

Final Report

STUDYING EFFICIENCY OF NUTRI TABLE MIX AND NUTRI MIX SPARK ON CHLOROPHYLL CONTENT AND MUNG BEAN GROWTH

by

Assistant Prof.Dr. Jiraporn Inthasan

Faculty Agricultural and Plant Production

Maejo University

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Abstract

The studying efficiency of nutri tabble mix and nutri mix spark on mung bean growth by foliar application was prepared in green house at faculty of Agricultural and Plant Production, Maejo University, Chiang Mai, Thailand. Nine treatments were laid out in a completely randomized design (CRD) with four replications consist of Nutri Tabble Mix and Nutri Mix Spark application rates 1)control (no foliar apply), 2-5) Nutri Tabble Mix rating as 0.025, 0.050, 0.1 and 0.2% , 6-9) Nutri Mix Spark rating 0.025, 0.050, 0.1 and 0.2% respectively. The result showed that spraying both Nutri Tabble Mix and Nutri Mix Spark with optimized rate at 0.1% provided the higher mung bean yield than control treatment. That rate of application still increased the highest quality of mung bean such as number seed per pod, weight of 100 seeds and percentage of protein. Moreover, the content of chlorophyll in leave samples all stage especially at R1 (beginning of flowering) to R4 (fully seed in pod) caused the significant highest by application of Nutri Tabble Mix and Nutri Mix Spark. However, it was not significantly different between Nutri Tabble Mix and Nutri Mix Spark products.

Introduction

TNA Group, a Dutch – Thai Joint venture company, who specializes in the design and manufacturing of high quality foliar fertilizers and other products for the agricultural and horticultural industries. TNA is committed to research and produce innovative products for the Asian and Middle Eastern regions by combining knowledge and technologies from the Netherlands and Europe with manufacturing facilities in Thailand. TNA Group was founded in 2005 and was successful in supplying over 100 domestic customers in Thailand, then in 2016 TNA International was founded together with investors from the Netherlands. TNA Group has expanded to Myanmar, Vietnam, Nepal and India and strives to continue to grow and expand into the rest of Asia and the Middle East.

Moreover, TNA Group still have more product such as nutri tabble mix and nutri mix spark that have a good characteristic for plant production. Nutri table mix is the latest innovative product with effervescent micronutrient as tablet form. Nutri Tabble aims to solve many problems common for farmers when using (foliar) fertilizer. Nutri Tabble could solve this by making special formulations to fit in tablet form. Nutri Spark product line is effervescent powder nutrient mix products that focus primarily on secondary and trace elements. The Nutri Spark range covers a wide variety of nutrients like Zinc, Magnesium, Sulfur, Calcium combined with trace elements. Nutri spark products can for example be packaged in small single use sachets for maximum simplicity with contain buffer agent to lower and control the pH level which makes nutrients more efficient and allow for combining this product with other agrochemicals like pesticides, herbicides and fungicides. Hence this experiment would like to record the efficiency of nutri tabble mix and nutri mix spark on chlorophyll content and mung bean growth.

Objective

1. To compare the mung bean growth on folia application of Nutri Tabble Mix and Nutri Mix Spark
2. To study the chlorophyll content in mug bean leave samples after application Nutri Tabble Mix and Nutri Mix Spark

Materials and Method

Experimental designed

Mung beans were planted in plastic pot (20 inches) with 3 plant/pot in green house at faculty of Agricultural and Plant Production, Maejo University, Chiang Mai, Thailand. Completely Randomized Design: CRD was set with 9 treatments and 4 replications consist of 1) control (no spraying), 2-5) Nutri Tabble Mix rating as 0.025, 0.050, 0.1 and 0.2% , 6-9) Nutri Mix Spark rating 0.025, 0.050, 0.1 and 0.2% respectively. Soil fertilizer application as N-P-K fertilizer (12-24-12) was added at the rate 25 kg/rai by DOA recemented (2.5 gram/pot) at 14 days after emergence (DAE). The mung bean plants were watered 300 ml/plant/pot everyday, then increased the rate of water up to 500 ml/plant/pot when plant age at 3 weeks after emergence.

