



## Conservation Tillage for Cotton Growing

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### ABSTRACT

*The systems of consumption, production and trade, speciality after the Second World War, have deteriorated as consequence of degradation of the environment and natural resources. During the last year as an answer to this situation, Conalgodón has been working around the conservation tillage to increase and protect the soil, considering it the base of the improvement for cotton growing in a tropical country like Colombia.*

### Introduction

The characteristics of world development, in particular the patterns of consumption and systems of production and commercialization after the second war, have resulted in the waste of natural resources and degradation of environment. As a response to these events, the concept of sustainable development has emerged, proposing that present needs shall not compromise the ability of future generations to attend to their needs.

Conservation tillage in cotton is a system that reduces wind and water erosion and water evaporation that occurs with each tillage operation. Maintaining crop residue on the soil surface as a mulch retains moisture and insulates the soil surface from extreme temperatures.

This paper proposes a new technological blueprint that offers timely answers, using the current stock of knowledge, so that systematic quantifiable analysis can determine optimal practices to improve cotton production under a sustainable development scheme. Specifically, it elaborates on soil protection using a system of tillage conservation for cotton growing through sustainable preparation, planting and weed control techniques that permit higher returns than conventional production systems.

Colombia is a tropical country, located in the North of South America. Cotton cultivation has been a very important part of the economy and rural development. However, in the last eight years, the area has been decreasing due to physical, chemical and biological soil degradation that reduces productivity and affect the soil capacity to support plants. This situation originated mainly through inadequate tillage practices that affected fertility and moisture. As a result, an increase of production cost and a decline of yield have occurred.

Cotton production costs have also increased dramatically in the last eight years as a result of a change in macroeconomics that caused inflation of

20% each year (hand labour, diesel fuel, land rent and other components of the cotton cost) and a decrease in the real value of the dollar. In addition, Colombia has one of the highest interest rates of about 34-40% per year. Under these conditions and with soil degradation due to excessive tillage operations, Conalgodón decided to choose the only alternative technologies.

### Methods

In the early 1980's, Córdoba department growers in the North West of Colombia, attempted to initiate a conservation tillage program, but it failed due to lack of suitable equipment and adequate management knowledge. The current conservation tillage project began anew in 1995, with a small core group of growers in Cesar department, in the Northeast and Cauca Valley department in the Southwest. This started with small-scale on-farm demonstration plots, using different kinds of tillage, including:

1. No tillage. In this case we use a cover crop (soybean, sorghum and corn) and in some cases we need to use a vibrator chisel to reduce the value of the apparent density or the compacting sub-soil.
2. Conventional tillage.

There were also regional-wide grower meetings and workshops integrated with the official agencies (Ministry of Agriculture, ICA, SENA, Corpoica) that focused on topics such as cover crop management, cost reduction and integrated pest management.

Finally, a series of farm tours and field days were organized, open to agronomists, cotton growers and the general public.

### Results and Discussion

Interest in conservation tillage has increased dramatically in all cotton areas in Colombia, and an alliance of co-operating growers, agrochemical enterprises, farm supply companies, machinery dealers, government agencies and a group of consultants has promoted adoption of conservation

tillage in the country. The land under conservation tillage has increased from 55 hectares in 1995 to an estimated 15,000 hectares for 1998 as a result of this co-operating alliance between cotton growers. This is the only way to remain competitive in an open trade of cotton fiber with erratic market prices that result in variable (usually shrinking) profit margins for growers who need to find ways to reduce their overall inputs.

The major benefit of this program is that the system is multidisciplinary, grouping soil quality, integrated pest management, weed control and rotation crop with good yield and higher returns than conventional system (Table 1). The major disadvantage reported by growers is the unavailability of machinery specially adapted for the system (chisel ploughs, sowing machines etc.). In addition, stalk destruction and weed control need to be adapted to the system.

Soils with conventional tillage (4-6 discs ploughing plus 2 more with the incorporation of herbicides of pre-sowing) provokes loss of fertility and more than 100 ton of soil/ha per year. With conservation tillage, erosion is stopped, creating a new soil surface, calculated in 10 tons. of soil/ha per year.

The use of systemic herbicides in conservation tillage versus contact and residual herbicides in conventional systems is also an advantage, since it does not degrade soil microbial activity in the same way, improving organic transformation. Microbial degradation in conventional systems increases fertilizer requirements to maintain the same production levels, increasing production costs and reducing profit margins.

*M. Poveda* Colombia generally has a broad spectrum of weed, but *Cyperus rotundus* or purple nutsedge is present in all cotton zones. With conventional system there has been a steady increase in this problem. This affects the cost of production and the physiology and development of cotton plants. In two years of conservation tillage, this weed has practically disappeared because systemic herbicides have achieved complete control and vegetative propagation through conventional disc ploughing has been eliminated.

These herbicides increase the mulching effect of conservation tillage, they have no pre-sowing effect on cotton, their cost is equal to and sometimes cheaper than herbicides in conventional system, and they are not affected by rain. In addition, their toxicological rating is number four, the lowest toxicity.

Conservation tillage protects the soil from sun radiation, raining drops and wind. The organic residue is activated and absorbed as nutrients by cotton plants. Conventional tillage reduces the soil oxygen level water infiltration while annual conservation tillage increases oxygen and water infiltration, promoting better root development, higher levels of organic matter and improved nutrient availability.

With current knowledge of topical weed control, soil preparation and planting techniques under a scheme of sustainable agriculture, cotton growers of Colombia have an alternative for better returns in an open trade situation and without government intervention in contrast to conventional systems. Cotton growers can realize a number of benefits from conservation tillage systems, including

- greater flexibility during planting and harvesting;
- increased number of beneficial insects;
- lower soil temperatures during drought periods;
- reduced land preparation time; reduced soil erosion;
- reduced irrigation frequency and number;
- improvement in the bio-structure of the soil;
- reduced the apparent density value;
- reduced equipment maintenance and repairs; and
- increased organic matter in the soil

## Conclusions

The agronomic and economic benefits, associated with conservation tillage are many and varied. Some benefits that Colombian cotton growers have realized are reduced soil erosion, and lower soil temperatures during drought periods. This approach is believed to be a biologically and ecologically sound system that provides a potential for greater profit margins. However, there is a need to explore a new culture that introduces cover crops, different herbicides treatments, crop rotation and strategy like on-farm demonstration to promote an increase in conservation tillage acreage in future.

## References

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**Table 1. Overall input costs, yield and returns per hectare in conservation and conventional cotton fields (average 1996 and 1997).**

Item	US\$	
	Conservation	Conventional
	Field	Field
Tillage and planting	18	104
Fertilizer	168	229
Weed control	83	152
Irrigation	240	420
Other inputs	1113	1113
Total	1622	2018
Yield (lint/ha)	2426	2617
Return (\$0.81/lb)	1965	2120
Difference/ha	99	