The Effect of Various Organic and Biofertilizers on Growth and Yield of *Vigna Mungo* (L.) Hepper (Black Gram)

Marlar

Abstract

In this study, the effect of various organic treatment fertilizers (Cowdung, Chickendung, *Spirulina* powder and Compost) was tested with blackgram cultivar (Yezin-6). In pot experiment, the best *Spirulina* treatment activates growing point and dramatically speeds up rising on plant height, root length, number of nodes, number of leaves, number of pods per plant and number of seeds per pod become bigger than other treatments and control. Therefore, *Spirulina* treatment (104) plays an effective role in the fertility of agricultural fields. The effects of various organic fertilizers were investigated as a biofertilizer in cultivation of blackgram. Organic fertilizers application showed increased yield over the control.

Keywords: various organic fertilizer, biofertilizer, blackgram

Introduction

Blackgram belongs to the family Fabaceae and the genus *Vigna*. Only seven species of the genus *Vigna* are cultivated as pulse crops, five Asian species of *Vigna mungo* (blackgram), *V. radiata* (mungbean), *V. aconitifolia* (mothbean), *V. angularis* (azuki bean) and *V. umbellata* (rice bean) and two African species of *Vigna unguiculata* (cowpea) and *V. subterranean* (the bambara groundnut) (Verdcourt, 1969). Blackgram (*Vigna mungo* (L.) Hepper) is a member of the Asian *Vigna* crop group. It is a staple crop in the central and South East Asia; however it is extensively used only in India and now grown in the Southern United States, West Indies, Japan and other tropies and subtropies (Delic *et al.*, 2009).

Blackgram is one of the most highly prized pulse crop, cultivated in almost all parts of India. It has inevitably marked itself as the most popular pulse and can be most appropriately referred to as the "king of the pulses" due to its mouth wartering taste and numerous other nutritional qualities.

Blackgram is used as a pulse, direct or in various preparations for man to eat. Small amounts are used as cattle feed. Some are used as a green manure and in medicine.

Myanmar is standing as a lead country of pulses production among ASEAN member countries and second largest exporter in the world. Major exportable cultivars of pulses are green gram, blackgram, pigeon pea, soybean, 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 are fertilizers derived from animal matter, animal excreta (manure), human excreta, and vegetable matter (e.g. compost and crop residues). Naturally occurring organic fertilizers include animal wastes from meat processing, peat, manure, slurry, and guano. The main organic fertilizers are peat, animal wastes (often from slaughter houses), plant wastes from agriculture, and treated sewage sludge.

In recent decades, agricultural scientists and farmers have been interested in natural and biofertilizers to substitute the chemical fertilizers. The main sources of biofertilizers are

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bacteria, fungi, cyanobacteria (blue green algae) and other micro and macro algae (Ghosh and Mukherjee 1998).

In the present study, the effect of various organic fertilizers (Cowdung, Chickendung, *Spirulina* powder and Compost) was found on the growth and yield of *Vigna mungo* (L.) Hepper (blackgram). All treatments increased their maximum growth and yield of blackgram at *Spirulina* powder treatment (104). Then, all of the growth and yield declined at Control (101).

The aims and objectives of this research are to determine the use of various organic fertilizers as a biofertilizer for the improvement of crop growth and yield of blackgram; to inform the beneficial effect of using this biofertilizer to the local farmers; to study the effects of various organic biofertilizer on the enhancement of crop capacity; to analyze the first experiment cultivation and the second experiment cultivation of soil to find out its relationship to crop productivity.

Materials and Methods

In this research laboratory and pot experiments were carried out during March 2017 to December 2017.

Pot Experiment

The pot experiment was conducted at Wha Htaung Streets during seasonal period of March 2017 to December 2017. The experiment was located at North latitude 21° 19' 49"and East longitude 95° 04' 29". It is situated at elevation 70.0 m above sea level. The soil was used in this study on clay loamy to sandy loamy and originated from annual Ayeyarwady river flood sediments. The soil pH (7.0) is measured; the soil (4 Kg) with 3:1 was prepared in earthen pots which was 13" in diameter and 9.5" in height. Ten seeds were planted at a depth of 2-3 cm approximately in each pot. Each pot was watered to maintain the moisture content. The pot experiment was laid out in randomized complete block design with five replications. The pot experiment was tested with without organic fertilizer (Control (101)), organic fertilizers (Cowdung (102), Chickendung (103), *Spirulina* powder (104) and Compost (105) were designated to treatment in this investigation (Fig. 1).

