

Chlorophyll Content of Wheat Plant on Some Nitrogen Interaction with Potassium in the Karo Highlands

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Abstract

All green plants contain chlorophyll that plays a role in the process of photosynthesis by absorbing and converting solar energy into chemistry. Chlorophyll functions not only play a role in photosynthesis but also very useful for human health who consume them. One of the factors that affect the chlorophyll content is the availability of nitrogen and also supported by potassium nutrients. Therefore research on the chlorophyll content of wheat plants in some of the nitrogen interactions with potassium in the Karo highlands is aimed at obtaining a model of nitrogen interaction with potassium that affects the highest chlorophyll content of wheat plants in different locations. This research was conducted in Tigapanah and Berastagi in rainy season, 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. The results indicated that both N and K application significantly affected chlorophyll content in each location. Highest chlorophyll content was obtained in Berastagi with N_3K_3 treatment and the highest chlorophyll content in Tigapanah with N_3K_3 treatment. Graphic models obtained show that chlorophyll content of wheat leaf increases when planted at higher locations for all treatments.

Keywords: chlorophyll content, location, nitrogen, potassium, wheat

INTRODUCTION

The chlorophyll content reflects the photosynthetic activity in leaves. Thus, criteria based on root health and chlorophyll content report the health of a plant directly and indirectly (Cornelissen *et al.* 2003). Meanwhile, green plants contain chlorophyll which is a green leaf substance that contributes to the process of photosynthesis. Factors affecting chlorophyll formation among others sunlight, nitrogen, water and temperature (Dwidjoseputro, 1994).

Deficiency of nitrogen leads to loss green color in the leaves, decrease leaf area and intensity of photosynthesis. Understanding the processes that govern N uptake and distribution in crops is of major importance with respect to both environmental concerns and the quality crop products (Gastal and Lemaire, 2002).

Wheat consumes nitrogen in the greatest quantities, potassium in somewhat smaller amounts and phosphorus in the smallest amounts. In dependence of type, weather conditions and other factors, soils generally lack nitrogen and phosphorus in greater measure and potassium in less extent. Nitrogen uptake is much better with addition phosphorus and potassium in the soil. However, the supply of N, P, and K can affect the plant dry mass, and the chlorophyll content (Gurgul and Herman, 1994).

The main aim of this study was to analyze whether the addition of nitrogen and potassium to wheat plant affects chlorophyll content in leaves in each location.

MATERIALS AND METHODS

The research was conducted in Tigapanah (1100 meters above sea level) and Berastagi (1400 meters above sea level) in the rainy season of April-August 2017, soil nutrients in each location were analyzed. The plant used is a specific location of the wheat plant that is genotype C (LAJ3302 / 2 * MO88). The research was conducted 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) performed three replications. Data were analyzed by using Anova test. The result that Anova test shows the real effect then it is followed by Duncan Multiple Range Test.

RESULTS AND DISCUSSION

Obtained chlorophyll content of wheat plants treated with nitrogen fertilizer with potassium showed a real difference in each location as well as in both locations. The highest chlorophyll content in Tigapanah is found in N_3K_3 treatment, in Berastagi the highest chlorophyll content is found in N_3K_3 treatment and in both locations the highest chlorophyll content is also found on N_3K_3 treatment.

This shows that the treatment of N_3 (90 g Urea / plot) with K_3 (60 g KCl / plot) is best for chlorophyll content with soil conditions of high nitrogen content in Tigapanah and Berastagi, in accordance with soil analysis (Table 2). In line with the opinion of Tucker (2004) and Daughtry *et al.* (2000) that nitrogen is a structural element of chlorophyll and protein molecules, and thereby affects formation of chloroplasts and accumulation of chlorophyll in them. factors that influence chlorophyll synthesis among others: light, sugar or carbohydrates, water, temperature, genetic factors, nitrogen, magnesium, iron, manganese, Cu, Zn, sulfur, and oxygen. Hossain (2010) reported that leaf chlorophyll content was significantly influenced by the levels of N, P and K and declined with decreasing doses of fertilizer treatments during the treatment period due to growth.

