A Long-Term Application of Conventional and Conservation Practices for Durum Wheat Cultivation

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Abstract

Conservation practices represent a solution able to cut down production costs of durum wheat cultivation and at the same time guarantee satisfactory yields while reducing CO_2 environmental impact in accordance with the directions of Community policy.

The long-term experimentation (2005-2010) aimed at evaluating mechanization and energy consumption aspects for the different combinations of machines and techniques distinguishing the experimental years, as well as soil moisture content and crop yield aspects for the cultivation of durum wheat.

Three theses were compared: "tillage" "minimum tillage" and "no-tillage" in a representative flat land area, which is mainly used for extensive cereal farming (Mineo - CT - Sicily). Two plot-scale repetitions were carried out for each thesis in plot of about 1800 m^2. The machines and techniques used over the five consecutive years of tests were alternated in accordance with those commonly adopted for the cultivation of durum wheat in the territory where the tests were carried out, excluding the sod-seeding machine.

In general, "no-tillage" thesis showed a better efficiency and timeliness because mean work capacities were always higher than other theses, as well as unit work time of this thesis. In all years, there were a remarkable increase in the yields of the "tillage" and "minimum tillage" thesis and particularly the differences were not significant statistically.

In the specific context the results show even if the average yield are lower in "no-tillage" than in "tillage" thesis, the variable costs are also lower. This is due to the greater work capacity in "no-tillage" thesis than in "tillage" thesis as well as the lower energy consumptions.

Aim

According to an estimate of the International Grain Council (IGC), Italy represents the second producer in the world after Canada and the first in Europe. At a national level, more than 20% of the surface used for durum wheat is in Sicily, the second producer after Puglia. The meagre profitableness of the crop, however, means that the cereal cultivators have to adopt cultivation and agronomic strategies suitably designed to reduce production costs, safeguard the environment, increase the yield and improve the quality of the product.

Conservation practices (minimum and no tillage) could represent a solution able to cut down production costs of durum wheat cultivation and also guarantee satisfactory yields while reducing CO_2 environmental impact in accordance with the directions of Community Policy.

The long-term experimentation (2005-2010) aimed at evaluating mechanization and energy consumption aspects for the different combinations of machines and techniques distinguishing the experimental years, as well as soil moisture content and crop yield aspects for the cultivation of durum wheat.

Methodology

Three theses were compared: "tillage" "minimum tillage" and "no-tillage" in a representative flat land area, which is mainly used for extensive cereal farming (Mineo - CT - Sicily). Two plot-scale repetitions were carried out for each thesis in plot of about 1800 m^2 each. The machines and techniques used over the five consecutive years of tests were alternated in accordance with those commonly adopted for the cultivation of durum wheat in the territory where the tests were carried out, excluding the sod-seeding machine. Sowing in the tilled lots was carried out with a 3 m wide seed drill with 16 tines, while the sowing in the untilled lots was carried out with a 2.5 wide sod seeding machine with 13 tines.

In order to assess the performance of the machines used for the various trials, standardized methods [1] were adopted. The work times for the cultivation operations (weeding, fertilising, tilling and sowing) were found and the work capacity (ha/h) and work unit times (h/ha) calculated. The energy consumption (kg/ha) of the tractors used was quantified by means of the "refilling in the field" method. The costs (€/ha and €/kg)) were calculated on the basis of current prices charged by third parties in the area under consideration.

At harvest time the productive yield was determined (kg/ha).

From the second trial year, after sowing, periodically samples of soil were taken for each hypothesis at a depth of 20 cm in order to determine the water content.

The energy return on investment (EROI) were calculated for each hypothesis and data were statistically processed.

Figure 1. Mechanical seeder

Figure 2. Sod-seeding seeder

Results

In general, "no-tillage" thesis showed a better efficiency and timeliness because mean work capacities were always higher than other theses, as well as unit work time of this thesis. With "minimum tillage", on the other hand, it is possible to obtain higher work capacities and equal or even lower unit times than those obtained with "tillage", given that fewer runs are carried out and an inferior depth required.

These results would imply that over a long period in the "tillage" cultivation of durum wheat there is a greater consumption of energy and work. On the other hand, these results show that the "no-tillage" hypotheses allow considerable savings of diesel consumptions, but it is right to consider the costs of the herbicide used in pre-sowing weeding.

[1] See CIOSTA (Commission Internationale de l'Organisation Scientifique du Travail en Agriculture).

From the data collected, it would seem that ploughing and deep harrowing with a cultivator for the first tillage use the most fuel. The other cultivation processes do not seem to greatly affect consumption, but it is very important to highlight the importance of selecting a suitable tractor to trail the machines in order to reduce energy consumption.
In all years, there were a remarkable increase in the yields of the "tillage" and "minimum tillage" thesis and particularly the differences were not significant statistically. The earlier sowing permitted the no-tillage hypothesis to show its production potential.

Conclusions and perspectives
The results obtained demonstrate the adaptability of the conservation techniques because a significant reduction in energy consumption and in CO_2 was also obtained. The differences in cost per surface unit between the hypotheses appear to be irrelevant, especially for the years in which ploughing was not carried out.
In the specific context the results show even if the average yield are lower in "no-tillage" than in "tillage" thesis, the variable costs are also lower. This is due to the greater work capacity in "no-tillage" thesis than in "tillage" thesis as well as the lower energy input consumptions and best EROI.