Data Collection and Statistical Analysis

Data collection was carried out at 14 DAS at weekly intervals. The recorded data were analyzed by student's "t" test using the formula of Fowler, Cohen and Jaris (1996). Comparison between the mean of the treatment percentages and that of the control was also made using the same formula. The followings were collected measurements of germination percentage, plant height, root length, number of nodes, number of leaves, number of pods per plant, number of seeds per pod, 50% flowering time and dry weight of 100 seeds (g) were measured and expressed the mean and standard deviation (10 seedlings for each).

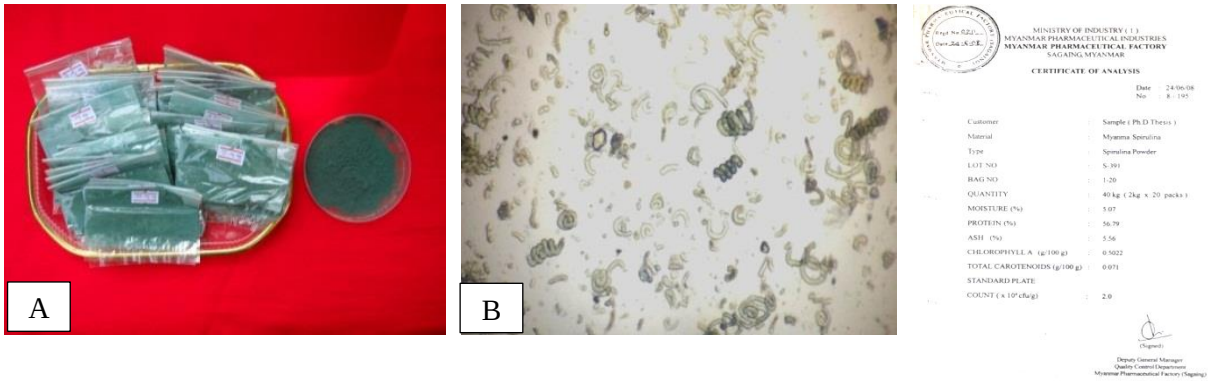

Figure (1).(A). *Spirulina* powder (Lot. No. S-391), (B). *Spirulina platensis* Turpin.

103	**101**	**104**	**102**	**105**
101	**104**	**103**	**105**	**102**
104	**105**	**102**	**103**	**101**
102	**103**	**105**	**101**	**104**
105	**102**	**101**	**104**	**103**

Figure (2). Pot experiment design-randomized complete block design (RCBD)

Replication-5

Control = 101

Treatments, Cowdung = 102

Chickendung = 103

Spirulina Powder = 104

Compost = 105

Results

Morphological Characters of *Vigna mungo* (L.) Hepper

Family Name : Fabaceae

Scientific Name : *Vigna mungo* (L.) Hepper

English Name : Blackgram

Myanmar Name : Mat Pe

Flowering Time : Febuary to May

Annual trailing herbs about 80cm high; stems and branches, gray brownish hairy; Leaves trifoliolate pinnately compound; stipulate, pubescent persistent; petioles terete, furrowed above 6.2 to 9.3cm long, pubescent; leaflet broadly ovate, 5.4-2.7cm by 11.3-5.9cm, pubescent to glabrescent, cuneate or rounded at the base, entire along the margin, acute or occasionally obtuse at the apex. Inflorescence axillary or terminal raceme, 5-6 flowered at a node. Flower bisexual zygomorphic, about 1.1cm in diameter, pale yellow;

bracts lanceolate; pedicels short. Calyx 5-lobed; campanulate; tube 0.5mm long; glabrous within, villous without. Corolla papiliolaceous, exserted; standard squarish, orbicular, about 5.0mm by 7.0mm; wing obovate to oblong; keel oblong, pale yellow, glabrous. Stamens 10, diadelphous; filament filiform, white glabrous; anthers ovoid, about 1.0 mm long, dithecous, basifixed, dehiscent by longitudinal slit. Ovary oblong about 0.6 cm long, green, pubescent; style short, about 1.00 mm long, white, pubescent; stigma simple. Fruits pod, oblongoid 3.5 cm-0.5cm by 5.0 cm-0.6 cm, green, yellowish brown when ripen, bristely hairy. Seeds globose, glabrous black.

