Effect of *Nostoc* Fertilizer on Germination and Seedling Growth of *Zea mays* L. (Maize) in Laboratory Experiment

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Abstract

The effect of Nostoc on germination of Zea mays L. (maize) was studied by using Nostoc suspension under the laboratory experiment. This experiment was carried out at Department of Botany, Yadanabon University from December 2019 to February 2020. The seeds of maize 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 maize plant..

Keywords: *Nostoc, fertilizer, Zea mays L, maize, germination*

1. Introduction

Zea mays L. (Pyaung bu) also called India corn or maize, cereal plant of the grass (Poaceae) and its edible grain. The domesticated crop originated in the Americas and is one of the most widely distributed of the world's food crops. Corns is used as livestock feed, as human food, as biofuel, and as raw material in industry. The maize is now grown would wide for its edible cereal crop. Many varieties of maize are being cultivated in different regions in Myanmar. Maize plants are also one of the most common home garden plants. Maize can be easily grown form seeds [10].

Chemical fertilizers has led to reduced in the crop yield and resulted in imbalance of nutrients in the soil, which has adverse effects on soil health [7]. Various inorganic fertilizers used for agriculture for high yield purposes but it affect the soil fertility and living organisms. Chemical fertilizers are very costly and it produced environmental pollution. (nitrogen, phosphorus and potassium) [11]. Biofertilizer improves soil fertility and enhances nutrient uptake and water uptake in deficient soils, thereby aiding in better establishment of plants. Biofertilizers also secrete growth substances and antifungal chemicals as well as improve seed germination and root growth. It supplies the nitrogen continuously through the entire period of crop growth in the field under favorable conditions [9].

Nostoc is not technically a plant; rather it is a genus of photosynthetic cyanobacteria, some of the most ancient organisms on the planet. Free-living *Nostoc* species, form large colonies which appear lile flattish, wrinkled, gelatinous masses. These masses are particularly prominent on soil surface prolong period of rain. When conditions get drier, the colonies shrivel, become pale brown in colour, and blend into the soil surface. Cyanobacteria can survive prolonged period of desiccation. *Nostoc* genus of blue green algae with cells arranged in bed-like chains that are grouped together in a gelatinous mass. Ranging from microscopic to walnut size, masses of *Nostoc* may be found on soil and floating in quiet water. A special thick-wall cell (akinete) has the ability to withstand desiccation for long period of time. After 70 years of dry storage, the akinetes of one species germinate into a filament when moistend like most blue green algae [2].

In the present work, germination and seedling growth of *Zea mays* L. have been studied. The aims and objects of this study were to find the effect of germination and seedling growth of *Zea mays* L. by using *Nostoc* suspension and to investigate the proper amount of *Nostoc* biofertilizer by applying seed treatment on *Zea mays* L. (maize).

2. 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* fertilizer was purchased from Zaycho Supermarket, Mandalay. I grind *Nostoc* myself. An then I have *Nostoc* powder to show Figure (1A). Maize 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, one liter of water is added into the different weight of *Nostoc* powder (1g, 2g, 3g, 4g and 5 g). 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 maize were soaked in different concentration of *Nostoc* suspension for 12 hours. Then, control was soaked in the pure water.

After treatment, twenty five maize 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 (20º-23ºC) in natural condition. The experimental designs were arranged in Completely Randomized Design (CRD) with five replications [3]. Twenty milliter of water was added to each petridish to get moisture. Each petridish was regularly water with 10

ml once a day. Germination percentage were counted and 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 [1] 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. Preparation of laboratory experiment
A. Fresh specimen and *Nostoc* powder
B. Maize seed soaked in different concentration of *Nostoc* suspension ($1gl^{-1}$, $2gl^{-1}$, $3gl^{-1}$, $4gl^{-1}$ and $5gl^{-1}$)
C. Maize seed
D. Experimental lyout in CRD design

4. Results

In this study, *Zea mays* L. (maize) seeds were treated with different concentrations of *Nostoc* suspension and control. At 1 DAS mean germination percentage of T_1, T_2, T_3, T_4, T_5 and control were 64.23%, 68.43 %, 73.42 %, 70.03 %, 68.55 % and 62.72 % respectively.

At 2 DAS, the maximum germination was found at T_3 followed by T_1, T_2, T_4, T_5 and control. An addition, the highest mean of germination was 97.76 % but control was 82.86 % on 3 DAS.

According to these results, the best germination percentage of *Zea mays* L. (maize) seeds were found in *Nostoc* suspension ($3\ gl^{-1}$) treatment than higher other treatments and control at 1 DAS to 3 DAS. Thus effect of T_3 was 17 % higher than control (97.76 % - 82.86 %) (Table 1, Figure 2)

The mean shoot length of *Zea mays* L. (maize) seeds treated with *Nostoc* suspension T_1, T_2, T_3, T_4 and T_5 were found 13.60 cm, 14.0 cm, 16.80 cm, 15.37 cm, 14.76 cm and control was 12.50 cm on 7 DAS (Table 2, Figure 3).

