# A tool to identify cows eligible for Selective Dry Cow Therapy (SDCT)

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## Introduction

Bovine mastitis is an inflammatory condition affecting the udder tissue of the mammary gland, typically triggered by physical trauma or infections from microorganisms. It is the most common disease in the dairy industry, leading to significant economic losses due to reduced milk yield and poor milk quality (Gomes and Henriques, 2016). On average, the total economic loss attributed to bovine mastitis is estimated at $147 per cow annually, primarily due to decreased milk production and culling. This represents 11% to 18% of the gross margin per cow each year (Hogeveen *et al*., 2019). Damage to mammary tissue, resulting in decreased milk production, accounts for approximately 70% of these total losses (Zhao and Lacasse, 2008).

Bovine mastitis can be classified into three categories based on the degree of inflammation: clinical, sub-clinical, and chronic. Clinical bovine mastitis is easily detectable through visible abnormalities such as a red and swollen udder, and fever in the affected cow. The milk appears watery with flakes and clots. Clinical mastitis can be further subdivided into per-acute, acute, and sub-acute, depending on the severity of inflammation. Severe cases of clinical mastitis can be fatal. In contrast, sub-clinical mastitis shows no visible abnormalities in the udder or milk, but milk production decreases with an increase in the somatic cell count (SCC).

Mastitis significantly impacts the profitability of dairy farms. The major economic effects of mastitis in dairy cattle breeding include:

1. **Decreased milk production**: Mastitis reduces milk yield in infected cows, affecting the overall profit potential of the dairy operation.
2. **Loss from discarded milk**: Milk discarded during treatment or deemed unsuitable for human consumption (with SCC >200,000 cells/ml) represents a significant loss. A cow is not profitable unless she produces saleable milk.
3. **Veterinary fees and drug costs**: Expenses for mastitis diagnosis and treatment.
4. **Additional labour demand and related costs**: Managing infected cows, including veterinary treatment and health monitoring, increases labour costs, which can be challenging, especially when labour is scarce or expensive.
5. **Increased risk of culling and cow mortality**: Decisions to cull cows due to mastitis can substantially impact the dairy's economic performance, with premature culling leading to significant losses.

The negative effects of mastitis underscore the importance and necessity of effective management and prevention strategies. The risk of mastitis onset is not constant throughout the productive life of a dairy cow. The dry-off period is a critical time due

to a decrease in immune defences (Schukken *et al*., 2011). At the beginning of this period, the absence of physical barriers, such as keratin plugs at the nipple sphincter, allows mastitogenic agents to enter (Schukken *et al*., 2011). According to Green *et al*. (2002), 50% of environmental mastitis cases in the first 100 days of lactation originate from infections contracted during the dry period. Consequently, significant efforts are made during this period to prevent mastitis infections.

## Treatments against mastitis during dry-off

The traditional approach to preventing mastitis during the dry-off period has been blanket dry cow therapy (BDCT). This veterinary protocol involves two main criteria for dried-off cows:

1. treating all udder quarters with antibiotics to eradicate existing infections at the time of dry-off and prevent new infections during the dry-off period, and
2. using an external or internal sealant for nipples to prevent pathogen entry into the udder.

BDCT is a prophylactic approach recommended to reduce intramammary infections, decrease the prevalence of contagious pathogens, and contribute to the overall reduction in bulk tank somatic cell count (SCC). While this approach ensures a robust risk protection, it requires high antibiotic usage and associated costs, contributing to microbial antibiotic resistance to both animals and humans.

The growing demand for responsible antimicrobial use and cost reduction for farmers promoted an alternative approach known as selective dry cow therapy (SDCT). This method consists in treating individual cows based on a risk factor analysis and administering antibiotics to cows showing infection symptoms at dry-off only. The correct application of the SDCT protocol reduces antibiotic by 21-60% without compromising health status in the subsequent lactation (Zecconi *et al*., 2020; Cameron *et al*., 2014; Kabera *et al*., 2020; Rowe *et al*., 2020a, 2020b). In 2019, the European Union approved the Prohibition of Antibiotics for Prophylaxis (EU Reg. 2019/6), officially replacing BDCT with SDCT.

SDCT relies heavily on a thorough assessment of mastitis risk factors at the individual level, primarily based on somatic cell counts and, more recently, on differential somatic cell counts, both produced routinely by DHI milk analysis

To promote the adoption of the SDCT approach in Italy, the Italian Breeders Association (A.I.A.), the official Dairy Herd Improvement Association (DHIA), developed a tool called “Report Asciutta Selettiva” (Selective Dry-off Report). This tool is designed to assist farmers and veterinarians in accurately identifying cows eligible for SDCT therapy.

