Spirulina Biofertilizer on Growth Parameters of *Lablab purpureus* (L.) Sweet cv. Shweyinmar in Field Experiment

San San Aye
Yadanabon University
sandar.mdy412@gmail.com

Tin Tin Maw
Myingyan Degree College

Chaw Su Nandar
Yadanabon University

Abstract

Field experiment was conducted to effect of Spirulina biofertilizer on growth parameters of Lablab purpureus (L.) Sweet cv. Shweyinmar (lablab bean) at Yadanabon University during 2017 and 2018. This experiment was using Complete Randomized Design (CRD) with 3 replications and Spirulina suspension 3 g l^{-1} (ST_3) and 4 g l^{-1} (ST_4) were treated with lablab bean seeds. According to these results Spirulina biofertilizer 3 gl^{-1} has increased growth parameters of lablab bean cultivar (Shweyinmar) statistically significant than other treatment and control.

Keywords: *Biofertilizer, Suspension, Spirulina, Lablab bean, growth parameters*

1. Introduction

In Myanmar, the total crop sown area in 1999-2000 about 14.7 million hectares pulses occupies the second largest sown area (2.7 million hectares) after rice (6.3 million hectares). Pulses are one of the most important good export potential cover 25% of total cultivated land area [8]. Algae are characterized by higher productivities than terrestrial plants and can be used for the production of valuable products for plants, including fertilizers [13].

Biofertilizer are products containing living cells of different types of microorganisms, which have an ability to convert nutritionally important element from unavailable to available from through biological process [11].

Bio-fertilization is considered an important factor in reducing the used rates of chemical fertilizers which appear to be safely for environment, improving soil fertility and increasing soil productivity [2].

Cyanobacteria can play a crucial role in the sustainable agriculture that contributes to the soil fertility, crop growth and yield and improvent of the environmental quality. Cyanobacteria biomass is also known to improve soil physicochemical characteristic such as water-holding capacity and mineral status of the degraded soil [7].

Spirulina was applied directly to the soil or was added in the form of the algal suspension. Plants biofortified with the macro- and micronutrients of cyanobacterial origin can be used as novel [10][5].The use of *Spirulina* based fertilizers is impeded by the low cost, ready availability and preferred used of inorganic fertilizers. *Spirulina* contain 10% N w/w (high are slowly released under normal soil conditions and increase fertility) [3].The aim and objectives of this study was to assess the optimum ratio of *Spirulina* suspension ,to evaluate the effect of *Spirulina* biofertilizer on growth parameters and improvement of highest growth via application of biofertilizer so if possible to able to recommend this *Spirulina* biofertilizer replacement to the chemical fertilizer.

2. Materials and Methods

Lablab purpureus (L.) Sweet cv.Shweyinmar obtained from Department of Agricultural Research (DAR), Naypyitaw, Pyinmana and *Spirulina* biomass (Lot No.S.391) obtained from Myanmar Pharmaceutical Factory (MPF), Ye Kharr, Sagaing were used in these experiments. *Spirulina* suspension 0 (control), (3 gl^{-1}) and (4 gl^{-1}) (w/v) were used for lablab bean cultivar and sown in 2017 and 2018 at Taung Ywa Thit, Amarapura Township, near the Yadanabon University. The land used for the experimental study was virgin area. The land was thoroughly prepared before the experiment started. The experiment was designed as complete randomized design with five replications. Each plot was 3.20 m × 4.11 m in size and it consists of eight rows with spacing of 0.49 m (45.72 cm) between rows and plants. The outermost two rows were bordered and the second outermost four rows were used for destructive sampling and innermost two rows for harvest area. The total experimental areas was 320.61 m^2 including 1 m of platform area and 0.60 m of the space between plots.

Lablab bean seeds were sown at the rate of three seeds per hole in rows at different concentrations of *Spirulina* suspension and control with a uniform depth of about 2 to 4 cm. Thinning was done two weeks after emergence and one plant per stand was kept.