From these results, the highest root length *Zea mays* L. (maize) seed was T_3 and followed by T_1, T_2, T_4, T_5 and control at 7 DAS (Table 2, Figure 3).

In seedling growth, the mean shoot length and root length of *Zea mays* L. (maize) on T_3 was higher than other treatments and control. The mean shoot length of *Zea mays* L. (maize) treatment with T_3 was 46 % higher than control (16.80 cm – 11.50 cm). The mean root length of *Zea mays* L. (maize) treated with T_3 was 65 % higher than control (24.26 cm – 14.70 cm).

The present results show that the mean shoot and root length *Zea mays* L. (maize) at T_3 ($3\ gl^{-1}$) were higher than other treatments and control. Thus *Nostoc* could gave a potential value of germination percentage and seedling growth of *Zea mays* L. (maize).

The comparative study using the mean standard deviation (sd) of germination percentage, shoot length and root length with *Nostoc* suspension ($1\ gl^{-1}$, $2\ gl^{-1}$, $3\ gl^{-1}$, $4\ gl^{-1}$ and $5\ gl^{-1}$) and control were shown in (Table 1,2 and Figure 2-6).

Table 1. Effect of different percentage of *Nostoc* suspension on the germination of maize (Laboratory experiment)

Control and Treatments	Mean germination % ± sd		
	1 DAS	2DAS	3DAS
Control	62.72 ± 2.570	77.83 ± 3.785	82.86 ± 4.293
T_1	64.23 ± 2.706	81.50 ± 2.890	89.50 ± 5.243
T_2	68.43 ± 3.230	83.56 ± 4.617	94.10 ± 2.889
T_3	**73.42** ± 2.450	**88.68** ± 5.597	**97.76** ± 1.830
T_4	70.03 ± 2.408	85.76 ± 5.329	93.78 ± 3.253
T_5	68.55 ± 2.705	83.05 ± 3.795	91.86 ± 3.926

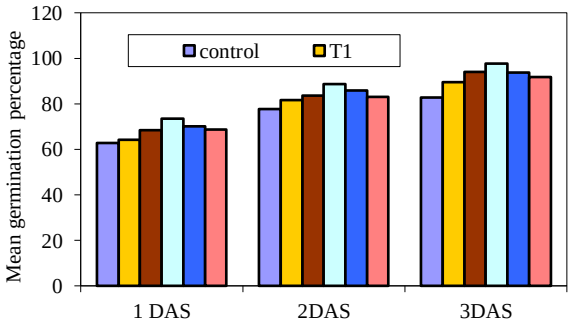

Figure 2. Comparison on the effect of different concentrations of *Nostoc* suspension on mean germination percentage of maize

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

Nostoc Suspension Treatment(gl^{-1})	7DAS	
	Mean shoot length (cm) ± sd	Mean root length (cm)±sd
Control	11.50 ± 1.720	14.70 ± 3.639
T1	13.60 ± 1.619	17.40 ± 3.357
T2	14.00 ± 1.266	19.66 ± 3.237
T3	**16.80 ± 2.208**	24.26 ± 3.167
T4	15.37 ± 1.532	22.30 ± 3.786
T5	14.76 ± 2.983	19.50 ± 3.229

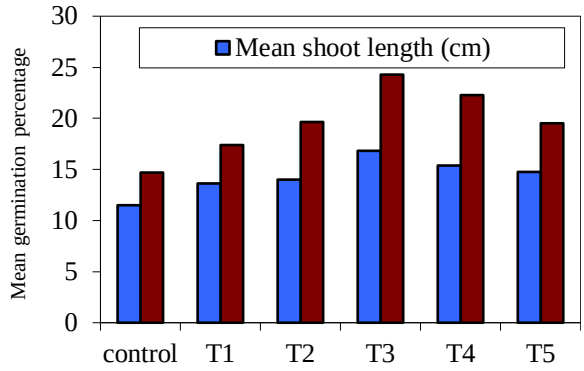

Figure 3. Comparison on the effect of different concentration of *Nostoc* suspension on mean shoot and root length of maize

