Research article

Suitable Timing of Compost Application and Its Effectiveness on Mung Bean in the Crop Station of Royal University of Agriculture

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Received 15 December 2011 Accepted 12 March 2012 (*: Corresponding Author)

Abstract Agriculture is one of the main sectors for Cambodian economy since 85% of citizens live in the countryside, and among which 75% are farmers. They use the same soil every year for farming, which causes the soil to become infertile. To solve this problem, adding organic fertilizer is the best method to improve the stability of soil fertility. Compost is one type of organic fertilizers which can be applied to improve soil properties such as the soil's physical, chemical and biological properties. Because of these reasons, an experiment on suitable timing of compost application and its effectiveness on mung bean was conducted. The experiment aimed to determine which kind of organic fertilizers is appropriate for mung bean growth and yield, and to identify the suitable timing of compost application for the mung bean crop. There were 4 kinds of compost for conducting the experiment: conventional compost, pellet compost, neem conventional compost and neem pellet compost, and two different timings of compost application (one week before seeding and during seeding of mung bean). Plots were designed as randomized complete blocks design (RCBD) with three blocks. In each block there were nine treatments including the control. As a result, there was no significant difference between different timings of compost application (one week before seeding, and while seeding). We had the highest yield by application of neem compost one week before seeding, which was 2.056 t/ha. The next was neem compost during seeding=1.850 t/ha, and the lowest yield was found in the control treatment=1.341 t/ha. According to the results above, application of neem compost one week before seeding is suitable to get higher yield of mung bean though there was not a significant difference between timings of compost application.

Keywords conventional compost, pellet compost, neem conventional compost, neem pellet compost, timing of application

INTRODUCTION

To produce rice and other crops from year to year, it is necessary to apply nutrients continually. So, organic fertilizers have been applied into the soil in order to keep the soil fertility and ensure sustainable agriculture. Compost is one type of organic fertilizer which is made from plant residues, that can offer nutrients to soil, decrease the level of compacted soil, and improve chemical and physical properties of soil (soil quality) (Mihara and Fujimoto, 2009; Aero Sun Time, 1990). According to the experiment of Ungsa (1990-1991) about the effectiveness of fertilizer and spacing on quality and mung bean yield, it was concluded that the application of chemical fertilizer did not improve the quality of mung bean significantly, but the applied compost increased mung bean yield significantly.

Pellet compost or granular compost was developed by Institute of Environment Rehabilitation and Conservation (ERECON) and Tokyo University of Agriculture (TUA) (Mihara and Fujimoto, 2007). Pellet compost is made of conventional compost, clayey soil, and molasses in the proportion of 10:1:0.01 (Mihara and Fujimoto, 2007). 0.01 units of molasses is the most suitable proportion for making pellet compost (Mihara, et al, 2005). Between conventional compost and pellet compost, conventional compost is more likely to be prone to erosion than pellet compost, as the molasses plays roles as connectors for compost aggregate. It means that nutrient losses of farm land applied with pellet compost can be reduced compared to the conventional compost (Mihara and Fujimoto, 2007). Siriwattananon and Mihara (2008) concluded that pellet compost application is an effective way for reducing soil fertility loss which is one way to contribute to the practice of sustainable agriculture.

Neem compost is a type of compost made from neem leaves and other materials. Neem compost is used to increase soil quality, soil fertility, and it also provides more nutrients to soil and crops. Neem compost is being used by many farmers and agronomists because of the discovery of its benefits such as the increase of pest resistance for plants, which can be applied to all kinds of plants and crops, improvement of soil condition, and the prevention of some kind of root diseases (Oil seeds shop, 2010).

Harvesting age of mung bean is 70-90 days depending on the variety (Sokha, 1997), and nutrient releasing rate of compost is slower than chemical fertilizer (Mihara and Fujimoto, 2007). Hence, different timings of compost application should be studied.

Based on good features of these organic fertilizers and the above-mentioned factors, an experiment was conducted about the suitable timing of compost application and its effectiveness on mung bean in the crop station of Royal University of Agriculture. The objectives of this experiment aimed to determine which kind of organic fertilizers is appropriate for mung bean growth and yield, and to identify the suitable timing of compost application for the mung bean crop.

MATERIALS AND METHODS

Conventional compost, pellet compost, neem conventional compost, and neem pellet compost were made at ERECON CaM-branch (Institute of Environment Rehabilitation and Conservation, Cambodia Branch). The field experiment was conducted in the crop station of Royal University of Agriculture.

Materials such as cow manure, water hyacinth, siam weed, morning glory, grass, chaff ash, rice husk, vegetables, tree leaves, neem leaves, and fertile soil were collected to make compost (Kinal, et al., 2007). After putting materials into the compost box, water was used to moisturize the solution. Then compost was turned regularly until it became mature. After that, conventional compost, and neen conventional compost were sieved with 1.5 millimeter diameter sieve to get powdered compost for making pellet compost by mixing it with clayey soil, and palm sugar in the ratio of 10:1:0.01.