Foliar fertilizers management were applied when plant getting mature stage at V4, R1 R2 and R4 stages. The rate of Nutri Tabble Mix and Nutri Mix Spark were set with the adjuvant was mixed with fertilizer as 0.5 ml/ 1 liter of water. All fertilizers were sprayed only one time at 8.00 a.m. with the exactly rate treatments as this following:

- 1) control (no foliar apply)
- 2) Nutri Tabble Mix 0.025%
- 3) Nutri Tabble Mix 0.050%
- 4) Nutri Tabble Mix 0.1%
- 5) Nutri Tabble Mix 0.2%
- 6) Nutri Mix Spark 0.025%
- 7) Nutri Mix Spark 0.05%

- 8) Nutri Mix Spark 0.1%
- 9) Nutri Mix Spark 0.2%

Data collection

1). To evaluate chlorophyll contents after spraying 3 days, 3 leave mung bean samples was analyzed by chlorophyll meter SPAD-502Plus (Konnica Milnolta) at 9.00-10.00 am.

2). Fresh and dry weight were collected at harvesting stages (75-80 DAE). The yield, number seed per pod, weight of 100 seeds, pod length, percentage of protein and amylase starch were also evaluated at the same time.

Result

The respond of fresh weight by applying Nutri Tabble Mix and Nutri Mix Spark was not significant. Nutri Mix Spark rate 0.05% could provide the highest fresh weight at 334 g/pot compared with the lowest fresh weight at 259 g/pot by control treatment. However, Nutri Mix Spark had slightly trend to cause higher fresh weight of mung bean than Nutri Tabble Mix. Whereas it was no different significant in dry weight at harvesting stage with the average at 68.3 g/pot. Nutri Mix Spark rate 0.05% gave the highest dry weight at 75.1 g/pot but not significant with Nutri Tabble Mix (0.1%) at 74.6 g/pot. Moreover, mung bean yields were collected for 14 days after harvesting as composite yield samples. Nutri Tabble Mix and Nutri Mix Spark rate 0.1% could provide the higher yield than other treatments at 49.0 and 44.7 g/pot respectively. The control treatment showed the lowest of mung bean yield at 33.4 g/pot (Table 1)

Table 1: Fresh and dry weight and yield of mung bean at harvesting stage (72 DAE)

Treatment	Fresh weight	Dry weight	Yield
	-----g/pot-----		
control (no foliar apply)	259	59.9	33.4
Nutri Tabble Mix 0.025%	284	64.6	39.8
Nutri Tabble Mix 0.05%	273	61.1	44.7
Nutri Tabble Mix 0.1%	306	74.6	49.0
Nutri Tabble Mix 0.2%	275	67.1	39.7
Nutri Mix Spark 0.025%	332	70.0	36.7
Nutri Mix Spark 0.05%	334	75.1	43.3
Nutri Mix Spark 0.1%	324	71.9	44.7
Nutri Mix Spark 0.2%	315	70.6	38.5
Grand Mean	300	68.3	41.1
F-test	NS	NS	NS
CV (%)	19.37	21.12	18.58

* = Significant difference at P< 0.05 level. ** = Significant difference at P< 0.05 level. NS = Non-significant difference. 1/ = Values followed by different letter are significantly different according to DMRT.

For evaluating the quality of mung bean, it can be seen that Nutri Tabble Mix proved the length of bean longer than Nutri Mix Spark. The rate 0.2% both of Nutri Tabble Mix and Nutri Mix Spark caused the higher recording data at 10.16 and 10.21

cm respectively. The highest number seed per pod at 11.8 seed/pod was showed by Nutri Tabble Mix rate 0.1%(P<0.05) that higher than the rate at 0.05% and 0.2%. The control treatment was recorded the lowest number seed per pod at 8.5 seed/pod Another parameter, weight of 100 seeds was hit by Nutri Tabble Mix rate 0.1% with the average datum at 10.30 gram (P<0.05) but not significant with Nutri Tabble Mix rate 0.2%. Spraying Nutri Mix Spark had no significant effect with Nutri Tabble Mix. However, the control treatment (no foliar application) was gotten the lowest weight of 100 seeds at 6.95 gram (Table 2)

Table 2: Pod-length, number seed per pod and weight 100 seeds at harvesting stage (72 DAE)

