Lodging Characters Of Wheat: Effect Of Nitrogen And Potassium Combination

Dafni Mawar Tarigan, Irna Syofia, Wan Arfiani Barus, Asritanarni Munar

Abstract: Wheat development in Indonesia still continues to this day are still focused on the highland. But the limitations of location-specific varieties and seasons as well as the strong winds that often occur in the highlands during the rainy season can cause lodging plant, an obstacle for the development of wheat in the country. Then carried out a study to analyze the character of lodging wheat plant in the Karo highlands, North Sumatra. The study was conducted on two location of the Karo highlands and three repetition with uses non-factorial randomized block design with using wheat plant genotype C (LAJ3302 / 2 * MO88) and the treatment used is nitrogen fertilizer ((N_1 = 50 g/plot, N_2 = 70 g/plot, N_3 = 90 g/plot) and potassium fertilizer (K_1 = 30 g/plot, K_2 = 45 g/plot, K_3 = 60 g/plot). This study aims to determine the genotypes of wheat which had fallen through the analysis of the character of lodging. Observation data were tested by analysis of variance and combined. Character of lodging was observed stem diameter, strong of stem, internode number and distance between internode. The results of the study and combined analysis of variance showed that stem diameter, strong of stem and distance between internode showed significant differences for each location. While the internode number not significantly different for each location.

Index Terms: Wheat, Lodging Character, Nitrogen, Potassium,

1 INTRODUCTION

Lodging is the shift of the stem or root from a vertical state due to strong wind and heavy rainfall. Lodging has two forms, namely root lodging and stem lodging which can cause loss of crop yields and quality yields [1]. High nitrogen fertilization causes plants to be more susceptible to lodging, this is because of fast stem growth. In addition, plant lodging can also be caused by the combined effect of inadequate standing power from plants and adverse weather conditions, such as rain and wind [2]. The Highland generally have the wind speed and rainfall is quite high in certain seasons which can cause lodging of the plant. This can be a problem for the growth and yield of wheat plants grown in these locations. Of research [3] has been done previously obtained genotypes of wheat that has good yield potential in the highlands but can not stand fall and eventually lowering the yield. While [4] states that Severe lodging is costly due to its effects on grain formation resulting in yield loss, reduction in grain quality, and other harvest associated problems. It takes about twice the time to harvest a lodged crop than a standing one. There are agronomic actions that can overcome lodging in plants including the application of nitrogen fertilizer, potassium, silicon and application time.

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Giving nitrogen which increases and the time is right, causes rapid vegetative growth and increases the size and weight of panicles, but can experience lodging. While the application of potassium is not enough, it can cause lodging too. So that the availability of nitrogen and potassium is a key factor in overcoming lodging [5].

2 MATERIAL AND METHODS

The research was conducted in the highlands of Tigapanah (1100 m above sea level = location 1) and Berastagi (1400 m above sea level = location 2) pada bulan April hingga September 2017. Wheat seeds used are genotype of wheat that is LAJ3302/2*MO88 (C). Wheat planting repeated three times for each location by using array's system where the distance between the array's 25 cm. The study was conducted using a single factor. This study using Factorial Randomized Block Design with 2 (two) factors: nitrogen fertilizer (N_1 = 50 g / plot, N_2 = 70 g / plot, N_3 = 90 g / plot) and potassium chloride fertilizer (K_1 = 30 g / plot, K_2 = 45 g / plot, K_3 = 60 g / plot) with 3 (three) replicates. Data were analyzed by using Anova test. The result that Anova test shows the real effect is Duncan Multiple Range Test. Character of lodging was observed stem diameter, strong of stem, internode number and distance between internode. If the results of the study showed significant differences, it will be followed by Duncan's Multiple Range Test with a level of 5%.

3 RESULTS AND DISCUSSION

In both location, significant differences in all parameters due to location were observed (Table 1, 2 and 4) except Table 3.

Stem Diameters

The diameter of the greatest stems of plants at location 1 is N_2K_3 = 0,48 cm, while at location 2 is N_2K_3 = 0,54 cm which is different from other treatments. According to [6] that large stem tend to have a large panicle stalk to support the panicle and minimize fall. In addition, large stem has a tendency of more tissue vessels (vascular bundles), where these networks can help strengthen the establishment of the plant.

Table 1. *Average Stem Diameters (cm) at Location 1, Location 2 and Combined*

Treatment	Tigapanah (L_1)	Berastagi (L_2)	Two Location
N_1K_1	0.35e	0.47bc	0.41de
N_1K_2	0.36e	0.47bc	0.41de
N_1K_3	0.44b	0.36de	0.36f
N_2K_1	0.37d	0.41cd	0.39e
N_2K_2	0.35e	0.44bc	0.46ab
N_2K_3	0.48a	0.54a	0.49a
N_3K_1	0.34f	0.34e	0.34f
N_3K_2	0.43b	0.43c	0.43cd
N_3K_3	0.41c	0.49ab	0.45bc

Testing performed by Duncan's Multiple Range Test at the 5% level

Figure 1 shows a graph of each treatment against stem diameter in each location and combination.

