Effect of *Nostoc* Biofertilizer on Germination and Seedling Growth of *Lablab purpureus* (L.) Sweet. cv. Shwe yin mar

Khaing Khaing[*], Khin Soe Aye[**] and Cherry Soe[***]

Abstract

The effect of *Nostoc* on germination of *Lablab purpureus* (L.) Sweet. cv. (Shwe yin mar) was studied by using *Nostoc* suspension under the laboratory experiment. This experiment was carried out at Department of Botany, Yadabnabon University from December 2019 to February 2020. The seeds of Shwe yin mar were treated with different concentrations of *Nostoc* suspension (1 gl^{-1}, 2 gl^{-1}, 3 gl^{-1}, 4 gl^{-1} and 5 gl^{-1}) and assigned as T1, T2, T3, T4 and T5 using CRD (Completely Randomized Design) with five replication. Among them, 3 gl^{-1}, *Nostoc* suspension treatment showed the best germination and plant growth of laboratory experiment. According to the results, it was found that *Nostoc* suspension can actually improve the seed germination, shoot and root length of Shwe yin mar plant.

Keywords: *Nostoc,* biofertilizer, *Lablab purpureus* (L.) Sweet. cv. Shwe yin mar, germination

Introduction

Myanmar is an agricultural based country and development of agricultural sector plays an important role in natural economic development. At present, Myanmar is a leading country of the production of pulses among ASEAN countries. It exported 866 thousand metric tons in 2007. The major exportable pulses are black gram, green gram, soybean and cowpea, chick pea, butter bean and lablab bean. Export of pulses increased from 17,000 metric tons in 1988–89 to around 1.46 million metric tons in recent years. They are grown with many purposes such as food crop, fodder crop, inter crop, cahs crop, cover crop etc. Lablab bean is one of the major export legume crops in Myanmar and it is used both for local consumption and export. It covered about 4.5% of the total sown area of pulses (MOAI, 2010).

Lablab bean is native to India, South–East Asia or Africa. It is cultivated in the tropics and subtropics, particularly in India, South–East Asia, Egypt and the Sudan. The lablab bean is an important legume in many tropical countries. The plant is a woody climber with a large yield of pods, continuing over several years (Hill, 1952). 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 macro and micro algae. Biofertilizers are a substance which contains beneficial living microorganisms which, when applied to seed, plant surfaces, or soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant (Vessey, 2003).

[*] Lecturer, Dr, Department of Botany, Yadanabon University, Myanmar, Email: khaingmindan@gmail.com

[**] Lecturer, Dr, Department of Botany, Yadanabon University, Myanmar

[***] Lecturer, Daw, Department of Botany, Sagaing University, Myanmar

Cyanobacteria (Blue–green algae) and other groups of microalgae are highly abundant in soil and are able to contribute in biotechnical respects to soil fertility or crop yield within different ways (Sirenko & Pulz, 2001). Many cyanobacterial strains such as *Aulosira, Anabaena, Nostoc, Cylindrospermum,* etc. are well known free nitrogen fixers. Their importance is realized in the water–logged condition of the paddy fields where these microorganisms multiply and fix the molecular nitrogen. They release amino acids and growth promoting substrances (Singh, 2004). Just as *Nostoc* performs photosynthesis, it also carries out another unique activity often associated with leguminous plants. *Nostoc* takes nitrogen gas from the atmosphere and 'fixes' it into a form that plants and animals can use. Whereas legumes partner with rhizobia bacteria in the soil to fix nitrogen, *Nostoc* colonies produce specialized nitrogen–fixing cells called heterocysts. *Nostoc muscorum* are important for the nutrient cycling of carbon and nitrogen within the soil ecosystems in which they are found. The process of fixing atmospheric nitrogen contributes plant–available nitrogen to the soil, improving plant growth (Rogers & Burns, 1994). Than Tun (1959) studied the inter–relationships between photosynthesis and nitrogen fixation in a blue–green alga. Tun Chun (1982) investigated the relative efficiency of 10– blue green algae in promoting the growth and yield of rice. Thet Naing Htwe and Win Naing Oo (2008) had studied the effect of *Spirulina* on the germination and growth of cereal crops and some legume. Aye Mya Nyein (2012) reported that the effect of *Spirulina* on germination and growth of Bo Sa Pe.