Treatment	Pod length (cm)	No.Seed/Pod (Seed)	Weight 100 seed (g)
control (no foliar apply)	9.21	8.5C ^{1/}	6.95C
Nutri Tabble Mix 0.025%	9.89	10.7AB	8.47B
Nutri Tabble Mix 0.05%	9.79	11.5AB	8.65B
Nutri Tabble Mix 0.1%	10.16	11.8A	10.30A
Nutri Tabble Mix 0.2%	10.27	11.5AB	8.99AB
Nutri Mix Spark 0.025%	9.39	10.3B	8.30B
Nutri Mix Spark 0.05%	9.56	10.9AB	8.59B
Nutri Mix Spark 0.1%	9.50	11.5AB	8.82B
Nutri Mix Spark 0.2%	10.21	11.0AB	8.42B
Grand Mean	9.78	10.9	8.61
F-test	NS	*	*
CV (%)	10.28	8.65	6.43

* = Significant difference at P< 0.05 level. NS = Non-significant difference. 1/ = Values followed by different letter are significantly different according to DMRT.

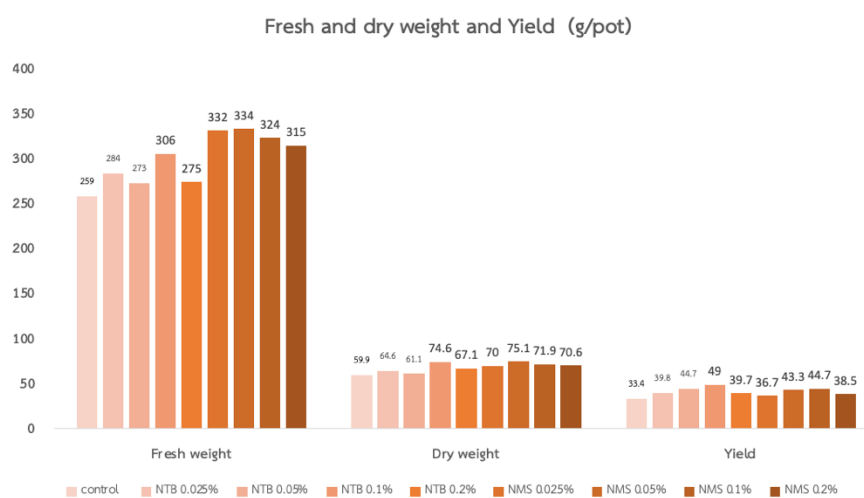


Figure 1: Fresh and dry weight and yield of mung bean at harvesting stage (72 DAE)

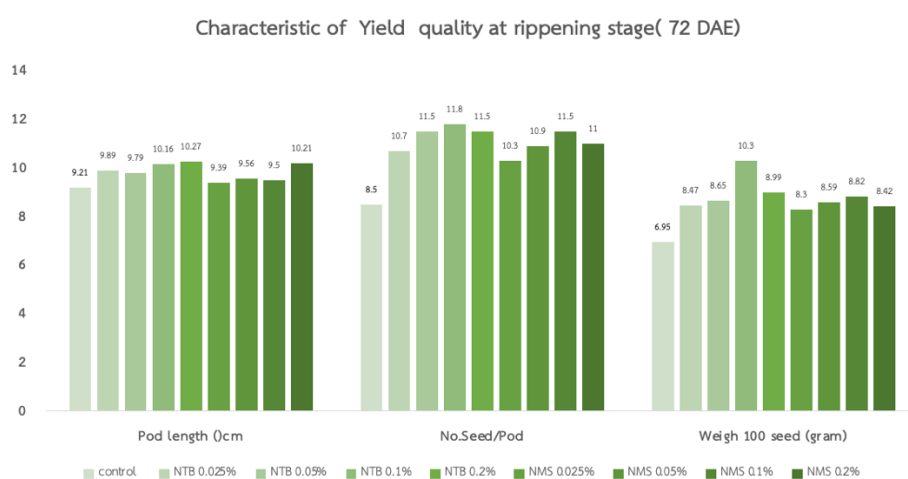


Figure 2: Pod-length, number seed per pod and weight 100 seeds at harvesting stage (72 DAE)

Nutri Mix Spark trended to provide the percentage of protein higher than Nutri Tabble Mix. The maximum of protein content in mung bean seed was analyzed by treatment Nutri Mix Spark rate 0.1% at 24.2% ($P < 0.01$). It was clearly different with Nutri Tabble Mix all rate of applications. The minimum of protein percentage was collocated in control treatment (19.9 %). Both spraying of Nutri Mix Spark and Nutri Tabble Mix at rate 0.1% could significantly provide higher protein content than other rates. On the other hand, the percent of amylase starch showed in opposite way with protein content. Application Nutri Mix Spark caused the lower of amylase than Nutri Tabble Mix (18.6 and 20.3%) . The rate of spraying at 0.1% provided the lower amylase content than other rates The highest percentage of amylase was found in control treatment at 22.7 % but not significant with Nutri Tabble Mix all rate of applications (Table 3)

Table 3. The percentage of protein and amylase contents in mung bean yield.