The tool complies with National Veterinary Official Protocols and allows users to input a set of parameters and thresholds, enabling the algorithms to be customize to specific needs and circumstances.

## How the tool works

The tool implies two steps:

1. listing candidate lactating cows for drying-off (e.g., pregnant or low production cows), and
2. applying protocols based on SCC and other information to select cows for treatment based on their specific risk.

## Step 1. Use DHI data to list candidate lactating cows to be dried off

Farmers can access A.I.A.'s performance recording data (both current and historical) through the dedicated software Si@lleva, which includes the selective dry cow therapy (SDCT) report. This tool enables farmers to select a specific date, either the current day or a future date, to list the candidate cows candidate for SDCT treatment based on two independent eligibility criteria

### *Pregnancy status*

Among the lactating cows those with a positive pregnancy diagnosis are selected and their conception date is calculated to predict:

1. The expected calving date as "Conception date plus 283 days" where 283 days is the average gestation length in Italy.
2. The expected dry-off date as "Expected calving date minus Average farm dry-off period" in days, where the average farm dry-off period is selected by the farmer.
3. The number of days between the current date and the expected dry-off date.

If the number of days between the current date and the expected dry-off date is less than the average farm dry-off period, the cow is eligible for drying off. Otherwise, the cow is not eligible (Figure 1).

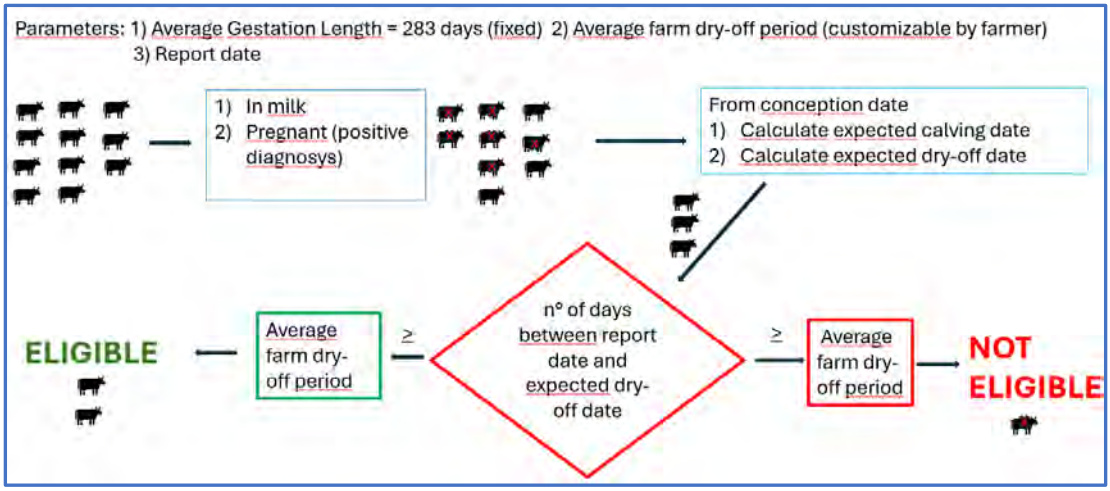


*Figure 1. Identification process of lactating cows eligible for dry-off basing on pregnancy status*

### *Daily milk yield individual production*

The second criterion (Figure 2) for identifying cows eligible for dry-off is low milk yield. Cows no longer profitable for their milk production should be dried off. In this step, two main parameters must be set by the farmer:

1. the threshold milk yield (m) below which the cow is no longer profitable (for Italian Friesian, the default is 14 kg), and
2. the stage of the lactation curve to monitor is specified as the number of test days (n) after which monitoring begins (default setting:4 test days).