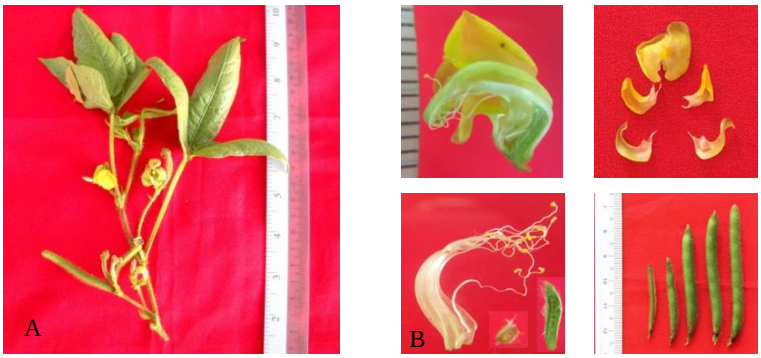

Figure (3).(A). Habit of Inflorescence, (B). Floral parts of Flower and Pods

Effect of Morphological Parameters of Plant Height *Vigna mungo* (L.) Hepper

In experiment these results showed the difference in plant height of treated (cowdung, chickendung, *spirulina* powder, compost) and untreated plant (control). At 83 DAS, the longest plant height was that of *spirulina* powder which was much higher than that of cowdung, chickendung, compost and control. In experiment-1, the maximum plant height of 59.07 cm plant^{-1} that of cowdung was 55.40 cm plant^{-1}, chickendung was 28.42 cm plant^{-1}, compost was 23.43 cm plant^{-1} and control was 23.40 cm plant^{-1} respectively (Table 1 and Fig. 4).

Table (1). Effect of various organic fertilizers and control on mean plant height of blackgram cultivar (Yezin-6)

Various Organic Treatments	Mean Plant Height (cm)±sd			
	41 DAS	55 DAS	69 DAS	83 DAS
Control	8.61±1.10	10.20±3.56	15.21±4.03	23.40±8.2
Cowdung	12.64±2.45	21.56±4.86	44.67±16.14	55.40±18.07
Chickendung	10.15±1.54	14.39±2.72	22.35±6.30	28.42±10.12
***Spirulina* Powder**	**15.09±1.91**	**23.16±3.51**	**45.06±10.13**	**59.07±18.11**
Compost	9.46±1.72	11.20±2.11	17.90±4.31	23.43±7.41

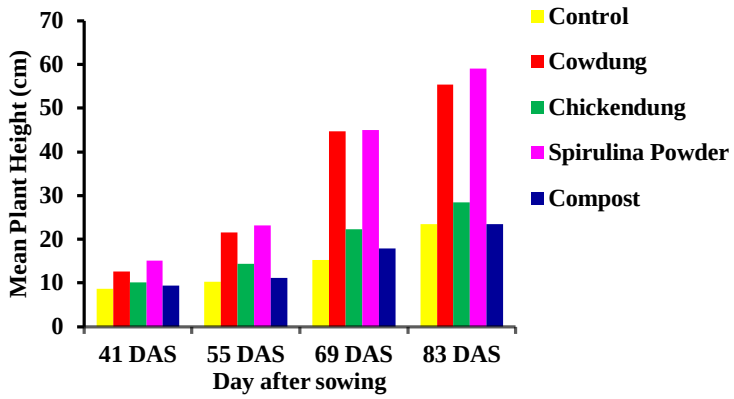

Figure (4). Comparison of various organic fertilizers and control on mean plant height of blackgram cultivar (Yezin-6)

In pot experiment (at 69 DAS), the miximum root length of *Spirulin*a powder was 10.23 cm plant^{-1}, cowdung was 9.83 cm plant^{-1}, chickendung was 7.91 cm plant^{-1}, compost was 7.49 cm plant^{-1} and control was 4.98 cm plant^{-1} respectively (Table 2 and Fig. 5). The result indicated that the root length gradually increased from 41 DAS to 69 DAS. Firstly, *Spirulina* powder treatment and secondly, cowdung treatment were enhanced root growth significantly to that higher than control and another treatments. The root length of all treatments was observed to be increased.

