Effect of selected organic sources on growth and yield of different maize (*Zea mays* L.) varieties in sandy regosol of Batticaloa district

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Introduction

The increased cost and ill effects on the environment and human being by using inorganic fertilizers have directed attention towards the use of organic manures, recently. Demand for organic agricultural products is rising in Sri Lanka due to attitude change of the people on health and environmental aspects. The increased demand for organically grown products urges scientists to disseminate knowledge to farmers. Maize is a popular coarse grain crop in Sri Lanka, grown in the second highest extent of land next to rice. Maize has a demand in foreign countries as it is used as a raw material in various industries. *There is an* increasing demand for exporting organically grown products **including maize in Sri Lanka**. In this situation, organically produced maize would gain more attraction from foreign consumers. Organic manures such as compost, cowdung etc. provides many advantages; improving soil tilth, aeration, water holding capacity and stimulating microorganisms in the soil that makes nutrients readily available (Lal, 1997) for plant absorption. However, there seems to be little use of organic manures island wide, and there is lack of knowledge on the effect of different manures on crop production. More information in relation to the use of organic manures is needed to educate the farmers. Hence, this research was carried out to evaluate the effects selected organic sources on growth and yield of maize varieties in sandy regosols of Batticaloa district and to select best manure for organic maize cultivation.

Methodology

The experiment was conducted at the crop farm of the Faculty of Agriculture, Eastern University, Sri Lanka, Vantharumoolai. The soil type is sandy regosols (according to soil taxonomy) and the experiment was conducted during June to September (*Yala* season) 2013. Varieties of maize and different organic sources were arranged factorially. The experimental design was randomized complete block design with three replications having following treatments:

F1V1 –Recommended dosage of inorganic fertilizers + Var. *Bhadr*a (Control)
F1V2 –Recommended dosage of inorganic fertilizers + Var. *Pacific* 984 (Control)
F2V1 - Cowdung at the rate of 20 t ha^{-1} + Var. *Bhadr*a
F2V2 - Cowdung at the rate of 20 t ha^{-1} Var. *Pacific* 984
F3V1 – Compost at the rate of 20 t ha^{-1} + Var. *Bhadr*a
F3V2 – Compost at the rate of 20 t ha^{-1} Var. *Pacific* 984
F4V1 – Glyricidia (*Gliricidia sepium*) fresh leaves at the rate of 20 t ha^{-1} + Var. *Bhadr*a
F4V2 – Glyricidia fresh leaves at the rate of 20 t ha^{-1} Var. *Pacific* 984
F5V1 – Liquid organic mixture once a week + Var. *Bhadr*a
F5V2 – Liquid organic mixture once a week + Var. *Pacific* 984

All the organic manures were applied as basal dressing except liquid organic mixture. Liquid organic mixture (Jeewamirta) was prepared using 10 kg of cowdung, 10 L of indigenous cow urine, 2 kg of jaggery, 2 kg of pulse powder and handful of farm soil (ingredients for one acre). All six ingredients were mixed in a plastic barrel and stirred well. Then, the barrel was covered with gunny mat and placed under shade. Mixture was stirred clockwise twice a day in order to accelerate the microbial activities. The prepared Jeewamirta was applied after three days of

fermentation. Jeewamirta was diluted 10 times with water before the application. Plants were arranged at a spacing of 60 cm × 30 cm and one plant per hill. All other management practices were followed uniformly to all treatments. Destructive sampling method was practiced and samples were selected randomly for measurements. Growth parameters *viz*. plant height (cm), leaf area (cm^2), and plant biomass (g) were measured at monthly interval and seed yield (kg ha^{-1}) was recorded at the end of the experiment. Statistical analysis were performed using analysis of variance (ANOVA). Means of values were subjected to Duncan's multiple range test (DMRT) at 0.05 probability level.

Results and Discussion

It was found that there were significant ($p<0.05$) differences between the treatments in the measured parameters *viz*. plant height, leaf area, biomass and yield. However, the interactive effect of the maize varieties and manures on the measured parameters was not significant ($p<0.05$) (Table 1). In all measured parameters maize varieties grown with recommended dosage of inorganic fertilizers (F1) showed significantly ($p<0.05$) higher performance than other treatments tested. It was also observed that, there was no significant ($p<0.05$) difference between the plots amended with recommended dosage of inorganic fertilizers (F1) and Glyricidia leaves at the rate of 20 t ha^{-1} (F4).

Table 1. Effect of different organic inputs on the growth of maize varieties at two months after planting.

