

COVER CROPS AND GREEN MANURING FOR AGRICULTURAL ADAPTATION TO CLIMATE CHANGE AND REDUCTION OF GREENHOUSE GAS EMISSIONS IN THE CERRADO

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This scientific research aimed at identifying the best cover crops for surface mulching to favour soil carbon sequestration, pest control or nutrient cycling and the best manure crops for the supply of nitrogen to the cultivated plant (cotton, soy) in the Cerrado biome¹. Farmers, consultants, technical assistance and academics benefit from this information. Cover crops are usually grasses (eg. *Braquiaria ruziziensis*) used in crop rotation aiming at the formation of straw, essential for the maintenance of the Direct Tillage System or Crop Livestock Forest Integration (ICLF), fulfilling its role in helping crops adapt to the adverse impacts of the climate, especially high temperatures that have been worsening in the last years. Mulching results in protection of the soil surface against erosive rainfall, providing greater water infiltration and soil moisture retention, while enabling survival and better crop performance during summer dry spells. In addition, cover crops capture atmospheric carbon and nitrogen that are added to the soil on a large scale and quite efficiently. Green manures, usually legumes (eg. *crotalaria*), are plants that, in addition to producing a large mass of green matter and a deep root system, have the ability to fixate nitrogen through symbiosis with bacteria. This characteristic generates less use of nitrogenous mineral fertilizers for the subsequent crop (eg. corn, cotton, beans), benefiting the profitability of production and contributing both to the adaptation to climate change and to the reduction of greenhouse gas emissions, while preserving soil biodiversity. The project was financed by Embrapa, the Incentive Fund for the Cotton Chain in Goiás (FIALGO), the Fund for the Development of Cotton Agribusiness (FUNDEAGRO-Bahia), AGRISUS, CNPq and CAPES.

RESULTS

Brachiaria phytomass can exceed 10 t/ha of dry matter. Depending on the commercial crop and its cycle, dry mass values greater than 6 t/ha are sufficient to provide protection against high amplitudes of thermal variation in soils (SIDIRAS; PAVAN, 1986) and also against water erosion (ROTH et al., 1986; PORTELA et al., 2010), in addition to contributing to less weed infestation (OLIVEIRA JUNIOR et al., 2014). However, some cover crops, such as millet and pigeon pea, even producing up to 5 and 7 t/ha of dry matter, respectively, were not sufficient to control weeds prior to cotton planting under zero-till prior to direct sowing of cotton (FERREIRA et al., 2018).

The quantities of dry mass can exceed 11 t/ha for *Brachiaria brizantha* and capim colonião or *Panicum maximum* (FERREIRA et al., 2018). Due to their capacity for rooting at great depths, cover crops can mobilize nutrients from the deeper layers of the soil, making them available on the surface and favoring greater nutrition for crops in succession (MUZILLI, 1986; PACHECO et al., 2011), in addition to rationalizing nitrogen and potassium mineral fertilizer use, which have an energy and carbon footprint already purchased by producers (CARMO et al., 2016). The amount of nutrients that cover crops can mobilize depends on the desiccation time after sowing. *Brachiaria* intercropped or not with jack beans mobilized about 150 kg/ha of N and 120 kg/ha of K₂O during summer crop sowing. In addition to *brachiaria*, there are other crops that can be used as cover crops or green manures, as shown in Figure 1. It is very important to acquire high quality seeds for the production of a good amount of dry matter, in addition to preventing infestation of the area with weeds and phytopathogens. The selection of the cover plant to be used must also consider the existence of soil compaction, the presence of which type of nematode or the white mold infestation. Table 1 shows the recommendation for the quantities of seeds per hectare to be used for single cultivation in the Cerrado.

Figure 1: Options of cover crop species in the off-season of soybean and cotton between February and December in the Cerrado (from left to right: sunflower, sorghum, corn, *brachiaria*, pigeon pea, sun hemp, millet and fodder radish)



Source: Ferreira et al. (2012).

NEXT STEPS AND RECOMENDATIONS

This technology is already available and should be promoted and publicized in conjunction with the No-Till Systems and the ICLF in their different variations. The positive impact for the adaptation of agriculture to climate change associated with mitigation is quite evident and can be scaled to all Brazilian agriculture in its different dimensions.

DATA PUBLISHED IN:

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Table 1: Quantity of seeds per hectare for single cultivation of cover crops in the off-season, between February and December

Espécie/cultivar	kg ha ⁻¹ de sementes com VC de 100% (*)	kg ha ⁻¹ de sementes com VC de 60%	kg ha ⁻¹ de sementes com VC de 40%
<i>Panicum maximum</i> Mombasa and Tanzania	2 - 3	3.3 - 5	5 - 7.5
<i>P. maximum</i> Aruana	2 - 4	3.3 - 6.7	5 - 10
<i>P. maximum</i> x <i>P. infestum</i> (Massai hybrid)	2 - 2.5	3.3 - 4.2	5 - 6.3
<i>Brachiaria ruziziensis</i>	2 - 4	3.3 - 6.7	5 - 10
<i>Brachiaria brizantha</i> Piatã, MG-5 (Xaraés) and MG-4 (Libertad)	3.5 - 5	5.8 - 8.3	8.8 - 12.5
Graniferous sorghum	10 - 15	16.7 - 25	25 - 37.5
Millet	10 - 12	16.7 - 20	25 - 30
<i>Crotalaria spectabilis</i>	8 - 12	13.3 - 20	20 - 30
<i>Crotalaria ochroleuca</i>	4 - 8	6.7 - 13.3	10 - 20
<i>Crotalaria juncea</i>	20 - 30	33.3 - 50	50 - 75
Cajanus cajan	20 - 30	33.3 - 50	50 - 75

Caption: (*) Amount of commercial seed to be used per hectare = [(amount of total pure germinated seed) x 100]/% quality of commercial seed (**)

(**) If the VC of the commercial seed is not provided, calculate it according to the following formula: VC = (% of germination x % of purity) / 100

Source: Ferreira et al. (2016)