Vol. 13, No. 3, pp. 724-732, August 2025 DOI: https://doi.org/10.23960/jat.v13i3.9815

Jurnal Agrotek Tropika

P-ISSN: 2337-4993
E-ISSN: 2620-3138

Journal homepage: https://jurnal.fp.unila.ac.id/index.php/JA

PENINGKATAN KANDUNGAN KLOROFIL DAN HASIL TANAMAN TERONG PADA BERBAGAI DOSIS MAGNESIUM

INCREASING CHLOROPHYLL CONTENT AND YIELD OF EGGPLANT ON VARIOUS MAGNESIUM DOSES

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ARTICLE HISTORY:
Received: 7 October 2024
Peer Review: 14 March 2025
Accepted: 27 July 2025

KEYWORDS:
Chlorophyll, eggplant, magnesium, photosynthesis, yield.

ABSTRACT

Eggplant is a vegetable that is rich in vitamin and antioxidant so is beneficial for health. Base on this, demand for eggplant continues to increasing. Eggplant production can be increased by increasing the chlorophyll content with additional doses of magnesium (Mg). Mg is the main component of chlorophyll and plays an important role in various plant metabolic pathways. Puprpose of this study determine effect of Mg on increasing Chlorophyll content and its correlation with increasing eggplant yields. This research was conducted in August-Desember 2023 in the Integrated Garden Rumah Tani Nusantara located in Kayamanya Village, Poso. Central Sulawesi. This Study was designed in CRBD, treatment with 6 levels of Mg doses, namely without Mg doses as control. 0.5 g.polybag-1, 1 g.polybag-1, 1.5 g.polybag-1, 2 g.polybag-1, 2.5 g.polybag-1 with three replications. The parameters observed were chlorophyll content (chlorophyll a, b and Total), plant height and yield component (number of fruits, fruit weight and Fruit Length). The results showed that the Mg dose treatment increased the chlorophyll content of eggplant leaves, both chlorophyll a, b, plant height and yield components. There is a correlation between increased eggplant yields and magnesium doses.

KATA KUNCI:
Hasil, fotosintesis, klorofil, magnesium, terong

ABSTRAK

Terong adalah sayuran Tinggi nutrisi, vitamin dan antioksidan yang bermanfaat untuk kesehatan. Berdasarkan hal tersebut, permintaan terhadap buah terong terus mengalami peningkatan. Produksi terong dapat ditingkatkan melalui peningkatan kandungan klorofil dengan pemberian dosis magnesium (Mg). Mg merupakan penyusun utama klorofil dan memegang peranan penting dalam berbagai lintasan metabolisme tanaman, namun demikian penggunaan magnesium sering diabaikan oleh petani. Penelitian ini bertujuan untuk mengetahui pengaruh magnesium terhadap peningkatan kandungan klorofil dan korelasinya dengan peningkatan hasil buah terong. Penelitian ini dilaksanakan pada bulan Agustus – Desember Tahun 2023 di kebun Terpadu milik Rumah Tani Nusantara Poso Sulawesi Tengah. Penelitian dirancang dalam perlakuan Rancangan Acak Kelompok Lengkap (RAKL) dengan 6 taraf dosis magnesium yaitu tanpa dosis magnesium sebagai kontrol , 0.5 g.polibag-1, 1 g.polibag-1, 1.5 g.polibag-1, 2 g.polibag-1, 2.5 g.polibag-1 dengan tiga replikasi. Parameter yang diamati adalah kandungan klorofil (a, b dan total), Tinggi Tanaman dan Komponen hasil (jumlah buah, berat buah dan Panjang Buah). Hasil penelitian menunjukkan bahwa perlakuan dosis Mg meningkatkan kandungan klorofil daun terong baik klorofil a, b, tinggi tanaman dan komponen hasil. terdapat korelasi antara peningkatan hasil tanaman terong dengan pemberian dosis Mg.

1. INTRODUCTION

Eggplant is a vegetable that has high nutritional content, such as vitamins (A, B and C), bioactive compounds, phenolics such as flavonoids, tarpenoids, ethanol, alkaloids and tannins which are beneficial for body health (Bose *et al*., 2011; Blando *et al*., 2018; Kaushhik *et al*., 2019, Peng *et al*., 2019); Improves heart health, reduces cholesterol and blood sugar (Sahid et al. 2014). Because of its benefits, its causing the demand for eggplant. Eggplant production in 2024 is 1,143,788 tons, an increase of 69.11 % from production in 2023 (BPS, 2024). However, this increase has not been able to meet national eggplant needs, so efforts are needed to increase eggplant production.