The aim of this study is to investigate the effect of *Nostoc* biofectilizer on improvement of the Shwe yin mar and to analyze the effect of different concentration of *Nostoc* suspension on germination and seedling growth of Shwe yin mar in laboratory experiment.

Materials and Methods

In the present study, laboratory experiment was conducted at Department of Botany, Yadanabon University, during December 2019 to February 2020. The *Nostoc* powder was purchased from Zaycho Supermarket, Mandalay. Shwe yin mar seeds were obtained from Myanmar Agricultural Service, Mandalay. The plastic petridishes 16 cm in diameter and 4.5 cm in height were used. In this experiment, *Nostoc* powder was weighed according to w/w ratio and different concentration such as (1 g/l, 2 g/l, 3 g/l, 4 g/l and 5 g/l) by using digital balance. The various weight and *Nostoc* powders were dissolved in pure water for about 24 hours. And then, different concentrations of *Nostoc* suspension were obtained. The seeds of lablab bean were soaked in different concentration of *Nostoc* suspension for 12 hours. Then, control was soaked in the pure water.

After treatment, twenty five Shwe yin mar seeds were placed on tissue paper in each petridish according to different treatment and control. The petridishes were covered with lids to prevent from drying, and placed at room temperature (20°–23°C) in natural condition. The experimental designs were arranged in Completely Randomized Design (CRD) with five replications. Twenty milliter of water was added to each petridish to get moisture. Each petridish was regularly water with 10 ml once a day. The percentage of germinating seeds was counted on 2 DAS. The shoot and root length (cm) were measured in 7 DAS by using ruler. Percentage germination was recorded for every 24 h after the treatment up to 72 h. Percentage of germination was measured according Achakzai (2009) and it was expressed in terms of

percentage (%). All the collected data were analyzed by using statistical standard deviation analysis.

$$\text{Germination percent} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds}} \times 100$$

Figure 1. riment

A. Fresh specimen and *Nostoc* powder

B. Shwe yin mar seed soaked in different concentration of *Nostoc* suspension ($1gl^{-1}$, $2gl^{-1}$, $3gl^{-1}$, $4gl^{-1}$ and $5gl^{-1}$)

C. Shwe yin mar seed

D. Experimental lyout in CRD design

Results

Morphological Character of Lablab Bean

Scientific Name – *Lablab purpureus* (L.) Sweet. cv. Shwe yin mar
English Name – Lablab bean
Local Name – Shwe yin mar
Family – Fabaceae

Small climbers or erect herbs, herbaceous bushes, annual, 1 m in height. Leaves trifoliolate, imparipinnate, alternate; stipules foliaceous, pulvinous; petiolate. Inflorescence axillary racemes, few to numerous flowered, 2–4 flowered at each node. Flowers bisexual, zygomorphic, hypogynous, pink or purple. Calyx 5, synsepalous, campanulate. Corolla 5, polypetalous, papilionaceous; standard ovate–orbicular the outermost large one; wings obliquely obovate; keels incurved, glabrous. Stamens 1+ (9), diadelphous, free, white; anther ovoid, dithecous, equal, basifixed. Ovary monocarpellary, superior, marginal placentation; style long; stigma simple. Fruit pod, linear–oblongoid, straight or curved, flattened. Seeds 3–6 seeds, obovoid, slightly compressed, white (Figure 2).

