

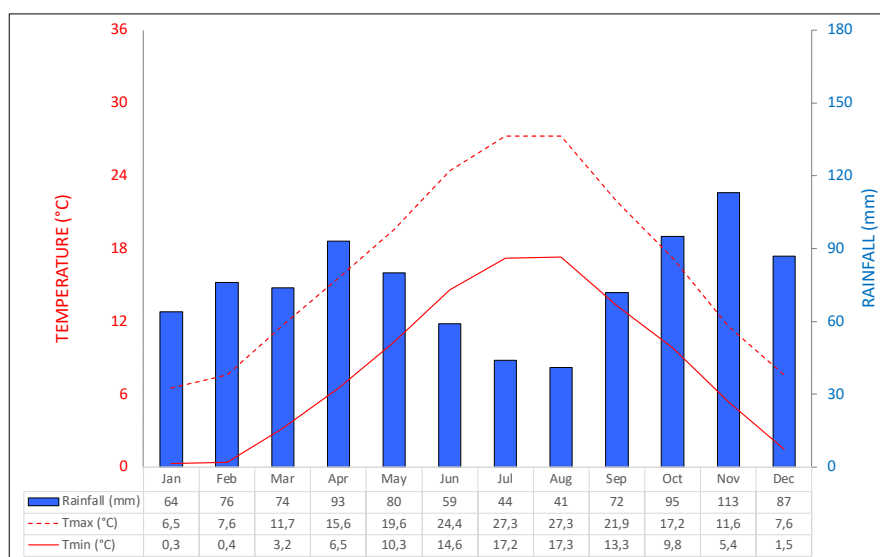
Testimonial video and associated training material

2. Spotlight on organic manure



Lorenzo Guidalotti is a young farmer working on his family farm for over 10 years. They always produced drinking milk and more recently they developed other sectors such as “Cinta Senese” pigs breeding in the wild and the growing 5 hectares of vegetables. Lorenzo and his family grow various crops to feed dairy cattle such as silage maize, forage and grain sorghum, forage wheat, barley and a mix of winter forages of legumes and cereals, and alfalfa.

Over time, they have gradually changed their minds about livestock manure. They have moved from considering it as a waste to be disposed of (and therefore a cost) to its agronomic valorization with considerable environmental and economic benefits, since they drastically reduced the use of synthetic fertilizers.



The area has a continental climate, with significant rainfall throughout the year, cold winters and hot summers.

The mean annual temperature is around 12°C and cumulative precipitation almost reaches 900 mm.

It is a hilly area, with predominant clay soils.

Observed benefits

∅ *Nutrients supply*

Manure contains a range of nutrients that are essential for plant growth. Especially the liquid fraction, is sufficient to cover the nutritional requirements of the cultivated crops as 1 m³ of slurries can contain up to 4 kg of nitrogen. Also, manure carries a balanced supply of meso- and micro-nutrients, usually sufficient for the plant's needs: sulphur, magnesium, calcium, manganese, boron, copper.

∅ *Improved soil fertility*

The solid fraction contains from 15% to more than 40% of organic matter and a significant amount of nutrients (nitrogen, phosphorous, and potassium). Due to its composition, manure improves all aspects of soil fertility:

- physical, improving the regulation soil moisture by reducing runoff and waterlogging while increasing infiltration and water holding capacity, thus increasing soil workability.
- microbiological, providing nourishment to those microorganisms essential for the protection of the plant root system and for its efficient nutrition.
- chemical, acting as a 'bank' where the nutrients that plants need at specific points in their cycle are kept available for years.

∅ *Economic and environmental sustainability*

The use of manure closes an important virtuous circle that makes agriculture sustainable, thanks to the link between crop production and animal husbandry, which manages to recycle all products and by-products, turning them into resources: manure becomes fertilizer and not a waste difficult to dispose of; straw and fodder are functional for the stable, which increases its economic value.

Observed limits

The use of manure has potentially negative aspects only if it is not properly produced or managed.

∅ *Unmatured manure*

If manure is fresh (less than three months), it can have a very low nutrient content and an increased presence of weeds and pathogens can be brought to soil.

∅ *Unsuitable manure*

Attention should be paid to feedstock management (nutrition, health, etc.), to avoid the presence of heavy metals or antibiotics.

∅ *Unsuitable machinery*

Unsuitable spreading machinery may result in uneven distribution and soil compaction.



When?

In general manure applied in autumn has time to break down before the spring growing season, providing nutrients to the soil, and improving its structure. However, in very loose soils, it is preferable to wait until the time of sowing/transplanting so as not to lose organic matter.

Perennial plants should have manure applied shortly before planting, while annual crops should have manure applied every 3-5 years before planting.

How much?

To establish the right amount, considerations must be made regarding the type of crops and their rotation, the use of green manure or other organic matter, the soil and its characteristics, the climate and the type of manure. Further, it is important to know that in **organic farming** there is a limit of **170 kg per hectare per year of nitrogen from animal origin** (42-44 tons of cattle manure).

How?

Manure should be buried in the surface (15 -20 cm) using light implements such as a disc harrow, to facilitate mixing with the surface layer of the soil.



Manure maturation

Fresh manure: is manure with less than 3 months of maturation, in which the plant residues are still visible and not homogeneously mixed with animal dejection. At this stage, manure normally contains too much nitrogen and pathogens and weed seeds can be present, so its use is not recommended.

