Conservation Tillage Development at the ABC Cooperatives in Paraná, Brazil

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ABSTRACT

Soils of Brazil are highly susceptible to degradation and erosion when managed with conventional tillage systems. When native grasslands were cleared and farmed under conventional tillage methods, soil organic matter (SOM) decreased from 4% to 2% in 12 years. Ten years of subsequent no-tillage management brought SOM back up to 5%. The increase in SOM suggested that we could develop systems that not only increase biomass production, but also integrate forage systems in crop rotations. Today, about 40% of Brazil's cultivated land is under conservation tillage. The rapid adoption of conservation tillage was made possible by practical experience, education, and research, as well as the development of new products, such as selective herbicides. Farmers' cooperatives play an important role in research, development, and technology transfer through demonstration fields. They also assist farmers with marketing and the purchasing of supplies. Education is a high priority for the future – to inform producers of the economic and ecological benefits, and to inform consumers of the quality, efficiency, and environmental stewardship made possible by conservation tillage systems.

INTRODUCTION

This paper describes the performance of conservation tillage systems used in the "Campos Gerais" region in the state of Paraná in southern Brazil, where the ABC Conglomerate of Farmer Cooperatives and my family farm are located. It also describes the successful and rapid adoption of no-till in Paraná and other regions of Brazil.

Fig. 1. Native climax vegetation (pasture and the Paraná pine) and climate in the Campos Gerais region of Paraná state in southern Brazil. Mean rainfall is 75 inches, mean maximum/minimum temperature is 81/55 EF, with median temperature of 68 EF and 3 to 4 killing frosts a year.

DEVELOPMENT OF CONSERVATION TILLAGE SYSTEMS

When observing most of Brazil's agricultural areas whether they be the rolling fields in southern Brazil or the plains and savannas of the Cerrado region – it is readily apparent that soils managed under conventional tillage systems are highly vulnerable to erosion and rapid degradation from the action of wind, rain, and sun. These soils require intensive management and the most up-to-date technology to remain fertile. Although the region's conditions allow for multiple crops (the climate in some areas allows up to 3 crops a year), land becomes degraded in a few years when farmed under conventional tillage. This has been witnessed directly by large-scale growers such as myself.

IN E. van Santen (ed.) 2002. Making Conservation Tillage Conventional: Building a Future on 25 Years of Research. Proc. of 25th Annual Southern Conservation Tillage Conference for Sustainable Agriculture. Auburn, AL 24-26 June 2002. Special Report no. 1. Alabama Agric. Expt. Stn. and Auburn University, AL 36849. USA.

Fig. 2. The problem and the solution to farming in this climate and region.

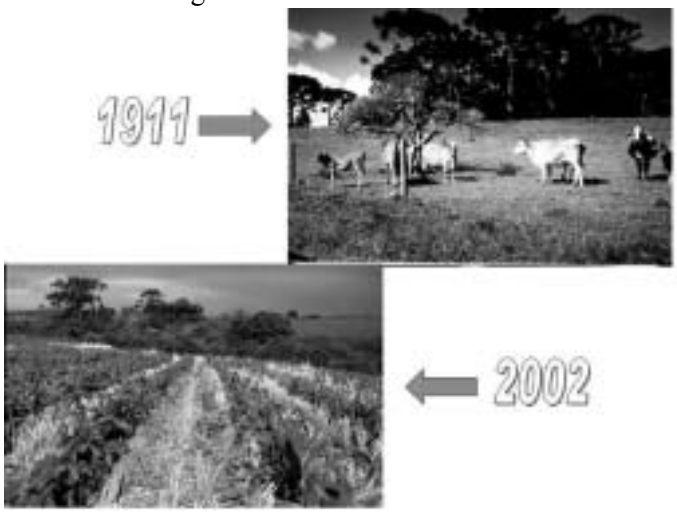

Fig. 3. Evolution of agricultural and soil management systems in southern Brazil.

Nature forced us to either make changes or abandon our land. We initiated several studies, and in 1976, began our first attempts to develop a viable no-till system.