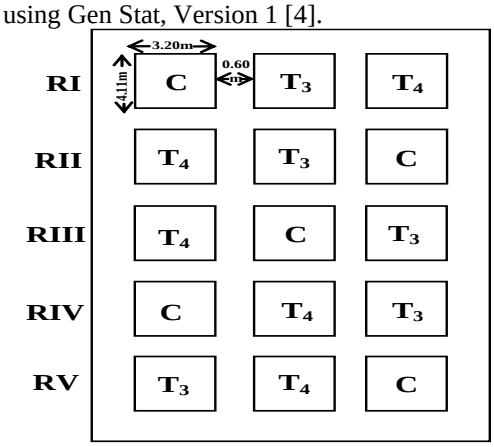
2.1. Data Collection

To record data on growth parameters, plant sample were collected at 30,60,90,120,150 and 180 day after sowing (DAS).Everytime selected plants were uprooted carefully to minimize loss of roots. The root systems were washed with running tap water to remove adhering soil and blotted with blotting paper to remove excess water. The plant parts were used dried in natural condition and dry weighed of each component were recorded.

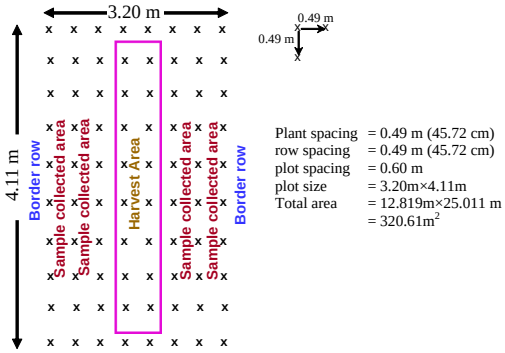
2.2. Statistical Analysis

There were three replicates for each treatment and mean data per plant was calculated for various studied.

Data of various plant growth parameters are analyzed by using Gen Stat, Version 1 [4].



(A)



(B)

Figure 1. Experimental Field Layout
(A) Randomized Complete Block Design
(B) Sample Plot Size

3. Results

3.1. Plant height

Application of *Spirulina* biofertilizer ST_3 ($3gl^{-1}$) caused significant improvement in the plant height of lablab bean cultivar.The highest amount of plant height was 69.6 cm at ST_3 ($3gl^{-1}$), which was followed by 62.2 cm at ST_4($4gl^{-1}$) (Table 1).

Table 1. Effect of Spirulina suspension on mean plant height of Lablab purpureus (L.) Sweet cv.Shweyinmar

Treatment	30 DAS (cm $plant^{-1}$)	60 DAS (cm $plant^{-1}$)	90 DAS (cm $plant^{-1}$)	120 DAS (cm $plant^{-1}$)	150 DAS (cm $plant^{-1}$)	180 DAS (cm $plant^{-1}$)
Control	14.2	31.56	38.56	55.66	58.34	59.4
ST_3($3gl^{-1}$)	19.2	41.52	50.76	62.76	67.24	69.6
ST_4($4gl^{-1}$)	15.1	36.46	44.91	59.44	62.18	62.2
F value	3.03	3.47	1.82	2.06	0.76	1.21
Fpr	<0.001	<0.001	<0.001	<0.001	0.006	0.026
$LSD_{0.005}$	2.352	1.428	2.419	1.860	4.408	7.26
CV%	3.4	2.7	3.7	2.2	4.9	7.8

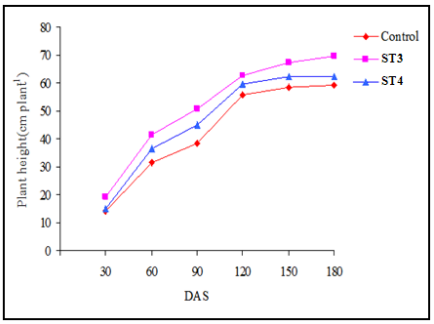


Figure 2. Effect of *Spirulina* suspension on mean plant height of *Lablab purpureus* (L.) Sweet cv.Shweyinmar

3.2. Dry Weight of Stem

The effects of *Spirulina* suspension on dry weight of stem are shown in Table2. Dry weight of stem in all treatments increased with age from 30-150 DAS, and it declined at harvest time (180 DAS). Effect of ST_3 ($3gl^{-1}$) on dry weight of stem produced highest values than control. These results are statistically significant.