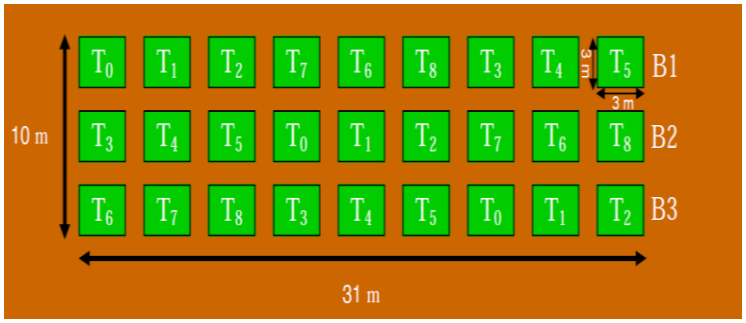

Fig. 1 Experimental plots design

After getting organic fertilizers, conventional compost, pellet compost, neem conventional compost, and neem pellet compost, they were applied at the time set at the rate 18t/ha (Mihara and Fujimoto, 2007) by using CARDI CHEY variety—mung bean variety released by Cambodian Agricultural Research and Development Institute (CARDI) in 2001.

Total experimental site was 310 square meters (31m x 10m). Plots were designed through randomized complete block design (RCBD) consisting of 3 replications with 9 treatments for each block. The space between blocks and treatments was 0.5m. The size of treatment was 3m x 3m, and mung bean was seeded with 30cm spacing in row and 40cm spacing in column.

Data collection

To measure the effectiveness of those fertilizers, indicators such as plant height (cm), total number of pods per plant (number), weight of 1000 seeds (g), and mung bean yield (t/ha) were collected from 15 random plants of each treatment.

Data analysis

Collected data was calculated and determined the significant difference of each treatment by testing analysis of variance (ANOVA) and least significant difference (LSD) by using Microsoft Excel and SPSS software.

Table 1 Result of N P C, and OM analysis of compost

Type of compost	Total N ($x10^{-5}$ kg/kg)	Total P ($x10^{-5}$ kg/kg)	Total OM ($x10^{-2}$ kg/kg (=%))	Total C ($x10^{-2}$ kg/kg (=%))
Conventional compost	263.5	60.2	13.0348	7.2994
Pellet compost	234.3	98.7	11.4161	6.3939
Neem conventional compost	241.3	187.3	20.2767	11.3549
Neem pellet compost	367.2	120.9	13.3969	7.5022

Source: Compost analysis at laboratory of Tokyo University of Agriculture, Japan, 2010

RESULTS AND DISCUSSION

The results of the experiment were summarized in Table 2. There was not a significant difference of plant height ($P>0.05$) among different treatments. Similar to the result of Sithradeth (2008), the experiment on effect of cow manure and N P K application on the same mung bean variety (CARDI CHEY variety), demonstrated that plant height was not significantly different between treatments. Anyway, Table 2 showed that the average plant height of all treatments in which compost was applied were higher than the control, which was the same result of Ungsa (1990-1991), where compost treatments improved agronomic characteristics of mung bean.

Table 2 Results of the experiment

Treatments applied	Plant height (cm)	Total pods per plant (number)	Weight of 1000 seeds (g)	Yield (t/ha)
T_0: Control	64.326	36.42^{c}	75.91^{b}	1.341^{c}
T_1: Conventional compost one week before seeding	65.111	38.85^{bc}	81.21^{abc}	1.598^{bc}
T_2: Pellet compost one week before seeding	64.488	39.62^{bc}	79.62^{bc}	1.703^{b}
T_3: Neem conventional compost one week before seeding	64.400	42.5^{a}	81.04^{ab}	2.056^{a}
T_4: Neem pellet compost one week before seeding	65.133	41.73^{ab}	78.99^{bc}	1.764^{ab}
T_5: Conventional compost while seeding	65.488	40.68^{ab}	83.26^{a}	1.660^{bc}
T_6: Pellet compost while seeding	64.644	38.05^{bc}	78.90^{cd}	1.757^{bc}
T_7: Neem conventional compost while seeding	64.888	40.11^{b}	81.98^{ab}	1.850^{ab}
T_8: Neem pellet compost while seeding	65.911	38.88^{bc}	80.81^{abc}	1.686^{b}
significant difference between treatment	Ns	*	**	*
Coeficient of Variance(C.V=%)	5.94	4.49	2.11	11.94

