

APPLICATION METHOD OF GREEN MANURES AFFECT ROOT DEVELOPMENT OF FIELD GROWN MAIZE AND MUNGBEAN IN TROPICAL MINOR SEASONS

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ABSTRACT

A field experiment evaluated the impact of two green manures (leaves of *Gliricidia sepium* or *Tithonia diversifolia*) on root development characteristics of maize (*Zea mays*) and mungbean (*Vigna radiata*). The organic matter was either incorporated 14 days prior to planting or placed on the surface at planting. The root length densities (RLD) and root weight densities (RWD) were determined upto a depth of 60 cm at 30 days after planting and the final yields of crops and N contents of seeds and residues. Incorporation of organic matter stimulated root development, especially the RLD, N use efficiency (NUE) and seed yields. *Tithonia* promoted root growth to a greater extent and the beneficial effect was greater on roots of maize than in mungbean. Incorporation also enhanced NUE and seed yields irrespective of the green manures.

KEYWORDS: Green manures, Placement, Root growth, Tropics

1. INTRODUCTION

Degraded tropical soils are generally cultivated by smallholders and obtain under marginal conditions. Thus sustaining productivity is vital in these systems and green manuring is a very useful method for developing soils and also possibly to mitigate global warming (Tejada et al, 2008). Although legume species are considered the most beneficial to provide N, the most limiting source of nutrients in tropical soils (Nakhone and Tabatabai, 2008), there are species such as *Tithonia diversifolia*, which are used successfully for these species. Their use promotes growth of tropical crops as shown in pot experiments (Sangakkara *et al.* 2004). As field studies have not shown their impact on root development and N use patterns as affected by method of addition, a project evaluated the benefits of surface application or incorporation of two green manures (*Gliricidia sepium* and *Tithonia diversifolia*) on root development of maize (*Zea mays* L) and mungbean (*Vigna radiata*) at 30 days after plant establishment

2. METHODOLOGY

The field studies carried at the University of Peradeniya, Sri Lanka in 2005, used plots of 4 x 4 m to plant the two crops after the application of the leaves of the two green manures at a rate equivalent to 6 mt/ha to the selected plots and incorporated to a depth of 30 cm manually or placed on the surface. Uniform seeds of the two species were planted in all plots 14 days later and managed as per recommendations for Sri Lanka. At 30 days after planting, soil cores were taken upto 60 cm depths in subsections of 0 – 20, 20 – 40 and 40 – 60 cm in all plots in subunits, and roots washed to determine RLD and RWD as described in Table 1. N contents and seed yields were determined at crop maturity and NUE determined. The data was subjected to appropriate statistical analysis to determine treatment differences.

3. RESULTS AND DISCUSSION

Green manures had a similar impact on RLD and RWD (Table 1, incorporation enhanced root extension and dry matter accumulation. Growth of maize roots were enhanced to a greater extent due to its fibrous nature, especially by *Tithonia*. Surface placement enhanced root development in the surface layer of soil and incorporating promoted deeper penetration. The interaction of the treatments were also significant except in the RWD of mungbean.

Table 1 Impact of method of addition of green manures on root growth parameters of maize and mungbean in a minor season

Green manure	Method of addition	Maize		Mungbean	
		RLD (cm.cm ⁻³)	RWD(mg.cm ⁻³)	RLD(cm.cm ⁻³)	RWD(mg.cm ⁻³)**
Tithonia	Surface placement	3.98	0.39	3.19	0.48
	Incorporation	4.29	0.43	3.46	0.52
Gliricidia	Surface placement	3.52	0.34	2.96	0.42
	Incorporation	3.94	0.32	3.08	0.47
Control		3.18	0.29	2.88	0.38
Probability (P= 0.05)	Green manure	0.028	0.037	0.041	0.022
	Addition	0.030	0.019	0.024	0.038
	Interaction	*	*	*	NS

** Root characteristics are based on means values obtained after sampling at 0 – 20, 20 – 40 and 40 – 60 cm depths
RLD and RWD values calculated as RLD (cm.cm⁻³) = Total length in a soil core/ Volume of core
RWD (mg.cm⁻³) – Total dry weight of roots in core/Volume of core.

Placement of green manures stimulated root expansion rather than dry matter accumulation, as shown by the increments in RLD and RWD. This could be related to the improvement of soil properties by green manures as shown by Sangakkara *et al* (2004) in pot trials.

Tithonia promoted root development to a greater extent than the legume due to its ability to provide phosphorus to crops and supports the pot study by Sangakkara *et al* (2004). The nitrogen supplied by *Gliricidia* would promote shoot development. While data on N use efficiencies (NUE%) and seed yields are not presented, the correlations between NUE and RLD and RWD for maize were 0.79** and 0.58* for maize and 0.64* and 0.59* for mungbean respectively. The correlations between RLD and RWD with seed yields for maize were 0.74** and 0.61* while for mungbean they were 0.62* and 0.52* respectively. This implied the benefits of green manuring on N uptake and also seed yields, although incorporation of the material irrespective of source had a greater impact (data not shown). Thus farmers in the tropics cultivating crops on marginal soils need to be encouraged to apply green manures especially *Tithonia*, and preferably incorporate it prior to planting to stimulate root development, especially in dry seasons when crops are possibly subjected to moisture stress. Thus, to promote higher yields, incorporation of any type of green material is the better option, rather than surface placement.

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