EFFECT OF DIFFERENT FERTILIZERS ON GERMINATION AND SEEDLING GROWTH OF *VICIA FABA* L. (FAVA BEAN) IN LABORATORY EXPERIMENT

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Abstract

The present study was carried out to determine the effect of different fertilizers on germination and seedling growth of *Vicia faba* L. (Fava bean) at Department of Botany, Yadanabon University from August 2022 to January 2023. In laboratory experiment, the seeds of fava bean were treated with T_1 (Cowdung $4gl^{-1}$), T_2 (*Spirulina* $4gl^{-1}$), T_3 (*Nostoc* $4gl^{-1}$) and Control ($0gl^{-1}$) using Completely Randomized Design (CRD) with five replications. These results showed that, $4gl^{-1}$ of *Spirulina* treatment was the best germination percentage and maximum mean value of seedling growth of *Vicia faba* L. Therefore, the present research indicated that *Spirulina* ($4gl^{-1}$) suspension fertilizer has in effective role of *Vicia faba* L. in laboratory experiment.

Keywords: Fertilizer, Cowdung, *Spirulina, Nostoc*, Fava bean

Introduction

Vicia faba L. appears to have organized in north Africa and Southwest Asia and extensively cultivated elsewhere. Broad beans have a long traditional of cultivation in old world agriculture, being among the most ancient plants in cultivation and also among the easiest to grow. It is believed that along with lentils, peas and chickpeas, they became part of the eastern Mediterranean diet in around 6000 BC or earlier. They are still often grown as a cover crop to prevent erosion because they can over winter and as a legume, they can fix nitrogen in the soil. Myanmar is standing as a lead country of pulses production among ASEAN member countries and second largest exporter in the world. Major exportable cultivar of pulses is green gram, black gram, pigeon pea, soybean, fava bean, cowpea and kidney bean. Cultivation of pulses, with relatively less expenses in cost of cultivation and due to the increasing demand for domestic consumption and export, has increased substantially from 1.8 million acres in 1988-89 to 8 million acres in 2003-04 (MOAI, 2006).

Organic fertilizers, on the other hand, provide beneficial effects to the soil and also increase availability of nutrients, which helps to maintain the quality and yield of crops and are less expensive than inorganic fertilizers (Thy and Buntha, 2005). Organic fertilizers are not only the source of organic matter and nutrient, but also the booster of microbial population, physical, biological and chemical properties of the soil (Albiach *et al.,* 2000). The application of plant growth regulators with an effective nitrogen fixation plant potential is one of the effective ways of increasing the productivity of legumes. Microbial products from soil organisms are expected to make important contributions to production of food in coming years. Microalgae will also make important contributions to agriculture. In the near-term, the efficiency of cyanobacterial biofertilizer for rice will be improved (Kots and Mykhalkiv, 2001).

Cowdung has long been recognized as the most desirable animal manures because of its high nutrient and organic matter content. Addition of cow dung increases the organic carbon content of degraded soil which may lead to the increasing activity of beneficial soil microorganisms

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as well as the fertility status of soil by increasing the availability of nutrients for the plants from soil. Cow dung significantly increased the growth and yield of plants (Gudugi, 2013).

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 (Jordan Franklin, *et al.* 2018). *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.

Spirulina grows naturally in alkaline lakes containing sodium carbonate (Na_2CO_3) or sodium bicarbonate ($NaHCO_3$), other minerals and a source of fixed nitrogen. These lakes are found on every continent including Antartica and very often lie near volcanoes within the caldera of the volcano. They are found also in deserts which receives mineralized water runoff periodically from mountains. There are many countries where *Spirulina* grow or has grown in the past. Few selected sites were Africa (Algeria, Chad, Sudan, Ethiopia, Kenya, Tanzania, Zambia, and Madagacar), Asia (India, Myanmar, Sri Lanka, Pakistan, Thailand, and Azerbaijan), South America (Peru, Mexico, Urguay, Bolivia), North America (Caliifornia, Haiti, Dominican Republic) and Eruope (France and Hungary) (Fox, 1996).

