Research article

Incentives of Local Farmers toward Organic Fertilizer Application in Nan Province of Thailand

LALITA SIRIWATTANANON
Association of Environmental and Rural Development, Pathum Thani, Thailand
Email: aerdthailand@hotmail.com

MACHITO MIHARA
Tokyo University of Agriculture, Tokyo, Japan

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Abstract In recent year, many of agricultural and environmental problems occur due to high amounts of agricultural chemical or pesticide applied. The most important step for reducing soil degradation or water pollution is to mitigate nutrient losses from agriculture fields where used to work as non-point sources. For decreasing the amounts of agricultural chemicals, organic fertilizer has been proposed as it may contribute to reduce the expense of agricultural chemicals and to be safe for human health and natural environment. However, it is important to make farmers understand the background of the application of organic fertilizers, such as its benefit or technology, through the demonstration or the training. The studies were conducted to evaluate granular compost application comparing with chemical fertilizer or conventional compost application from viewpoints of reducing soil and nutrient losses under natural rainfall, and of plant growth for 2 cycles of cultivation in agricultural field. The experimental results showed that in the natural rainfall having 14 to 38 mm/hr, the losses of soil, total nitrogen and organic matter from the plot applied granular compost were significantly lower than that from the plot applied chemical fertilizer or conventional compost. Additionally, the results of the 1st cultivation showed that plant length and live weight of the ridge broadcasted granular compost after planting were higher as same as the ridge applied chemical fertilizer. However for the 2nd crop, plant length and live weight of the ridges applied granular compost before or after planting were the highest among all ridges. It means granular compost application is the effective way for decreasing the amounts of soil and nutrient losses from agricultural fields, and for making plants grow efficiently.

Keywords organic fertilizer, granular compost, soil loss, nutrient loss, plant growth

INTRODUCTION

Since 50 years ago, there has been a major change in agricultural sector from small scale farming to larger monoculture for commercials or agro-businesses. Farm productivities have increased dramatically with lager amounts of chemical fertilizers and pesticides applied (Novotny, 1999).

Agriculture fields are recognized as a non-point source of nutrient components, which causes pollution in the water system (Sharpley et al., 1994). Especially, eutrophication occurs when the nutrients in sediments, animal wastes, plant nutrients, crop residues or chemical fertilizer are discharged into the water system by surface runoff or percolation (White and Howe, 2004). Boers (1996) reported that agriculture caused 60% of total nitrogen losses and 40-50% of total phosphorus to the further down water system which were mainly caused by the large amounts of fertilizers used.

Especially, soil erosion is one of the dominate processes discharging nutrients associated with soil particles or organic matters (Correll et al., 1999). Mihara (2001) reported that around 40% of annual nitrogen loads from the vegetable fields were lost by one day typhoon event. Surface runoff with severe soil erosion was the main factor to enhance nitrogen loss from agricultural fields.

So, a strategy to reduce agricultural nutrient losses especially nitrogen and phosphate needs to be implemented where water systems have been identified as at risk or polluted. The most important step in the control of soil degradation or water pollution is mitigating nutrient losses from agriculture fields or non-point sources (Johnes, 1996; Cherry et al., 2008).

The objective of this research is to evaluate granular compost application comparing with chemical fertilizer or conventional compost from a viewpoint of reducing soil and nutrient losses in the field under natural rainfall and plant growth for 2 cycles of cultivation.

RESEARCH METHODS

Soil and nutrient losses under natural rainfall

In the experiment of soil and nutrient losses under natural rainfall, 4 plots (Fig. 1) of 0.8 m wide x 2.5 m long were set up in the agricultural fields of Nan, Thailand. As shown in Table 1, fertilizers of chemical, conventional compost and granular compost were broadcasted in each plot at the same rate of 10.0 g N/m^2. Then, surface runoff occurred by natural rainfall was sampled and the concentration of soil, total nitrogen and organic matters was analyzed. In addition, surface discharge was measured at a certain interval.

