Spirulina Effect on the Growth and Yield of *Brassica campestris* L. cv. Indian Mustard (Mon-nyin)

Nu Nu Yee[1], Thet Naing Htwe[2], Zin Mar Tun[3]

Abstract

The present study was conducted to determine the effect of *Spirulina* fertilizer application on growth and yield of *Brassica campestris* L. cv. Indian mustard (Mon-nyin), at the Department of Botany, Yadanabon University during December 2013 to February 2014. Indian mustard seeds were treated with different concentrations of *Spirulina* suspension $T_1(1gL^{-1})$, $T_2(2gL^{-1})$, $T_3(3gL^{-1})$, $T_4(4gL^{-1})$and $T_5(5gL^{-1})$ in the pot experiments. The experimental designs were arranged by using a Randomized Complete Block Design (RCBD). The results showed that *Spirulina* suspension $T_3(3gL^{-1})$ was much more effective in growth and yield of Indian mustard (Mon-nyin) than those of control. Therefore, the present research concluded that *Spirulina* suspension to be used as a successful biofertilizers instead of chemical fertilizer for growth and yield of Indian mustard (Mon nyin).

Key words: Biofertilizer, *Spirulina*, Treatment, Mustard plant

Introduction

Fertilization increases efficiency and obtains better quality of product recovery in agricultural activities. It is one of the most important ways. Fertilizers are substances added to improve its fertility, and promote the growth and yield of plant (Connelly, 2011). In recent decade, agricultural scientists and farmers were interested in natural and biofertilizers to substitute the chemical fertilizers. Thus, biofertilizer became well known in agriculture. The main sources of biofertilizer were bacteria, fungi, cyanobacteria (blue green algae) and other marco and micro algae (Ghosh, 1998).

In Myanmar, *Spirulina* is abundantly found in Twin Taung, Twin Ma, Taung Pyauk and Yekhar Lake in Sagaing Region. *Spirulina* farming in Myanmar was initiated at about 1986. An extensive account on *Spirulina* farming and its potential uses had been reported by Min Thein (1987). Toe Aung (2007), Khin Pyone Lwin (2007) and May Yu Khaing (2007) were some of Myanmar workers who had worked on *Spirulina* farming culture and citing the physico-chemical properties of *Spirulina* from Twin Taung.

Commonly known as the mustard family, the Brassicaceae consists of more than 300 genera and 3000 species and distributed throughout the world. Most are grown in temperate regions, and some are even grown in subarctic climates (Rubatzky, 1983). In Myanmar, it is commonly cultivated in Kachin State, Chin State, Shan State and Yakhaine State. All parts of mustard plant are used as vegetables. It is also used as pickle. Mustard oil is used for both therapeutic uses and culinary applications. However, there were still exist unknown facts related with the effects of Myanmar *Spirulina* suspension on the growth and yield of Indian mustard seeds. Therefore, the effects of *Spirulina* suspension as biofertilizer are studied.

The present study was aimed to test the effects of *Spirulina* in various rates on the growth and yield of the Indian mustard (Mon-nyin) under pot culture. The objectives of this work were to study the effect of *Spirulina* suspension as biofertilizer

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on growth of Indian mustard (Mon-nyin) and effects of *Spirulina* on the fertility of soil.

Materials and Methods

The pot experiments were conducted at the Department of Botany, Yadanabon University, during December 2013 to February 2014. The soil (12.1kg) was prepared in the ethylene bag which is 22 cm in diameter and 34 cm in depth. Before sowing, the seeds were soaked in different concentration of *Spirulina* suspension ($1gL^{-1}$, $2gL^{-1}$, $3gL^{-1}$, $4gL^{-1}$, $5gL^{-1}$) and the control in the pure water for 1 hour. Then, these seeds were sown in the soil of each pot according to *Spirulina* suspension treatments and control. These seeds were planted at a depth of 1 cm approximately in pot using 3 seeds per pot. And then, these pots were placed under natural condition. Pots were arranged by using a Randomized Complete Block Design (RCBD) with five replications. Each pot was watered daily with 0.3 liter to maintain moisture at field capacity and harvested 56 days after sowing (DAS). Plant height was measured in weekly and then total fruit number, seed number and fresh weight of fruit were measured at harvest.