In Myanmar, *Spirulina* was found nonspecifically in 4-natural alkaline lakes. *Spirulina* is found all the year round although peak blooming season occurs in summer months. Abundance of *Spirulina* is especially noticeable in Twyan Taung Lake where surface blooms may form thick mats filling more than half the lake area in summer months (Min Thein, 1987). The effects of algal suspension with various concentrations were improved to the germination of some vegetables. Cherkezov and Christov (1996) reported that the lowest concentration of *Spirulina* suspension led to highest stimulation in carrot and onion seeds. Khin Pyone Lwin (1987) stated that Ye Kharr lakes are a series of volcanic creater lakes with bicarbonate and carbonate salts and it is a shallow lake with its salt content mainly as sulphate. The relative efficiency of 10-blue green algae in promoting the growth and yield of rice was found in Tun Chun (1982). Thet Naing Htwe (2008) studied the effect of *Spirulina* on the germination and growth of chick pea, soybean and butter bean. Khaing Khaing (2012) found that the effect of *Spirulina* on the germination, growth, yield and nutritive value of *Phaseolus lunatus* L. (lima bean). Shwe Yee Win Maung Maung (2014) had observed the effect of *Nostoc* on germination growth and yield of Yonbade. The aims and objectives of the present research were to investigate the best application rate of different fertilizers for fava bean and to analyze the effects of different fertilizers on percentage of germination, shoot and root length of fava bean.

Materials and Methods

Laboratory Experiment

In the present study, laboratory experiment was conducted at the Department of Botany, Yadanabon University, from August 2022 to January 2023. Cowdung biomass was collected from See Mee Htun Village, Amarapura Township. *Nostoc* biomass was bought from Zay Cho markets. *Spirulina* powder (Lod No. 391) was obtained from Myanmar Pharmaceutical Factory, Ye kharr, Sagaing Region. Morphological character of fava bean (*Vicia faba* L.) was obtained from Hundley and Chit Ko Ko (1961), Dassanayake (1980-2000) and *Spirulina* and *Nostoc* were from Prescott

(1962). The experimental design were Complete Randomized Design (CRD) with five replications. The plastic petridishes (16.2 cm in diameter and 5 cm high) were used in this study. Cowdung, *Spirulina* and *Nostoc* powder were weighted by using digital balance, according to w/v ratio and different fertilizers, such as (T_1, Cowdung; T_2, *Spirulina* and T_3, *Nostoc*) were conduced for this experiment.

Laboratory Experiment with Cowdung, *Spirulina* and *Nostoc* Suspension

In this experiment, Cowdung, *Spirulina* and *Nostoc* powder (4 g) were weight. It took about 24 hours. Therefore, different fertilizers of Cowdung, *Nostoc* and *Spirulina* suspension were obtained. Before treatment, the seeds were presoaked in water for 6 hrs., 12 hrs. and 18 hrs. The 18 hrs presoaked was the best for germination. Therefore, the seeds of *Vicia faba* L. were soaked in different fertilizers of Cowdung, *Spirulina* and *Nostoc* suspension for 18 hours and control was soaked in pure water. After treatment twenty-five fava bean seeds were placed on blotting paper in each plastic petridishes for each treatment fifteen ml of purified water were sprayed twice a day to keep the moisture. All of these plastic petridishes were kept under natural condition and room temperature ranging from 22-25°C. Five replications were made at the same condition. The germinating seeds were counted on the 3rd, 6th, 9th day. The length of the shoots and roots (cm) were measured on the 9th day after sowing by using ruler (Figure 1).

Germination Percentage (%)

Germination percentage of fava bean (*Vicia faba* L.) in laboratory experiment was counted. Germination rate of each treatment was expressed in percentage.

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

Figure 1. Preparation of laboratory experiment

A. Fava bean seeds
B. Fava bean seeds soak in different fertilizers
C. Different fertilizers
D. Experimental layout in Complete Randomized Design (CRD)

Results

Morphological Character of Fava Bean

Scientific name : *Vicia faba* L.
English name : Broad bean: Horse bean; Fava bean
Local name : Pe let ma; Tayoke pe gyi
Family : Fabaceae