Table 1 Soil and fertilizers applied for field experiment at Nan

	Total nitrogen (g/kg)	Organic matter (g/kg)	Soil type
Field experimental soil	0.05	61.3	Light clay
Chemical fertilizer	80	-	-
Conventional compost	10.7	320.9	-
Granular compost	8.83	302.1	-

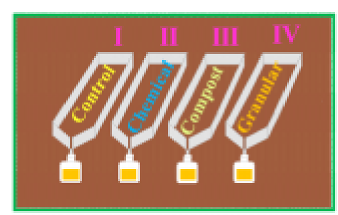


Fig. 1 Field experimental plots

Plant growth for 2 cycles of cultivation

Plant growth for 2 cycles of cultivation was conducted in the agricultural fields of Nan, Thailand for observing the efficiency of plant growth by fertilizers applied. Six ridges (Fig. 2) of 1.0 m wide x 2.0 m long were prepared in the fields and fertilizers of chemical, conventional compost or granular compost was broadcasted in each ridge at the same rate of 10 g N/m^2.

For the 1st cultivation, morning glory (*Ipomoea aquatica*) was planted by seeding at the same amount of seeds in each ridge on 5 July, 2007. After 25 days growing, morning glory was harvested and measured the live length and weight on 30 July, 2007. Then after 4 days of harvested morning glory, the 2nd cultivation of kwang tung (*Brassica juncea* var.) was cultivated at the same soil of six ridges from 3 to 31 August 2007 for 28 days without any fertilizers added. Then plant length and live weight were measured. Plant growth for 2 cycles of cultivation was conducted under natural condition with giving same amounts of irrigation at 5-7 mm/day to every ridge.

- **Ridge 1: no added any fertilizer**
- **Ridge 2: applied chemical fertilizer after planting**
- **Ridge 3: applied compost before planting**
- **Ridge 4: applied compost after planting**
- **Ridge 5: applied granular compost before planting**
- **Ridge 6: applied granular compost after planting**

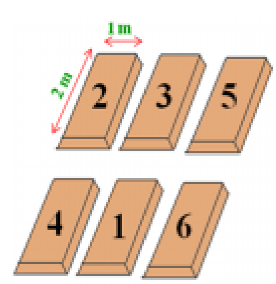


Fig. 2 Six ridges for plant growth experiment

RESULTS AND DISCUSSION

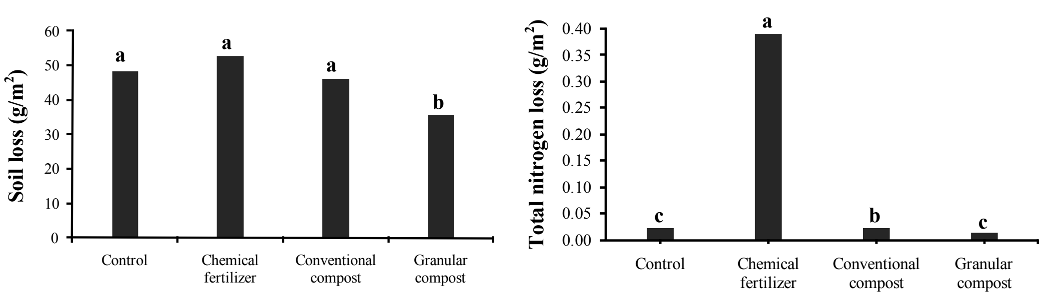
Changes in soil and nutrient losses under natural rainfall

In order to evaluate granular compost application comparing with chemical fertilizer or conventional compost from a viewpoint of reducing soil and nutrient losses under natural rainfall, the experiment was conducted in Nan, Thailand on 24 July 2007.

The water samples of surface runoff from every plot were collected during the time of 5:00 – 7:00 a.m. This rainfall was started from 4:00 a.m. and finished around 8:00 a.m., and had rainfall intensities in the range from 14 to 38 mm/hr.