Table 2. Effect of *Spirulina* suspension on mean dry weight of stem of *Lablab purpureus* (L.) Sweet cv.Shweyinmar

Treatment	30 DAS (g $plant^{-1}$)	60 DAS (g $plant^{-1}$)	90 DAS (g $plant^{-1}$)	120 DAS (g $plant^{-1}$)	150 DAS (g $plant^{-1}$)	180 DAS (g $plant^{-1}$)
Control	1.412	2.762	4.374	6.024	7.01	6.362
ST_3($3gl^{-1}$)	2.074	3.616	5.282	7.416	8.34	7.984
ST_4($4gl^{-1}$)	1.772	3.518	4.622	6.298	7.70	7.126
F value	0.82	1.83	0.28	2.15	2.44	2.11
Fpr	<0.001	<0.001	0.012	<0.001	0.011	<0.001
$LSD_{0.005}$	0.1914	0.2999	0.5374	0.4880	0.796	0.5217
CV%	7.5	6.5	7.7	5.1	71	5.0

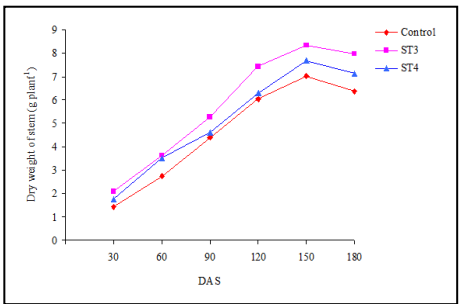


Figure 3. Effect of *Spirulina* suspension on mean dry weight of stem of *Lablab purpureus* (L.) Sweet cv.Shweyinmar

3.3. Dry Weight of Leaves

Initially, dry weight of total leaves was slowly and steadily increased until the maximum dry weight at 150 DAS. It declined the total dry weight of leaves at 180 DAS. It was due to the death of some leaves at the base of the stem. ST_3 ($3gl^{-1}$) produced the highest dry weight of leaves than other treatments and control (Table 3).

Table 3. Effect of *Spirulina* suspension on mean dry weight of leaves of *Lablab purpureus* (L.) Sweet cv.Shweyinmar

Treatments	30 DAS (cm^2 $plant^{-1}$)	60 DAS (cm^2 $plant^{-1}$)	90 DAS (cm^2 $plant^{-1}$)	120 DAS (cm^2 $plant^{-1}$)	150 DAS (cm^2 $plant^{-1}$)	180 DAS (cm^2 $plant^{-1}$)
Control	0.926	2.956	8.008	9.61	11.39	8.992
$ST_3(3gl^{-1})$	1.252	3.694	9.868	11.43	12.78	10.424
$ST_4(4gl^{-1})$	1.140	3.184	8.882	10.43	11	9.508
F value	0.50	3.72	3.82	0.76	0.82	2.19
Fpr	0.001	0.003	<0.001	0.002	0.005	<0.001
$LSD_{0.005}$	0.1319	0.3398	0.5577	0.770	0.734	0.5048
CV%	8.2	7.1	4.3	5.0	4.2	3.6

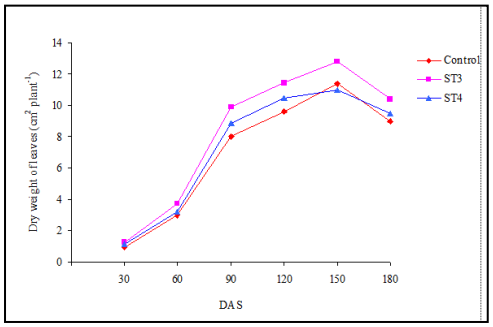


Figure 4. Effect of *Spirulina* suspension on mean dry weight of leaves of *Lablab purpureus* (L.) Sweet cv.Shweyinmar

3.4. Dry Weight of Root

The dry weight of root in all treatments generally increased with increasing age. The maximum mean dry weight of root 3.548 g $plant^{-1}$ was produced by ST_3 ($3gl^{-1}$) and followed by other treatment and control.(Table 4).