No-till soon showed improvements and significant progress was made in the third year with the introduction of crop rotations and winter cover crops. Our Cooperative's technical department carried out several tests to evaluate the effects of winter cover crops on subsequent cash crops. The benefits of several crops were observed. Black oat (*Avena strigosa* Schreb.) provided an excellent covering with good weed control and deep rooting, while legumes (e.g., *Lupinus* and *Vicia* spp.), supplied life-giving nitrogen, but did not provide sufficient protection to the soil because their residue decomposed quickly. All grass crops increased soil nitrogen and residue/organic matter. These tests assisted us in choosing more appropriate combinations of cover crops. Crop rotation presented itself as a healthy and logical practice that contributed to increased production, preventative diversification, and cost reduction.

When we cleared native grasslands in 1964 under a conventional system, the soil consisted of 3.5 to 4% organic matter (Fig. 5). After 12 years of planting soybean [*Glycine max* (L.) Merr.] and wheat (*Triticum aestivum* L.) under conventional tillage, it declined to between 1.8 and 2.2%.

After just ten years of no-till 1976, soil organic matter content jumped from 1.8 to 5%. The root system that formerly occupied only the upper 25 centimeters of the cultivated soil is now exploring much deeper soil (Fig. 6). The increase in soil water retention allows us to better withstand drought, and reduces the overall severity of environmental fluctuations, resulting in a steady increase in production. Rapid increase in soil organic matter suggested we could develop systems that not only produce sufficient biomass to increase soil organic matter, but could also convert some of this fixed carbon into another source of farm income: e.g., integrating forage systems into a rotation, using cover and green manuring crops to sustain organic matter as well as feed livestock.

Figure 7 clearly shows the learning curve in using the best techniques in conservation tillage. We had ups and downs during the first years, but in 1987 there was a more uniform and linear increase from 4,800 to 8,600 kg ha^{-1} (4,300 to 7,680 lbs A^{-1}), achieved through better soil structure and greater infiltration and storage of water. During this time of

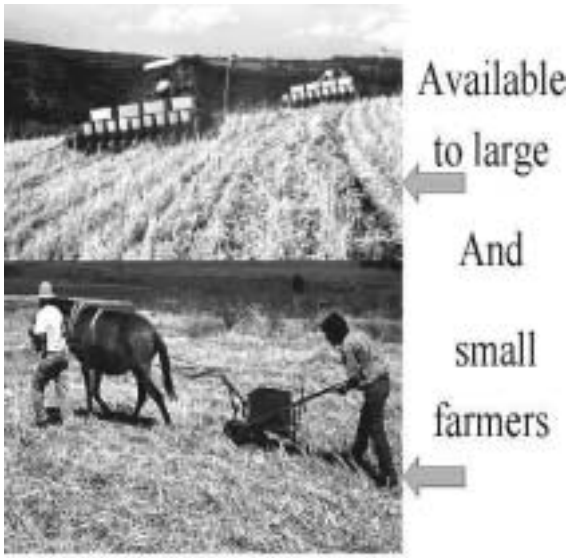

Fig. 4. No-tillage technology has been developed and is transferred to both large and small landholders in the region.