Matured manure: it has at least 9-10 months of maturation and plant residues is largely processed by microorganisms. Maturation process is due to fermentation. During this phase, the high temperatures reached devitalize most of pathogens and seeds, while nutrients become stabilized. It may be used, but it should be distributed 3-4 months before sowing in order to complete the fermentation in the soil.

Composted manure: it has more than 12 months of maturation. Fermentation and sanitization are completed. It looks like a fine compost and the different components cannot be distinguished. Composted manure can also be used shortly before sowing.

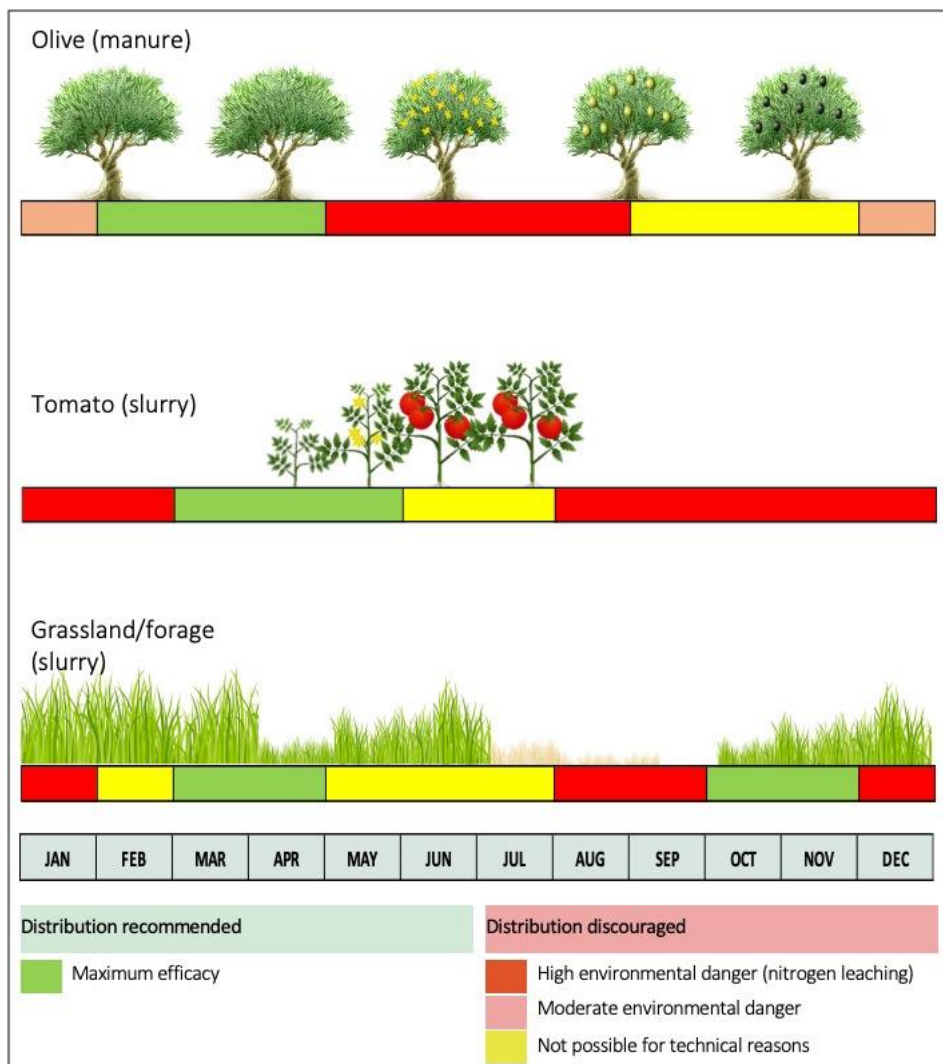
In addition to the nutrients contained in manure, the humus that develops from it has a key role in making available to plants minerals that, although present in the soil, are not in an absorbable form. Phosphorous and iron, for example, are 'hooked' by organic molecules and made more absorbable by plant roots.

Animal	Manure nutrient content			
	N	P ₂ O ₅	K ₂ O	Organic Matter
Cattle	0,37%	0,12%	0,33%	16%
Sheep	0,81%	0,21%	0,82%	30%
Horse	0,69%	0,22%	0,71%	26%
Poultry	2,00%	1,30%	2,50%	43%
Pig	0,45%	0,21%	0,60%	23%

Composition of manure is very variable and depends on the animal species from which it is derived (cattle, horses, sheep, etc.) and the origin of the bedding (cereal straw, maize stalks, hay, etc.), as well as the preparation and maturation process.

Livestock slurry

Slurry is obtained by storing only the liquid manure and water in tanks for at least three months. The lack of plant residues (straw, maize stalks, etc.) makes slurry poor in organic matter and rich in nutrients, especially soluble nitrogen. Nitrogen is quickly available to crops, however, it can be easily leached into groundwaters. Further, the spreading phase can release significant amounts of ammonia into the atmosphere.



For these reasons, its use is regulated by laws in many countries and many factors should be taken into account before spreading on soil. Here, it is reported the suitability of different times of the year for the distribution of manure and/or slurry according to the crop type, the crop development and the potential risk for the environment.

Periods for manure and slurry distribution should be adapted to local soil and climate conditions, and to local regulations.