Leaf chlorophyll content is the main limiting of plant production (Dewi *et al*., 2020). Leaf chlorophyll content is often ignored even though it is the main key in the process of assimilation (Huang *et al*., 2018; Chou *et al* ., 2020; Dewi *et al*., 2021) in the process of photosynthesis. Photosynthesis affected to plant productivity because its the only process that converts solar radiation into chemical energy to produce carbohydrates (assimilates) on the plants metabolism (Kaushik *et al*., 2019; Dewi *et al*., 2023), further explained that 90% of plant biomass is produced by photosynthesis (Mun *et al*., 2020).

Magnesium (mg) is a major component of plant chlorophyll (Prastowo, 2013; Peng *et al*., 2019; Chou *et al*., 2020; Huber and Jones, 2013; Mun *et al*., 2020), howefer, its rarely use by famers. The main role of mg is a regulates physiological processes in the plants tissue (Tappino *et al*., 2014; Kabayashi *et al*., 2015; Hermans *et al*., 2013; Zhang *et al*., 2020; Li *et al*., 2011). Mg deficiency in leaves causes leaves to experience *senescence* (Tanoi and Kobayashy, 2015; Kobayashy and Tanoi, 2015). Futhermore, Mg is an activator of severeal photosynthetic enzymes, instance is RuBP-*carboxylase* which plays a role in CO_2 fixation in photoshynthesis procces. In addition, Mg also an activator/enzyme cofactor in carbohydrate metabolism procces, wherefore, Mg deficiency can inhibit enzyme activity (Guo *et al*., 2016; Dias *et al*., 2017; Magnesium play important role in photosynthate transport (distribution of dry matter) from *source* to the *sink*. It was further reported that sufficient Mg increases the rate of photosynthesis, chlorophyll content and biomass of mulberry plants (Jin *et al*., 2013) and oranges (Chai *et al*., 2019). Thus affecting plant growth and development (Chaudhry *et al*., 2021; Gransee *et al*., 2013; Xu *et al*., 2015). Considering the description above, the purpose of this study was to observe the chlorophyll content of plants and the yield of eggplant plants at various doses of Mg

2. MATERIAL AND METHODS

2.1 Materials

The research was conducted in the Integrated Garden by Rumah Tani Nusantara, Poso Regency. The coordinates of the research location are 123'43.9"S 120 44'37.3"E with an altitude of 10 m above sea level. The research implementation time is in August - December 2023.

2.2. Methods

The study was arranged in a non-factorial Randomized Block Design with 6 levels of Mg doses, without Mg dose as a control, 0.5 g. Mg. Polybag^{1}, 1 g Mg. Polybag^{1}, 1.5 g. Mg polybag^{-1}, 2 g Mg. polybag^{-1}, 2.5 g Mg. polybag^{-1}. Treatment replication was carried out 3 times so that there were 18 experimental units. Each unit consisted of 12 polybags so that there were 216 polybags. Observation variables included Leaf Chlorophyll Content, plant height and yield components consisting of number of fruits, fruit weight and fruit length

3. Result and Discusion

3.1 Leaf chlorophyl content

Chlorophyll is a photosynthetic pigment that absorbs sunlight to form chemical energy. The role of chlorophyll in absorbing sunlight cannot be replaced by other substances in plants. The dose of Mg effected the formation of chlorophyll a, b and total eggplant leaf levels at 2, 4 and 6 MST. The dose of Mg fertilizer applied differed significantly between treatments. The application of a higher dose of magnesium increases the level of chlorophyll formed in eggplant leaves. (Graph 1). Mg is a component of chlorophyll and also controls enzymes that play a role in chlorophyll biosynthesis such as ChlG (*Chlorophyll synthase*), CHLI, CHLD (Li *et al*., 2021).

Futhermore, Mg is a cofactor for the enzyme Mg-*protoporphyrin*-IX-*methyltransferase* which is a key enzyme in the 15 stages of chlorophyll b formation (Wang et al., 2017). Mg is also reported to be able to binding with nitrogen to form Mg-N-CD which can absorb UV rays and emitting blue light in rice plants, in other words, Mg can protect plants from UV rays and increase photosynthesis (Li *et al*., 2017; Li *et al*., 2019; Li *et al*., 2021).