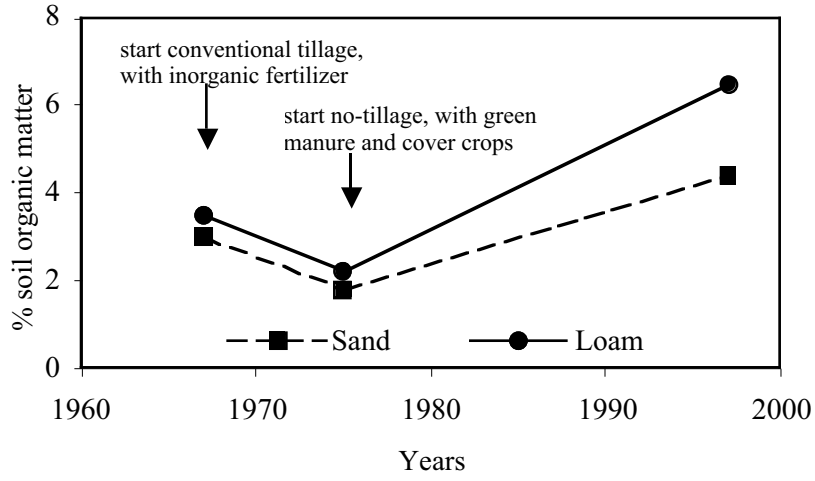

Fig. 5. Change in soil organic matter over time on my farm (Frank'Anna Farm), as affected by soil management strategies. Soil organic matter averaged 3 to 3.5% in native pasture before clearing and conversion to soybean cropping with moldboard plowing in 1968.

increasing production, the corn crop (*Zea mays* L.) exhibited the greatest upswing, because of an improvement in varieties. Soybean yields grew consistently until 1991, when they began to plateau at 2,000 kg ha^{-1} (30 bu A^{-1}) because of a decline in the introduction of new varieties. The production increased after 1991 to 3,300 kg ha^{-1} (49 bu A^{-1}).

Comparing the ABC Cooperative Group which encompasses farms totaling 180,000 ha (445,000 A) and my family farm (1,500 ha or 3,700 A) (Fig. 8), we can see the same tendencies resulting from the introduction of no-till practices. After 7 years, the degraded soil has recovered most of its productivity.

Because of the growing complexity of farming operations, especially as farms become more diverse and integrate livestock and cropping enterprises, it has become necessary to use contract services for many farm operations. This is what we have done on our property. Many types of work, such as transport, silage production, and manure application, have been outsourced to service firms, who perform them in a more professional way, benefiting everyone involved while aiding rural development.

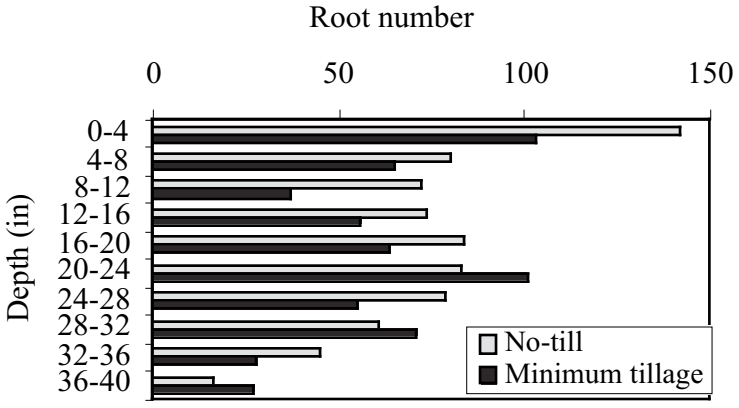

Fig. 6. Crop roots by depth in two fields from Frank'Anna Farm managed with no-tillage or minimum tillage begun in 1976 (from Sa, J.C.M., Fundacao ABC, 1993).

THE ADOPTION OF CONSERVATION TILLAGE IN BRAZIL

Brazil is a relative newcomer to agriculture, especially with respect to soybean production. In spite of the fact that the vast majority of Brazilian fields have been used primarily for livestock**,** everyone (especially farmers in the USA) knows about the rapid adoption of the Brazilian soybean crop. Today, Brazil cultivates approximately 40 million ha (99 million A) annually, and more than 16 million ha of this cropland (40 million A) are managed under conservation tillage. The many changes producers have had to face in our country have forced a rapid movement towards new and improved farming methods, and younger and more open-minded farmers have been quick to change. In our region of "Campos Gerais", the most significant shift to conservation tillage occurred in 1993, after there had been several producer-sponsored conferences and technical meetings demonstrating research results. The introduction of selective herbicides facilitated production of no-till crops, allowing us to make the most of the short time we have available to plant soybean after harvesting the previous crop.