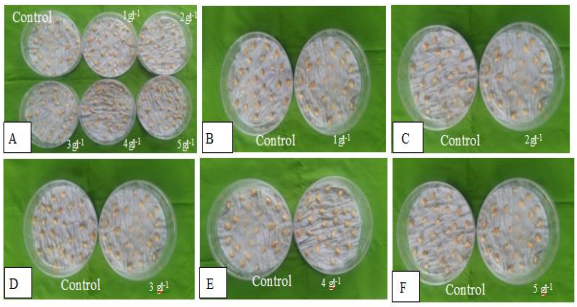

Figure 4. The effect of different concentrations of *Nostoc* suspension on germination of maize
A. C and 1 to 5gl-1 of Nostoc suspension
B. C and 1gl-1 of Nostoc suspension
C. C and 2 gl-1 of Nostoc suspension
D. C and 3gl-1 of Nostoc suspension
E. C and 4 gl-1 of Nostoc suspension
F. C and 5 gl-1 of Nostoc suspension

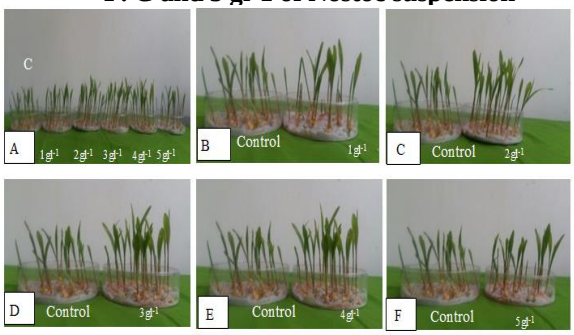

Figure 5. The effect of different concentrations of *Nostoc* suspension on germination of maize in laboratory experiment (7 DAS)
A. C and 1 to 5gl^{-1} of *Nostoc* suspension
B. C and 1gl^{-1} of *Nostoc* suspension
C. C and 2 gl^{-1} of *Nostoc* suspension
D. C and 3gl^{-1} of *Nostoc* suspension
E. C and 4 gl^{-1} of *Nostoc* suspension
F. C and 5 gl^{-1} of *Nostoc* suspension

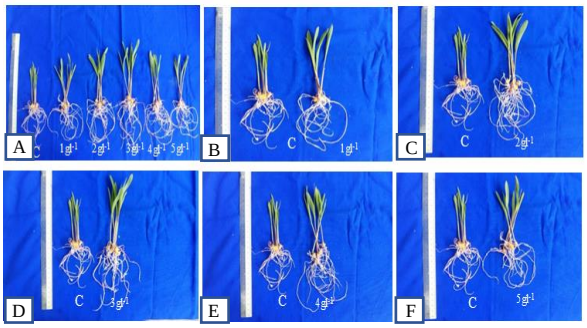

Figure 6. The effect of different concentrations of Nostoc suspension on shoot and root length of maize in laboratory experiment (7DAS)
A. C and 1 to 5gl-1 of Nostoc suspension
B. C and 1gl-1 of Nostoc suspension
C. C and 2 gl-1 of Nostoc suspension
D. C and 3gl-1 of Nostoc suspension
E. C and 4 gl-1 of Nostoc suspension
F. C and 5 gl-1 of Nostoc suspension

5. Discussion and Conclusion

Laboratory experiment were carried out to evaluate the biofertilizer effect of *Nostoc* suspension on *Zea mays* L. (maize). From laboratory experiment, it was found that *Nostoc* suspension 3 gl^{-1} was the best germination percentage and seedling growth for *Zea mays* L.

At 3 DAS, *Nostoc* suspension 3 gl^{-1} was found 97.76 % germinated and control was found 82.86% germinated. Thus effect of *Nostoc* suspension 3 gl^{-1} on germination percentage was 18% higher than control.

At 7 DAS, the mean shoot length of *Zea mays* L. treated with *Nostoc* suspension 3 gl^{-1} was 46% higher than control (16.80 cm – 11.50 cm) and the mean root length of *Nostoc* suspension 3 gl^{-1} on *Zea mays* L. was 65 % higher than control (24.26 cm – 14.70 cm). The present result showed that the use of *Nostoc* suspension was needed in small amount of *Nostoc* powder.

According to [8] founded that 4 gl^{-1} treatment of *Nostoc* suspension was the best germination and seedling growth of okra. The present finding was not agreed with above author. However agreed with [4] reported that 3 gl^{-1} of *Nostoc* suspension gave highly significant results for black grain compared to other treatments.

Beside, [5] presented that 2.0 gl^{-1} *Spirulina* suspension was best germination and seedling growth on *Phaseolus lunatus* (L.). The present experiments showed that, *Nostoc* suspension fertilizer 3 gl^{-1} had the best germination percentage, shoot, and root length of *Zea mays* L. (maize).

The results of the present study indicated that the optimum amount of *Nostoc* biofertilizer increase the germination and seedling growth of *Zea mays* L. (maize) in Laboratory experiment.

It can be concluded that *Nostoc* biomass could give a potential for improving the germination and seedling growth of *Zea mays* L. (maize).

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