Fertilizers	Variety	Plant height (cm)	Leaf area (cm^2)	Biomass (g)
F1	V1	188.67^{ab}	4932.28^{a}	291.65^{a}
	V2	183.67^{ab}	3942.70^{b}	208.39^{ab}
F2	V1	162.33^{bc}	2514.63^{cd}	77.85^{c}
	V2	141.33^{c}	2385.87^{d}	101.92^{c}
F3	V1	166.67^{bc}	3356.21^{bc}	158.52^{bc}
	V2	138.67^{c}	2330.30^{d}	105.75^{c}
F4	V1	206.33^{a}	3648.31^{b}	257.55^{a}
	V2	192.00^{ab}	3824.47^{b}	258.22^{a}
F5	V1	143.67^{c}	1723.75^{d}	126.99^{bc}
	V2	167.00^{bc}	2531.87^{cd}	89.28^{c}
P value	Fertilizers	0.0011	0.000	0.000
	Varieties	0.2325	0.2134	0.1859
	Interaction	0.2432	0.0206	0.3608
F value		*	*	*

Value represents mean of three replicates. * represents significant at $p<0.05$. Means followed by the same letter in each column are not significantly different according to DMRT at 0.05 probability level.

The highest seed yield was produced by treatment F1V1 followed by F4V1 and F4V2 with the values of 5493.9 kg ha^{-1}, 5373.0 kg $ha^{-1}$and 5228.5 kg ha^{-1} respectively. However, there were no significant differences between treatments F1V1, F1V2, F4V1 and F4V2 in seed yield (Fig. 1). All the other treatments produced lowest yields. It may be due to delayed release of nutrients by other organic manures.

In this experiment, application of fresh Glyricidia leaves significantly ($p<0.05$) increased the growth and yield of maize varieties than other organic manures. The maize plants treated with Glyricidia leaves showed almost equal performance in growth and yield to plants which

received recommended dosage of inorganic fertilizers. Liyanage (1987) reported that, Glyricidia is an excellent organic fertilizer with high nutrient content. Several studies (Kidd and Taogaga, 1985; Budelman, 1989 and Gonzal and Raros, 1988) showed that, addition of Glyricidia leaves as green manure increases growth and yield of many crops.

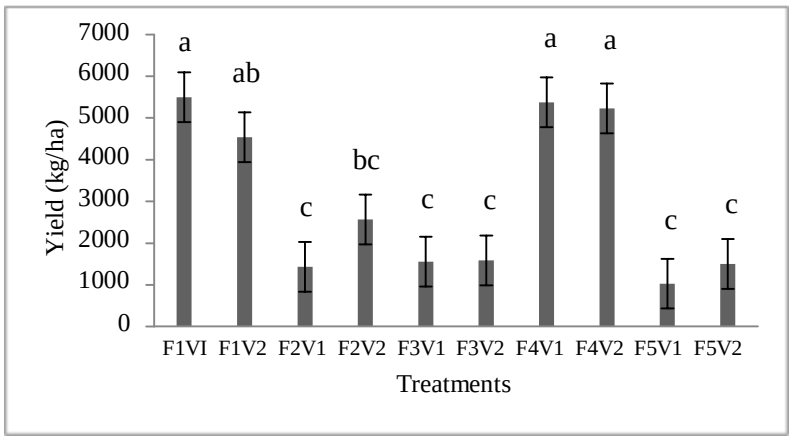

Figure 1. Effect of different organic sources on the mean seed yield of maize varieties. Bars on the graph with same letter are not significantly different according to the DMRT test at 5% level of probability.

Nitrogen influences the vegetative growth of plants. Boroujerdnia and Ansari, (2007), pointed out that, application of nitrogen fertilizer stimulates vegetative growth by increasing the number of leaves and leaf area (LA). Glyricidia consists of high amount of nitrogen. Patil (1989) reported that one ton dry weight of Glyricidia leaves was equivalent to 27 kg of Nitrogen. Green manures have low C:N ratio and release nitrogen quickly. The higher nitrogen content and rate of release of Glyricidia leaves may have increased the growth of maize varieties. It could be the reason for highest LA produced by the Glyricidia leaves treated plants. LA is the most important photosynthesis acceptor and varies among cultivation practices (Bavec *et al*., 2007). LA greatly influences the rate of photosynthesis and accumulation of plant biomass. Hence, in this experiment, highest biomass was produced by maize varieties subjected to treatment with Glyricidia leaves at the rate of 20 t ha $^{-1}$ (F4).

Biomass accumulation has considerable direct effect on grain yield. Plants subjected to inorganic fertilizer and Glyricidia leaves treatments produced highest LA and biomass during reproductive stage (Table 1). A proportion of biomass is subsequently remobilized to the reproductive organs (Yan and Wallace, 1995). LA of maize also has strong correlation with yield (Bavec and Bavec, 2002). Therefore, increased biomass accumulation and LA would have contributed for the highest yield produced by the plants which received Glyricidia leaves at the rate of 20 t ha $^{-1}$ (F4). These may be the possible reasons for highest yield produced by the plants subjected to treatments with recommended dosage of inorganic fertilizers (F1) and Glyricidia leaves at the rate of 20 t ha $^{-1}$ (F4).

Conclusions

In this experiment, maize varieties received fresh Glyricidia leaves as organic manure showed higher plant height, leaf area, biomass accumulation and seed yield. Further, there was no significant difference between the plants treated with fresh Glyricidia leaves and recommended dosage of inorganic fertilizers in measured growth and yield parameters. Fresh Glyricidia leaves

at the rate of 20 t ha $^{-1}$ could be used as organic manure for maize cultivation in the sandy regosols of Batticaloa district, Sri Lanka.

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