formation of seeds, seed weight, and reduced starch accumulation. Figure 5 (Berastagi) and Figure 6 (Tigapanah) show histogram between each wheat genotype with grain weight/spike.

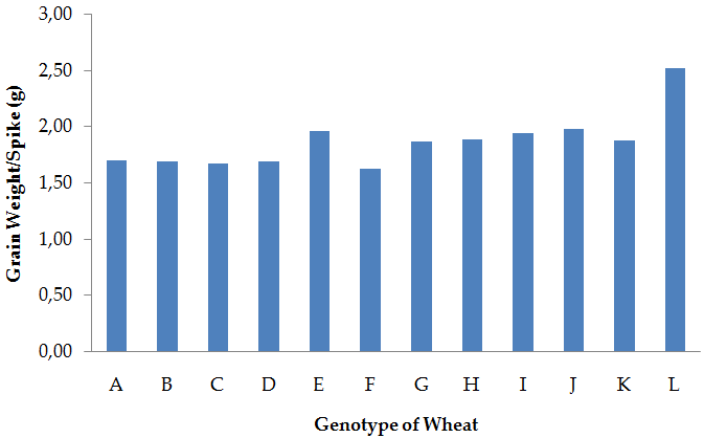


Figure 5. *Histogram Wheat Genotypes with grains weight/spike in Berastagi*

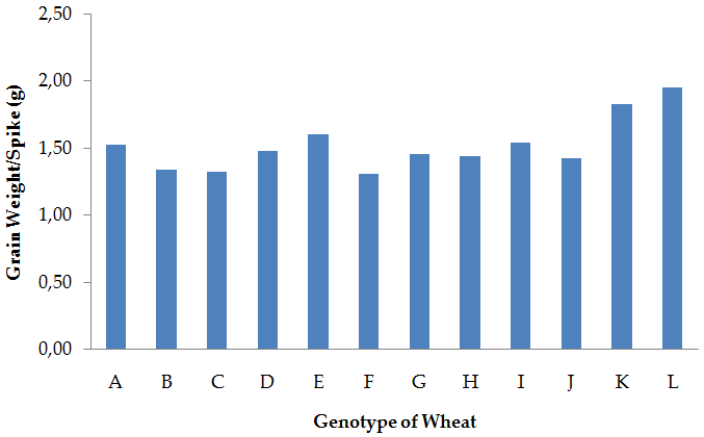


Figure 6. *Histogram Wheat Genotypes with grains weight/spike in Tigapanah*

4 CONCLUSION

Environmental differences at different altitudes affects some morphological characters of wheat. At the location of Berastagi (1400 meters above sea level) all the morphological characters (plant height, number of seeds per panicle and seed weight per panicle) were significantly different for each genotype of wheat. Similarly, in locations Tigapanah (1100 meters above sea level). Wheat crop that has the highest plant height at Berastagi is the C genotype, varieties of Dewata (L), E genotype and G genotype. While in Tigapanah is C genotype, E genotype and G genotype. For wheat crop that has the highest number of grain/spike in Berastagi are varieties of Dewata (L), E genotype, G genotype, varieties of Selayar (K), I genotype, J genotype, D genotype and H genotype. Whereas in Tigapanah are varieties of Dewata (L), E genotype and varieties of Selayar (K). Wheat crop that has the highest grain weight/spike in Berastagi are varieties of Dewata (L), E genotype, I genotype and J genotype. Location Tigapanah highest grain weight/spike is varieties of Dewata (L). Judging from the three morphological characters observed, the varieties of Dewata (L) and E genotype is consistently able to adapt well in two altitude (temperature and different environments).

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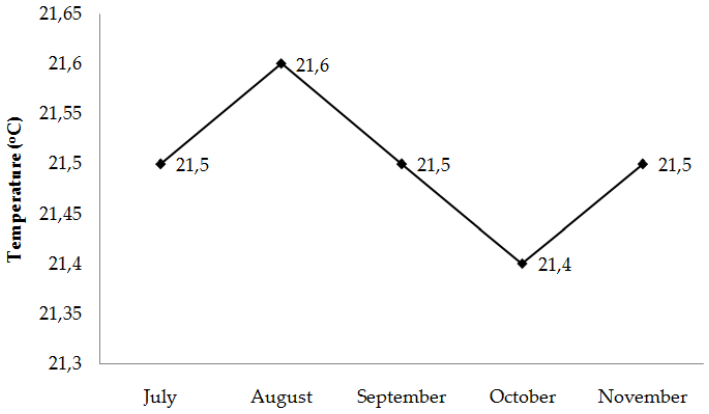

Figure 7. *Temperature changes every month (July-november 2012) in Tigapanah.*

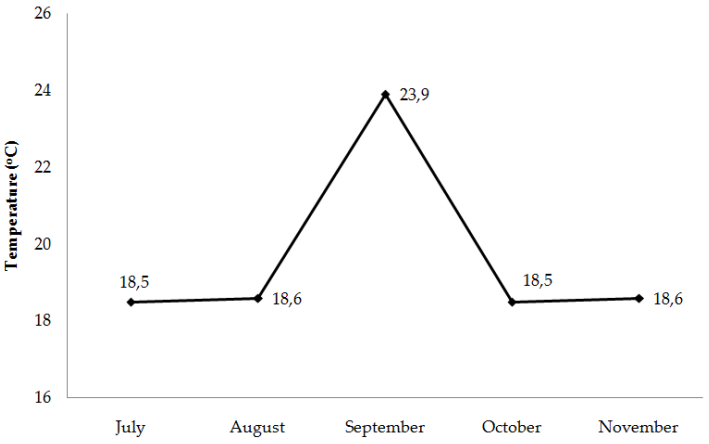

Figure 8. *Temperature changes every month (July-november 2012) in Berastagi.*