Table (2). Effect of various organic fertilizers and control on mean root length of blackgram cultivar (Yezin-6)

Various Organic Treatments	Mean Rood Length (cm)±sd		
	41 DAS	55 DAS	69 DAS
Control	3.23±0.56	4.12±0.32	4.98±0.47
Cowdung	5.67±0.61	6.82±0.45	9.83±0.52
Chickendung	4.76±0.61	5.25±0.89	7.91±0.46
***Spirulina* Powder**	**8.02±0.78**	**8.42±0.75**	**10.23±0.67**
Compost	4.33±0.58	4.78±0.45	7.49±0.43

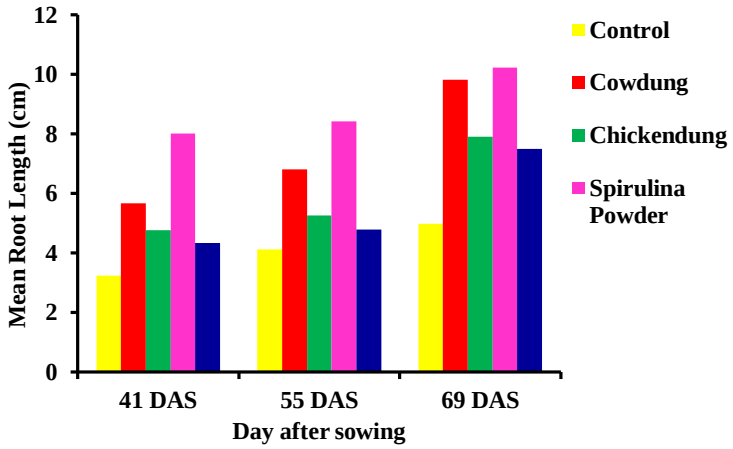

Figure (5). Comparison of various organic fertilizers and control on mean root length of blackgram cultivar (Yezin-6)

In pot experiment table (3) and figure (6) show the effect of various organic fertilizers on blackgram cultivar (Yezin-6). According to these results DAS 27, 41, 55, 69, and 83 at (104), the highest numbers of nodes were 1.00, 3.34, 5.53, 13.26 and 16.13 respectively, while that of control were 1.00, 1.73, 3.00, 6.07 and 8.74 respectively. Generally, the node number of control and all treatments increased with 27 DAS up to 83 DAS. The node number of *Spirulina* powder, cowdung and chickendung treatments were significantly at 1% and 5% levels respectively, but compost treatment was non-significantly differently from each other.

Table (3). Effect of various organic fertilizers and control on mean nodes number of blackgram cultivar (Yezin-6)

Various Organic Treatments	Mean Number of Nodes ±sd				
	27 DAS	41 DAS	55 DAS	69 DAS	83 DAS
Control	1.00±0.00	1.73±0.46	3.00±0.53	6.07±1.16	8.74±1.75
Cowdung	1.00±0.00	3.14±0.52	5.13±0.86	10.74±1.79	14.13±4.70
Chickendung	1.00±0.00	2.46±0.52	4.21±0.80	8.57±3.41	11.61±4.77
***Spirulina* Powder**	**1.00±0.00**	**3.34±0.49**	**5.53±0.52**	**13.26±3.47**	**16.13±4.77**
Compost	1.00±0.00	1.80±0.41	3.34±0.72	6.40±1.96	9.07±2.95