The losses of soil, total nitrogen and organic matters with surface runoff were measured and compared among the plots without fertilizer (control), with chemical fertilizer, conventional compost and granular compost.

As shown in Fig. 3, soil loss from the plot applied granular compost was significantly lower than that from other plots of control, chemical fertilizer and conventional compost at 95% confidence level based on one-way ANOVA analysis. Additionally, there was no significant different in soil losses among the plots of control, chemical fertilizer and conventional compost. It means that conventional compost was not effective for decreasing soil loss under this natural rainfall.

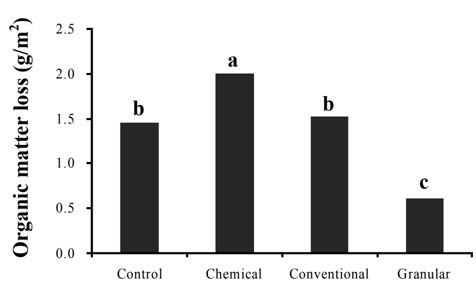


**The data followed by different letters differs significantly at 95% confidence interval based on one-way ANOVA.*

Fig. 3 Soil and total nitrogen losses with surface runoff under the natural rainfall

In case of total nitrogen losses, the results showed that total nitrogen loss from the plot applied chemical fertilizer was significantly higher than that from other plots at 95% confidence level. Additionally, total nitrogen losses from the plot applied granular compost and the plot of control were significantly lower than the plot applied conventional compost at 95% confidence level. So, it showed that total nitrogen in granular compost was not washed off easily by rainfall or surface runoff under the rainfall intensities from 14 to 38 mm/hr.

The results of organic matter losses (Fig. 4) with surface runoff showed the same tendency as soil loss. The loss of organic matters from the plot applied granular compost was significantly lower than that from the plot applied chemical fertilizer or conventional compost at 95% confidence level.



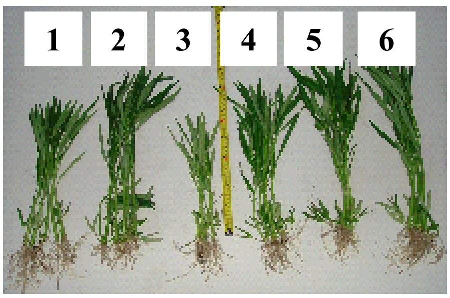
**The data followed by different letters differs significantly at 95% confidence interval based on one-way ANOVA.*

Fig. 4 Organic matters losses with surface runoff under the natural rainfall

Changes in plant growth for 2 cycles of cultivation

The experiment of plant growth for 2 cycles of cultivation was conducted in the agricultural fields of Nan, Thailand for observing the efficiency of fertilizers applied for plant growth. Duration of cultivating the 1st cultivation of morning glory (*Ipomoea aquatica)* was from 5 to 30 July 2007. Then the 2nd cultivation of kwang tung (*Brassica juncea* var.) was cultivated at the same soil without any fertilizers added at six ridges from 3 to 31 August 2007.

Fig. 5 shows the 1st cultivation of morning glory *(Ipomoea aquatica*) and Fig. 6 the 2nd cultivation of kwang tung (*Brassica juncea* var.). The efficiency of fertilizers for plant growth was evaluated by the measurement of plant length and weight.



- Ridge 1: no fertilizer added
- Ridge 2: broadcasted chemical fertilizer after planting
- Ridge 3: mixed compost with soil before planting
- Ridge 4: broadcasted compost after planting
- Ridge 5: mixed granular compost with soil before planting
- Ridge 6: broadcasted granular compost after planting

Fig. 5 First crop cultivation in Nan

- Ridge 1: no fertilizer added
- Ridge 2: no fertilizer added after the 1st crop cultivation
- Ridge 3: no fertilizer added after the 1st crop cultivation
- Ridge 4: no fertilizer added after the 1st crop cultivation
- Ridge 5: no fertilizer added after the 1st crop cultivation
- Ridge 6: no fertilizer added after the 1st crop cultivation

Fig. 6 Second crop cultivation in Nan

The results of plant length for 2 cycles of cultivation were shown in Fig. 7. The 1st cultivation showed that plant length of the ridges broadcasted conventional compost and granular compost after planting was higher than 47 cm, it was similar to the plant length of the ridge applied chemical fertilizer. Plant length of the 1st cultivation from the ridges mixed conventional compost or granular compost with soil before planting tended to be short; it may be affected from releasing rate of nutrients from fertilizers.

