MECHANICAL CONTROL OF QUACKGRASS IN GRASSLAND

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ABSTRACT It is well known that quackgrass is both very aggressive and persistent. It is considered as one of the most troublesome perennial grassy weeds as it rapidly spreads by creeping rhizomes. In agriculture, many attempts have been made to control this weed without success. Within the context of a sustainable agriculture, mechanical control of quackgrass represents an interesting alternative to chemical means. In this research study, the effectiveness of using a rotary cross-harrow, a C shaped mounted tine cultivator, and an S shaped tine cultivator alone or in combination to control quackgrass in grassland was investigated. Trials were carried out on grassland using a Latin square experimental design. Three treatments were considered: (1) four passages using a C shaped mounted tine cultivator, (2) use of the rotary cross-harrow followed by three passages of a C shaped mounted tine cultivator, (3) use of the rotary cross-harrow followed by three passages of an S shaped trailed tine cultivator. Each treatment was replicated three times. The percentage rate of quackgrass present in each experimental plot was determined before and after the four passages of the equipments using a one square meter quadrant randomly placed in the plot and replicated ten times. Also, the time required for each passage as well as the fuel consumption were computed for every treatment. Analysis of the data revealed that the use of the rotary cross-harrow in combination with the C shaped tine cultivator resulted in a better control of quackgrass compared to the use of the S shaped tine cultivator in combination with the rotary cross-harrow. The use of the rotary cross-harrow requires however more energy to remove quackgrass plants from the soil. All three weeding strategies are comparable in terms of time requirement.

Keywords: Quackgrass, grassland, mechanical control, rotary cross-harrow, cultivator.

INTRODUCTION AND LITTERATURE REVIEW The quackgrass, also called Elytrigia repens, is a widespread perennial weed in Canada. In 1990, the economic losses due to the couchgrass in the conventional cultures of seeds and oleaginous plants in eastern Canada were estimated at approximately $17/ha (Fox and Haque, 1990). These losses are even more important in organic farming as no chemical weeding is allowed. Moreover, adequate quackgrass weeding equipments in wet and fertile soils are not yet available.
Native of Europe and western Asia, *Elytrigia repens* was introduced in Canada in the 17th century in cereal production (Reidy and Swanton, 1993). This perennial weed can proliferate not only by seeds but more importantly by rhizomes. In grassland, rhizomes spread out laterally in the first few centimetres of the ground surface (Duval, 2005). This is not the case in a tilled field where segmented rhizomes go deeply in the ground under the effect of tillage equipments. Knowing that rhizomes can survive in the most extreme conditions, a small rhizome segment is enough to produce a whole plant of couchgrass.

The mechanical weeding of couchgrass mainly aims at eliminating its rhizomes. One of the approaches used for this purpose is the dehydration of the rhizomes. This consists on placing them on ground surface to dry. The success of this approach is mainly related to the weather conditions because it requires hot, sunny, and particularly dry days.

In general, the control of couchgrass in field crops requires repetitive soil tillage (two to six passages) for two to four weeks. During the most drying period of the year (hot and sunny days combined with dry soil), the time required to dehydrate couchgrass rhizomes could however be as short as one to two weeks. Under these conditions, two passages with tillage equipments could be enough. This short fallow land begins with stubble ploughing. It aims at uprooting the rhizomes and burying lifted plants in a single passage. C or S-type cultivators as well as wide duckfoot tooth chisels are usually used as tillage tools. However, disk tools are no longer widely used in grassland because they lead to the segmentation of the couchgrass rhizomes and consequently enhance their propagation. After this tillage operation, the rhizomes have to be dried. For this purpose, several passages with a tillage tool are required to bring the rhizomes at the ground surface and consequently expose them to dry weather conditions.

**OBJECTIVE** The objective of this research study was to investigate the effectiveness of using a rotary cross-harrow, a C shaped mounted tine cultivator, and an S shaped trailed tine cultivator alone or in combination to control quackgrass in grassland.