Annual erect herbs, up right, about 30 cm high, stem unbranched, quadrangular glabrous, pale green and soft. Leaves unipinnate compound, paripinnate, alternate, stipulate and petiolate; stipules triangular, glabrous, pale green and foliaceous, exstipellate; petiole slightly flattened, glabrous and pale green; leaflets 4-6 broadly elliptic to oval, pale green and fleshy. Inflorescences axillary short raceme, 1-6 flowered; peduncle flattened, caniculate above, glabrous and green. Flower bisexual, zygomorphic, white with dark purple markings; bracts minute and deciduous; pedicels flattened, softy tomentose and pale green. Calyx 5-lobed; tube oblique, glabrous and pale green, lobes acuminate, lower lobes longer than others, glabrous and pale green. Corolla papilionaceous exserted; standard elliptic, glabrous and white with brownish vein above, wings oblong with long claw, glabrous and white with dark-violet blotch; keels ovate with short claw, glabrous and white. Stamens 1+(9), diadelphous; staminal tube, glabrous and white; anther dithecous, uniform, minute, basified and longitudinally slits. Ovary oblong, tomentose and pale green; unilocular with 2-4 ovuled, marginal placentae; style terete, tomentose and pale green; stigma simple, glabrous. Pod oblong, tomentose, dehiscent, green, with 3-4 seeded. Seeds ovoid to oblong, smooth and green (Figure 2).

Figure 2. A. Habit of *Vicia faba* L. (Fava bean)
B. Inflorescence of *Vicia faba* L. (Fava bean)

Laboratory Experiment

In this study, *Vicia faba* L. seeds were with different fertilizers at Cowdung, *Spirulina* and *Nostoc* suspension ($4gl^{-1}$) were treated on the germination, shoot and root length were shown in Table (1) and Figure (1). In this result, the best germination percentage of *Vicia faba* L. 77.00 % was found in *Nostoc* suspension treatment $4gl^{-1}$ on 3 DAS.

The best mean germination percentage of Cowdung, *Spirulina*, *Nostoc* and control were 76.40 %, 85.10 %, 81.40 % and 70.60 % at 6 DAS. And then mean germination percentage of *Spirulina* suspension was 95.10 % and control was 78.20 % on 9 DAS (Table 1 and Figure 3 and 5).

The mean shoot length of *Vicia faba* L. (Tayoke pe gyi) seed was treated with different suspension (4 gl^{-1}) (Cowdung, *Spirulina, Nostoc*) on the highest mean shoot length were found 18.34 cm and that of control was 12.64 cm(Table 2 and Figure 4)

At different fertilizers suspension (4 gl^{-1}), (Cowdung, *Spirulina, Nostoc*) on the mean root lengths were found 9.17 cm, 11.85 cm, 10.66 cm and control was 8.02 cm respectively on 9 DAS. The germination percentage, the mean shoot and root length of *Vicia faba* L. (Tayoke pe gyi) at T_2 ($4gl^{-1}$) were higher than the other treatment and control in Table 2 and figure 4 and 6.

Table 1. Effect of different fiertilizers on germination percentage of *Vicia faba* L. (Laboratory experiment)

Control and Treatments	Mean germination % ± sd		
	3 DAS	6 DAS	9 DAS
Control	64.20 ± 8.180	70.60 ± 3.314	78.20 ± 3.472
T_1 (Cowdung)	69.70 ± 2.162	76.40 ± 5.316	82.20 ± 6.951
T_2 (Spirulina)	75.20 ± 5.334	85.10 ± 9.334	95.10 ± 9.284
T_3 (Nostoc)	77.00 ± 9.921	81.40 ± 9.637	87.00 ± 7.618