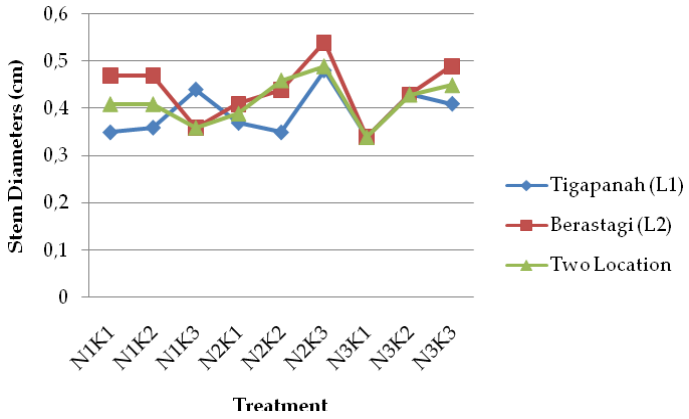

Fig 1. *Graph of treatment against stem diameter in tigapanah, berastagi and its combination*

Figure 1 shows that the treatment of N_2K_3 (70 g / plot nitrogen and 60 g / plot potassium) in Berastagi has the largest stem diameter compared to Tigapanah and the combination, followed by treatment N_3K_3 (90 g / plot nitrogen and 60 g / plot potassium). While in Tigapanah the N_2K_3 treatment also had the highest effect on stem diameter, followed by N_1K_3 treatment (50 g / plot nitrogen and 60 g / plot potassium).

Strong of Stem

The strong of stem the greatest at location 1 is N_2K_3 = 524.917 g, while at location 2 is N_2K_3 = 550.97 g which is different from other treatments. According to [6] that large stem tend to have a large panicle stalk to support the panicle and minimize fall. In addition, large stem has a tendency of more tissue vessels (vascular bundles), where these networks can help strengthen the establishment of the plant. Other than that according to [7] that medium plants height are most suitable and tend to be more resistant to fall than higher plants. Varieties that respond to nutrients, especially nitrogen, show excessive vegetative growth and these varieties will be more sensitive to fall.

Table 2. *Average Strong of Stem (g) at Location 1, Location 2 and Combined*

Treatment	Tigapanah (L_1)	Berastagi (L_2)	Two Location
N_1K_1	338.987e	402.33d	370.66e
N_1K_2	391.567d	475.37bc	433.47cd
N_1K_3	436.897b	398.53d	369.60e
N_2K_1	422.693c	472.33bc	447.51bc
N_2K_2	340.670e	426.50cd	475.71ab
N_2K_3	524.917a	550.97a	493.93a
N_3K_1	318.100f	333.73e	325.92f
N_3K_2	429.767bc	500.40ab	465.08ab
N_3K_3	391.860d	443.87bcd	417.86d

Testing performed by Duncan's Multiple Range Test at the 5% level

Figure 2 *shows a graph of each treatment against strong of stem in each location and combination.*

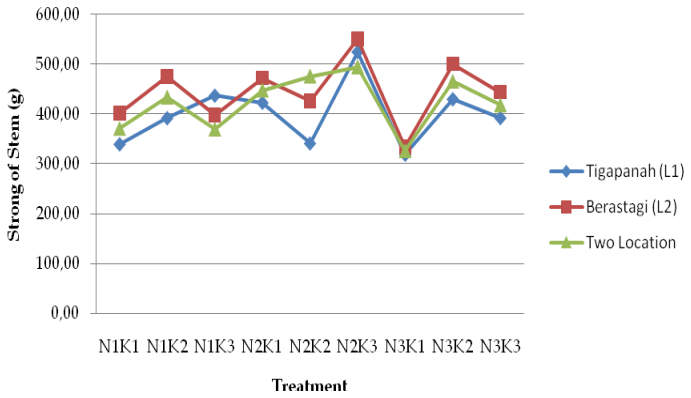

Fig 2. *Graph of treatment against strong of diameter in tigapanah, berastagi and its combination*

Figure 2 shows that the treatment of N_2K_3 (70 g / plot nitrogen and 60 g / plot potassium) in Berastagi has the largest strong of stem compared to Tigapanah and the combination, followed by treatment N_3K_2 (90 g / plot nitrogen and 45 g / plot potassium). While in Tigapanah the N_2K_3 treatment also had the highest effect on strong of stem, followed by N_1K_3 treatment (50 g / plot nitrogen and 60 g / plot potassium).

Internode Number

The Largest of Internode number at locations 1 is N_2K_3 = 4,67. While the largest of internode number at location 2 is N_2K_3 = 4,00. which is not different from other treatments. Lodging, strongly linked with plant height where the plant height not too high more trend lodging resistant than higher plants. According to [8] plant height associated with long stem segments. Short stems will produce a number of segments that little or short.

