EFFECT OF MULCHING ON WEED INFESTATION IN RICE

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INTRODUCTION

Because of limited land availability in the irrigated plains, rice production in the lake Alaotra region has been expanded on the rainfed areas. These areas are generally characterized by low crop productivity. Soils have low fertility and are prone to erosion. Furthermore, weed infestation is a major problem on these lands, especially for farmers who cannot afford to buy herbicides. Conservation Agriculture (CA) has been introduced in Madagascar in the late 90s to improve productivity of rainfed agriculture. CA cropping systems are based on three principles: a) minimum soil disturbance, (b) permanent soil cover through mulching with crop residues and (c) crop rotations or associations (FA0, 2014). One of the functions of mulching is to control weed emergence and growth. It has been reported that the efficiency of weed control through mulching depends on the type of crop residues, its quantity and the weed species (Teasdale & Mohler, 2000). In this study we determined the effects of different amounts of surface crop residues of *Stylosanthes guianensis* (S) and *Dolichos lablab* in association with maize residues (M+D) on weed emergence and growth in a rice crop.

MATERIALS AND METHODS

The study was carried out during the 2013-2014 growing season at the CALA-FOFIFA research station located at Ambohitsilaozana (17°30'S; 48°30'E, 760 m asl) near the city of Ambatondrazaka in Madagascar. The region is characterized by a tropical climate, Cwa (Köppen classification) with a mean annual temperature of 22°C. Annual average rainfall (2004 to 2014) is 972 mm. The soil of the experimental field is a Ferralsol (FAO classification).

The experimental design was a split-plot with four replications, with type of surface crop residues as main treatment and amounts as sub treatments. . Two types of residues were used: *S. guianensis* (S) and maize in association with *D. lablab* (M+D). For each type, five amounts were applied on 5th November 2013 before seeding of a rice crop: 0, 0.9, 3.2, 12 and 18.3 t/ha for S mulch and 0, 1.4, 4.8, 18.4 and 27.5 t/ha for M+D mulch, resulting in 0, 30, 70, 99 and 99.9 % soil cover for both types of residue. Each subplot measured 4 m² (2 m x 2 m)

The B22 rice variety was hand-sown under no-till on 6th December 2013. All plots were fertilized with 150 kg ha^{-1} of NPK (11:22:16) and 5 t ha^{-1} of farmyard manure at seeding and 50 kg ha^{-1} of urea (46 % N) after the first (7th January 2014) and second weeding (30th January 2014).

Weed emergence was measured on a 0.5 m x 0.5 m quadrate in each subplot. Emerged seedlings were counted and removed from the plot every week during the rice growing season.

Weed biomass measurements were taken at four dates during the cropping season, before weeding. Weed dry matter was determined by cutting the weeds in a 1m x 1m quadrate, drying the samples at 70°C for 48 hours and weighting. Rice grain was harvested at maturity on the 4 m² subplots and measured to determine yield on a hectare basis.

RESULTS AND DISCUSSION

Weed emergence

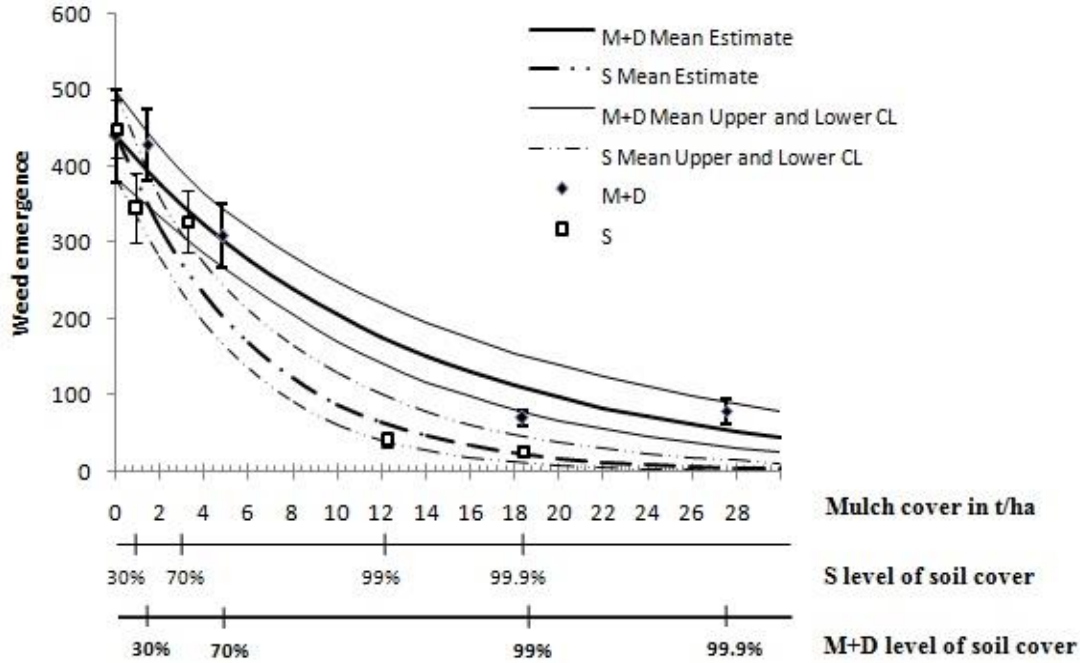

Figure 1: Effect of type and amount of surface crop residues on weed emergence. M+D: Maize + *D. lablab* mulch; S: *S. guianensis* mulch; (♦;□) experimental data (lines) mean estimate using an exponential function with 95% lower and upper confidence limits.