Table 4. Effect of *Spirulina* suspension on mean dry weight of root of *Lablab purpureus* (L.) Sweet cv.Shweyinmar

Treatment	30 DAS (g $plant^{-1}$)	60 DAS (g $plant^{-1}$)	90 DAS (g $plant^{-1}$)	120 DAS (g $plant^{-1}$)	150 DAS (g $plant^{-1}$)	180 DAS (g $plant^{-1}$)
Control	0.464	0.842	1.332	1.810	2.340	2.574
$ST_3(3gl^{-1})$	0.666	0.982	1.692	2.350	3.168	3.548
$ST_4(4gl^{-1})$	0.558	0.882	1.556	2.086	2.732	2.984
F value	3.23	1.13	0.78	2.74	3.15	0.54
Fpr	0.002	0.05	0.005	0.010	<0.001	0.005
$LSD_{0.005}$	0.0821	0.0839	0.1774	0.3000	0.2928	0.4854
CV%	10.0	19.2	8.0	9.9	7.3	11.0

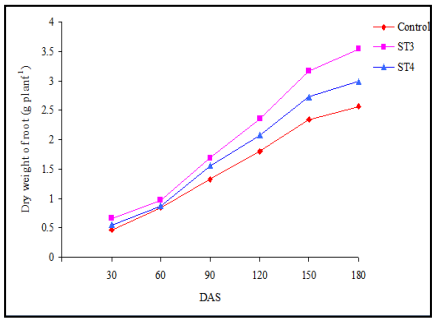


Figure 5. Effect of *Spirulina* suspension on mean dry weight of root of *Lablab purpureus* (L.) Sweet cv.Shweyinmar

3.5. Total Plant Dry Mattter (TDM)

Plant mass increased with increasing projected and total leaf area, leaf mass, total stem ,root and emergences.From this results,*Spirulina* suspension 3 gl^{-1} produce 72.07 g $plant^{-1}$,4 gl^{-1} was 64.29 g $plant^{-1}$and control was 57.06 g $plant^{-1}$respectively.

Table 5.Effect of *Spirulina* suspension on total dry matter of *Lablab purpureus*(L.) Sweet cv.Shweyinmar

Treatment	30 DAS (g $plant^{-1}$)	60 DAS (g $plant^{-1}$)	90 DAS (g $plant^{-1}$)	120 DAS (g $plant^{-1}$)	150 DAS (g $plant^{-1}$)	180 DAS (g $plant^{-1}$)
Control	2.808	6.560	13.78	17.45	27.69	57.06
$ST_3(3gl^{-1})$	4.012	8.392	16.91	21.19	34.55	72.07
$ST_4(4gl^{-1})$	3.470	7.298	14.90	18.81	29.06	64.29
F value	1.40	0.75	2.36	2.48	1.06	2.55
Fpr	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
$LSD_{0.005}$	0.260	0.547	0.649	0.824	2.434	3.102
CV%	5.2	5.1	2.9	2.9	5.5	3.3

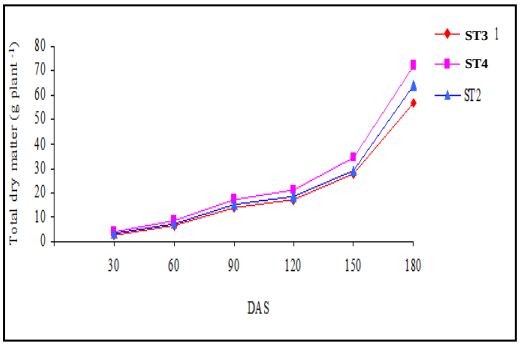


Figure 6. Effect of *Spirulina* suspension on total dry matter of *Lablab purpureus* (L.) Sweet cv.Shweyinmar

3.6. Total Leaf Area (TLA)

The results of the effect of *Spirulina* suspension on total leaf area at 30 to 180 DAS were presented in Table 6. At 150 DAS, 3 gl^{-1} produce highest TLA value (1206cm^2 $pant^{-1}$), which was followed by 4 gl^{-1} (1002 cm^2 $pant^{-1}$) and control (924 cm^2 $pant^{-1}$) but it declined at harvest time (180 DAS).