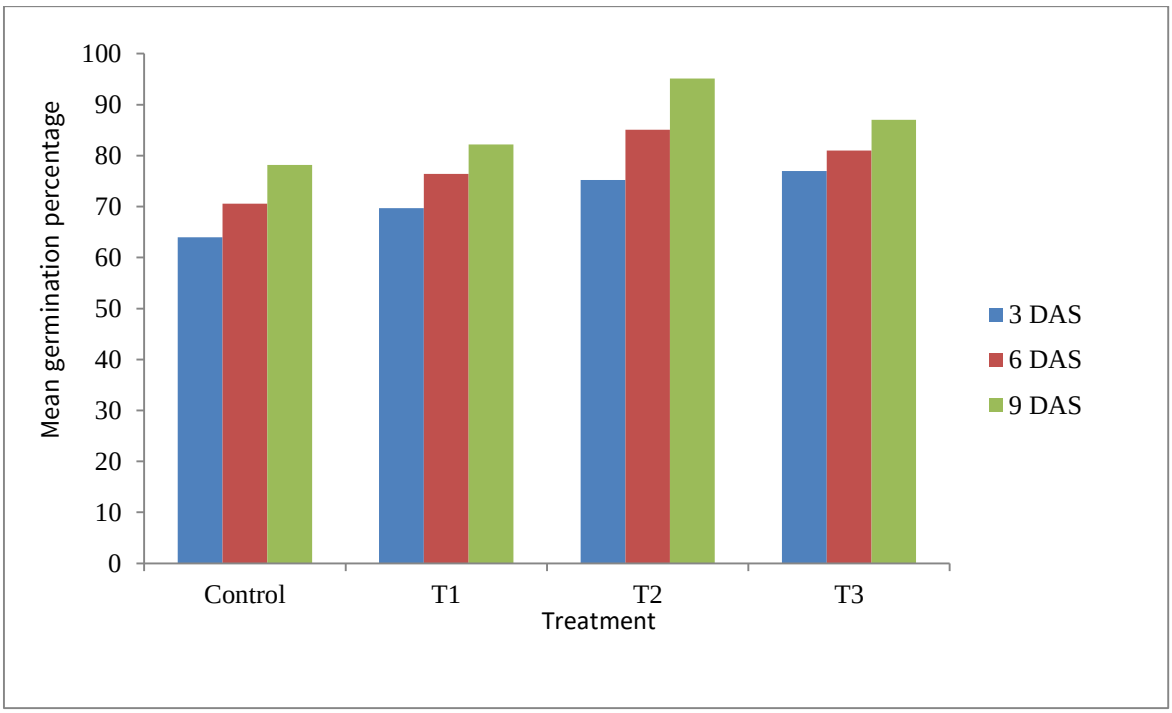

Figure 3. Comparison of different fertilizers on germination percentage of *Vicia faba* L. (Laboratory experiment)

Table 2. Effect of Cowdung(T_1), *Spirulina*(T_2) and *Nostoc*(T_3) suspension on mean shoot length and root length of *Vicia faba* L. (Laboratory experiment)

Nostoc Suspension Treatment (gl^{-1})	9 DAS	
	Mean shoot length (cm) ± sd	Mean root length (cm)± sd
Control	12.64 ± 0.442	8.02 ± 1.544
T_1	15.32 ± 0.915	9.17 ± 1.362
T_2	18.34 ± 0.718	11.85 ± 1.168
T_3	16.77 ± 0.754	10.66 ± 2.573

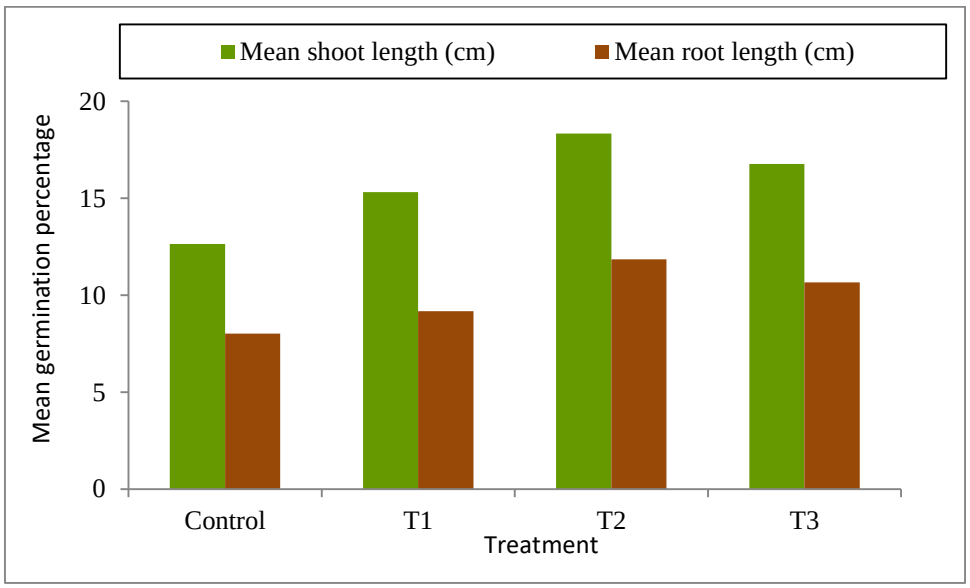

Figure 4. Comparison on different fertilizers on mean shoot length and root length of *Vicia faba* L. at 9 DAS (Laboratory experiment)