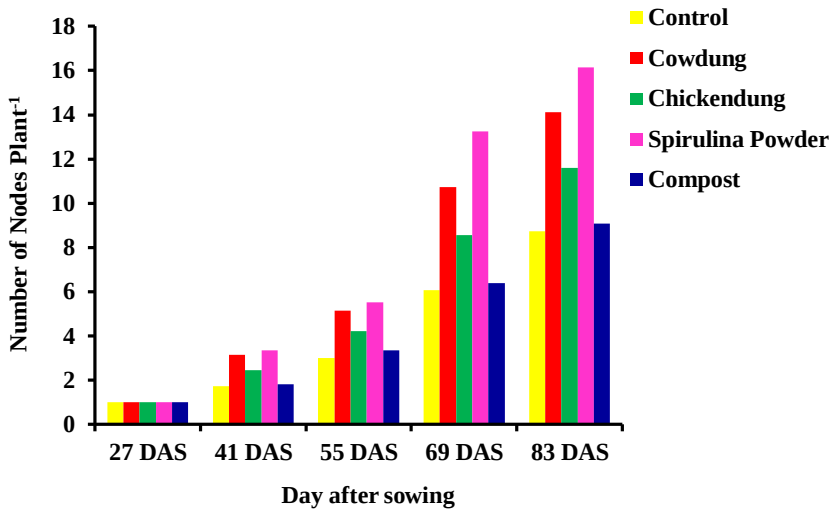

Figure (6). Comparison of various organic fertilizers and control on mean nodes number of blackgram cultivar (Yezin-6)

In pot experiment, blackgram cultivar (Yezin-6) was used (Table 4 and Fig. 7), the results showed the effect of various organic fertilizers on leaf number. According to these results, at DAS 27, 41, 55, 69, and 83 the highest leaf number of *Spirulina* powder treatment were 2.0, 3.40, 6.20, 13.26 and 15.86 respectively, while that of control were 1.30, 2.00. 3.34, 7.06 and 9.27 respectively. Generally, the leaf number of control and all the treatments increased with 27 DAS up to 83 DAS. The leaf number of *Spirulina* powder and cowdung treatments were significantly at 1% and 5% levels respectively, but chickendung and compost treatment were non-significantly different from each other.

Table (4). Effect of various organic fertilizers and control on mean leaves number of blackgram cultivar (Yezin-6)

Various Organic Treatments	Mean Leaves Number ±sd				
	27 DAS	41 DAS	55 DAS	69 DAS	83 DAS
Control	1.30±0.51	2.00±0.35	3.34±0.62	7.06±1.41	9.27±2.49
Cowdung	2.00±0.00	3.34±0.49	6.00±1.06	9.86±2.06	13.34±3.87
Chickendung	1.86±0.35	2.90±0.45	4.50±1.09	8.92±3.36	11.76±5.17
***Spirulina* Powder**	**2.00±0.00**	**3.40±0.63**	**6.20±1.01**	13.26±3.17	15.86±4.69
Compost	1.60±0.51	2.20±0.61	3.60±0.92	7.40±2.05	9.93±3.32

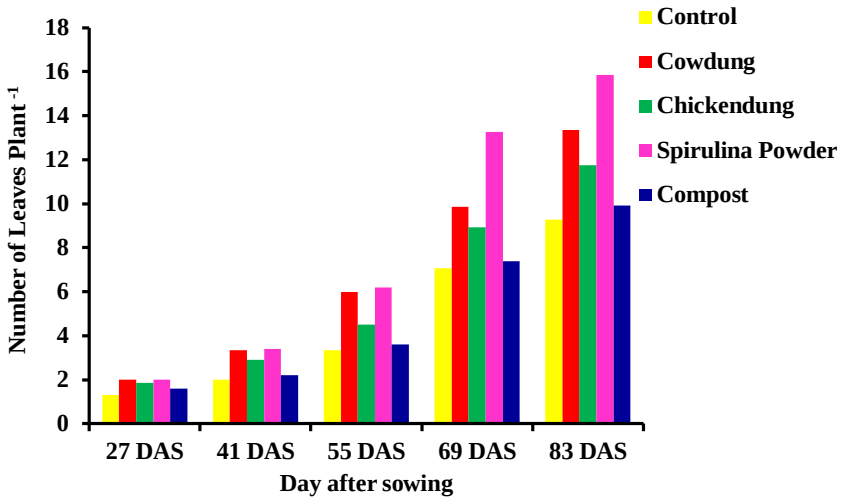

Figure (7). Comparison of various organic fertilizers and control on mean leaves number of blackgram cultivar (Yezin-6)

In pot experiment (at 111 DAS), the results showed that the maximum number of pods per plant in treatment 104 with 34.00 pods per plant, in 102 with 24.27 pods per plant, in 103 with 23.33 pods per plant, in 105 with 18.73 pods per plant and in control with 10.20 pods per plant respectively (Table 5 and Fig. 8). The number of pods per plant in 104 treatments was significantly higher than control. The number of pods per plant in 104 treatment was significantly higher than control.

