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DEVELOPMENT, EVALUATION AND DEMONSTRATION OF A NO-TILL TECHNIQUE WITH A MODIFIED ROLLER CRIMPER IN ORGANIC AND CONVENTIONNALLY-MANAGED SYSTEMS IN EASTERN CANADA

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Abstract: According to many, soil tilling is one of the practices contributing the most to soil degradation. In conventional systems, farmers can practice no-till with the use of chemical herbicides to kill cover crops prior to the next planting whereas their use is forbidden in organic systems. Alternatives to herbicides are available to farmers including the utilization of a roller crimper, a farm equipment developed by the Rodale Institute. The roller crimper is a water-fill drum with chevron-patterned blades attached to the front of a tractor. This technique allows farmers planting soybean into a roller-crimped rye cover crop. A critical step with this technique is the timing of cover crop termination. The roller crimper is used when rye has reached flowering stage. Under Southern Quebec climatic conditions, this brings us to mid-June which is too late for soybean planting. Inspired by other techniques developed in the United States, a nearby farmer decided to conceive a new model of roller crimper that would adapt the technique to the climatic and cultural conditions of Eastern Canada farms. The expected results are the development of approaches without herbicide use, promote organic soybean production and reduce soil erosion and improve their health in Eastern Canada.

Introduction: Cultivation practices commonly used in field crops play a major role in soil degradation and the frequent use of pesticides poses a risk to the environment, biodiversity and health. Managing weeds in agriculture is an ongoing concern of great importance. Competition for resources between existing crops and weeds is sometimes responsible for significant yield declines and may affect crop quality. In organic system, tillage and weed control are time-consuming and energy-intensive operations. There are many field operations to control weeds between seeding and harvesting, with an average of 5 mechanical operations for soybean cultivation. In conventional agriculture, dependence on the use of herbicides is strongly criticized. Glyphosate, a non-selective herbicide is currently the most widely used herbicide in the world (Mollier, 2018). Whether organic or conventional, weed management presents many challenges and it is important to develop alternatives and innovative techniques. In the United States, the Rodale Institute has developed a technique of direct sowing for soybean without the use of herbicide and tillage. A winter cover crop is sown early in the autumn to be terminated at the flowering stage and soybean is planted at the same time. The use of winter rye as mulch in a no-till

soybean seeding system has several advantages including weed control, limited mechanical interventions, soil erosion prevention and improved soil quality.

Promising results achieved in the United States early in this century have prompted trials in Eastern Canada that have been more or less successful under our conditions. Estevez's (2008) work has shown that yield and biomass of winter rye are correlated, that rye must be rolled at flowering stage to be properly terminated, and that the rye mulch slows down the soybean emergence. Leroux (2011) also showed that mulch slightly reduces soybean growth with an impact on yield and that the seedling rate of winter rye may slightly influence the potential for weed suppression. The use of the technique controls most annual weeds; however, he recommends perennial weeds management before using the technique as it is less effective against perennial weeds. Leblanc et al. (2011) has shown that the use of winter rye mulch can be as beneficial in some cases as mechanical weeding.

Tests carried out in recent years by farmers under our climatic conditions showed several limitations to the technique. Among others, winter rye reached flowering stage only in mid-june both in 2017 and 2018. Late soybean planting significantly reduces yield and was particularly affected by drought in 2018. Also, the roller crimper does not crush the stems perfectly when the soil surface is uneven. Like other work done in Eastern Canada, the results of these trials indicate that the potential of the technique used in the United States and elsewhere in the world is limited under our climatic and cultural conditions. To overcome the limitations of the technique, a farmer tried an innovative method for direct seeding of soybean.

Material and methods: The experiment was established in Princeville, a city in the province of Quebec. A cover crop of winter rye and mustard/radish was established in the autumn 2017 and terminated mid-June 2018. Three rows of winter rye were sown alternately with a row of mustard and radish. Three seedling rates of winter rye were tested: 90, 135 and 180 kg/ha. In spring 2018, only the winter rye remained making it easier to plant soybean. Soybean was planted on May 20th and winter rye was terminated mid-June with a modified roller crimper.

Mulch biomass was sampled just before termination. Soil temperature and humidity were sampled every 10 days from soybean sowing to mid-July between and in soybean rows. Visual estimates of weed cover and disease severity were also assessed.

Results: Soybean was harvested on October 15th and data has not yet been analyzed. This is an ongoing project and we are in the first year of testing. Overall, field results are very promising. The modified roller crimper did a very satisfying cover crop rolling with very little damage to soybean.

Discussion: Direct sowing of soybean on rye cover has the potential to improve water quality and promote soil health. This project will allow further development and popularization of the technique of sowing on rolled rye in Eastern Canada. The technique could then be transposed to many agricultural operations under organic and conventional management that grow soybeans. Such an agricultural practice which reduces soil degradation in the agricultural sector can therefore be implemented on several farms. It is also expected to increase the resilience and stability of Quebec's agricultural production in the context of climate change through the adoption of practices that contribute to the conservation of water and soils, a basic orientation in agriculture.

Soybean seeding on rye cover can be easily integrated into current organic and conventional crop management and therefore has short-term scope and potential for applicability. The potential for adoption is even greater for producers with rocky soils for whom mechanical weeding is a problematic operation.

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Leroux, G (2011) Evaluation of hairy vesce and fall rye cover crops and pancake roller as weeding methods in organic production of sweet, soy and breadable wheat. Seasons 2007-2010.

Mollier, S (2018) Glyphosate, one pesticide among others? National Institute for Agricultural Research. France. [online].

Image:



a. Modified roller crimper developed by a farmer in Eastern Canada

Image 2:



b. Soybean three weeks after cover crop termination

Disclosure of Interest: None Declared

Keywords: conventional farming, Cover crops, no-till, organic farming, Soybean, winter rye