Table 1. Average chlorophyll content (mg/g)

Treatment	Tigapanah (L_1)	Berastagi (L_2)	Two Locations
N_1K_1	45.10h	45.83e	44.88b
N_1K_2	45.73d	45.97e	45.85b
N_1K_3	45.57e	45.67e	48.20a
N_2K_1	45.43f	46.93d	46.85b
N_2K_2	46.07c	47.67c	45.88b
N_2K_3	46.53b	46.90d	45.67b
N_3K_1	45.23g	48.90c	45.53b
N_3K_2	46.10c	49.47b	48.87a
N_3K_3	48.03a	53.63a	49.60a

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

From the data in Table 1. it can be obtained a nitrogen interaction model with potassium that affects the highest chlorophyll content of wheat plants in different locations, can be seen in the graph below.

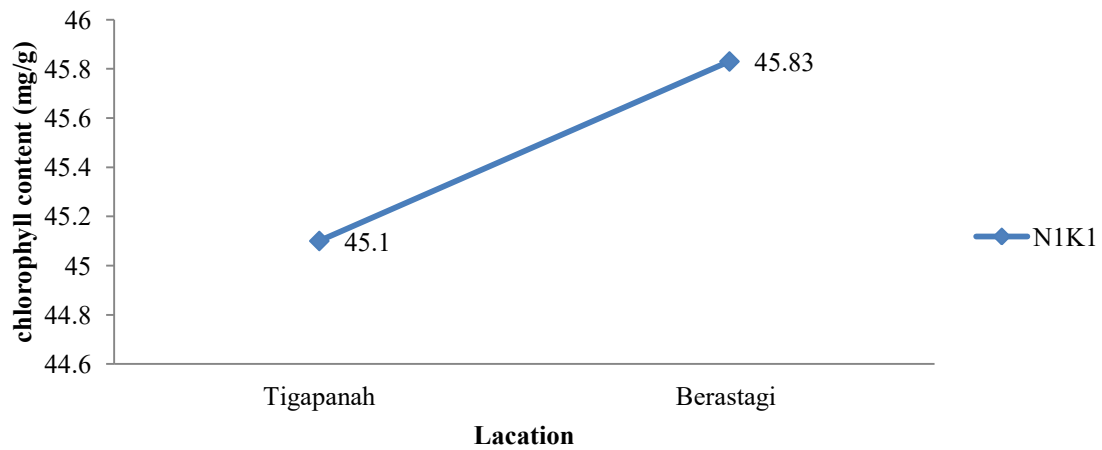


Figure 1. Leaf chlorophyll content of wheat plants with N_1K_1 treatment at two locations

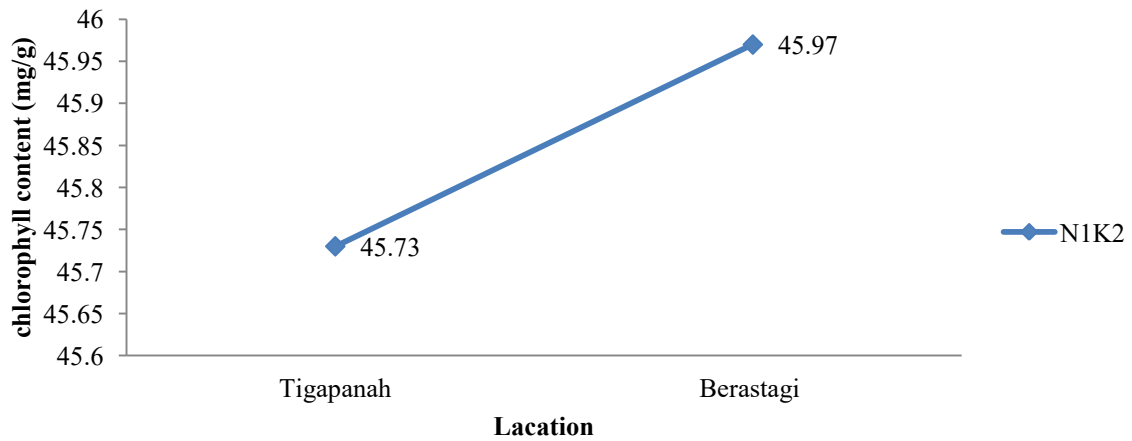


Figure 2. Leaf chlorophyll content of wheat plants with N_1K_2 treatment at two locations