Based on the results of the regression analysis (Figure 2.) exhibbit that each additional dose of mg will increase the levels of chlorophyll a, b and Total by the R value. The average increase in the R value during the measurement phase is 0.95%, 0.94%, and 95%. This figure also exhibbition that the increasing plant growth can be enhance the leaf chlorophyll content. The increase in leaf chlorophyll content is due to increased magnesium absorption by plants.

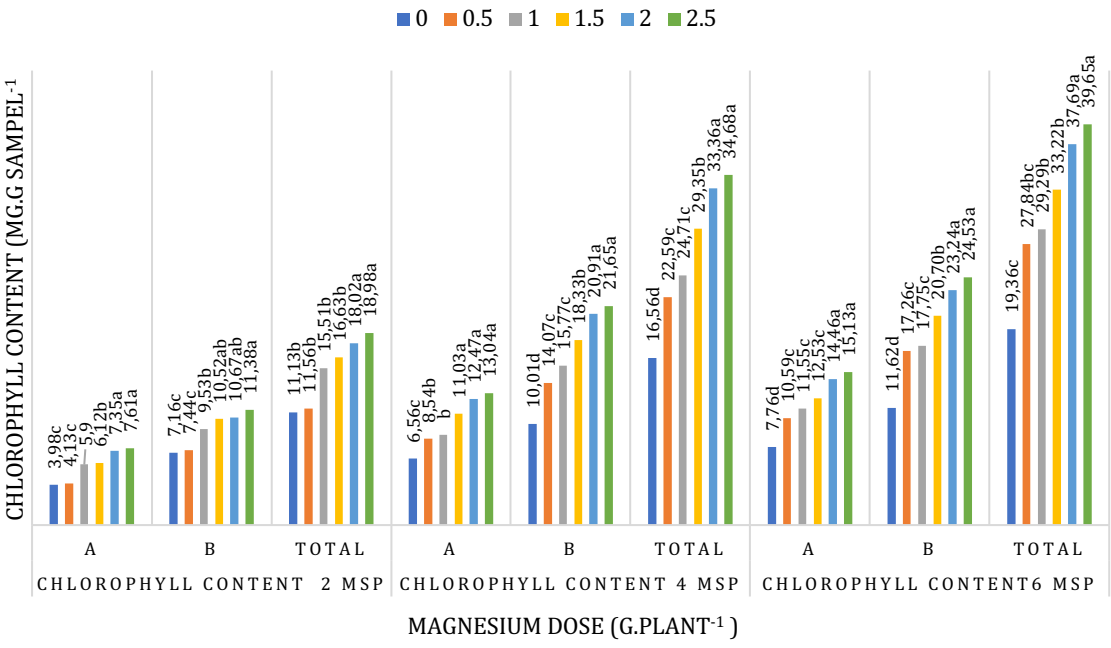

Figure 1. Chlorophyll content of eggplant leaves at various magnesium dose applications.