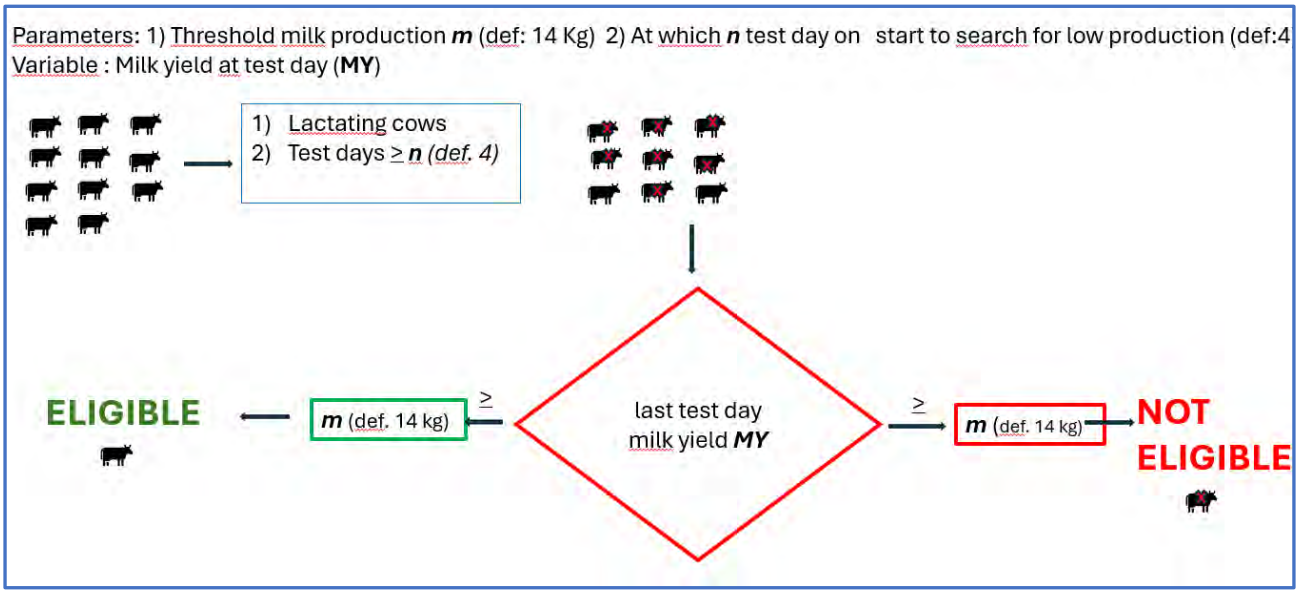


*Figure 2. Identification process of lactating cows eligible for dry-off basing based on milk yield.*

If , during the monitored lactation period the MY is less than the threshold value, the cow is eligible for dry-off. Farmers can modify the parameters n and m to set different productivity thresholds at various stages of lactation.

## Step 2. Elicit the cows to be treated among the selected

To select cows to be treated with SDCT among those eligible for dry-off (step 1) we combine data from DHI with all other available information on mastitis such as the California Mastitis Test or antimicrobial scans. More in detail, if DHI data only are available, cows will be treated if:

1. the average somatic cell count calculated on a fixed number of sequential Test Day data is above the threshold
2. the value of somatic cell count is above the threshold in at least one among a fixed number of sequential test days

Both the number of sequential test days and somatic cell count threshold can be user-modifiable

One the Eligible criteria and the protocols parameters are set, the system generate the comprehensive report in Figure 4.