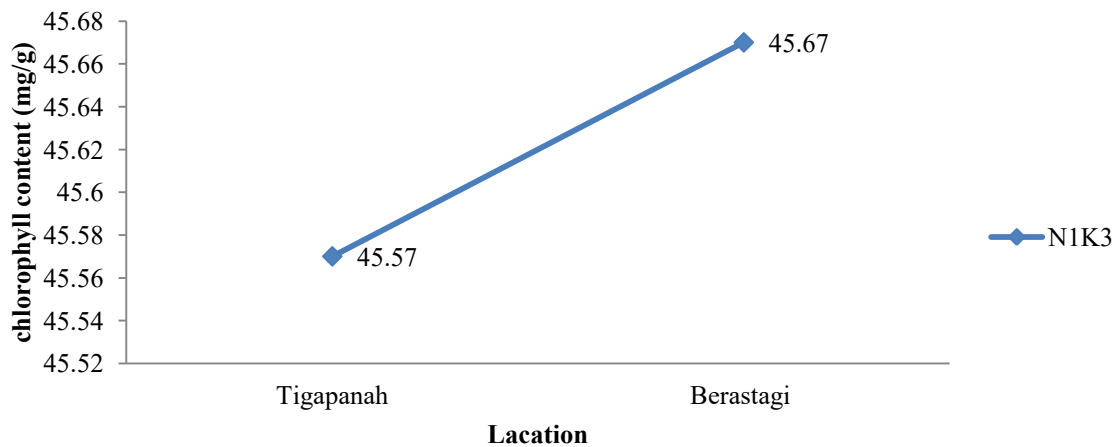


Figure 3. Leaf chlorophyll content of wheat plants with N_1K_3 treatment at two locations

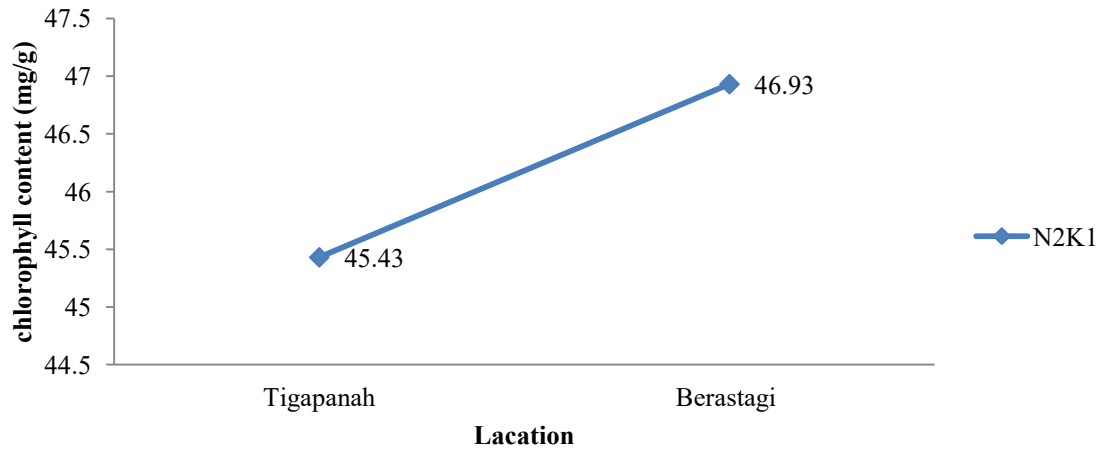


Figure 4. Leaf chlorophyll content of wheat plants with N₂K₁ treatment at two locations