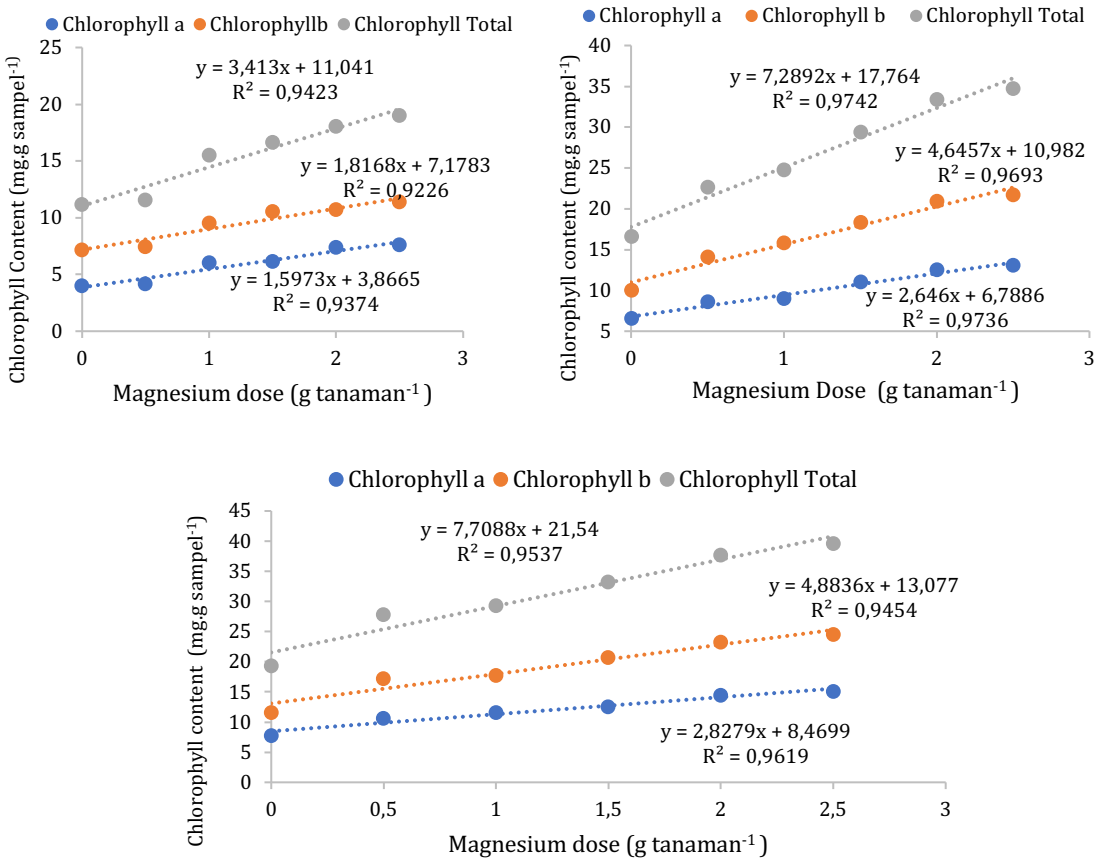

Figure 2. Relationship between magnesium dose and leaf chlorophyll content at 2 MSP (A); 3 MSP (B) and 6 MSP (C)

3.2 Plant height

The results showed that Mg applied to eggplant plants significantly affected plant height in weeks 2, 4 and 6 MST. Doses of 2 g polybag^{-1} and 2.5 g polybag^{-1} showed the highest plant height (Table 2.). Application of magnesium treatment with a dose (0.5 g polybag^{-1}, 1 g polybag^{-1}, 1.5 g polybag^{-1}, 2 g polybag-^{1} and 2.5 g polybag-^{1} showed a rate of increase in plant height of 57.59%, 53.59%, 71.32%, 80.67%, and 80.57% respectively, while the treatment without magnesium application only showed an increase in plant height of 22.86%. Mg with a dose of 2 g. plant^{-1} and 2.5 g. The rapid increase in plant height in eggplant plants that received Mg application inashmuch as the plants received sufficient assimilates, this can be measured from the high chlorophyll content compared to the treatment that did not add Mg treatment. In addition, Mg is one of the elements that affects the sucrose synthase enzyme which is responsible for converting glucose into sucrose in the assimilate transport process. Thus, Mg indirectly plays a role in the assimilate partition process from the leaves to all parts of the plant.

The explanation is strengthened by Figure 3. which showing a positive relationship between increasing plant height and leaf chlorophyll content. Leaf Chlorophyll content increase plant growth and development by increasing the rate of photosynthesis (Mun et al., 2020). Other research, report that Mg directly plays a role in the transport of nitrogen from the soil to actively dividing plant organs. Furthermore, Mg reported is an enzyme cofactor for the synthesis of organic acids such as *citric acid synthesis*, *malic acid synthesis* and *pyruvic acid synthesis* (Igamberdiev *et al*., 2016). Plants under certain conditions will form organic acids from incomplete photosynthesis oxidation, or often referred to as carbon accumulation caused by metabolic disorders in plants. If these organic acids are not converted, they will have an impact on increasing the ROS content in plant cells (Bose *et al*., 2011; Yang *et al*., 2013).

Tabel 2. Average height of eggplant at various dose applicatons of magnesium

Magnesium dose (g.Polibag^{-1})	Plant height (Cm)		
	2 MST	4 MST	6 MST
0	14.58 d	17.91 d	26.69 d
0.5	16.21 d	25.54 c	38.71 c
1	16.67 bc	25.56 c	42.85 c
1.5	17.03 bc	29.26 b	52.59 b
2	19.28 a	34.84 a	64.62 a
2.5	19.44 a	35.11 a	65.11 a

Note : the average number followed by the same latters sows non significant Difference in the DMRT Test (taraf 0.05 %).