Table 6. Effect of *Spirulina* suspension on total leaf area of *Lablab purpureus* (L.)Sweet cv.Shweyinmar

Treatment	30 DAS (cm^2 $pant^{-1}$)	60 DAS (cm^2 $pant^{-1}$)	90 DAS (cm^2 $pant^{-1}$)	120 DAS (cm^2 $pant^{-1}$)	150 DAS (cm^2 $pant^{-1}$)	180 DAS (cm^2 $pant^{-1}$)
Control	143.5	312.0	768.0	723.0	954.0	731.0
$ST_3(3gl^{-1})$	184.0	389.0	1000.0	1143.0	1206.0	923.0
$ST_4(4gl^{-1})$	155.1	335.0	865.0	1029.0	1002.0	780.0
F value	1.43	3.78	0.69	0.47	3.82	1.99
Fpr	0.006	0.037	0.028	0.061	<0.001	0.021
$LSD_{0.005}$	20.96	57.5	158.4	351.3	57.1	127.8
CV%	8.9	11.4	12.4	25.0	3.7	10.8

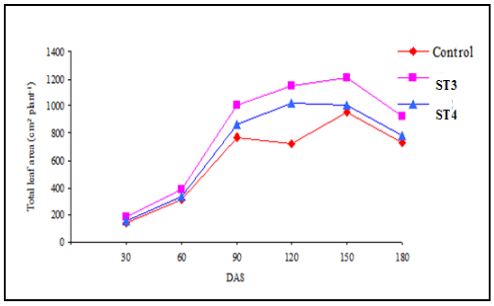


Figure 7. Effect of *Spirulina* suspension on total leaf area of *Lablab purpureus* (L.) Sweet cv.Shweyinmar

4.Discussion and Conclusion

In field experiment, the results of the effect of *Spirulina* suspension on growth parameters of *Lablab purpureus* (L.) Sweet cv. Shweyinmar indicated the beneficial effects of *Spirulina* suspension. The plant height of *Lablab purpureus* (L.) Sweet cv.Shweyinmar clearly showed that *Spirulina* suspension 3 gl^{-1}. It produced the highest value than control. It was 17 % higher than control (69.6 cm - 59.4 cm) on plant height. Both total dry matter (TDM) and total leaf area (TLA) were increased with increased in age. Although the increase of total dry matter and total leaf area were clear from 30-150 DAS, it declined after 150 DAS. It was due to the leaf senescence and death of some leaves at the base of the stem.

In the early stage, when the plant was young, the increase in dry weight was small. But as the plant becomes older, it showed faster growth. When the plant was matured the total dry matter increased steadily. Thus, the plant height and total dry matter was positively increased. The plant height and total dry matter (TDM) per plant per week increase with age.

Tin Tin Maw (2012)[9] cbserved that *Spirulina* suspension 7 gl^{-1} produced the plant growth highest growth of black gram. Win Mar (2012)[12] presented that *Spirulina* suspension 4 gl^{-1} was found to be the best plant growth and yield of cow pea.The present finding were not agreed with above authors. But agreed with Aye Mya Nyein (2012)[1],she reported that the highest mean plant height , number of leaves, total leave area and total dry matter were observed in *Spirulina* suspension 3 gl^{-1} for pole type of snap bean.

The present results showed that the use of *Spirulina* suspension treatment needed in smaller amounts of *Spirulina* powder than the use of powder alone. These results suggest that, the lower concentrations of the applied *Spirulina* suspension had a higher positive influence.

Increasing and extending the role of inoculation with microorganisms (biofertilizers) may reduce the need for chemical fertilizers and thereby decrease adverse environmental effect [6].

It can be concluded that Myanmar *Spirulina* biofertilizer could give a potential for improving the morphological parameters of *Lablab purpureus* (L.) Sweet cv.Shweyinmar.

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