Research Note

WEED SUPPRESSION AND SOIL EROSION CONTROL BY LIVING MULCHES ON UPLAND COFFEE PLANTATIONS[1]

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Weeds are the most expensive pests to control on coffee plantations (Liu et al., 1993). Complete weed control by hand weeding and herbicides usually results in bare ground areas that tend to promote or increase soil erosion, reducing soil fertility and crop productivity in upland areas. Although herbicide application is effective for weed control, this practice is difficult to perform on the steep slopes, usually with an inclination of 30% to 50%, where coffee is usually grown. Soil losses up to 67,000 kg/ha/yr have been quantified in these regions (USDA-NRCS, 1998; USDA-NRCS, 2001).

Because of the above-mentioned limitations, conservation practices are recommended in coffee production areas mainly to prevent soil erosion and maintain crop productivity (Monroig-Inglés, 1993). A potential conservation practice is the use of ground covers or living mulches (fairly low growing grasses and legumes) planted in coffee groves for weed suppression. Living mulches may exclude weeds that interfere with coffee plants, reducing herbicide usage and human labor, while protecting soil from excessive rainfall damage. Vicente-Chandler et al. (1968) indicated that ground covers on a coffee plantation may prevent 95% of the potential soil losses. The objective of this study was to evaluate weed suppression and soil erosion control by a legume and four grasses planted as living mulches with coffee plants.

The experiment was established at the Adjuntas Agricultural Experiment Station 24 April 1996. The site selected was a fallow area with 31% slope that was completely weeded by hand before planting. The soil belongs to the Alonso series (clayey, oxidic, isohyperthermic Typic Haplohumults) with pH of 5.4 and organic matter content of 2.78%. One-year-old coffee plants were transplanted into holes (10 cm^2 and 25 cm deep) at 1.8 m by 1.2 m planting distance. Plots measured 22.0 m^2, with 10 coffee plants each, plus border plants at each side. A randomized complete block design of six treatments (five living mulches and the control) with four replications was used for the experimental layout.

The five living mulches were bahiagrass (*Paspalum notatum* Flügge), dalisgrass (*Paspalum dilatatum* Poir.), carpetgrass [*Axonopus compressus* (Sw.) Beav.], Alexandergrass [*Urochloa subquadripara* (Trin.) R. Web.] and pond peanut (*Arachis kretschmeri* Kravov. & W.C. Gregory nov. sp.). Root cuttings from these species were sown one month after coffee planting. The control plots consisted of glyphosate (1% v/v) treatment directed to weeds every three to four months. Plots were surrounded by 10-cm-wide boards to prevent soil loss. Runoff water with soil sediments was collected from May 1996 until August 1997 in 19-L pans connected by plastic pipes at the end of each plot. Slope of plots was 6.1 m long.

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Weed emergence by species was recorded every three months after coffee planting. Individual weed species were counted in a 0.5 m^2-quadrant and numbers added to obtain total density. After each count, these weeds were removed by hand from the living mulches, and with the glyphosate treatment in the control plots. The five living mulches were also trimmed 2 September 1997 and 21 July 1998 to reduce potential interference with coffee trees. Canopy of coffee trees was directly measured in the field by determining the diameter of the longest branches 6 April 1998. Data were analyzed by ANOVA and means were separated by LSD (0.05) test. The experiment was discontinued after being damaged by Hurricane Georges, 21 September 1998.

The predominant weed species in the experimental area were *Urochloa maxima* (Jacq.) R. D. Web., *Digitaria sanguinalis* (L.) Scop., *Chamaesyce hypericifolia* (L.) Millsp., *Emilia sonchifolia* (L.) DC., *Eupatorium odoratum* L., *Borreria ocymoides* (Burm.f.) DC., *Hemidiodia ocymifolia* (Wild. ex R. & S.) K. Schum., and *Vernonia cinerea* (L.) Less. Total weed density was non-significant for the evaluation conducted in October 1996 and August 1997 (Table 1). Dalisgrass suppressed more weeds than both bahiagrass and the control treatment in May 1997. This result indicates that living mulches maintained weed populations at levels similar to those in the glyphosate treatment. By January 1998, in comparison with the control treatment, all five living mulches significantly reduced weed density. A similar situation was observed in July 1998 (two years after planting). Although weed density slightly increased in all plots, the control presented higher weed density than all plots with living mulches.

Table 1 presents cumulative soil losses for the first 15 months. A total of 149 rainfall events occurred, for a total amount of 2,749 mm for this period. Soil loss was negligible after one year and none was collected beyond that time. Soil erosion was greater in control plots than in all five plots with living mulches. The glyphosate treatment controlled weed vegetation but resulted in more soil erosion than that in control plots. All five living mulches reduced the canopy diameter of young coffee trees; thus, interference was evident although whole vegetation was trimmed after the first year of growth. This study demonstrated the feasibility of using living mulches as a conservation practice for coffee production. Two benefits can be derived from the living mulches: prevention of soil loss and weed suppression. However, interference to coffee growth must be prevented during the early stage of establishment. Research is required in that area.

TABLE 1.—*Total weed density and cumulative soil losses from coffee under five living mulches in Adjuntas, Puerto Rico.*

Living mulch	Weed density					Soil loss[1]	Canopy diameter[2]
	Oct./96	May/97	Aug./97	Jan/98	July/98		
	No. weeds/0.5 m^2					t/ha	cm
Bahiagrass	14	10	10	5	12	1.3	66
Dalisgrass	5	2	2	1	21	1.2	39
Carpetgrass	6	6	6	5	14	0.3	55
Alexandergrass	3	7	12	7	14	1.5	61
Pond peanut	7	6	5	3	3	0.1	71
Control[3]	16	10	2	40	207	15.0	108
LSD (0.05)	NS	5	NS	10	57	6.3	16

[1]Cumulative soil loss collected from May 1996 until August 1997.
[2]Coffee canopy measured 6 April 1998.
[3]Glyphosate (1% v/v) directed to weeds every 3 to 4 months.

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