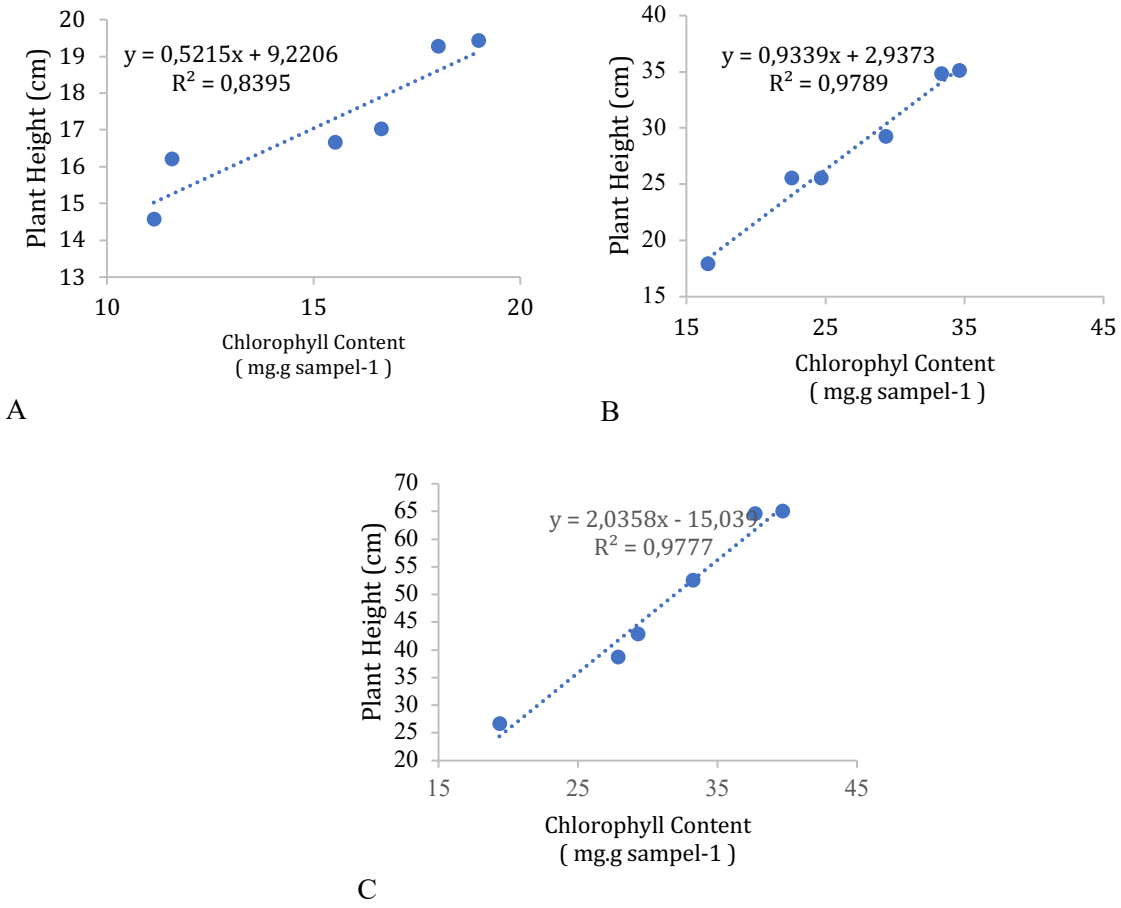

Figure 3. Correlation between leaf clorophyll content and eggplant height. (A) 2 week After Planting (B) 4 week After Planting, (C) 6 week After Planting.

3.3 Yield Component

Application of mg dose treatment increases the weight, number of fruits and length of eggplant fruit (Table 4.). The applied Mg is able to increase the chlorophyll content of leaves, there is a positive correlation between the leaf chlorophyll content and the yield parameters (number of fruits, fruit length and fruit weight). figure 4 exhibbition that each additional leaf chlorophyll content worth X will increase the yield component by 0.97, 0.87 and 0.91 respectively. Enhanchement of leaf chlorophyll content induce the formation of assimilates to support fruit development. Mg is the main component of chlorophyll levels so it is the main key in the photosynthesis process. Chlorophyll is closely related to all aspects of primary events in the accumulation of assimilates in plants (Park *et al*., 2019; Ciscomani *et al*., 2021; de-Santos *et al*., 2021. Kwon *et al*., 2019; Cakman, 2013). The mechanism of Mg in influencing photosynthesis includes: magnesium plays a direct role in

chlorophyll metabolism and biosynthesis, affects electron excitation and light absorption in photosystem II, plays a role in increasing electron transport in Photosystem II to Photosystem I, increases the effectiveness of the RUBP carboxylase enzyme in the CO2 assimilation process in Photosystem I, and ultimately increases the accumulation of carbohydrates (assimilates). Increased assimilates in leaves will support plant growth, fruit formation, fruit weight and fruit length. Li et al (2019) and Li et al (2021) report that the increase and deficiency of Mg in cells are closely related to CO_2 assimilation in rice plant leaves.