In order to efficiently convert to no-till, a region must have a competent extension service, technical know-how, and up-to-date research data. Many people believe that our relatively favorable soils and climate are the reasons for the success of conservation tillage in our region. However, successful conservation tillage does not depend on climate and soil types, although these factors certainly impact the outcome of conservation tillage adoption. It depends primarily on the decisions of individual farmers. Harmony and open-mindedness (or lack thereof)can do more good or harm than any environmental factor. At first, some producers resisted the system, but later they became convinced of the need for more efficient tillage practices, and this system was eventually

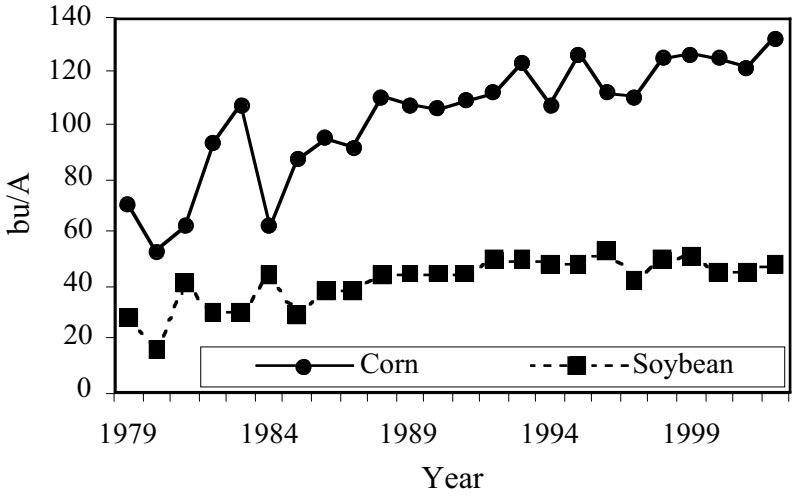

Fig. 7. Increase in corn and soybean yields on Frank'Anna Farm (3,700 A) since adoption of no-tillage. The use of no-tillage in a systems approach not only resulted in greater yields, but over time mitigated the effect of yearly environmental fluctuations on productivity.

adopted by all producers in the region. In my opinion , the soil degradation and loss of productivity caused by conventional tillage in tropical and subtropical regions outweighs any need to prepare the soil. I consider preparing the soil the same as performing surgery: it may be necessary, but only for valid and scientifically supported reasons. Currently, scientific justifications for the general conventional tillage of all soils are few and far between.

DIFFUSION

With the cooperatives *Arapoti* (A) and *Castrolanda* (C), we at *Batavo* (B) have formed our own private research institution, supported by funding from the producers, called the *ABC Foundation*, where research, development, and technology transfer are carried out for the benefit of our constituent producers (Fig. 9). We work in an area about 100 km (62 miles) in diameter, within which we choose four sites to work as demonstration fields, representing the regional micro-climates, in order to obtain information for our producers. The experimental fields have a scope of inference of about 180,000 ha (445,000 A). We conduct applied research on all aspects of production, including variety trials, disease control, insect control, weed control, fertility management, cover crop development, and alternative crop trials. We focus strictly on producer gain (profitability) and omit commercial interests, sharing all information with the farmers in our member cooperatives (Fig. 10).

THE SMALL FARMERS OF BATAVO COOPERATIVE

There are still several small isolated and diversified properties that are not in debt to banks or tied to cooperatives, but they tend not to accept changes, and are gradually becoming obsolete. These are true family farms, where a farmer's son has no other option but to take over his father's farm, and his antiquated ideas along with it.

The *Batavo* Cooperative and *Emater* of Paraná (the state Extension Service) implemented a project that enables a large number of small dairy producers scattered across the state on sloping and less productive soils to obtain corn silage produced locally on more suitable croplands controlled by the Cooperative. These producers can thus begin to focus more on dairy production, increasing production by an average of 16% per year. This partnership is working well and bringing ever-increasing returns to the participants.