Table (5). Effect of various organic fertilizers and control on pods per plant of blackgram cultivar (Yezin-6)

Various Organic Treatments	Mean Number of Pod Plant^{-1}		
	83 DAS	97 DAS	111 DAS
Control	1.07 ± 0.59	4.27 ± 1.53	10.20 ± 3.48
Cowdung	5.87 ± 3.54	17.27 ± 7.46	24.27 ± 5.49
Chickendung	2.47 ± 0.74	12.80 ± 3.14	23.33 ± 5.21
***Spirulina* Powder**	**8.13 ± 3.09**	**27.53 ± 4.86**	**34.00 ± 4.56**
Compost	1.87 ± 0.63	11.33 ± 4.89	18.73 ± 5.29

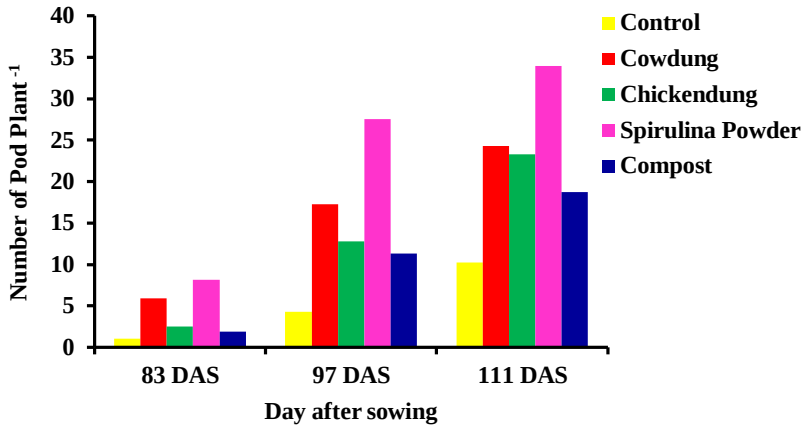

Figure (8). Comparison of various organic fertilizers and control on mean number of pods per plant of blackgram cultivar (Yezin-6)

In pot experiment (at 111 DAS), the height number of seeds per pod was observed in treatment 104 with 224.60 seeds per pod, in 102 with 165.80 seeds per pod, in 103 with 146.87 seeds per pod, in 105 with 118.93 seeds per pod and in control with 60.27 seeds per pod respectively. The number of seeds per pod in 104 treatment was significantly higher than control (Table 6 and Fig. 9). The number of seeds per pod in 104 treatments was significantly higher than control.

Table (6). Effect of various organic fertilizers and control on the number of seeds yield of blackgram cultivar (Yezin-6)

Various Organic Treatments	Number of seed pod^{-1}		
	83 DAS	97 DAS	111 DAS
Control	6.40 ± 3.39	26.00 ± 11.09	60.27 ± 21.24
Cowdung	40.80 ± 24.79	125.87 ± 45.20	165.80 ± 39.17
Chickendung	15.93 ± 7.06	78.73 ± 19.37	146.87 ± 42.05
***Spirulina* Powder**	**62.07 ± 26.18**	**162.87 ±60.79**	**224.60 ± 53.96**
Compost	11.20 ± 3.42	69.47 ± 34.65	118.93 ± 39.55

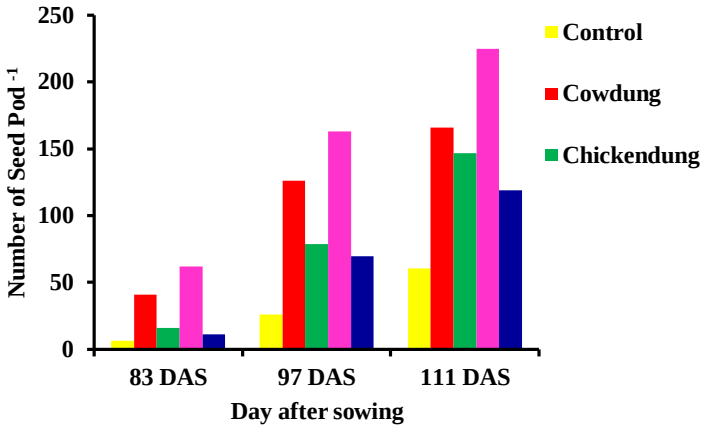

Figure (9). Comparison of various organic fertilizers and control on mean number of seeds yield of blackgram cultivar (Yezin-6)

In pot experiment, the highest dry weight of 100 seeds was observed in 104 with 5.28 g, followed by in 102 with 5.15 g, in 103 with 4.15 g, in 105 with 3.52 g, and then in control with 2.74 g respectively (Table 9). The maximum dry weight of 100 seeds in 104 treatment was significantly higher than control (Fig. 10). Therefore, the effect of various organic fertilizers on number of pods per plant and number of seeds per pod was studied and it was found that *Spirulina* powder has agained the highest effect in the 50% flowering time on 49 days and 38 days respectively.