Treatment	Protein	Amylase
	(%)	(%)
control (no foliar apply)	19.9 E ^{1/}	22.7A
Nutri Tabble Mix 0.025%	21.7 C	22.6A
Nutri Tabble Mix 0.05%	22.3 CD	21.5 AB
Nutri Tabble Mix 0.1%	22.6 BCD	20.3 BC
Nutri Tabble Mix 0.2%	22.0 CD	21.4 AB
Nutri Mix Spark 0.025%	23.1 ABC	21.2 AB
Nutri Mix Spark 0.05%	23.8 AB	19.9 BC
Nutri Mix Spark 0.1%	24.2 A	18.5 C
Nutri Mix Spark 0.2%	23.6 AB	19.8 BC
Grand Mean	22.6	21.9
F-test	**	**
CV (%)	3.88	5.02

** = Significant difference at P< 0.01 level. difference. 1/ = Values followed by different letter are significantly different according to DMRT.

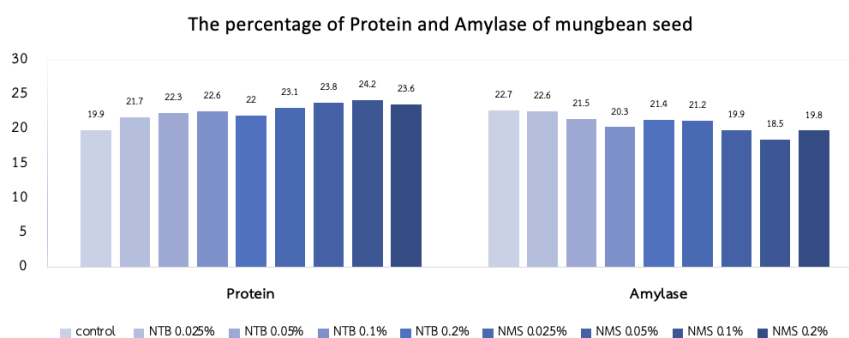


Figure.3 The percentage of protein and amylase contents in mung bean yield.

To evaluate the efficiency of translocating fertilizers in mug bean by collecting chlorophyll content at different stages was checked by chlorophyll meter SPAD-502 Plus. At vegetative stages, V4 stage showed that Nutri Tabble Mix and Nutri Mix Spark all rates had no significant different among treatments. Nutri Tabble Mix rate 0.05% provided the highest chlorophyll content at 45.48 SPAD-unit. Whereas, at reproductive stages: R-stages, the data were collected at first flower blooming (R1), the first pod approximate 1 cm (R2) and fully seed in pod (R4). The result found that Nutri Tabble Mix and Nutri Mix Spark rate 0.1% could optimize on chlorophyll contents at reproductive stages from R1 to R4 stages. At R1 stage, the highest chlorophyll content was caused by spraying Nutri Tabble Mix rate 0.1% at 45.68 SPAD-unit. Both of Nutri Tabble Mix and Nutri Mix Spark could not be showed in different effect on chlorophyll content. However, the control treatment still in lowest chlorophyll content. At R2 stage of growth, Nutri Tabble Mix rate 0.1% proved the highest chlorophyll content at 48.25 SPAD-unit ($P < 0.05$) but not significant different with Nutri Tabble Mix rate 0.05 and 0.2% and Nutri Mix Spark rate 0.05 and 0.1%. Moreover, at R4 stage, chlorophyll content was not significant among treatments. Spraying Nutri Mix Spark rate 0.1% showed the highest chlorophyll content at 46.70 SPAD-unit. (Table 4)

Table. 4 Chlorophyll contents at various stages of mung bean by chlorophyll meter SPAD-502 Plus (SPAD-unit)