This specialization of a farm's activities, conducted in a manner conducive to efficiency and productivity, is also applied off the farm by other organizations; they join their individual efforts to work toward as a larger entity – a Cooperative or Association. This model works to increase returns across all levels of

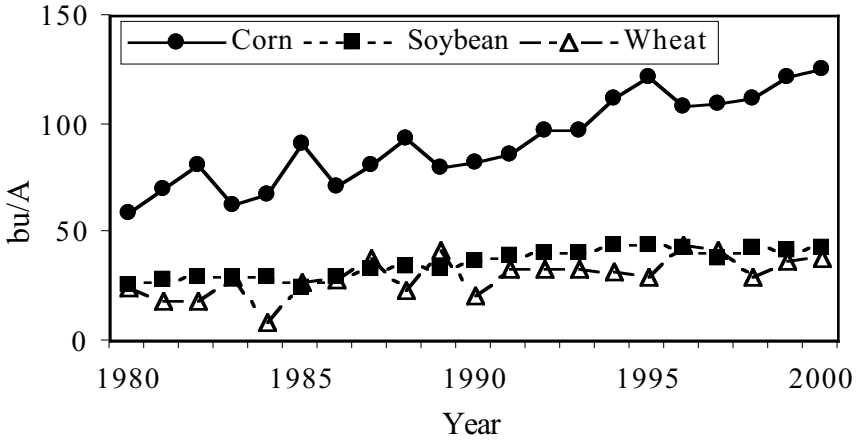

Fig. 8. Mean increase in productivity for the three major crops, corn, soybean, and wheat, produced by members of The ABC Cooperatives. There has been a rapid adoption of no-tillage by members since the early 1990s.

Fig. 9. Producer members of The ABC Cooperatives fund their own applied research and technology transfer service, The Foundation ABC. Research priorities for The Foundation ABC are determined by the producers and research is conducted at four locations representing micro-climate and soil variations of the group's members.

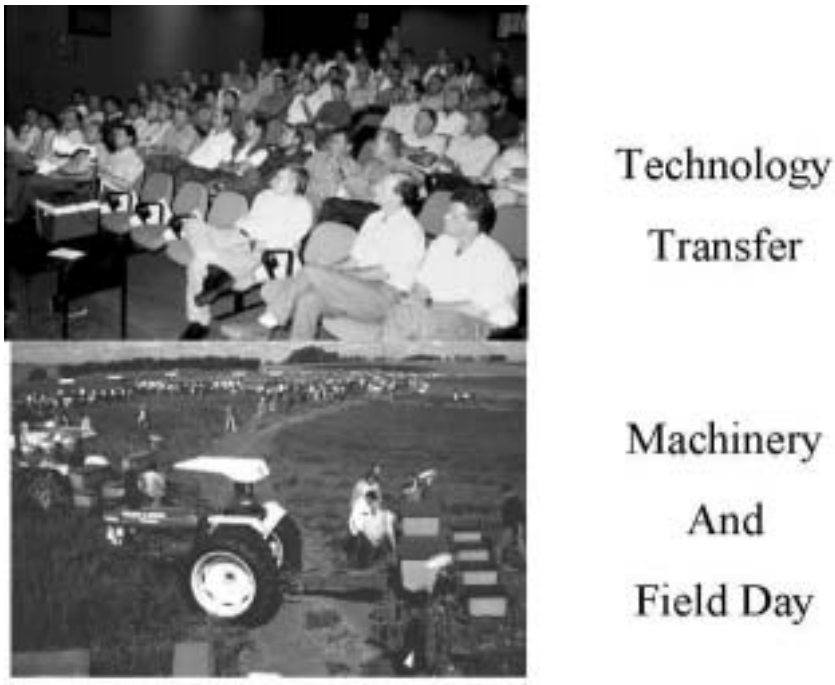

Fig. 10. Producers actively participate in training, field days, and other educational and technology transfer activities carried out by The Foundation ABC. The shared research and technology development focuses on profitability for the producer-members.