There were 2 ways of fertilizations in plant growth experiment, one was applying fertilizers and mixing with soil before planting and the other broadcasting fertilizers after planting. It was considered the nutrient releasing from fertilizers broadcasted after planting was higher than that mixed with soil before planting. So, plant growth in the ridges broadcasted fertilizers may be advanced more than that in the ridges mixed fertilizers with soil.

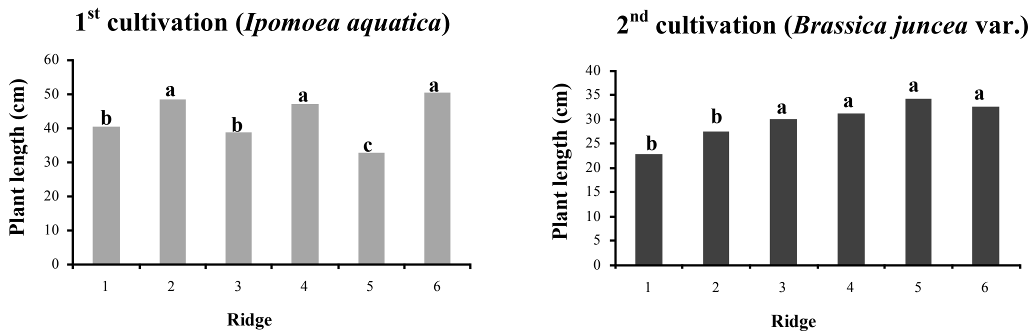
However for the 2nd cultivation, plant length of the ridges applied conventional compost before and after planting or applied granular compost before and after planting was significantly higher than that of the ridge applied chemical fertilizer at 95% confidence level.

Additionally, the 1st cultivation showed that plant weight (Fig. 8) of the ridges broadcasted granular compost after planting was 16 g heavier, and there was no significant different with plant weight of the ridge broadcasted chemical fertilizer at 95% confidence level. However, in the 2nd cultivation, plant weight of the ridge applied chemical fertilizer was the lowest among all ridges. Conversely, plant weight of the ridges applied granular compost before and after planting was significantly higher than that of all other ridges at 95% confidence level.

Discussion from soil and nutrient losses and plant growth

Granular compost application was compared with chemical fertilizer or conventional compost application from a viewpoint of reducing soil and nutrient losses under natural rainfall in the selected agricultural field of Nan province, Thailand. The rainfall intensities of field experiment were from 14 to 38 mm/hr at 30 minutes interval. But during the natural rainfall, there were high intensities beyond 50 mm/hr for several minutes. So, other areas having different rainfall intensities, the results of soil and nutrient losses may be difference.

Additionally, plant growths for 2 cycles of cultivation were conducted in the field of Nan province, Thailand. The types of vegetables applied in this research were popular and suitable for evaluating the fertilization effects within a few months. The results showed that conventional compost or granular compost broadcasted after planting was effective not only for the 1st cultivation but also for the 2nd cultivation. It was considered that the way of fertilization affects to the processes of decomposing and releasing nutrients. Generally, there may be 2 types of decomposing processes. One is the physical process advanced by slaking, shearing force of flowing water or impact of raindrop, and the other is the biological process by microorganism which is mainly inorganic process including nitrification.