Tabel 4. Average Yield component of eggplant at various dose applicatons of magnesium

Dosis Magnesium (g.tanaman^{-1})	Fruit Set (fruit)	Fruits weight (g)	Fruits lenght (cm)
0	13.57 d	102.02 d	17.86 d
0.5	14.44 c	113.28 d	20.57 c
1	15.11 bc	181.28 b	23.57bc
1.5	16.33b	205.07 c	25.83 b
2	20.54 b	234.58 a	27.52 a
2.5	21.58 c	238.67 a	26.80 ab

Note : the average number followed by the same latters sows non significant Difference in the DMRT Test (taraf 0.05 %).

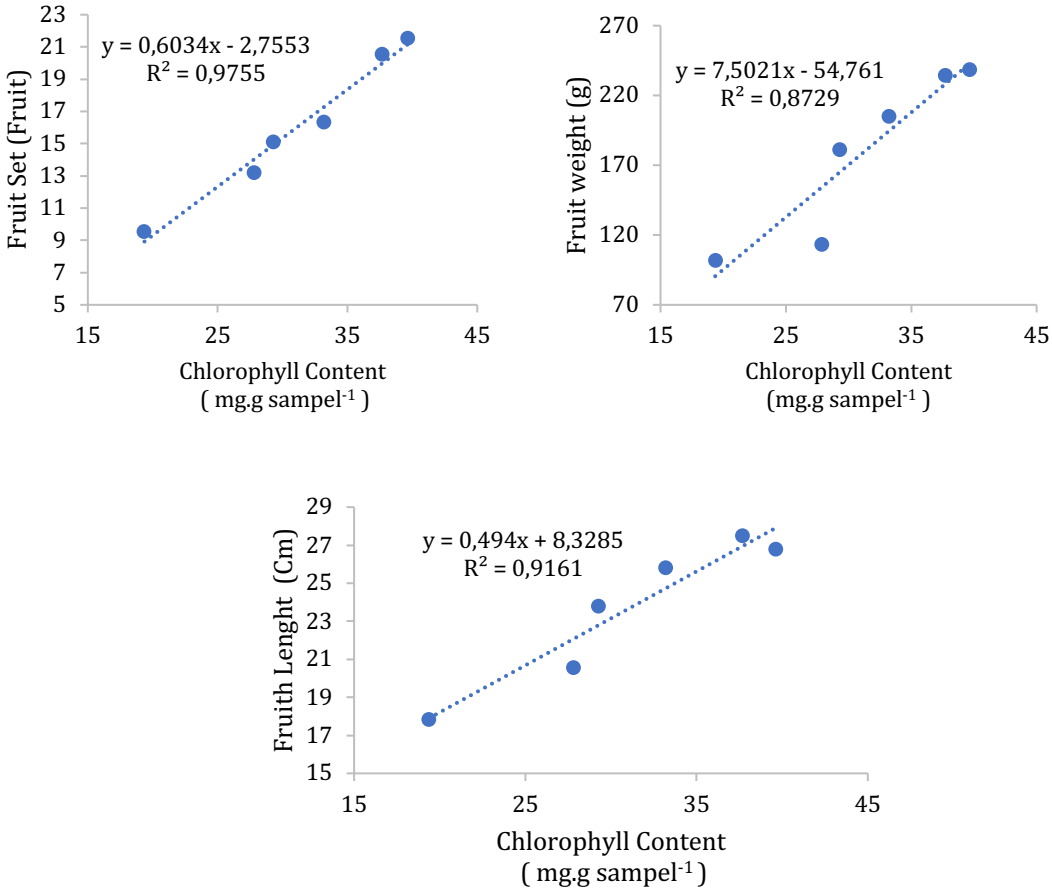

Figure 4. Relationship between leaf Chlorophyll content and Yield Component

4. CONCLUSION

Based on the results and discussion, it can be concluded that each additional dose of magnesium increases the levels of chlorophyll a, b and total by 95%, 94% and 95%, respectively. Enhancement of leaf chlorophyll content effect to increase yield components, namely the number of fruits, fruit weight and fruit length by 0.97%, 0.87% and 0.91%.

5. ACKNOWLEDGEMENT

Thank to Departement of Agrotechnology , Faculty of Agriculture, Sintuwu Maroso University, which has facilitated of this research through research assistance for Departement of Agrotechnology study program in 2023.

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