Fig. 11. Producing in harmony with nature ensures a better tomorrow. "No-tillage is not only a different technique, but also a matter of survival."

the production chain. The model's success is based on the following philosophy: ***"None of us are as important as all of us together".***

Brazilian farmers, however, often resist changes. They would rather work from sunrise to sunset and well into the night. They carry out their labor with pride, even though they often have to go through hardships just to honor their commitments to their family, their bank, and their community. Before they adopt new farming techniques, they must actually see the benefits. Realizing the benefits of change and cooperation makes producers far more likely to be receptive to change. In order to make this effective and successful, the "win-win" dialogue is essential for the longevity and success of these types of partnerships.

Strategic decisions from increasingly larger agricultural companies focus on corporate profit, and often make life difficult for small producers, because the corporate mentality is not concerned with the families on those properties, who are being deeply affected. These changes beg the questions:

1. What agricultural model will be better in the future?
2. Will there be a place for small producers in the future?

CAPITAL AND TECHNOLOGY

To be successful today, producers must employ modern technology. Those with capital need to seek out and form partnerships with those who have technology. In property-enterprise succession, or in division of property, we must first think on a scale that is economically viable. Many examples of succession exist that didn't reach their objectives. Over time, the division of property needs to transform the estate into parts that use the available technology while achieving a desired scale of production. Not all sons will work in livestock production, yet they can still choose other vocations, receive the same dividends, and maintain the heritage they have been given.

CONCLUSION

The majority of the remaining work in no-till is in educating and encouraging its use: primarily, informing the producer about the economic and ecological advantages that the system offers. We must inform consumers about our products and the high level of quality, efficiency, and environmental stewardship achieved using no-till. It seems odd that organic and biodynamic products have gained the sympathy of the media in recent times. I don't wish to discredit organic products, but in my opinion, you can't call something organic unless it was produced using conservation tillage. By relentlessly tilling the soil, we are opening the door to degradation, and ultimately, compromising our own future. Today, with rapid market globalization becoming ever more apparent, it is necessary to use all available tools for survival, especially as we are competing with an increasing number of subsidized products from First World countries (e.g., the European Union). Because of this, we need to maximize the potential of our existing resources responsibly. Unfortunately, the tendencies we observe in cities, where small commerce is not practical and is replaced by ever larger chain stores (e.g., Wal-Mart in the USA), such as increased capitalism, vertical and horizontal integration, and economies of scale, are also occurring in agriculture and in rural communities.

For today's producer, it isn't enough to produce a suitable volume of goods; he must also pay much attention to the demands of the market and its trends. In developed countries, the consumer demands traceable products and the setting of standards concerning the treatment of animals, grains, and vegetables, as well as their manner of production. The supermarket chains use these differences to their own advantage (and hopefully to the advantage of the producer) in the marketing of agricultural products.

It has been projected that, with the present rate of world population growth, there will be a food shortage by the year 2020. Land is available in limited quantities, so there aren't many possibilities for horizontal growth, and thus, it is necessary to promote vertical growth. This places an even

bigger responsibility on our shoulders concerning the management of our soils. Will we leave the individual producer unprepared, without appropriate technologies, degrading his way of life? Or will we instead prepare for him a future of healthy and well-managed soils? Future generations will depend on the attitudes we take on such issues. Our public officials also need to be made aware of this reality and to take part in exploring more options for agriculture.

After much destruction and degradation in the past, we have learned how to produce in harmony with nature, and we now face the new millennium with optimism (Fig. 11). I would like to leave you with the same message that I focused on in a 1981 no-till manual. ***"No-tillage is not only a different technique, but also a matter of survival."***

The challenge now is to convince farmers, not only on a regional basis – as with the *25th Southern Conservation Tillage Conference for Sustainable Agriculture*, but nationally and internationally as well: to gather, discuss, and think about how we can join forces and create the synergy that must exist between farmers, production areas and properties, so that with teamwork, there will be an increase in efficiency and scale, enabling producers to face the challenges and changes of the days ahead successfully – on a local, regional, national, and international level.