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A Comparison of strategies for weed management in nature farming

RAVI SANGAKKARA[1], PRASANNA AMARASEKERA, SIRIL BANDARANAYAKE

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Abstract

Mulching or growing crop in-between rows of the principal crop offers scope as a means of protecting soil and suppressing weeds in Nature Farming systems. Thus, field studies evaluated the impact of either a mulch or growing two intercrops as possible management strategies for controlling weeds of vegetables grown in major and minor seasons of the tropics under a Nature Farming regime. All three strategies controlled weed numbers and weed biomass while increasing crop yields. However the least beneficial impact was from the dead leaf mulch, while the highest degree of weed control and increments in crop yields was with the green manure intercrop. The effects of these regimes were also greater in the drier season, where weed populations are higher. The potential of these three strategies for weed management in Nature Farming or organic systems are presented on the basis of these results.

Introduction

Weeds are a primary problem in organic cropping, especially in upland crops (Anderson, 2010), and their successful management is difficult, which is a constraint for obtaining optimal yields (McDonald, 2011). The problem of weeds is greater in tropical upland smallholder systems, as the weed species are generally more aggressive than crops, especially in low fertility soils and also in dry seasons (Liebman and Davies, 2000; Major *et al.,* 2005). Thus integrated management of these weeds is vital for successful organic cropping, while maintaining soil fertility and quality to optimize productivity.

Mulching and intercropping organic crops offer possible solutions to reduce weed populations in organic systems (Sangakkara *et al.,* 2011). In Nature Farming, where low external input organic systems are developed to conform to nature's principles, as per guidelines of Mokichi Okada, both practices can be facilitated as there are minimal inputs from external sources (Amano, 2011). However the type of mulch and the intercrop could affect crop yields and the best possible intercrops need to be evaluated to optimize crop production. A field study thus studied the role of mulching with grass leaves obtained from the ecosystem, and intercropping with either a species giving a harvestable product (*Phaseolus* beans) or a green manure (sun hemp *Crotolaria juncea*), in managing weed populations and on yields of common tropical crops in a system managed as per guidelines of Nature Farming, over a major (wet) and minor (dry) tropical season.

Material and methods

Experiments were carried out in 2010/11 at a farm in the intermediate zone of Sri Lanka, located on a Ultisol having the following soil fertility parameters: - (pH (1:2.5 H_2O) 5.8, Organic C $g.kg^{-1}$, 5.55; N $mg.kg^{-1}$12.1, Exchangeable K 244 $g.kg^{-}$1.The rainfall received at the site was 1677 mm (70% in the major season October - December) and the mean temperature ranged between 28 – 31^{o}C over the period of study.

In September of 2010, prior to the onset of the major season, land was tilled and 32 plots, with dimensions of 3 x 3 m were prepared to accommodate 8 treatments in 4 replicates. At first, Compost (Bokashi) was prepared with chicken manure, green leaves and rice husk (C:N ratio18.4), inoculated with a diluted solution of Effective Microorganisms (EM). This was added to each plot at a rate of 200 $g.m^2$, and mixed. After 5 days, uniform 20 day old seedlings of tomato (*Lycospersicon esculentum* - variety Thilina) or seeds of long beans (*Vigna unguiculata* subspp. *sesquipidales*) were planted as per local recommendations in the plots in each replicate. Soon after crop establishment, the inter rows were supplied with a mulch using grass leaves or planted with seeds of *Phaseolus* beans (bush beans) or sunhemp.The plant material was incorporated into the soil at the time of flowering in the two main crops, which also corresponded to the harvest of pods in the intercropped *Phaseolus* beans. There was a control treatment having only the two vegetable species without a mulch or intercrop. Thus there were 8 treatments, i.e. two crops and four mulching/intercrop

1. [1]Faculty of Agriculture, University of Peradeniya, Sri Lanka Email ravisangakkara@sltnet.lk

treatments. The same process was adopted using Capsicum (*Capsicum annum* variety MI1) and mungbean (*Vigna radiata* variety MI 5), in the minor season (April – August), where planting was carried out in late April.

