ISSN: 2639-7455

Short Communication

Earth & Environmental Science Research & Reviews

Strategy for The Transition Towards Conservation Agriculture Practices in Rice Cultivation Systems in Cuba

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Submitted: 18 Oct 2021; **Accepted**: 25 Oct 2021; **Published**: 28 Oct 2021

Citation: *Calixto Domínguez Vento, Alexander Miranda Caballero, Guillermo Díaz López (2021) Strategy for The Transition Towards Conservation Agriculture Practices in Rice Cultivation Systems in Cuba. Eart & Envi Scie Res & Rev, 4(2), 82-83.*

Summary

Cuban agriculture to achieve the sustainability of agricultural systems needs to initiate a transition process towards conservation agriculture practices, which implies a change in production systems and the technologies they use. Rice (Oryza sativa L.) is considered a staple food for more than half of the world's population. However, the adverse effects of climate change, together with soil degradation and the scarcity of irrigation water threaten the sustainability of rice production under irrigated conditions [1, 2]. Intensive tillage practices have been shown to increase environmental pollution, deteriorate the soil and involve high water consumption [3, 4]. Therefore, conservation agriculture (CA) practices have been recommended to conserve resources and increase ecosystem services [2, 5]. The CA is an agricultural system that is characterized by the interrelation of three fundamental principles: to keep the soil permanently covered with crop residues or plant covers at least 30%, a minimum disturbance of the land and diversification of the species cultivated in rotation [6]. Some 140 thousand hectares of rice are planted in Cuba [7-9]. However, the low yields obtained require the importation of 400,000 tons of rice annually. A roadmap for the transition towards CA practices was recently adopted as the country's policy. But the current conditions of rice soils (characterized by low organic matter content, compaction and poor drainage), subjected to intensive (traditional) tillage practices for long periods of time (between 30 and 50 years), put at risk the implementation of the basic principles of CA and its adoption as an accepted practice by farmers.

Based on the results of the research that we have developed to date, the strategy for the transition towards Conservation Agriculture practices in rice cultivation systems in Cuba should be:

1. Condition the soil before implementing CA. Although in the cultivation of traditional rice (flooded) it is desirable that the soil conserves a compact layer to reduce the infiltration of water in the soil and to permanently maintain the sheet of water. The investigations carried out show compaction values higher than 2.8 MPa, with which the root development of the rice plant decreases by 35% and the yield by 25%. In addition, it makes it difficult to rotate with other crops.

a. If possible, correct nutritional deficiencies in the soil.
b. Level the field to ensure a more efficient use of water, avoid sowing problems and poor seed germination. Although leveling is not a prerequisite for small farmers and smoothing can be done with landplane. The best option is to use Global Navigation Satellite Systems Technology (GNSS) and variable slope soil leveling.
c. Construction of the dikes. They should be built wider, lower and with a softer section to facilitate transit through them, which allows planting on them and keeping them from one year to the next, with a slight repair if necessary.
d. Uncompact. Before sowing the first crop, carry out one or two subsoiling or chiselling tasks (vibratory chisel) in dry soil conditions. It should be done in two crossed passes at an angle of approximately 30 ° and at a depth of 20 to 25 cm.
e. Establish a good drainage system.

2. Obtain a dead mulch with crop residues or green manures. Select cover plants capable of surviving in high humidity conditions. Adopt the most appropriate for each type of soil, taking into account its root system.

a. Establish seed banks of green manures or of the crops to be rotated and guarantee the conservation of the seeds.
b. Alternating two crops of rice with corn or soybeans has given good results.

3. Adapt the machinery to the system. With the exception of the knife roll and the direct seeder, specifically designed for CA, the other equipment and implements can be the same used in traditional handling systems.

a. Coverage management. Use knife roll, with blades fixed to

the supports by screws and placed at an angle of 45 ° or 90 ° in relation to the surface of the cylinder. The region of the blades that come into contact with the plant material should be sharpened at an angle of 30 or 45 degrees, but the surface of the tip of the blades should be rhombic, no more than 5 mm wide to avoid a cut excessive.

b. Sowing. Initially, modify some sowing machines designed for sowing in soft soils and adapt them for direct sowing of the soil with minimal disturbance.

c. Harvest. Place straw distributors in the harvester that do not crush the plant material and spread the residues as evenly as possible over the harvested area. Cut the waste between 20 and 30 cm high above the soil.

4. ***Irrigation regime.*** Do not flood the rice field permanently. Germination is achieved without the seeds remaining under a permanent sheet of water. Irrigation is suspended for 7-8 days before the change of primordium and completely suspended when the paddy field reaches 50% of panicles.

The adoption and dissemination of CA in Cuba indicate the possibility of adapting a group of strategies implemented worldwide in rice agroecosystems.

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