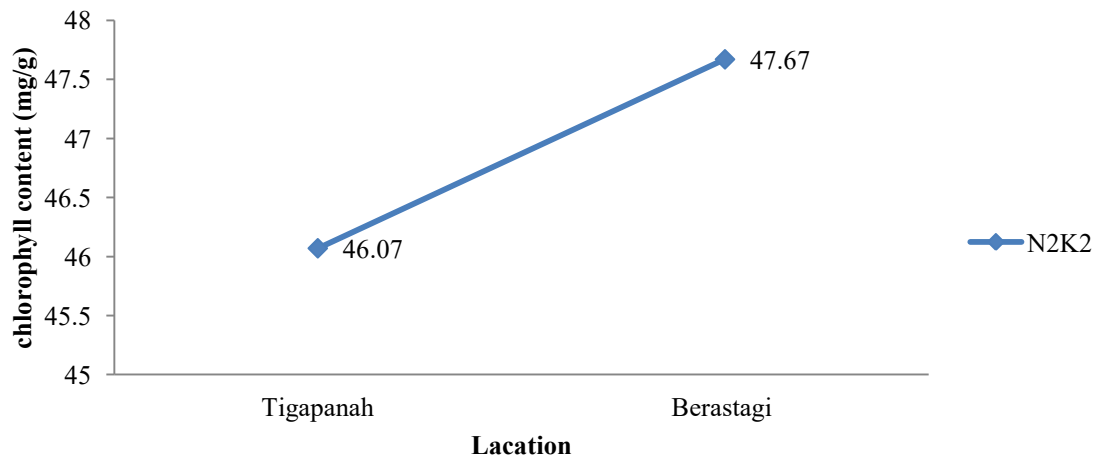


Figure 5. Leaf chlorophyll content of wheat plants with N₂K₂ treatment at two locations

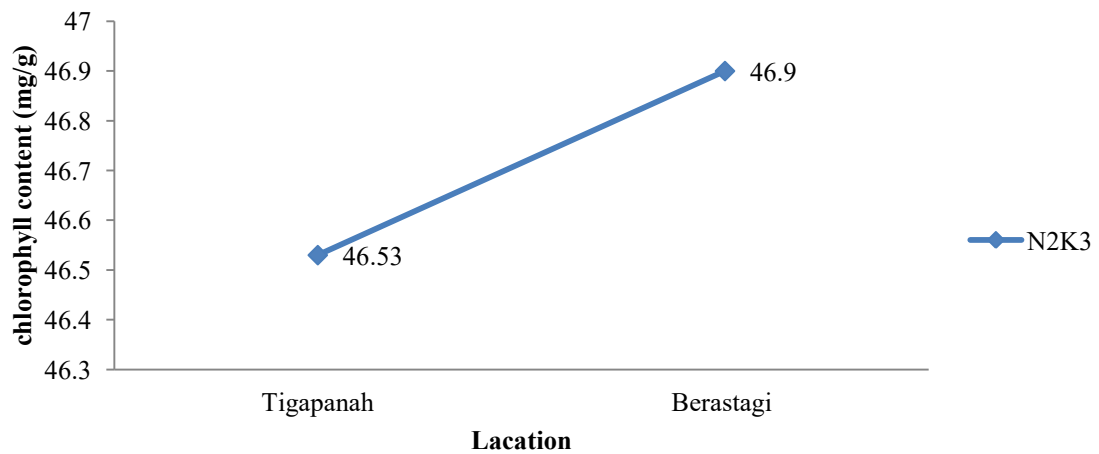


Figure 6. Leaf chlorophyll content of wheat plants with N₂K₃ treatment at two locations