**= significant difference at P< 0.05, **= significant difference at P< 0.01, ns= Non significant difference*

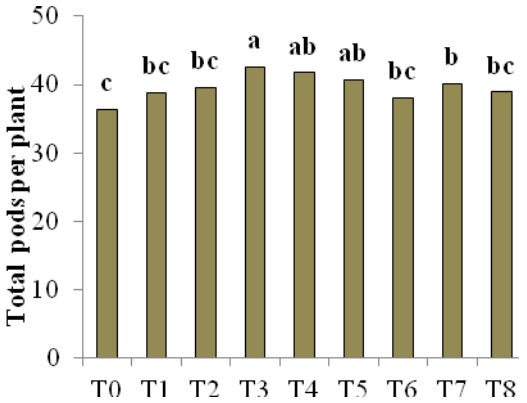

Fig. 2 Total pods per plant of different treatments

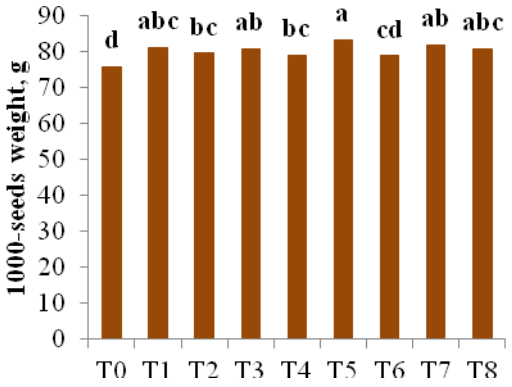

Fig. 3 Weight of 1000 seeds of different treatments

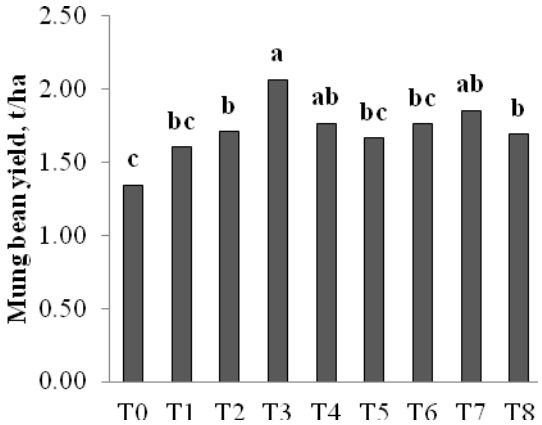

Fig. 4 Mung bean yield of different treatments

Total pods per plant of each treatment was significantly different ($P<0.05$). Treatment applied with neem conventional compost one week before seeding (42.50 pods) had more total pods per plant than the treatment applied with neem pellet compost one week before seeding (41.73 pods). These two treatments applied neem compost; according to the result of N P C and OM analysis of compost (Table 1), neem conventional compost ($P=187.3 \times 10^{-5}$ kg/kg) and neem pellet compost ($P=127.9 \times 10^{-5}$ kg/kg) contained more phosphorus (P) than other composts. Sokha (1997) found that phosphorus was very important for mung bean to improve root growth, and especially phosphorus was very active to make mung bean's flower and pods good. The treatment that had the least pods per plant was the control (36.42 pods) (Fig. 2) and (Table 2). Ungsa (1990-1991) pointed out that compost application could improve the total pods per plant more than control and chemical fertilizer application.

Among all treatments, the highest weight of 1000 seeds was the treatment applied with conventional compost while seeding (83.26 g), then neem conventional compost while seeding (81.98 g), conventional compost one week before seeding (81.21 g), neem conventional compost one week before seeding (81.04 g), neem pellet compost while seeding (80.81 g), pellet compost one week before seeding (79.62 g), neem pellet compost one week before seeding (78.99 g), and the lowest weight of 1000 seeds was the control (75.91 g). There was a significant difference between treatments ($P<0.01$) (Table 2 and Fig. 3).

The treatment that applied neem conventional compost one week before seeding got the highest yield (2.05 t/ha), followed by the neem conventional compost while seeding (1.85 t/ha), neem pellet compost one week before seeding (1.764 t/ha), pellet compost while seeding (1.757 t/ha), pellet compost one week before seeding (1.703 t/ha), neem pellet compost while seeding (1.686 t/ha), and conventional compost one week before seeding (1.598 t/ha). The lowest yield was observed in control (1.34 t/ha). Treatments were significantly different ($P<0.05$) (Table 2 and Fig. 4). Similarly, Ungsa (1990-1991) determined that application of compost increased yield significantly.

CONCLUSION

Based on the above results, applying compost one week before seeding or during seeding had no significant difference. In the case of mung bean yield between treatments of the same organic fertilizers at different timings: conventional compost (T_1) and (T_5), pellet compost (T_2) and (T_6), neem conventional compost (T_3) and (T_7), and neem pellet compost (T_4) and (T_8), had no significant difference in yields. However, the most suitable timing of compost application was one week before seeding due to the higher yield of mung bean than that of mung bean yield with composts applied while seeding. The most suitable compost for mung bean to get higher yield was neem conventional compost (based on comparision of yield got from each treatment).

ACKNOWLEDGEMENTS

Thanks to ERECON for supporting me to learn and practice how to make compost, pellet compost, and other technical knowledge to successfully conduct this experiment. Also, special thanks to Royal University of Agriculture and faculty of Agronomy for supporting and providing many agricultural courses and field experiments.

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