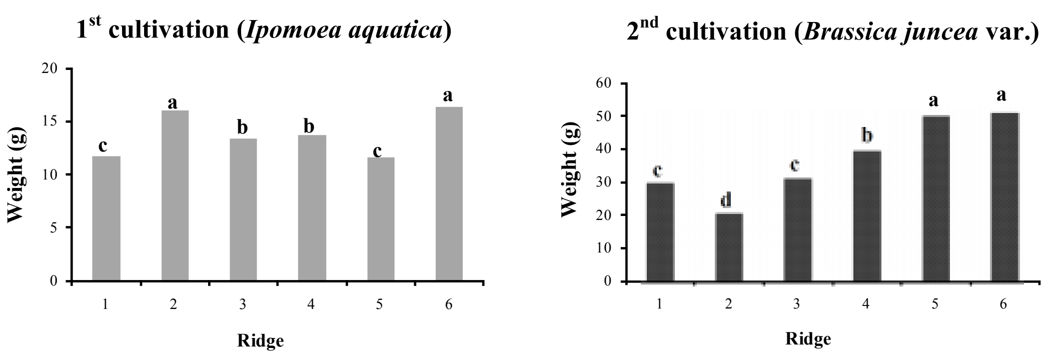


The data followed by different letters differs significantly at 95% confidence interval based on one-way ANOVA.

- Ridge 1: no fertilizer added
- Ridge 2: broadcasted chemical fertilizer after planting
- Ridge 3: mixed compost with soil before planting
- Ridge 4: broadcasted compost after planting
- Ridge 5: mixed granular compost with soil before planting
- Ridge 6: broadcasted granular compost after planting

- Ridge 1: no fertilizer added
- Ridge 2: no fertilizer added after the 1st crop cultivation
- Ridge 3: no fertilizer added after the 1st crop cultivation
- Ridge 4: no fertilizer added after the 1st crop cultivation
- Ridge 5: no fertilizer added after the 1st crop cultivation
- Ridge 6: no fertilizer added after the 1st crop cultivation

Fig. 7 Plant length for 2 cycles of cultivation



The data followed by different letters differs significantly at 95% confidence interval based on one-way ANOVA.

- Ridge 1: no fertilizer added
- Ridge 2: broadcasted chemical fertilizer after planting
- Ridge 3: mixed compost with soil before planting
- Ridge 4: broadcasted compost after planting
- Ridge 5: mixed granular compost with soil before planting
- Ridge 6: broadcasted granular compost after planting

- Ridge 1: no fertilizer added
- Ridge 2: no fertilizer added after the 1st crop cultivation
- Ridge 3: no fertilizer added after the 1st crop cultivation
- Ridge 4: no fertilizer added after the 1st crop cultivation
- Ridge 5: no fertilizer added after the 1st crop cultivation
- Ridge 6: no fertilizer added after the 1st crop cultivation

Fig. 8 Plant weight for 2 cycles of cultivation

CONCLUSION

This research dealt with the evaluation of granular compost application comparing with chemical fertilizer or conventional compost application from viewpoints of reducing soil and nutrient losses under natural rainfall and of plant growth for 2 cycles of cultivation.

The results showed that in the natural rainfall having 14 to 38 mm/hr, the losses of soil, total nitrogen and organic matter from the plot applied granular compost were lower comparing with that from the plot applied chemical fertilizer or conventional compost. Additionally, the 1st cultivation from 5 to 30 July 2007 showed that plant length and live weight of the ridge broadcasted granular compost after planting were same as that of chemical fertilizer. However for the 2nd cultivation from 3 to 31 August 2007, plant length and live weight of the ridges applied granular compost before or after planting were the highest among all ridges. It means chemical fertilizer application was effective for plant growth in a short time, less than around 30 days, but it did not sustain more than the period.

According to the experimental results, it was concluded that chemical fertilizer or granular compost broadcasted after planting were the most effective for getting higher yields in the crop cultivation within 30 days. In case the duration of crop cultivation would be more than 30 days; granular compost applied either before or after planting was the most effective.

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