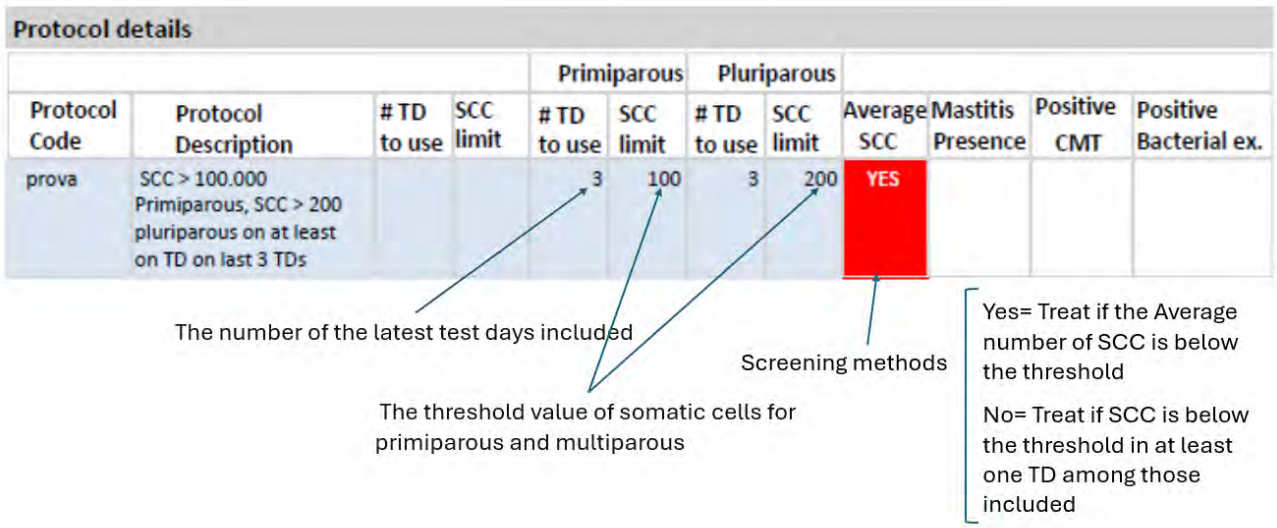


*Figure 3. Example of a customized setting.*

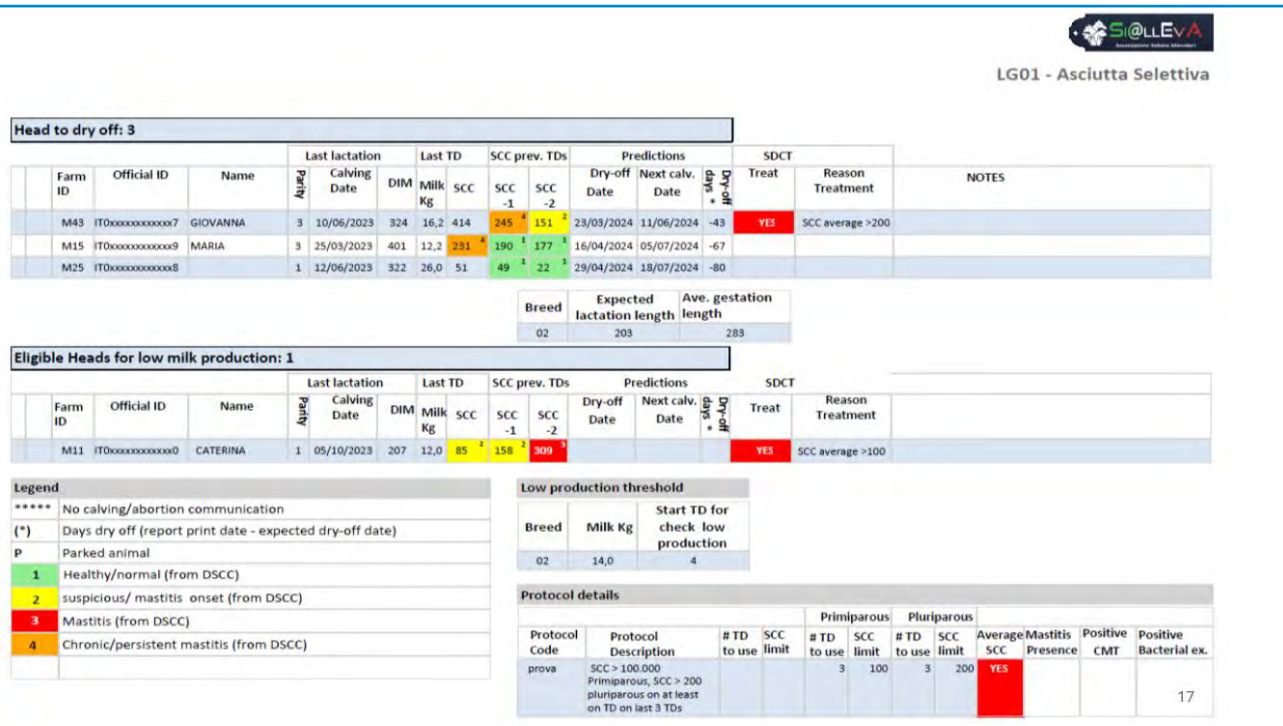


*Figure 4. Based on one the eligible criteria and the protocols parameters are set, the system generate the comprehensive report.*

## Adoption of the tool in Italy

The tool is freely available to all dairy farmers enrolled in A.I.A.'s official milk recording activity through the proprietary software Si@lleva. Each recorded farm can access all the information collected during milk recording up to the last test day.

Currently, about 14,000 farms are enrolled in the dairy milk performance recording activity. Of these, more than 500 farms (approximately 4% of the total recorded herds) are using this tool, involving about 7% of the total recorded dairy cows in Italy. The regional distribution of herds using this tool is presented in Figure 5.


Figure 5. Regional distribution of herds using the tool.

## Conclusions

The tool is freely available to all herds participating in A.I.A.'s milk performance recording program. It complies with National Veterinary Official Protocols and allows the setting of parameters and thresholds, according to specific needs and conditions. Its availability promotes the adoption of the Selective Dry Cow Therapy (SDCT) in Italy, helping farmers and veterinarians accurately identify cows at lower risk of mastitis and reduce unnecessary antibiotic treatments. Of course, Veterinarians are the only professionals authorized to prescribe medical treatments,

By incorporating additional diagnostic tools such as the California Mastitis Test (CMT) or PCR analysis, the accuracy of mastitis risk assessments and treatment decisions is further enhanced. This improvement will help promote best practices based on more precise diagnostic data still not very common.

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