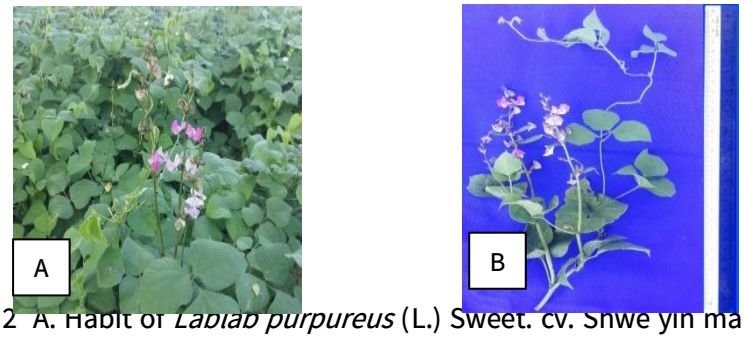

Figure 2 A. Habit of *Lablab purpureus* (L.) Sweet. cv. Shwe yin mar
B. Inflorescence of *Lablab purpureus* (L.) Sweet. cv. Shwe yin mar

The Effect of *Nostoc* Suspension on Lablab Bean in Laboratory Experiment

The results of the effect of the different concentration of ($1gl^{-1}$, $2gl^{-1}$, $3gl^{-1}$, $4gl^{-1}$ and $5gl^{-1}$) treatment of *Nostoc* suspension were tested as biofertilizer on the germination, shoot and root length were shown in Table 1. The highest germination percentage 89% and control 76 % was found in *Nostoc* suspension treatment 3 gl^{-1} on 2 DAS. The mean shoot length of 3 gl^{-1} treatment was 15.50 cm but control was 9.79 cm. The mean root length of 3 gl^{-1} treatment was 10.40 cm and that of control was 5.86 cm on 7 DAS (Table 2, Figure 4–7).

Table 1 Effect of different percentage of *Nostoc* suspension on the germination of Shwe yin mar (Laboratory experiment)

Control and Treatments	Mean germination % ± sd		
	1 DAS	2DAS	3DAS
Control	63.00 ± 2.571	76.00 ± 0.802	84.00 ± 3.235
T_1	66.00 ± 2.230	80.00 ± 2.503	89.00 ± 2.784
T_2	72.00 ± 2.402	85.00 ± 1.105	92.00 ± 0.803
T_3	**74.00 ± 2.603**	**89.00 ± 1.326**	**97.00 ± 0.902**
T_4	70.00 ± 1.702	84.00 ± 1.304	94.00 ± 0.805
T_5	68.00 ± 2.803	80.00 ± 3.690	91.00. ± 2.001

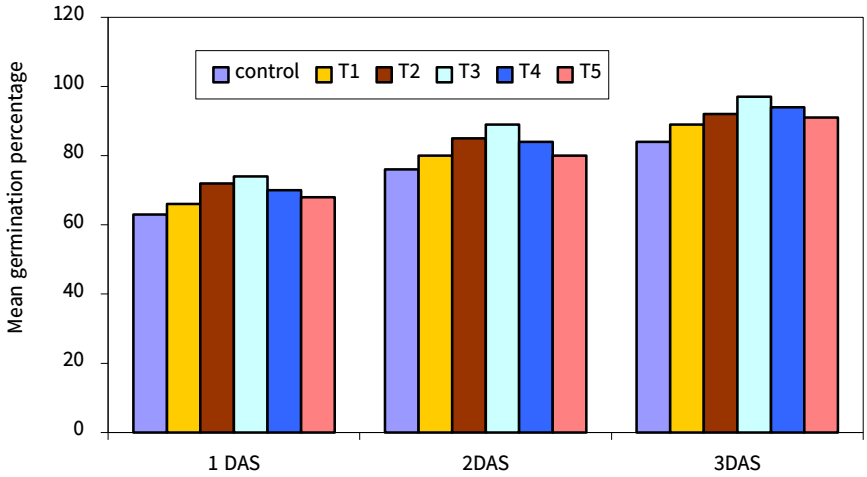

Figure 3. Comparison on the effect of different concentrations of *Nostoc* suspension on mean germination percentage of Shwe yin mar