Treatment	Stage on Mungbam Growth			
	V4	R1	R2	R4
control (no foliar apply)	42.88	42.03	40.28 C	41.20
Nutri Tabble Mix 0.025%	43.45	41.13	42.60 BC	43.53
Nutri Tabble Mix 0.05%	45.48	43.88	44.38 ABC	43.28
Nutri Tabble Mix 0.1%	43.33	45.68	48.25 A	46.33
Nutri Tabble Mix 0.2%	43.20	42.73	44.05 ABC	43.70
Nutri Mix Spark 0.025%	43.38	43.58	41.38 C	41.60
Nutri Mix Spark 0.05%	43.88	43.93	44.25 ABC	41.43
Nutri Mix Spark 0.1%	43.93	44.70	46.73AB	46.70
Nutri Mix Spark 0.2%	42.90	43.33	43.58 BC	42.03
Grand Mean	43.60	43.44	43.94	43.31
CV (%)	4.88	7.59	6.78	7.56
F-test	NS	NS	*	NS

* = Significant difference at P < 0.05 level. NS = Non-significant difference. 1/ = Values followed by different letter are significantly different according to DMRT.

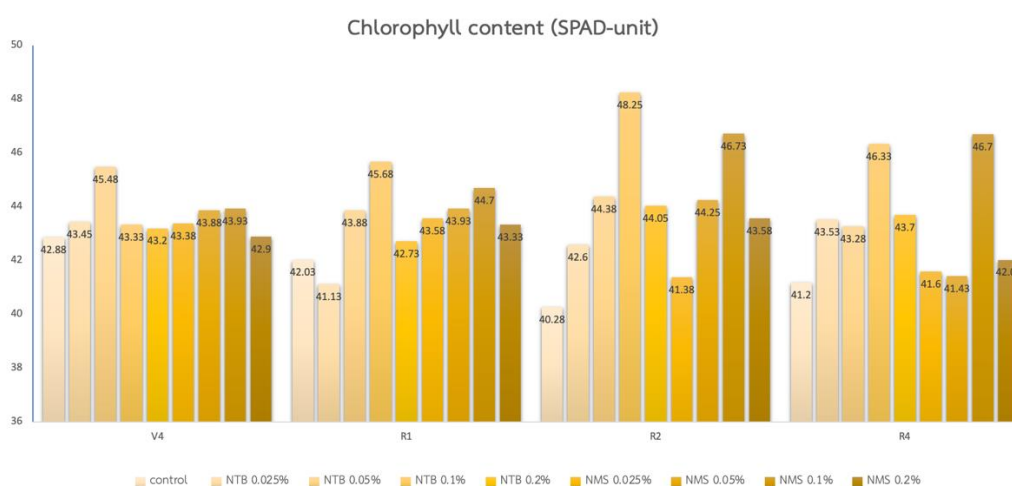


Figure. 4 Chlorophyll contents at various stages of mung bean by chlorophyll meter SPAD-502 Plus (SPAD-unit)

Discussion

The benefit of foliar application is normally focused on liquid forms that could fix on all leaf areas. The elements are easily translocated to other parts like branches and stems. Normally, liquid fertilizers are good in soluble and adsorb depending on optimum concentration. Hence, Nutri Tabble Mix and Nutri Mix Spark are product that TNA organized for more comfortable usage and adding more nutrients. Chelating agent and buffering agents are mixing in the consist of both Nutri Tabble Mix and Nutri Mix Spark. Synthetic or organic chelates could increase the adsorption of nutrients especially trace elements by chelation process. The efficiency of foliar application has correlation with types of fertilizer. The way to translocation elements cell by cell in form of ions or organic substances depends by efficiency of diffusion process. This process has affected from relative humidity and deliquescence of fertilizer. (Yongyuth, 2014; Chow, 1993)

The research found that Nutri Tabble Mix and Nutri Mix Spark at the rate 0.1% is the optimum apply for increasing yield more than other rates. Not only yield was increased but also in other parameters such as fresh and dry weight of shoot parts at harvesting stage. Moreover, application both 0.1 % of Nutri Tabble Mix and Nutri Mix Spark could significantly provide good quality of mung bean such as number seed per pod, weight of 100 seeds similarly with the result of other studies in Thailand and other countries (Yadegari et al., 2008; Ghanem and Abbas,2009; Inthasan and Dechjirarattanasiri, 2018). However, it was not significantly different between Nutri Tabble Mix and Nutri Mix Spark that consist similar of macro and trace elements ratios. Nutri Tabble Mix is in tablet form with exactly weight per tablet whereas Nutri Mix Spark is present in powder form with small particle and easy to soluble.

