

Ducks to weed rice fields: a promising crop-animal farming for Camargue organic rice producers

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A partnership between researchers and farmers to innovate in the management of weeds:

European agriculture must now face the need to invent less polluting and more sustainable cultivation systems. In Camargue, rice producers have embraced that approach. In partnership with the Institut National de Recherche Agronomique (INRA / *National institute for agronomic research*) and France Agrimer, they are experimenting alternatives to chemical weed control agents. In 2011, the INRA carried out the agronomic diagnosis of a farmer's innovation: the introduction of ducks in the rice fields. In Japan, this technique is applied after rice transplanting. In Camargue, rice seeds are broadcast after immersion of the field. Adapting the Japanese technique to the Camargue context proved a genuine challenge: the farmer opted for line sowing, i.e. buried and dry sowing, to later allow the ducks to move around the rice field between the lines of rice. He also selected a race of non-flying Mulard ducks; among which only the males are of interest to producers of foie gras. The purpose of this communication is to assess the agronomic relevance of this technique as an alternative to chemical weed control agents. The agronomic diagnosis made it possible to measure the effect of the sowing method on the emergence of weeds (compared to the stock already present in the soil) and to observe the ducks' capacity to eat them up without damaging the rice. The study was centered on barnyard grass (*Echinochloa Crus-Galli*), main weed of Camargue (Carlin et al, 2004).

An agronomic diagnosis to quantify the evolution of plant population:

The program includes a plot with row planting of dry buried rice seeds, chosen by the farmer in view of duck introduction into the plot and 3 plots with broadcast seeding after immersion (without ducks). The technical method implemented by the farmer in each plot was reported by the farmer in a survey. The agronomic monitoring of plots was performed at the level of a 100m² station in each plot. In the plot intended to welcome the ducks, there were two stations: a "control" station, closed off to prevent intrusion of the ducks and a station accessible to the ducks. Determination of the average stock of weed seeds (0-5 cm layer) was performed after greenhouse germination and counting of seedlings on samples from each station. The sample consisted in 8 blocks (50 cm² by 5 cm in depth) taken from the station's diagonal lines. The densities of rice and weed populations were determined by counting on 4 blocks of 0.5 m² (row planting) and 0.25 m² (broadcast seeding) in each station. The barnyard grass germination was calculated as the ratio: density of barnyard grass at 2-3 leaf stage / barnyard grass seed stock in the 0-5 cm layer. Before harvest, the dry matter (DM) of the barnyard grass at the level of each plot was measured per harvest, drying and weighing. The DM/density of barnyard grass at 2-3 leaf stage was used to estimate the average weight of a barnyard grass plant before harvest.

A sowing method which boosts the emergence of barnyard grass... which feeds the ducks!

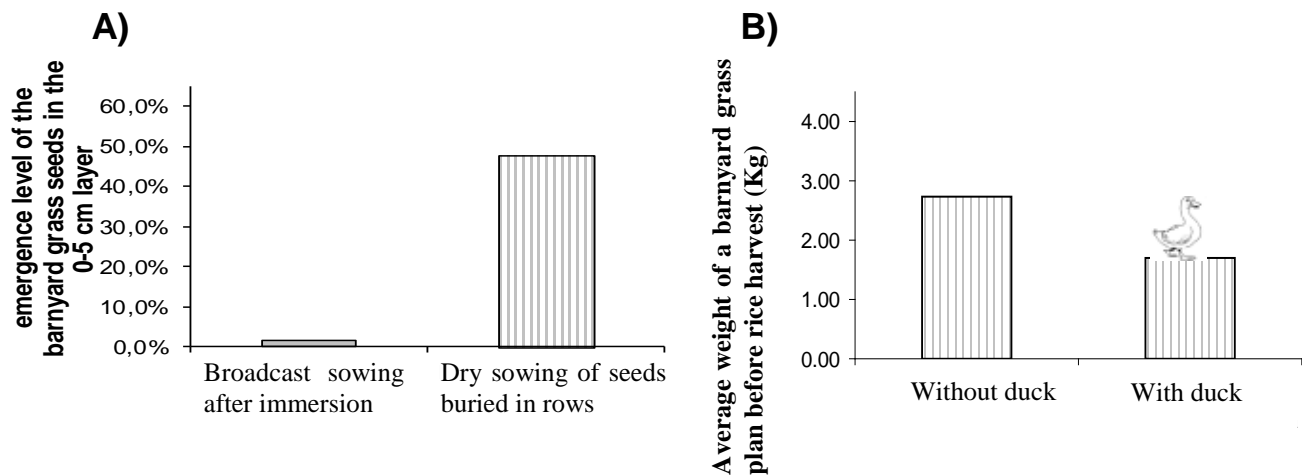


Figure 1: A) Influence of the sowing method on the emergence of the barnyard grass seeds in the 0-5 cm layer. The results shows that dry sowing of seeds buried in rows, to allow the ducks to cruise around the plot, greatly boosts the emergence of barnyard grass as compared to broadcast sowing after immersion.

B) Weight of a barnyard grass plant before the rice harvest, with or without ducks in the plot with row planting. This result shows that the ducks cut off the stalks of barnyard grass, trample them and thus limit their growth.

Our results show a 47.8% average emergence of barnyard grass seeds in the plot where rice is sown in line to welcome the ducks, against a mere 1.5% in plots where the seed was broadcast after immersion (Figure 1A). This rate of emergence in the row-planted rice plot corresponds to an average density of 131.5/m² barnyard grass at stage 2-3 leaf of the rice. This high density of barnyard grass at stage 2-3 leaves of the rice is accounted for by a weak competition from the rice, sown at low density, but also by a period of 12 dry days after sowing the rice. Indeed, dry soil proved favorable to the emergence of the barnyard grass. In the plots with broadcast seeding, the 15 cm of water at the moment of sowing prevented the emergence of the barnyard grass. As a matter of fact, under a 2-3 cm waterbed, the absence of oxygen prevents the emergence of barnyard grass (Chauhan et Johnson, 2011). The type of sowing chosen by the farmer to allow the entry of ducks therefore does not seem to be favorable to the primary aim which was to fight off barnyard grass. However, our results showed that in a row-planted plot with dry buried seeds, the average weight of the barnyard grass plant is lower by 1 kg in the presence of ducks (Fig 1B). The ducks cannot totally kill the barnyard grass as was expected by the farmer in view of results achieved in Japan (Tanveer et al., 2005). In fact, when the ducks were introduced in the plots, the barnyard grass was too developed to be completely eaten up. But the ducks cut the stalks of barnyard grass, trampled them, leaving dirty water behind, thus stopping their development. At harvest, the biomass of barnyard grass in the station with ducks was lower than in the station without ducks (2.46 t/ha vs 2.97 t/ha) and the rice yield was improved by 24% (2.85 t/ha vs 2.25 t/ha). We have thus highlighted the relevance of adaptation choices made by the farmer: in spite of a strong density of barnyard grass in the beginning, related to the sowing method, the ducks made it possible to curb their development and thus, to reduce the competition they impose on rice. Moreover, duck integration in rice fields offers interesting perspectives: the farmer chose to sell some of them to have a return on investment and keep the rest so that they would eat up the grains of barnyard grass during the winter. The economic assessment over several crop cycles of this rice-duck farming interaction remains to be analyzed.

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