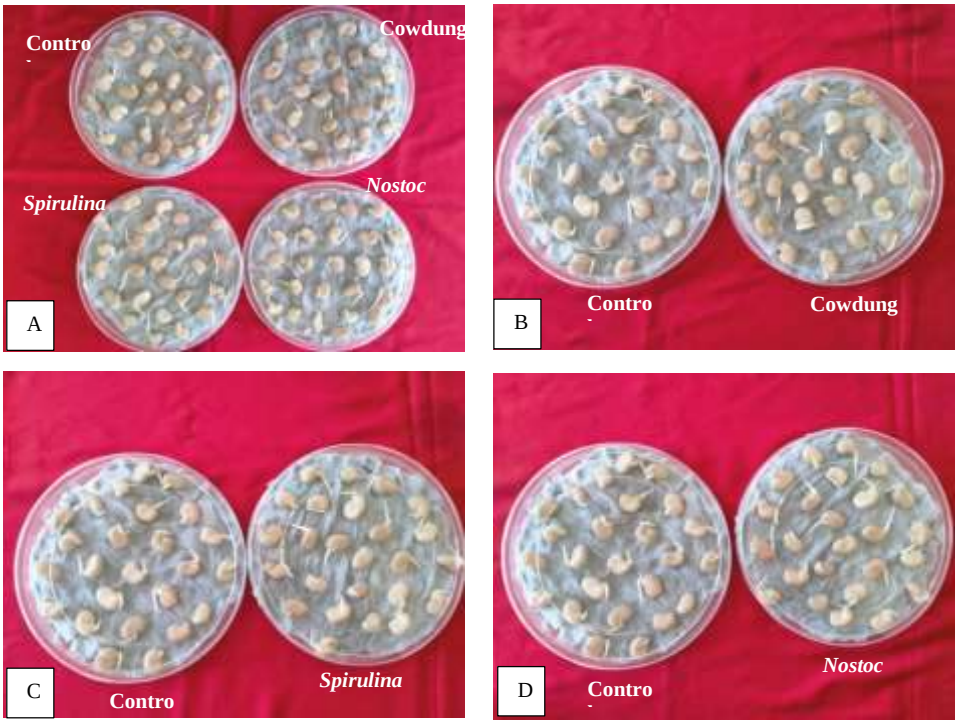

Figure 5. Effect of different fertilizers on germination percentage of fava bean at 3 DAS in laboratory experiment

A. Control and different fertilizers
B. Control and Cowdung suspension (4 gl-1)
C. Control and Spirulina suspension (4 gl-1)
D. Control and Nostoc suspension (4 gl-1)

Figure 6. Effect of control and different fertilizers on shoot and root length of fava bean at 9 DAS in laboratory experiment

A. Control and different fertilizers
B. Control and Cowdung suspension (4 gl-1)
C. Control and Spirulina suspension (4 gl-1)
D. Control and Nostoc suspension (4 gl-1)

Discussion and Conclusion

The effect of Cowdung, *Spirulina* and *Nostoc* on *Vicia faba* L. (Tayoke pe gyi) showed the best germination and seedling growth in 4 gl^{-1} treatment. Due to the comparative result of shoot and root length (cm) *Spirulina* suspension 4 gl^{-1} produced the highest efficient of shoot and root length. *Spirulina* suspension (4 gl^{-1}) was found 95.10 % germination and control was found 78.20 % germinated on 6 DAS.

The highest mean shoot length of *Vicia faba* L. treatment with *Spirulina* suspension (4 gl^{-1}) was 18.34 cm and that of control was 12.64 cm and the highest mean root length of *Spirulina* suspension (4 gl^{-1}) on fava bean was 11.85 cm but control was 8.02 cm on 9DAS. The present results showed that the application of *Spirulina* suspension on fava bean is beneficial.

Khaing Khaing (2012) observed that 2 gl^{-1} *Spirulina* suspension was the best germination and shoot and root length of *Phaseolus lunatus* (L.). In addition, Thida Aye (2011) reported that 3 gl^{-1} of *Nostoc* fertilizer suspension was the best for germination rate and shoot length of mustard. The present finding was agreed with Tin Tin Maw (2012) presented that *Spirulina* suspension (4 gl^{-1}) was the best germination and shoot and root length of *Vigna mungo* (L.) Hepper.

The present studies showed that, 4 gl^{-1} *Spirulina* suspension fertilizers had the best germination percentage, shoot length and root length of *Vicia faba* L. (fava bean) higher than control. The using of Cowdung, *Spirulina* and *Nostoc* suspension obtained enhancement in the germination and seedling growth of fava bean. However, *Spirulina* suspension was better than other fertilizers.

It can be concluded that *Spirulina* biomass could give a potential algal biofertilizer in germination and seedling growth of *Vicia faba* (Fava bean).

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