

DIVERSITY OF DIRECT SEEDING MULCH BASED CROPPING SYSTEMS (DMC) AND CONSEQUENCES ON SOIL CARBON STOCKS RIO VERDE REGION (GOIAS, BRAZIL)



A) Soybean directly seeded in sorghum residues.



B) In previous year sorghum was planted as the second crop of the year directly in soybean residues: an effective cover crop, recycling nutrients and protecting soil.

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In the "Cerrados" of Central Brazil, direct seeding mulch based cropping systems (DMC) applied by farmers have been adapted to tropical conditions (high temperature, high rainfall and resulting high rates of organic matter mineralization). Generally, time saved with no-tillage allowed farmers to plant another crop in the same year, producing additional biomass, increasing thereby organic matter entries into the soil, and maintaining the soil surface always covered and protected from soil erosion (pictures). However, the level of biomass restitution, and the long term impact on C sequestration in DMC systems will differ in function of the type of commercial crop rotation, the species used as cover-crops, the level of productivity and the farmer's management (Séguy et al., 2003).

In Rio Verde (Goias, Brazil), one of the principal region of the Cerrados where DMC systems has now been widely adopted, a study has been realized to characterize their diversity and to quantify their impacts on C stocks.

Materials and methods:

A first survey has been realized in 2001 on a sample of 50 farms randomly distributed in the region, characterizing the different DMC systems adopted by the farmers through a semi-open questionnaire guide.

In the following year (2002), soil has been sampled in 42 fields cultivated using the same principal DMC system over varying periods of time (from 0 to 12 years of application), in 4 sites of native forest and in 2 sites of improved pasture. At each site, total stocks of C have been calculated and classical chemical analyses were realized, on 0-20 top cm...

Results

After 14 years, 90% of the agricultural land in the region was cultivated with DMC systems. Soybean is the main commercial crop in the first and principal crop cycle (70% of the surfaces).

DMC systems used by farmers appeared to be poorly diversified as 2 main types cover about 77% of the surface with DMC systems (table 1):

■ Type 1 = Maize or Soybean in first cycle + fallow during the rest of the rainy season (32% of the surface).

■ Type 2 = Soybean in first cycle + C4 crops as maize or sorghum or millet in second cycle (45% of the surfaces).

Management of a given crop (chemical fertilizers doses, weeds controls, pest and diseases controls...) is generally very similar between fields and even between farms (Primot, 2001).

For soil analyses, data showed a logical and highly significant relationship between texture and stocks of C (figure 1). However, if we concentrate our study on sites with clay + silts contents between 50 and 70%, there is no more correlation between this parameter and stocks of C ($r^2 = 0.03$). For these situations there is a significant correlation ($r^2 = 0.44$) between stocks of C and time since adoption of the DMC systems (figure 2). On average, there is an increase of around 750 kg of C ha⁻¹ per year of DMC application (Doucène, 2002).

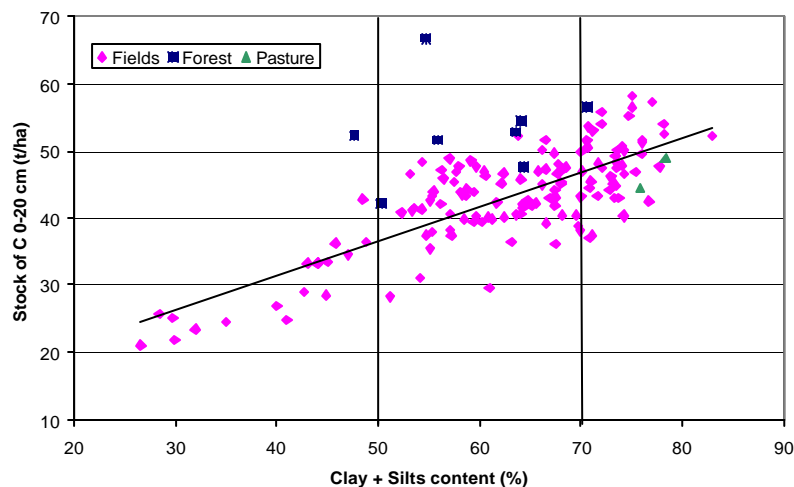


Figure 1: Relation between stock of C in the 0-20 cm top layer and clay + silt content. At all sites, $R^2 = 0.617$, at sites with clay + silts between 50 and 70%, $R^2 = 0.031$.

Type	Crop rotation(*)	% of the area
A	Soybean (I/L) + fallow	21
B	Maize + fallow	12
C	Maize conventional	1
D	Soybean (S) + Maize, Sorghum or Millet	24
E	Soybean (S/I) + Beans, Cotton or Sunflower	5
F	Soybean (I/L) + Maize, Sorghum or Millet	21
G	Maize + Maize, Sorghum or Millet	9
H	Maize + Beans, Cotton or Sunflower	6
I	Others	3

Table 1: Different types of crop rotations inventory and their respective importance in the Rio Verde region in 2001.

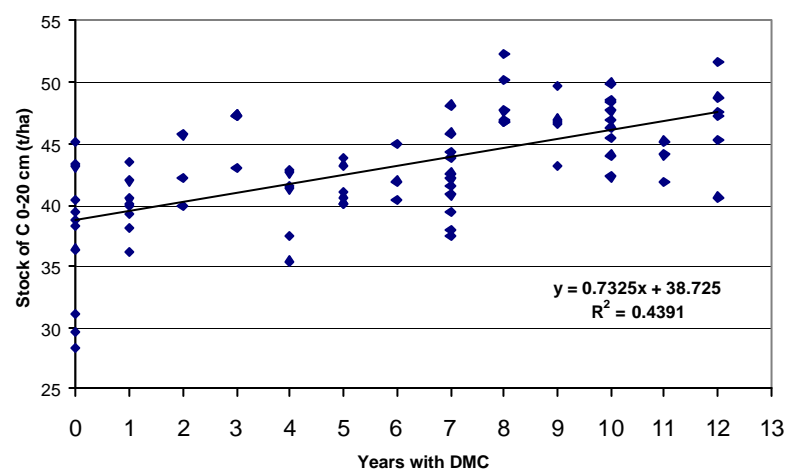


Figure 2: Relation between stock of C in the 0-20 cm top layer and time of application of DMC system only at sites with clay + silt contents between 50 and 70 %.

Concluding Comments

This preliminary study demonstrated that there is a limited diversity in the DMC systems applied by the farmers in the Rio Verde region despite a 14 years of adoption by some farmers. Our results also indicate that the DMC system most used in the region, which is mainly based on soybean in the first cycle and a grasses (maize, sorghum or millet) in the second cycle, showed a large potential to increase stocks of C in soil.

Our current research efforts focus on a more in depth study to confirm and quantify this impact on C sequestration (quantity and quality) and evaluate consequences on soil fertility.

References

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