Table (9). Effect of various organic fertilizers and control on 50% flowering time/date and dry weight of 100 seeds (g) of blackgram cultivar (Yezin-6)

Various Organic Treatments	**50% Flowering Time/Date**	**Dry Weight of 100 Seeds (g)**
Control	70	2.74g
Cowdung	61	5.15g
Chickendung	62	4.15g
***Spirulina* Powder**	**49**	**5.28g**
Compost	63	3.52g

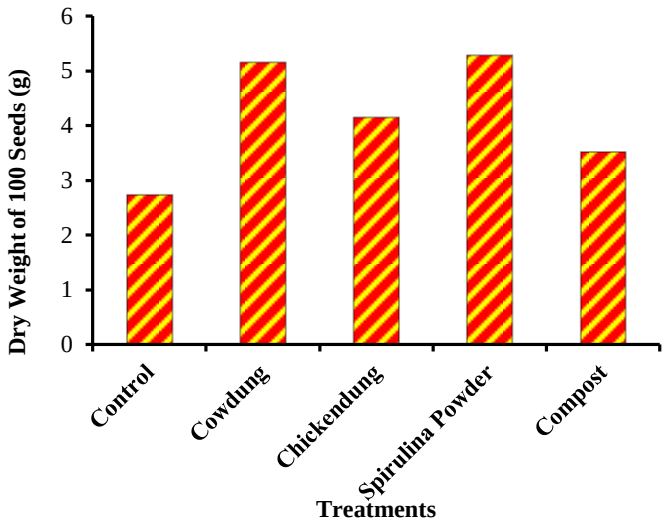

Figure (10). Comparison of various organic fertilizers and control on dry weight of 100 seeds of blackgram cultivar (Yezin-6)

Figure (11). Effect of various organic fertilizers and control on 100 seeds weight (g) of *Vigna mungo* cultivar (Yezin-6)