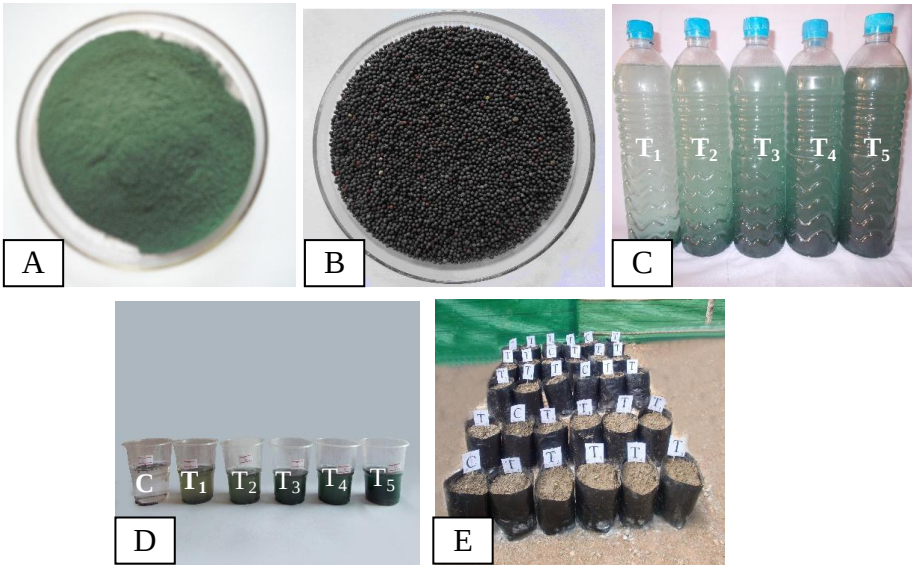

Figure 1. Mustard seeds and experimental design
(A) *Spirulina* powder
(B) Sample of mustard seeds
(C) *Spirulina* suspension
(D) Soaking seeds in control and treatments
(E) Preparation of experimental pot

Results and Discussion

Effect of *Spirulina* suspension on mean plant height (cm)

The highest value of mean plant height of Indian mustard (Mon-nyin) was found in T_3 and followed by T_4, T_5, T_2 and T_1. It was ranged 27.6-32.0 cm but control was 27.0 cm at 49 days after sowing (Table 1, Figure 2). Similarly, the mean plant height of Indian mustard (Mon-nyin) in T_3 was higher than other treatments and control at 21, 28, 35, 49 and 56 days after sowing (Figure 5). The mean plant height of Indian mustard (Mon-nyin) was not further raised at 56 days after sowing.

Table 1. Effect of *Spirulina* suspension on mean plant height (cm) of *Brassica campestris* L. cv. Indian mustard (Mon-nyin)

Treatment and control (gl^{-1})	Mean plant height (cm) ± sd					
	21 DAS	28 DAS	35 DAS	42 DAS	49 DAS	56 DAS
C	2.00±0.14	1.70±0.27	7.30±1.75	21.2±0.57	27.0±2.82	27.0±2.82
T_1 ($1gL^{-1}$)	2.20±0.75	2.00±0.35	7.40±1.02	22.7±2.88	27.6±2.88	27.6±2.88
T_2 ($2gL^{-1}$)	2.26±0.55	1.90±0.54	9.20±4.64	22.8±5.20	29.2±1.78	29.2±1.78
T_3 ($3gL^{-1}$)	**2.34±0.23**	**2.30±0.45**	**14.6±9.90**	**25.6±4.96**	**32.0±2.73**	**32.0±2.73**
T_4 ($4gL^{-1}$)	2.26±0.37	2.00±0.50	13.0±5.22	24.1±3.52	30.0±0.00	30.0±0.00
T_5 ($5gL^{-1}$)	2.20±0.57	2.10±0.54	10.7±1.39	23.3±0.75	29.6±0.55	29.6±0.55

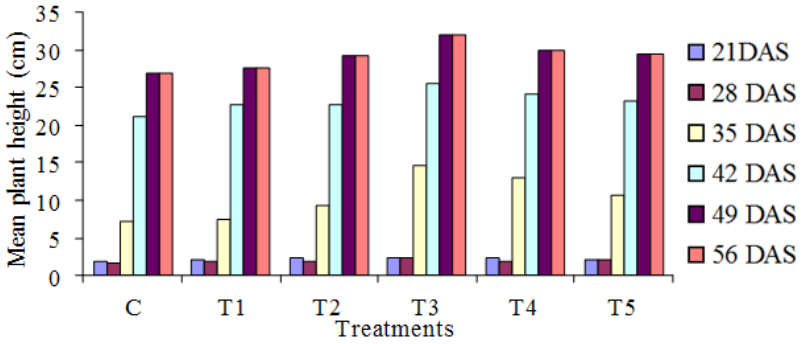

Figure 2. Effect of *Spirulina* suspension on mean plant height of *Brassica campestris* L. cv. Indian mustard (Mon-nyin)

Effect of *Spirulina* suspension on yield and yield components in harvest

Yield and yield components affected by *Spirulina* suspension were significantly increased than those of control on 56 days after sowing (Table 2, Figure 6 A, B).