Table 2. Effect of different *Nostoc* suspension (gl^{-1}) on shoot and root length of Shwe yin mar at 7 DAS in Laboratory experiment

Nostoc Suspension Treatment (gl^{-1})	7DAS	
	Mean shoot length (cm) ± sd	Mean root length (cm)± sd
Control	9.79 ± 3.472	5.86 ± 3.932
T1	11.30 ± 0.155	7.46 ± 3.943
T2	13.34 ± 2.350	9.55 ± 3.205
T3	**15.50 ± 2.712**	**10.40 ± 3.651**
T4	13.22 ±1.269	9.46 ± 3.359
T5	12.00 ± 1.587	8.26 ± 2.008

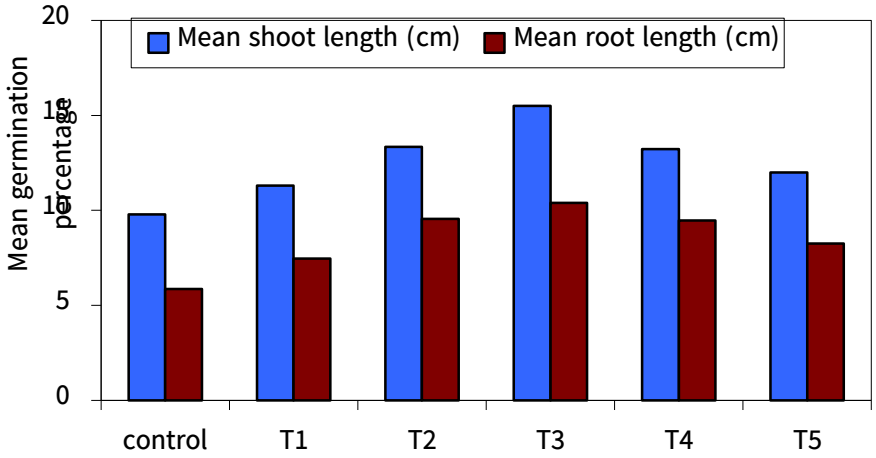

Figure 4. Comparison on the effect of different concentration of *Nostoc* suspension on mean shoot and root length of Shwe yin mar

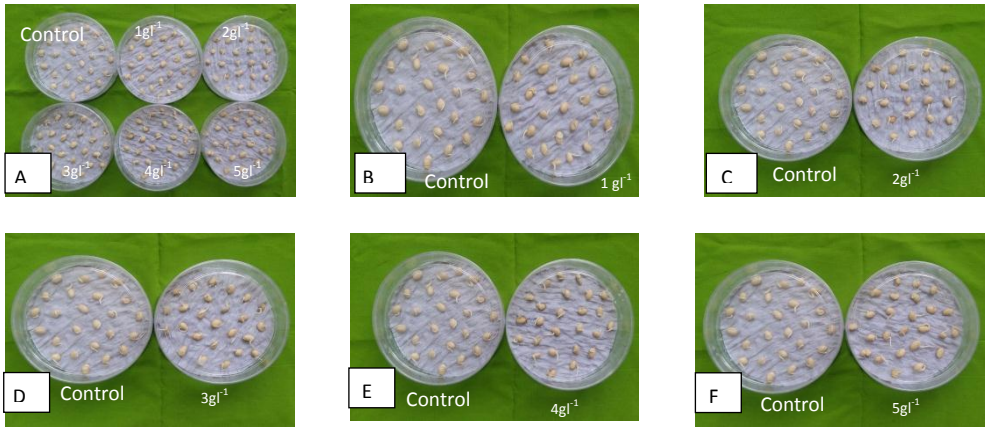

Figure 5 The effect of different concentrations of *Nostoc* suspension on germination of Shwe yin mar