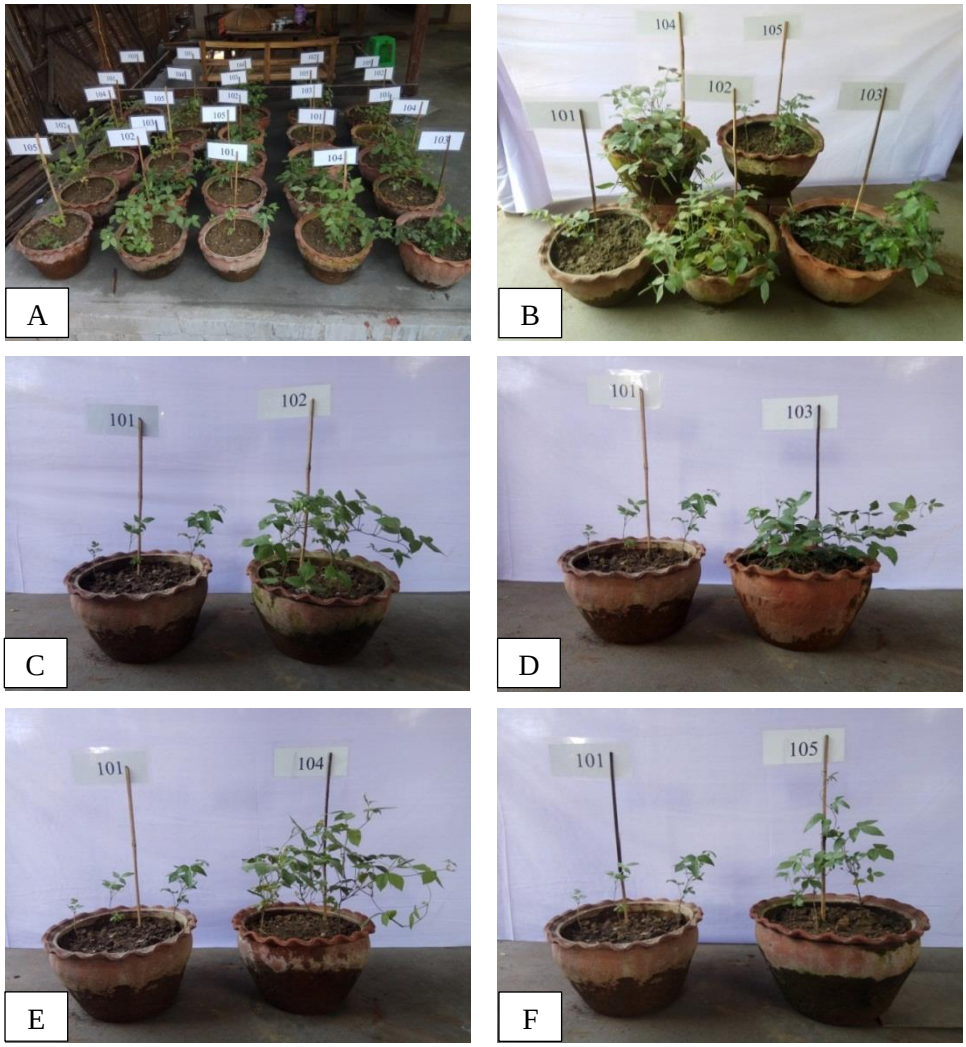

Figure (12). A. Effect of various organic fertilizers and control on *Vigna mungo* cultivar (Yezin-6) (83 DAS)

B. Effect of various organic fertilizers and control

C. Control and Cowdung treatment

D. Control and Chickendung treatment

E. Control and *Spirulina* powder treatment

F. Control and Compost treatment

Discussion and Conclusion

In this study, the blackgram cultivar (Yezin-6) was tested with various organic fertilizers (Cowdung, Chickendung, *Spirulina* powder and Compost) planted in pot experiment.

All treatments showed the increased rate of plant height of blackgram with 27 DAS up to 83 DAS. In pot experiment, the maximum plant height was observed in *Spirulina* powder treatment at 83 DAS 59.07cm and other treatments, Cowdung treatment, Chickendung treatment, Compost treatment and Control reached the 55.40cm, 28.42cm, 23.43cm and 23.40cm at 83 DAS (Table 1 and Fig. 3).

The *Spirulina* treatment of the biofertilizer was found to be significantly effective in maintaining higher root length 10.23cm at 69 DAS in pot experiment (Table 2 and Fig. 5).

The node formation of the blackgram crop in the experiments was significantly influenced by the *Spirulina* powder, Cowdung and Chickendung treatments at 83 DAS in pot experiment. Observations indicate that the maximum value was 16.13cm at *Spirulina* powder treatment of nodes count and the number of node decreased with the control (Table 3 and Fig. 6).

In this result, the best mean number of leaves, number of pods per plant, number of seeds per pod, flowering time and 100 seeds dry weight (g) was observed *Spirulina* powder treatment in promoting the above parameters (Figure 7-12).Therefore application of compost and *Spirulina* biofertilizer will be a better way to provide good growth and yield of *Vigna mungo* (L.) Hepper.

These findings were supported by Khin Lay Nandar Aung (2011) that *Spirulina* suspension 7 gl^{-1} produced the highest germination growth, highest yield, highest nodule number and nodule formation of green gram. Similar results of $2gl^{-1}$ are the best for promoting growth and yield were obtained by Win Naing Oo (2008) for wheat.

In recent study Aye Mya Nyein and Win Mar, San San Aye (2012) have showed the effect of *Spirulina* biofertilizer on germination growth and yield of different cereal crops.

Natural and organic fertilizer differs from chemicals in that they feed your plants while building the soil. Soils with lots of organic material remain loose and airy, hold more moisture and nutrients, foster growth of soil organisms, and promote healthier plant root development.

So, natural products are mainly considered to be less harmful, because they have biological sources of nitrogen and are often active at low doses. Thus, many researchers and agricultural scientists are investigating natural biofertilizers to substitutes for the chemical fertilizers since several years ago. The chemical fertilizers became less popular because of the increasing cost of using them in the crops production. Alternative fertilizers are thus called for and biofertilizer came into widely use nowadays.

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