The highest of fruit number per plant of T_3 and followed by T_5, T_4, T_2, T_1 and control on 56 days after sowing. It was ranged 35.0 - 45.4 but control was 20.6 (Table 2, Figure 3).

The highest of seed number per plant was found at T_3 and followed by T_4, T_5, T_2, T_1 and control. It was ranged 74.4 - 80.2 but control was 60.4 (Table 2, Figure 3).

The highest of fresh weight of fruit per plant was found at T_3 and followed by T_4, T_5, T_2 and T_1. It was ranged 2.89 - 5.46 g but control was 2.05 g (Table 2, Figure 4 and 6 C, D).

Table 2. Effect of *Spirulina* suspension on yield and yield components of *Brassica campestris* L. cv. Indian mustard (Mon-nyin)

Treatment and control (gl^{-1})	Mean fruit and seed numbers and fruit weight ± sd		
	Fruit number	Seed number	Fresh weight of Fruit (g)
C	20.6 ± 9.01	60.4 ± 23.3	2.05 ± 1.40
T_1 ($1gL^{-1}$)	35.0 ± 7.34	74.4 ± 8.87	2.89 ± 1.40
T_2 ($2gL^{-1}$)	38.4 ± 10.3	74.8 ± 13.4	4.38 ± 1.60
T_3 ($3gL^{-1}$)	**45.4 ± 10.2**	**80.2 ± 11.2**	**5.46 ± 2.00**
T_4 ($4gL^{-1}$)	42.0 ± 14.8	78.4 ± 8.56	5.09 ± 1.81
T_5 ($5gL^{-1}$)	43.8 ± 20.4	75.2 ± 6.22	4.60 ± 1.70

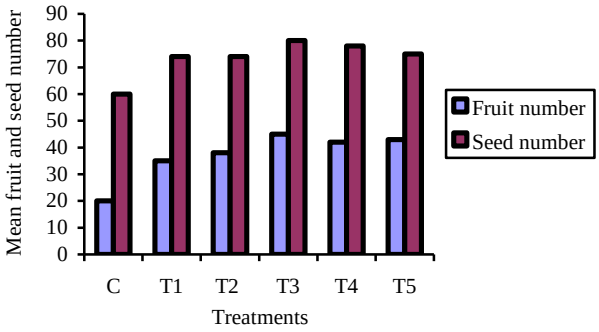

Figure 3. Effect of *Spirulina* suspension on mean fruit number and seed number of *Brassica campestris* L. cv. Indian mustard (Mon-nyin)

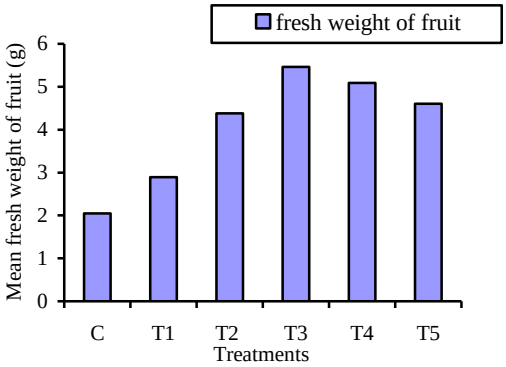

Figure 4. Effect of *Spirulina* suspension on mean fresh weight of fruit of *Brassica campestris* L. cv. Indian mustard (Mon-nyin)