Mung bean quality of this experiment like percentage of protein and amylase content in seed was dramatically responded by spraying both Nutri Tabble Mix and Nutri Mix Spark compared with control treatment. Indeed, apply both of Nutri Tabble Mix and Nutri Mix Spark could give the higher protein content than control treatment all rate of application. The average protein content in mung bean seed ranging from 20.97 to 31.32% with the optimum level (Yi-Shen et al, 2018) , but control treatment caused the lowest and lower than standard. This data could recommend for other legume plants with high protein content by spraying fertilizers on the right time such

as before flowering or beginning of pod (R1-R2 stage (Swietlik and Faust, 1984) This research was proved by theory that foliar fertilizer could increase efficiency of adsorption in large leaf area index (Yongyuth, 2017). Moreover, monocotyledon plants should be study in the future. The good adjuvant substant could improve more efficiency of foliar application. In addition, the percentage of amylase was showed in the oversite result with protein content. Then, for plant that need more amylase starch could recommend in low rate of Nutri Tabble Mix and Nutri Mix Spark. It was not found the good correlation between amylase starch and yield. Hence, to reduce foliar applicant could not skip out but could choose the optimum of rate to apply.

The influence of Nutri Tabble Mix and Nutri Mix Spark on chlorophyll content was not significant different in all stages of growth. However, the rate at 0.1 % trended to increase chlorophyll content especially at reproductive stage. Even, the high rate of spraying is not damage mung bean leaf as necrosis symptom but not good for recommending with high product cost. The good point of this study is legume plant have better respond with foliar application than other plant which small leaf areas. Furthermore, foliar fertilizer could help many plants that may cause the effect from cell stress condition, drought, and high temperature. Climate crisis may cause plant facing with poor metabolism processing and physiology developing organs. Hence, foliar fertilizer application could help plant to get optimum nutrient that soil fertilizer application.

Conclusion

The studying of efficiency of Nutri Tabble Mix and Nutri Mix Spark on chlorophyll content and mung bean growth in green house experiment found that Nutri Tabble Mix and Nutri Mix Spark caused the yield of mung bean higher than control treatment (no foliar application) . The optimize rate of application could be recommended at 0.1% both in Nutri Tabble Mix and Nutri Mix Spark. This rate of spraying could encourage the quality of mung bean such as number per pod, weight of 100 seeds and percentage of protein. The Nutri Tabble Mix and Nutri Mix Spark at 0.1 % rate of application could significantly provide the highest chlorophyll content especially in reproductive stage.

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Fig 1 Overall of Green house for studying Nutri Tabble Mix and Nutri Mix Spark on chlorophyll content and mung bean growth



Fig 2 Mung bean at 10 days before collecting only 3 plant/pot



Fig 3 Mung bean at flowering, beginning pod and harvesting



Fig 4 Spraying Nutri Tabble Mix and Nutri Mix Spark



Fig 5 Measurement chlorophyll content by chlorophyll meter SPAD-502Plus (Konica Minolta) at V4 R1 R2 and R4stages