Weed emergence declined exponentially with increasing amounts of surface crop residues for the two types of residues (Figure 1). The number of emerged weeds was twice smaller in mulched plots than in non-mulched plots, when mulch quantities reached 9.2 t/ha (M+D) or 4.3 t/ha (S), corresponding to about 80% soil cover.

Our results were in accordance with findings of Teasdale (2000) and Peachey (2004) who also observed a strong relationship between weed emergence and soil cover by surface residues. Surface crop residues interfere with the establishment of weeds by physically impeding their emergence and creating unfavorable soil conditions (Bilalis et al, 2003; Teasdale & Mohler, 2000). On the other hand, it has also been observed that partially covered soil can promote emergence of weed as a result of increased moisture in the topsoil layer.

Weed biomass

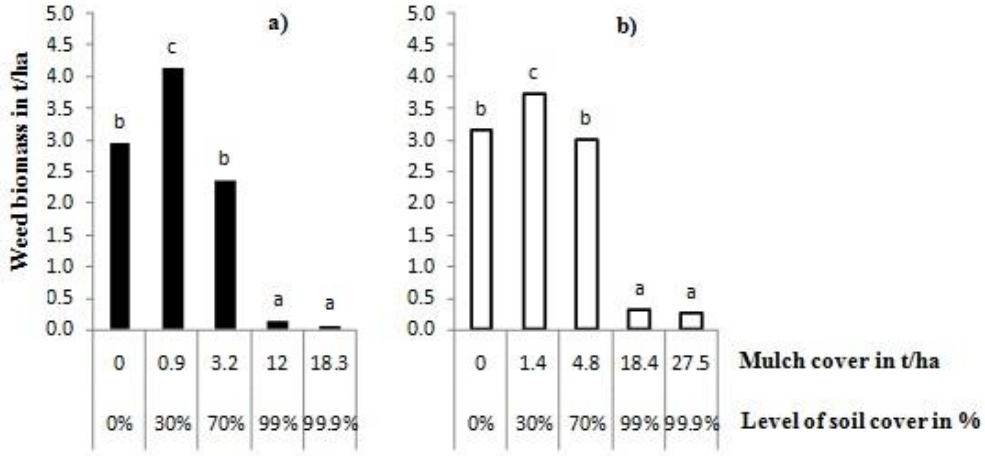

Figure 2: Effect of different levels of surface crop residues on total weed biomass (DM) from 4 weeding activities for two types of crop residues: a) *S. guianensis* and b) M+D. maize + *D. lablab*.

Weed biomass varied depending on the level of soil cover. Weed growth was drastically reduced with residues amounts of 12 t/ha or larger for S and 18.4 t/ha or larger for M+D, corresponding to 99 % of soil cover. With a soil cover of 99% weed biomass was reduced to 4 % and 10 % of the non-mulched treatments, respectively for S and M+D

Low amounts of surface crop residues did not affect or even increased weed growth. 30% of soil cover increased weed biomass compared to uncovered soil, whilst with 70% of soil cover weed biomass was similar as that of uncovered plots These results suggest that partially covered soil promotes weed growth. This may be explained by more favorable soil moisture conditions (Teasdale 2000) or higher soil fertility with crop residue mulching (Murungu et al, 2010). Complete soil cover was required to effectively control weed growth.

Rice yield

Rice grain yield increased with the amount of S residues, whilst no differences in yield were observed with M+D mulch. Treatments with 12 t/ha of S mulch or more increased significantly rice yields compared to treatments with lower S mulch amounts and treatments with M+D mulch (Fig. 3). Effects of surface crop residues on crop yield may be explained by improved soil moisture and/or plant nutrient availability.

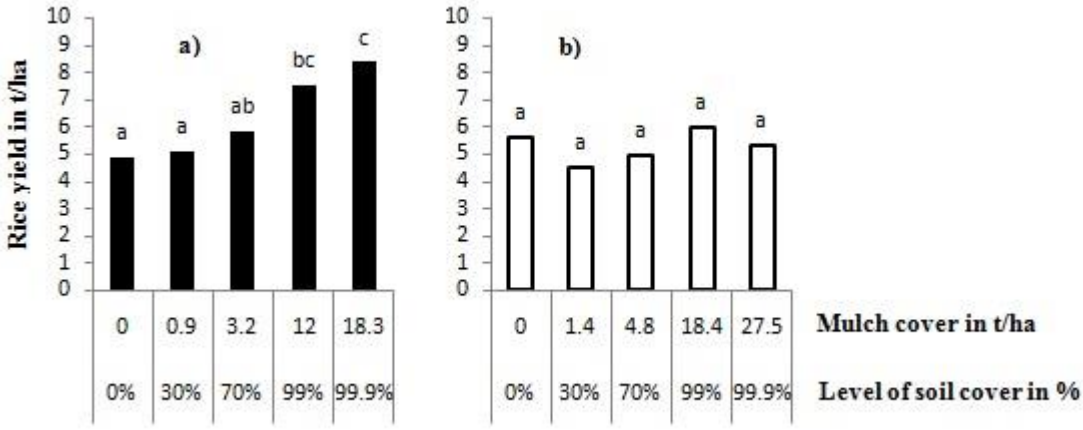

Figure 3: Effect of surface crop residues on rice grain yield for two types of crop residues: a) *S: guianensis* S and b) M+D. maize + *D. lablab*.

CONCLUSIONS

The results of this study demonstrate that the effectiveness of surface crop residues in weed control is highly dependent on the level of soil cover. A high level (> 80%) of soil cover is required to have a significant effect on weed emergence and growth in rice. Low soil cover tends to increase weed competition. The weed growth effect of mulching only explains partially the effect of surface crop residues on rice grain yield.

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