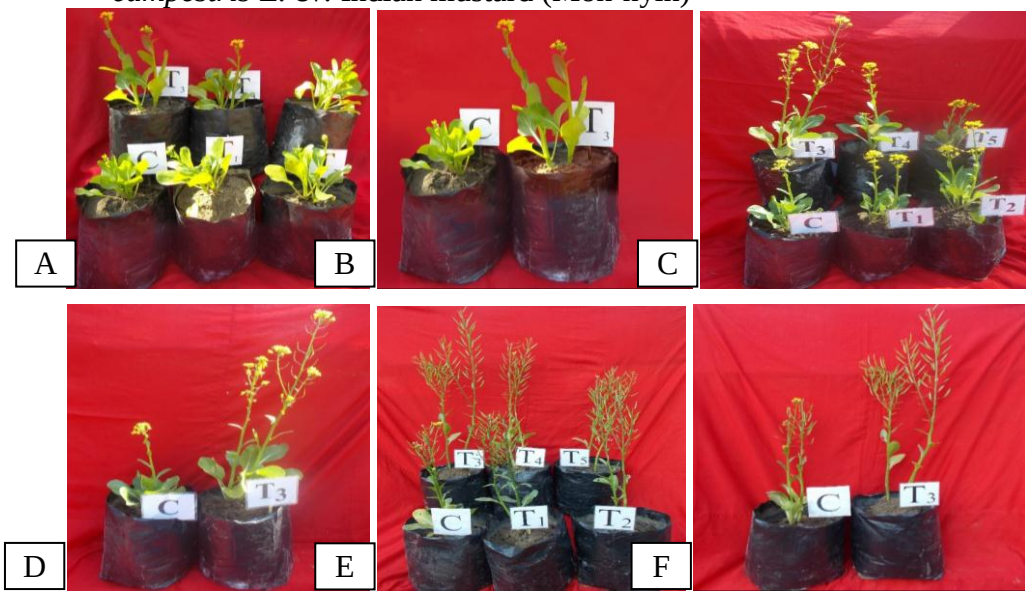

Figure 5. Effect of *Spirulina* suspension on plant height of *Brassica campestris* L. cv. Indian mustard (35, 42 and 49 DAS)
(A) Control and treatments (35 DAS) (B) Control and treatment 3 (35 DAS)
(C) Control and treatments (42 DAS) (D) Control and treatment 3 (42 DAS)
(E) Control and treatments (49 DAS) (F) Control and treatment 3 (49 DAS)

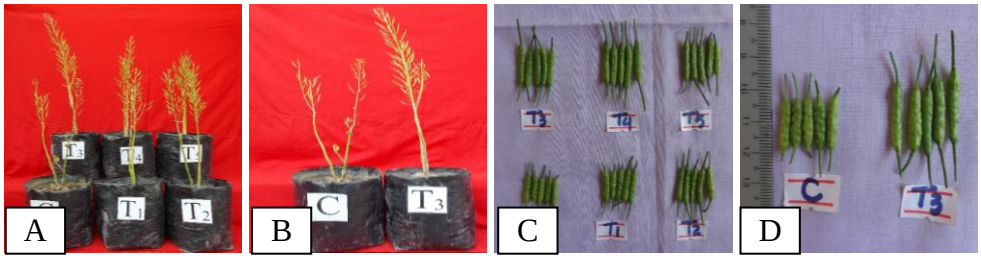

Figure 6. Effect of *Spirulina* suspension on yield and yield components of *Brassica campestris* L. cv. Indian mustard (56 DAS)
(A) Control and treatments (56 DAS) (B) Control and treatment 3 (56 DAS)
(C) Fruit of control and treatments (D) Fruit of control and treatment 3

A biofertilizer is a substance which contains living microorganisms which when applied to seeds, plant surfaces, or soil, and promotes growth by increasing the supply or availability of primary nutrients to the plants. Bio-fertilizers stimulate plant growth through the synthesis of growth promoting substances. Bio-fertilizers can be expected to reduce the use of chemical fertilizers and pesticides (Vessey, 2003). In the present study, Myanmar *Spirulina* was used as biofertilizer. It is one of the important components of plant nutrients. Before treatments, the seeds of Indian mustard (Mon-nyin) were presoaked in *Spirulina* suspension for 5 hrs, 10 hrs, 15 hrs, 20 hrs and 25 hrs and then control was soaked in pure water. The 5 hours presoaked seeds were quickly germinated than others. The suitable hours for germination were selected for experiments. And then, *Spirulina* suspension (3 gL^{-1}) effect on Indian mustard (Mon-nyin) seeds showed the best result in pot experiment. So the effects of *Spirulina* on the growth and yield of *Brassica campestris* L. cv. Indian mustard (Mon-nyin) were investigated in pot experiments.

Due to the results, it was found that the highest plant height was 32.0 cm in the treatment T_3 and the shortest plant height was 27.0 cm in the control. *Spirulina* suspension (3 gL^{-1}) was significantly increased on yield and yield components such as fruit number, seed number and fresh weight of fruit of Indian mustard (Mon-nyin). Therefore, the *Spirulina* suspension can be used as natural biofertilizer agriculture without unpleasant side effects. Moreover, it cannot be harmful to both living things and environments.

Thet Naing Htwe (2008) stated that *Spirulina* treatments promoted the hightest germination and growth of chick pea, soybean and butter bean than control. And then, Win Mar (2012) reported that *Spirulina* suspension was the best for germination, growth, yield and nutritive value of cowpea (pe lun phyu). It is recommended that blue green algae can be used as biofertilizers.

It can be seen that *Spirulina* really promote germination, growth of vegetative characters and increase in yield characters. However, this result showed that *Spirulina* suspension (3 gL^{-1}) promoted the greater growth and yield of Indian mustard (Mon-nyin).

Conclusion

So it can be concluded that Myanmar *Spirulina* is used as natural biofertilizer to Indian mustard (Mon-nyin). According to the literatures and studying the *Spirulina* biofertilizer, the other benefits can also be obtained by using *Spirulina* and improved the soil fertility of the fields. I hope that this paper can be useful and helpful to the future researchers.

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