A. C and 1 to 5gl^{-1} of *Nostoc* suspension B. C and 1gl^{-1} of *Nostoc* suspension

C. C and 2 gl^{-1} of *Nostoc* suspension D. C and 3gl^{-1} of *Nostoc* suspension

E. C and 4 gl^{-1} of *Nostoc* suspension F. C and 5 gl^{-1} of *Nostoc* suspension

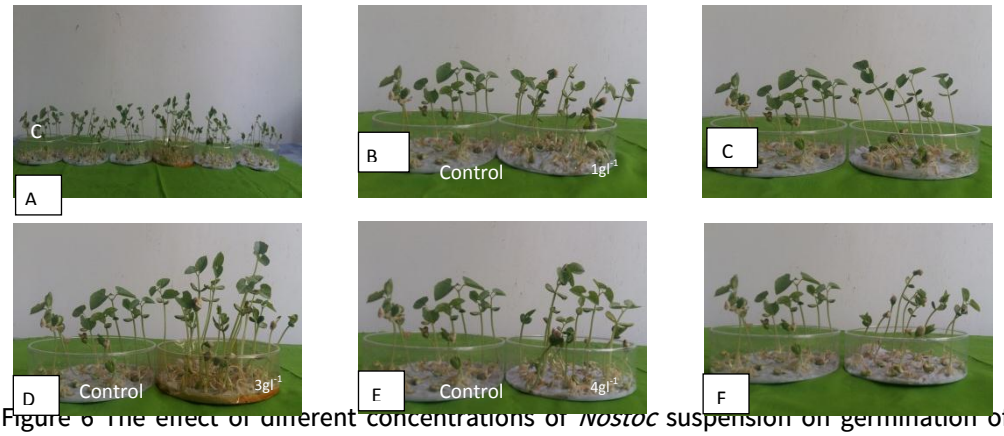

Figure 6 The effect of different concentrations of *Nostoc* suspension on germination of Shwe yin mar in laboratory experiment (7 DAS)

A. C and 1 to 5gl^{-1} of *Nostoc* suspension B. C and 1gl^{-1} of *Nostoc* suspension

C. C and 2 gl^{-1} of *Nostoc* suspension D. C and 3gl^{-1} of *Nostoc* suspension

E. C and 4 gl^{-1} of *Nostoc* suspension F. C and 5 gl^{-1} of *Nostoc* suspension

Figure 7 The effect of different concentrations of *Nostoc* suspension on shoot and root length of Shwe yin mar in laboratory experiment (7DAS)

A. C and 1 to 5gl^{-1} of *Nostoc* suspension B. C and 1gl^{-1} of *Nostoc* suspension

C. C and 2 gl^{-1} of *Nostoc* suspension D. C and 3gl^{-1} of *Nostoc* suspension

E. C and 4 gl^{-1} of *Nostoc* suspension F. C and 5 gl^{-1} of *Nostoc* suspension

Discussion

In the present study, the effects of algal biofertilizer (*Nostoc*) on germination and seedling growth of *Lablab purpureus* (L.) Sweet. cv. Shwe yin mar were investigated in laboratory experiment. The effect of *Nostoc* suspension with different ratio on *Lablab purpureus* (L.) Sweet. cv. Shwe yin mar showed the best germination and seedling growth in 3 gl^{-1} treatment. Thet Naing Htwe (2008) found that optimum *Spirulina* powder percentage for the best germination was 2 % treatment in chick pea, 6 % treatment in butter bean. According to the comparative results, the mean germination of T3 was found 89 % higher than control 76 % at 2 DAS. The mean shoot length and root length of T3 were also found to be higher than control respectively. Win Naing Oo (2008) reported that the effect of different presoaking period in *Spirulina* suspension (2gl^{-1}) was the best for germination and shoot growth of wheat. Aye Mya Nyein (2012) reported that, *Spirulina* suspension was 2 gl^{-1} for busy types and 3 gl^{-1} for pole type of Bo sa pe. According to the results, 3 gl^{-1} produced the highest mean shoot length which was 15.50 cm and that of control was 9.79 cm. Similarly, 3gl^{-1} produced the maximum root length which was 10.40 cm and control was 5.86 cm on 7 DAS. The present finding agreed with the reports of the above authors. Thus, 3 gl^{-1} treatment was chosen for the field experiment.