In both seasons, the crops were sprayed with EM at a dilution of 1: 250 litres of water to wet the plants at two weekly intervals. Weed numbers and dry weights were recorded on three occasions using a 50 x 50 cm quadrat. Crop yields were recorded at harvest and the data analysed using a GLM procedure for a Randomized Complete block design with four replicates per season.

Results and Discussion

The adopted management strategies had a significant impact on weed numbers and dry weights (Table 1), especially in the minor dry season, when the weed population was greater. The use of a mulch had the least beneficial impact on weed numbers as the decay of organic matter, especially with the use of EM, enabled weeds to emerge, in contrast to a live mulch (Erenstein, 2003). The bean crop, which produced an economic yield in terms of fresh pods, had a marginally greater beneficial effect in lowering weed numbers when compared to the mulch, due to its presence for a longer period. The best impact of weed management was with the live green manure, sunhemp, which shaded the ground (80%) within 4 weeks after planting the crops, thus reducing weed numbers significantly. The impact of all three management systems were also greater in the dry season, emphasising the value of these strategies for weed control, which is a major problem in Nature Farming, in such seasons.

The dry weights of weeds also followed that of weed numbers, which illustrated that the presence of a mulch or growing of a live mulch crop in-between the principal crop not only reduced weed numbers but also the growth of these unwanted plants, thus lowering their competitive ability.

Table 1. Weed populations in wet and dry seasons as affected by intercropping practices

Management strategy	Weed dynamics			
	Major (Wet) season		Minor (Dry) season	
	Weeds.m^2	Dry matter g.m^2	Weeds.m^2	Dry matter g.m^2
Mulch	15	4.55	18	5.89
Bean intercrop	17	4.18	24	7.04
Sun hemp intercrop	9	2.15	13	4.67
Control	28	8.32	37	10.25
Probability	0.024	0.043	0.008	0.038

Table 2. Crop yields in Nature Farming as affected by weed management strategies in wet and dry seasons

Management strategy	Crop Yields (g.m^2)			
	Major (Wet) season		Minor (Dry) season	
	Tomato fruits	Long Beans Fresh pods	Capsicum Fresh pods	Mungbean seeds
Mulch	522	1378	712	85
Bean intercrop	485	1455	885	74
Sun hemp intercrop	588	1985	935	99
Control	258	988	357	43
Probability	0.014	0.335	0.007	0.029

Crop yields of all species were benefitted by the adopted management strategies (Table 2), and again the beneficial impact was greater in the dry season. In all crop species, the yields were increased by some 100% due to the mulch, and the productivity of these crops were further enhanced by the other two management strategies. However, as in numbers of weeds, the impact of the bean intercrop was marginally greater on the main crops than the impact of the dead mulch. In the minor season, the bean crop reduced the yields of mungbean when compared to the dead mulch. This is due to the fact that mungbean is also a leguminous species, with the same stature and growth duration as *Phaseolus* beans, thus causing greater competitive effects. In contrast, sunhemp had the best beneficial effect on the harvested main crop, which could be attributed to lower weed populations and the nutritional benefits of this green manure crop being incorporated when compared to the grass mulch or bean crop residue which have higher C: N ratios (Data not presented). This implied that for weed management in Nature Farming, a green manure crop has a dual advantage of suppressing weeds and also as a source of organic matter when incorporated at the time of flowering of the main crop. The benefits of this strategy are greater in the drier minor season. Furthermore, in growing an intercrop, attention needs to be paid to the selection of the crop, as species with similar growth habits could reduce yields of the main crop as seen with mungbean and *Phaseolus* beans. The only advantage of such a system is the yield of the bean crop which is not found in a pure green manure crop such as sun hemp.

Conclusion

Weeds are a major problem in either Nature Farming or conventional Organic Farming and their control is essential for high yields. Mulching with dead or live material offers a possibility and the results illustrate the benefits of a green manure such as sunhemp to control weeds in both major and minor seasons, and the impact is especially greater in the latter season. Using live mulches with a harvestable product offers less scope for controlling weeds although it could provide a harvest which could bring an income. The use of a dead mulch was the least effective among the tested management strategies. Thus, as advocated by the founder of Nature Farming, Mokichi Okada, the use of live mulched offer a good management strategy for controlling weeds and increasing yields of Nature Farming units.

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