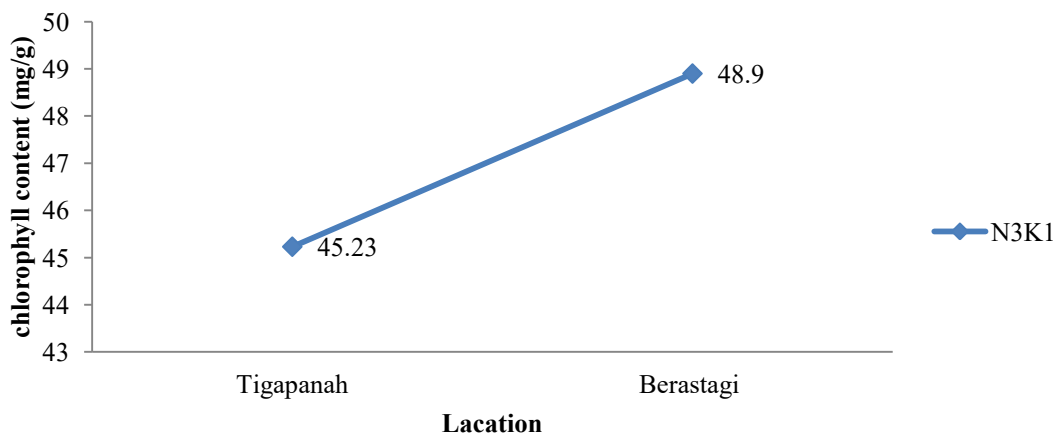


Figure 7. Leaf chlorophyll content of wheat plants with N₃K₁ treatment at two locations

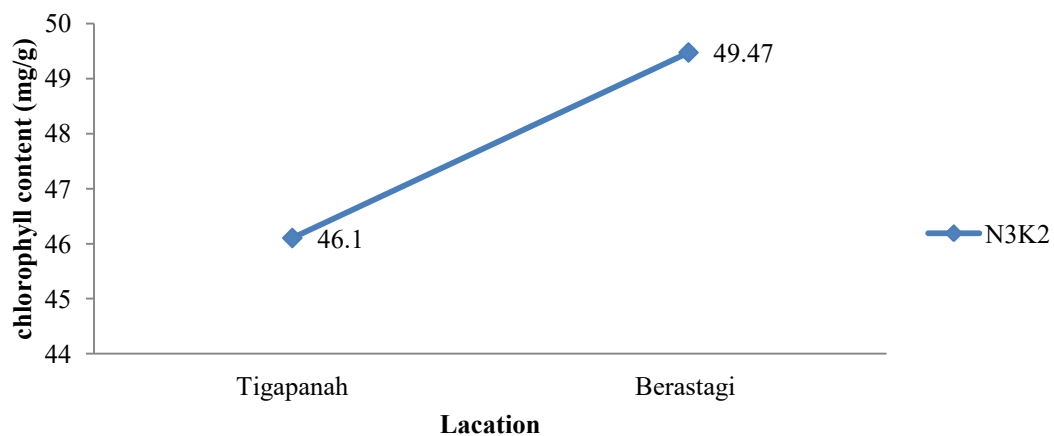


Figure 8. Leaf chlorophyll content of wheat plants with N₃K₂ treatment at two locations

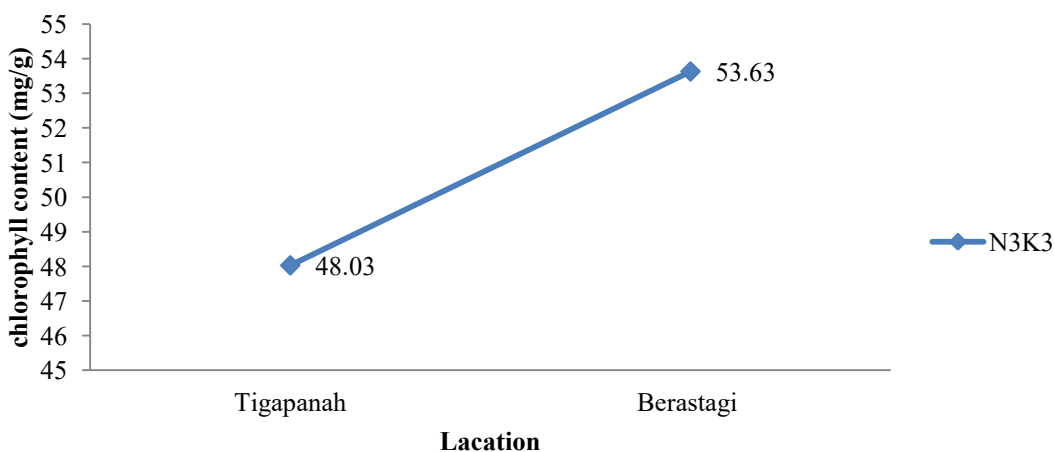


Figure 9. Leaf chlorophyll content of wheat plants with N₃K₃ treatment at two locations

From the figure obtained can be seen that the graph of chlorophyll content for all treatments in Berastagi is higher than in Tigapanah. This shows that soil conditions (Table 2) and the environment (Tables 3 and 4) in Berastagi are better for the formation of chlorophyll content at each treatment.