Conclusion

These results showed that *Nostoc* could be used as a successful biofertilizer. There was an increase in Shwe yin mar seed germination and seedling growth by using *Nostoc*. The quality crops could be produced by biofertilizer *Nostoc* and it is more safe from the health point of view. Therefore, the use of the bio–fertilizer *Nostoc* may cover shortage in these nutrients. Biofertilizes are beneficial to the soil, as they enrich the soil micro– organisms that help in recycling organic nutrients (N, P and K). It can be concluded that T_3 would be optimum biofertilizer to produce higher growth of Shwe yin mar.

Acknowledgements

We would like to express my deepest gratitude to Dr Htar Lwin, Professor and Head of Department; Dr Pyone Yi, Professor, Department of Botany, Yadanabon University for her interest and encouragement on this research. We are also very thankful to Dr Swe Swe Professor and Head, Department of Botany, Monywa University for her allowance to make a research concerning this topic

and her kind suggestion throughout the study. Finally, we want to express our sincere gratitude to our parents for their financial helps and continuous encouragement.

References

Achakzai, A.K.K. 2009. **"Effect of water stress on imbibition, germination and seedling growth of maize cultivar".**

Aye Mya Neyin, 2012. **"Effect of *Spirulina* on the Germination, Growth and Nutrtive Value of *Phaseulous vulgaris* L."** .PhD Dissertation, Department of Botany, University of Mandalay.

Fox, R. 1996. **"*Spirulina,* production and potential*",*** DEISUD

Hill, Albert F., 1952. **"Economic Botany Tata McGRAW W. Hill."**Publishing Company Ltd. New Delhi–110020.

Kress, J. W., Robert, A., Filipps, De., Farr, E. & Yin Yin Kyi, Daw. 2003. **A Checklist of the Trees, Shrubs, Herbs and Climbers of Myanmar**. National Museum of Natural History.

Ministry of Agricultural and Irrigation (MOAI). 2010. "**Myanmar agriculture in brief**. Ministry of Agricultural and Irrigation"*.* Nay Pyi Taw. Myanmar*.*

Rogers, S.L. and R.G. Burms, 1994. **"Changes in aggregate stability, nutrient status, indigenus microbial populations, and seedling emergence, following inoculation of soil with Nostoc muscorum".** Volume 18, No.3. p. 209–215.

Singh, D.P. and S.K. Dwivedi, 2004. **"Environmental Microbiology and Biotechnology",** Published by New Age Interational Ltd, P 126–148.

Sirenko, L.A. and O. Pulz, 2011. "**Fertilizing Effect of Microalgae on Soil and Crops**". Book of Abstracts Symposium on Microalgae and Sew Weeds Products in Plants/Soil–System, June 20–22, Hungary.

Than Htun, 1959. **"Studies on the inter–relationships between photosynthesis and nitrogen fixation in a blue–green alga"**. PhD Dissertation. University of London.

Thet Naing Htwe, 2008. **"Effect of *Spirulina* on the germination and growth pea, soybean and butter bean".** PhD Dissertation. Department of Botany. University of Mandalay.

Tun Chun, 1982. **"Relative efficiency of 10–blue green algae in promoting the growth and yield of rice"*,*** M.Sc (Thesis). University of Mandalay. Mandalay.

Vessey, JK. 2003. **"Plant growth promoting rhizobacteria as biofertilizers". Plant and Soil**. 255 (2): 571.

Win Naing Oo. 2008. **"Effect of *Spirulina* on the germination and growth of rice and wheat".** Ph.D Dissertation. Department of Botany. University of Mandalay. Myanmar.