**MATERIALS AND METHODS** Trials were carried out on grassland where soil moisture and quackgrass populations are not homogeneous. For this reason, a Latin square experimental design was used to minimize the effects of such variability between plots. Each plot was 18 m long and 9 m wide. Three treatments consisting on intensive soil tillage using the most commonly used weeding equipments in Quebec were considered: (1) four passages using a C shaped mounted tine cultivator, (2) use of the rotary cross-harrow followed by three passages of a C shaped mounted tine cultivator, and (3) use of the rotary cross-harrow followed by three passages of an S shaped trailed tine cultivator. Each treatment was replicated three times. The equipments used to carry out the treatments are presented on figure 1. The percentage rate of quackgrass present in each experimental plot was determined before and after the four passages of the equipments using a one square meter quadrant randomly placed in the plot. This procedure was replicated ten times in each plot. For each passage, the tractor fuel consumption was also determined. At the beginning of each passage, the reservoir was completely filled. At the end, the reservoir was again filled and the fuel required represented the effective fuel consumption for a given passage. Also, the time required for each passage was computed for every treatment and the new emerging quackgrass plants after treatments were counted.
RESULTS Analysis of the data showed that the use of C shaped mounted tine cultivator alone (treatment 1) allowed controlling 60% of the population of quackgrass (Figure 2). The use of the rotary cross-harrow in combination with the C shaped mounted tine cultivator (treatment 2) resulted in a better control of the populations of quackgrass as only 30% of this weed remained after the passages with this equipment (Figure 2). On the other hand, the use of the rotary cross-harrow followed by three passages of an S shaped trailed tine cultivator (treatment 3) did not result in a good control of quackgrass as its population was reduced by only 40% after four passages with this equipment (Figure 2). Compared to the treatment 1, this result clearly indicates that the use of the rotary cross-harrow in combination with the S shaped trailed tine cultivator was not effective in controlling the populations of quackgrass. This could be attributed to the inefficacy of the S shaped trailed tine cultivator in moving the rhizomes to the ground surface. Overall, obtained results clearly show that the use of the rotary cross-harrow in combination with the C shaped mounted tine cultivator highly contributed to the control of the populations of quackgrass.
The number of quackgrass emerged after the passage with the weeding equipments was computed and the results are presented in figure 3. These results show that less quackgrass plants emerged after the passage with the rotary cross-harrow followed by the C shaped mounted tine cultivator (treatment 2). On the other hand, more quackgrass emerged following the passages with the rotary cross-harrow and the S shaped trailed tine cultivator (treatment 3). This could be explained by the presence of more rhizomes in the soil resulting from the use of the S shaped trailed tine cultivator which enhances the emergence of more quackgrass plants.
Figure 4 presents the mean diesel fuel requirements per plot for the three weeding operations. It can be noticed that the use of the C shaped mounted tine cultivator alone (treatment 1) results in the lowest fuel consumption. The use of the rotary cross-harrow followed by three passages of a C shaped mounted tine cultivator (treatment 2) and the rotary cross-harrow followed by three passages of an S shaped trailed tine cultivator (treatment 3) resulted in 22 and 43% more fuel consumption, respectively, than the use of the C shaped mounted tine cultivator alone. This indicates that the use of the rotary cross-harrow requires more energy to remove quackgrass plants from the soil.

Figure 4: Average diesel fuel consumption for the three weeding operations.

Figure 5 indicates that the use of the C shaped mounted tine cultivator alone (treatment 1) required the least time to carry out the four passages at a travel speed of 4.8 km/h. However, this time is comparable to those required by the use of the C shaped mounted tine cultivator (4.8 km/h) and the S shaped trailed tine cultivator (8.5 km/h) in combination with the rotary cross-harrow (1.9 km/h). Indeed, times required to carry out treatments 2 and 3 were only 1 and 5%, respectively, higher than that required by the use of the C shaped mounted tine cultivator alone (treatment 1).
CONCLUSIONS The following conclusions were drawn from this study:

1. The use of the rotary cross-harrow in combination with the C shaped mounted tine cultivator resulted in the control of 70% of the populations of quackgrass;

2. The use of the rotary cross-harrow in combination with the S shaped trailed tine cultivator was not effective in controlling the populations of quackgrass;

3. Less quackgrass plants emerged after the passage with the rotary cross-harrow followed by the C shaped mounted tine cultivator;

4. The use of the rotary cross-harrow requires more energy to remove quackgrass plants from the soil.

5. All three weeding strategies are comparable in terms of time requirement.

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