Table 2. Soil analysis

The nature of the soil	Unit	Berastagi		Tigapanah	
		Value	Criteria	Value	Criteria
N	%	0,57	high	0,55	high
P total	mg/kg	754,65	Very high	396,06	Very high
K	cmol/kg	3,49	Very high	1,12	Very high
pH H ₂ O		5,95	A bit sour	4,87	Sour

Climatic conditions in Berastagi closer to subtropical climatic conditions where the origin of wheat plants that influence the growth. In accordance with opinion Patola and Ariyantoro (2015) reported that conditions similar to subtropical climate will support the growth of wheat crops.

Table 3. Rainfall (mm), temperature (°C) and the intensity of sunlight (%) in Tigapanah and Berastagi

Tigapanah											
Month											
April			May			June			July		
Ch	T	SS	Ch	T	SS	Ch	T	SS	Ch	T	SS
324	20.9	20.2	221	23.1	40.7	99	21.7	55.3	196	21.5	47.9

Berastagi											
April			May			June			July		
Ch	T	SS	Ch	T	SS	Ch	T	SS	Ch	T	SS
333	20.6	19.8	224	22.3	42.6	102	20.7	56.5	199	20.5	48.4

Ch = Rainfall, T = Temperature, SS = The Intensity of Sunlight

CONCLUSIONS

Treatment of N₃K₃ better affects chlorophyll content in Tigapanah, whereas in Berastagi N₃K₃ treatment better affects chlorophyll content than other treatments. For each treatment, it affects the chlorophyll content better at the Berastagi. Graphic model obtained can be seen that chlorophyll content of wheat leaf increased when planted in a higher location for all treatments.

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REFERENCES

- Cornelissen JHC, Lavorel S, Garnier E, Díaz S, Buchmann N, Gurvich DE, Reich PB, ter Steege H, Morgan HD, van der Heijden MGA, Pausas J, Poorter H. 2003. Handbook of protocols for standardised and easy measurement of plant functional traits worldwide. *Australian Journal of Botany* 51:335-380.
- Curtis OF, Clark GC. 1950. An introduction to plant physiology. McGraw Hill Book Compant. Inc.
- Daughtry CST, Walthall CI, Kim M S, Brown de Colstoun E, McMurtrey JE. 2000. Estimating corn leaf chlorophyll concentration from leaf and canopy reflectance. *Rem. Sens. Of Environment* 74:229-239.
- Dwidjoseputro. 1994. Pengantar fisiologi tumbuhan. PT Gramedia Pustaka Utama. Jakarta.
- Gastal F, Lemaire G. 2002. N uptake and distribution in crops: an agronomical and ecophysiological perspective 53 (37):789-799.

- Gurgul E, Herman B. 1994. Influence of nitrogen, phosphorus and potassium on chemical composition and activity of some enzymes in celery during its growth. *Biol Planta* 36:261–265.
- Hossain D, Musa MH, Talib J, Jol H. 2010. Effects of nitrogen, phosphorus and potassium levels on kenaf (*Hibiscus cannabinus* L.) growth and photosynthesis under nutrient solution. *Journal of Agricultural Science* 2 (2):49-57.
- Patola E, Ariyantoro H. 2015. Uji pemberian pupuk hayati biotamax dan macam pupuk kandang terhadap pertumbuhan dan hasil tanaman gandum (*Triticum aestivum* L.). *JOGLO* 29:10–18.
- Tucker M. 2004. Primary nutrients and plant growth. In: *Essential Plant Nutrients* (SCRIBD, Ed.). North Carolina Department of Agricultura.