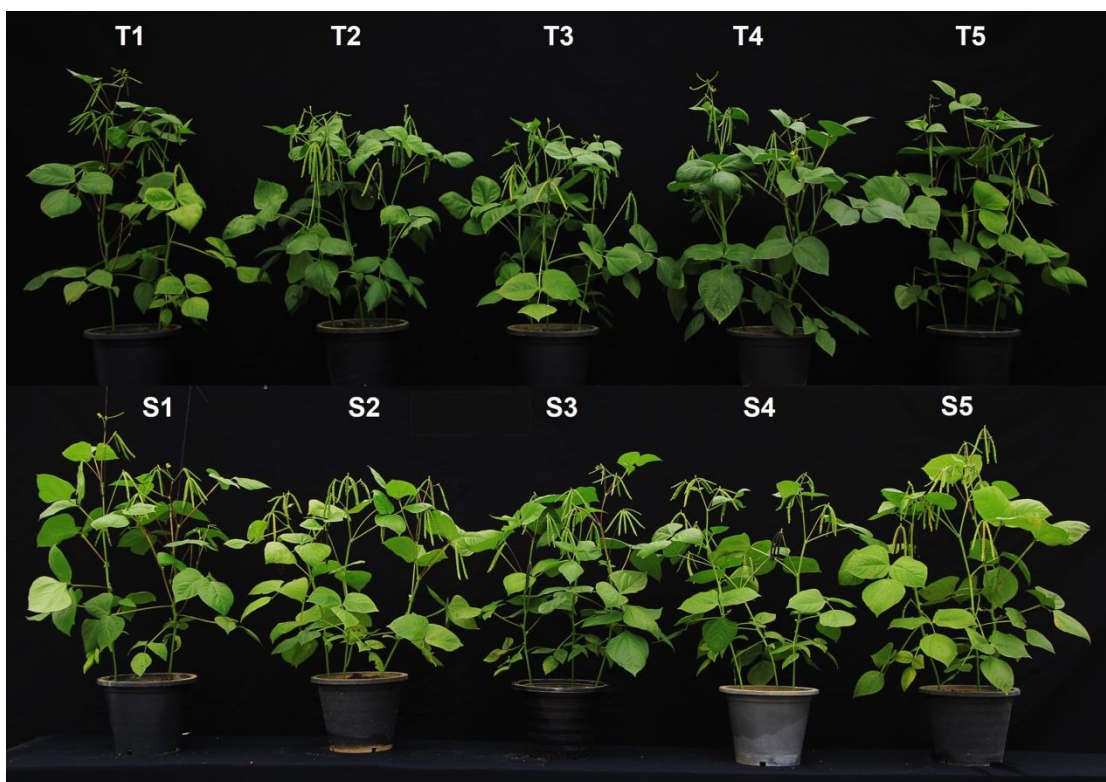


Fig 6 comparing the overall of mung bean at harvesting time

T= Nutri Table Mix and S = Nutri Mix Spark

(Number was showed is rate of application as follow: 1= control (no foliar apply),
2=0.025%3=0.05%, 4=0.1% and 5=0.2%)

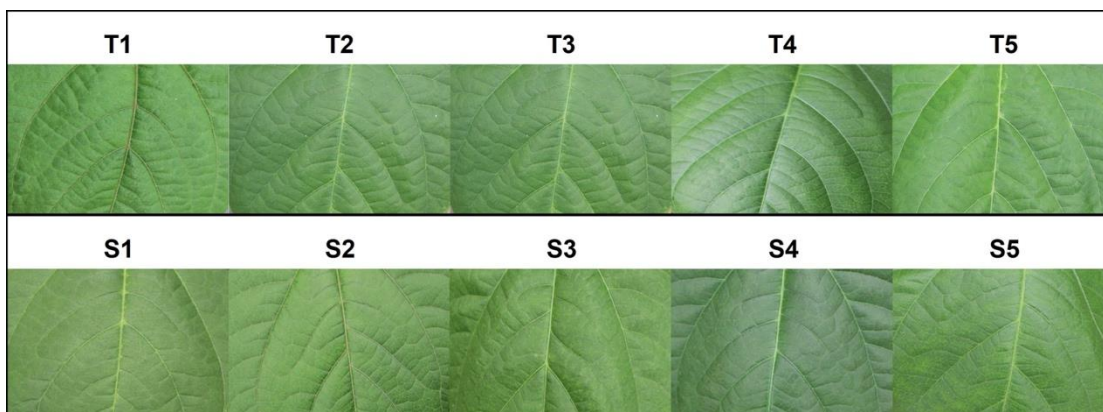


Fig 7 comparing the overall of chlorophyll content of mung bean leaf at R4 stage
 T= Nutri Tabble Mix and S = Nutri Mix Spark
 (Number was showed is rate of application as follow: 1= control (no foliar apply),
 2=0.025%3=0.05%, 4=0.1% and 5=0.2%)



Fig 8 comparing the overall of mung bean pods at harvesting time
 T= Nutri Tabble Mix and S = Nutri Mix Spark
 (Number was showed is rate of application as follow: 1= control (no foliar apply),
 2=0.025%3=0.05%, 4=0.1% and 5=0.2%)