Table 3. *Average Internode Number at Location 1, Location 2 and Combined*

Treatment	Tigapanah (L_1)	Berastagi (L_2)	Two Location
N_1K_1	4.33	4.00	4.17
N_1K_2	4.00	4.00	4.00
N_1K_3	4.00	4.00	4.00
N_2K_1	4.00	4.00	4.00
N_2K_2	4.33	4.00	4.17
N_2K_3	4.67	4.00	4.33
N_3K_1	4.33	4.00	4.17
N_3K_2	4.00	4.00	4.00
N_3K_3	4.00	4.00	4.00

Figure 3 shows a graph of each treatment against internode number in each location and combination.

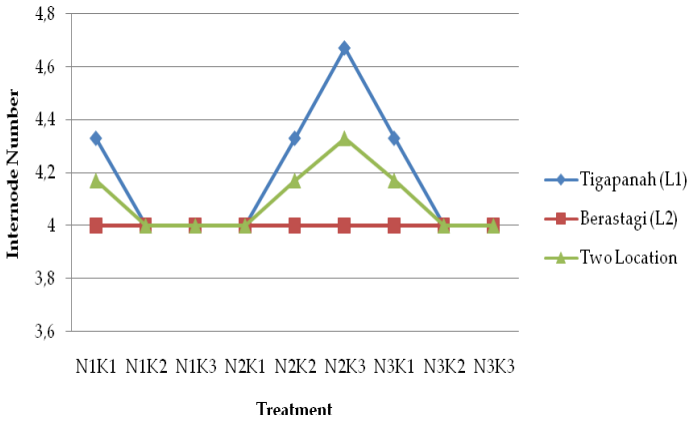

Fig 3. *Graph of treatment against internode number in tigapanah, berastagi and its combination*

Figure 3 shows that the treatment of N_2K_3 (70 g / plot nitrogen and 60 g / plot potassium) in Tigapanah has most number of internodes compared to Berastagi and the combination, followed by treatment N_1K_1 (50 g / plot nitrogen and 30 g / plot potassium), N_2K_2 (70 g/plot nitrogen and 45 g/plot potassium), N_3K_1 (90 g/plot nitrogen and 30 g/plot potassium). While in Berastagi the number of internodes is the same for each treatment.

Distance between Internode

The Largest of Distance between Internode at locations 1 is N_2K_3 = 21,00 cm. While the largest of Distance between Internode at location 2 is N_2K_3 = 23,87 cm which is different from other treatments. Lodging, strongly linked with plant height where the plant height not too high more trend lodging resistant than higher plants. According to [8] plant height associated with long stem segments. Short stems will produce a number of segments that little or short. Then, according to [9] that increased internode length can be caused by higher absorption of nutrients, especially nitrogen. Elongation of cells with increasing metabolic activity including merismatic tissue activity will cause an increase in internode length. While [10] also stated that plant height has a very important role in seed formation, while being an important component for resistance to lodging. The height of the plant is very much determined by the length of the internode, with a short section ensuring the plant is more resistant to lodging.

Table 4. *Average Distance between Internode at Location 1, Location 2 and Combined*

Treatment	Tigapanah (L_1)	Berastagi (L_2)	Two Location
N_1K_1	19.50d	22.43b	20.97b
N_1K_2	20.10c	21.80b	20.95b
N_1K_3	20.30bc	21.73b	21.02b
N_2K_1	19.97c	21.90b	20.93b
N_2K_2	20.60b	21.13b	20.87b
N_2K_3	21.00a	23.87a	22.43a
N_3K_1	20.23bc	22.13b	21.18b
N_3K_2	20.53b	21.07b	20.80b
N_3K_3	19.90c	21.00b	20.45b

Testing performed by Duncan's Multiple Range Test at the 5% level

Figure 4 shows a graph of each treatment against distance between internode in each location and combination.

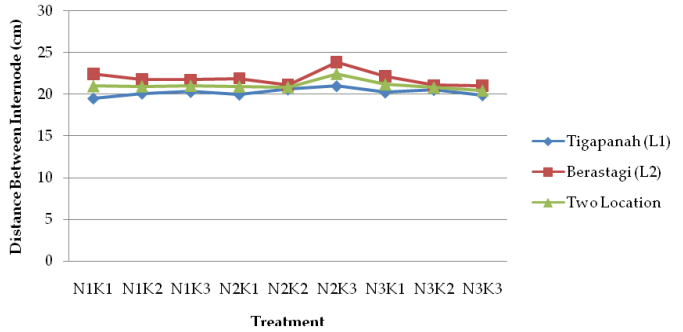

Fig 4. *Graph of treatment against distance between internode in tigapanah, berastagi and its combination*

Figure 4 shows that the treatment of N_2K_3 (70 g / plot nitrogen and 60 g / plot potassium) in Berastagi has the highest distance between internode compared to Tigapanah and the combination, followed by treatment N_1K_1 (50 g / plot nitrogen and 30 g / plot potassium). While in Tigapanah the N_2K_3 treatment also had the highest effect on distance between internode.

4 CONCLUSION

The results showed that N_2K_3 (70 g / plot nitrogen and 60 g / plot potassium) always experience of lodging for each location in the wet season and high winds in the Karo highlands. This is supported by the data obtained by the character of lodging. So we need a good cultivation technology to make wheat of genotype can be planted in the rainy season and windy.

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