Supplementing pastures with nitrogen

Adding nitrogen fertiliser will increase productivity and precocity of the fields. It can be beneficial if the purpose sought for the said field is intensive yield. It also contributes to the selection of grass species which are considered productive for feeding horses.

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Technical level

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What role does nitrogen play in plant development ?

Nitrogen (mineral element N) is the main **mineral component of plants**. Nitrogenous nutrition aims to provide the necessary nutritional elements to ensure multiplication of plant cells and tissues which constitute plant dry matter (DM) (DM= total amount of matter – water content). Nitrogen also plays a part in **favouring absorption by the plant of other nutritional elements in the soil**.

- For non-leguminous plants, nitrogen is absobed from the soil in two different forme :

- **Ammonium nitrate** in the form of **ammonium NH_4^+** ion, fixed by the soil. It is only available to the plant when near the roots.
- **Nitrogen in a nitric form**, **or nitrate (NO_3^-)** : more advantageous to the plant, it is mobile in the soil because soluble in water. It is therefore more readily available to the plant's roots

- **N2** (from the atmosphere) is absorbed by bacteria on the root knots of leguminous plants. This type of plant does not need a mineral form of nitrogen fertiliser.

Moreover, maximum efficiency of nitrogen fertiliser is only obtained when other nutritional elements (P -K) are not restrictive.

Lack of nitrogen directly affects the production of chlorophyll, and leads to yellowing of the grass leaves

In excess, nitrogen fertilisers lengthen the vegetative period, and delay plant maturity. They can also cause increased sensitivity to disease and parasite attacks. Another consequence is higher production of dry matter which is subject to laying or increased rough areas if the grass is not grazed on soon enough.

Why fertilise ?

The action is threefold :

- **Soil enrichement** : The effect is to add structure to the soil. It increases the Capacity of Exchange of Cations (CEC) and the useful reservoir (Capacity of the soil to retain water). It contributes to soil fertility.
- **Fertilising** : It provides the elements N, P and K, as well as the micro-nutrients the plant needs to develop and grow.
- **Living matter** : it is composed of micro-organisms (bacteria, fungus,….) which will contribute by mineralising organic matter, i.e transforming it into nutritive ions (NO^{3-}, HPO_4^{2-}) for the plant.

Manure is best spread on mowed fields used for hay, as fodder exports mineral elements, whereas grazing animals will restitute organic matter in the form of droppings and urine.

Why fertilise ?

For grass (Poaceae) species fertilising increases :

- **Precocity** : faster production of dry matter
- **Productivity** : Greater total production per plant life cycle.

Be careful, nitrogen fertilising favours the development of grass species, but is detrimental to the root system of leguminous plants (clover,….). Legumes absorb nitrogen from the air, not from the soil. Thus, it is better to opt for chemical nitrogen fertilisers early in the season (end of winter), when leguminous plants are still dormant, compared to grass, which has started growing.

Is nitrogen fertiliser necessary for pastures ?

For grazing

- Nitrogen fertilising is recommended when grazed intensively in the Spring. E.g rotational grazing, when grazing load is < 1 acre (30 – 40 ares)/ LSU (large livestock unit).
- Nitrogen fertilising is unneccessary when during spring grazing is more extensive : e.g continuous grazing with a grazing load > 1 acre /LSU

For fodder production

Grass growing following mineral nitrogen fertilising © P. Doligez

Nitrogen fertilising is recommended if high fodder yields are expected. Nitrogen fertilising (in large quantities : 100 units N/ ha, in 2 or 3 spreads, with no more than 50 units N/ha in one spread) increases the protein content in forage crops harvested early (before heading stage). It is beneficial when producing good quality fodder (haylage, hay) for horses with high needs.

To produce high fiber fodder, harvested later in the season (end of June, July), for animals with lesser needs, nitrogen fertilising is unnecessary.

What kind of fertiliser should be used ?

Fertilising can be done by spreading organic matter (liquid manure, compost) or with a chemical compound fertiliser. We favour recycling organic matter fromthe farm, rather than buying chemical fertilisers.

Nitrogen fertilising by spreading compost on the field

To cover the needs to maintain a natural pasture, producing around 6 tonnes of dry matter/ ha, a supplement of **15 to 20 tonnes of compost/ha is necessary**.

For compost based on horse manure, the agronomical values are the following (in kilogrammes per tonne of gross product) :

- Nitrogen (N) : 5.2
- Phosphorous (P) : 3.7
- Potassium (K) : 7.9
- Calcium (Ca) : 12.1
- Magnesium (Mg) : 1.6

With a total of 15 tonnes/ha spread on a field, the fertilising elements measured in agronomical units are the following :

- Nitrogen (N) : 78 (15 x 5,2 = 78 uN)
- Phosphorous (P) : 55
- Potassium (K) : 120
- Calcium (Ca) : 180
- Magnesium (Mg) : 24

The N units in organic form are freed progressively. Mineralisation (deterioration of organic matter into nutritive ions (NO3-, HPO42- …) is slow for the plant, and reaches a maximum when the temperatures are hot in Summer.

Thus for 78 units of N in the compost, 10-20 will be available to the plant in the first year, then a further 10 the following year.

Thus, the nitrogen available is low in the first year, due to the fact that it is being modified through the compost process to become stable, with an organic fraction mineralising progressively. When compost is spread regularly (every year), the deferred effects are substantial. Nitrogen from the previous spreads becomes available.

In the first two years, it can therefore be beneficial to provide a supplement of ammonitrates (Chemical N) to alleviate the lack of avilable N for the plant.

Compost in early stages of maturation (100 % horse manure) © IFCE

Compost once spread on a field (15 tonnes/ha) © P. Doligez

Using chemical nitrogen fertilisers

It is justifiable to supplement with a chemical nitrate fertiliser, when early yields are wanted at the start of the season (intensive grazing, harvest of haylage, high protein levels for fodder…). At the end of Winter, mineralisation of organic matter in the soil is slow, (low temperatures). The start of growth of the plant needs high levels of available nitrogen, which can only be met by adding a chemical fertiliser at the start of the season.

In an extensive grazing situation, where the grazing load is <1 LSU/ha (approximately 1 horse for 1 ha (2,5acres) of field for both grazing and fodder production), mineralisation of organic matter provided through droppings and manure or compost spreading, and the natural fixing process of atmospheric N by leguminous plants, will suffice to produce the grass necessary to feed the horses.

Example of chemical nitrogen fertiliser :

- **Simple** (N) : ammonitrates, urea, liquid nitrogen solutions
- **Binary** (ammonia-phosphates N-P, potassic- nitrates (N-K))
- **Tertiary** (N-P-K : 17-17-17 fertiliser for example)

Simple nitrogen fertilisers : these are manufactures from ammonia, obtained by combining nitrogen in the air with hydrogen from natural gas.

Ammonitrates : nitrogen fertilisers which are the most widespread in use in France and Europe, are obtained from ammonium nitrate, and the addition of a variable inert load (calcium carbonate or dolomite). They contain a total of 21 % to 33,5 % of nitrogen, of which 50 % ammonium nitrate and 50 % nitric nitrogen. Nitrogen fertilising using ammonitrates, which is the most widely used fertiliser (50% NH_4^+ and 50% NO_3^-), is a source of nitrogen which the plant can absorb directly (Source UNIFA)

Spreading chemical fertiliser : when is the best time

The date when you first spread nitrogen fertiliser, in order to optimise grass production in spring, is defined when a total of 200°C is reached. This 200°C sum total of temperatures is calculated by adding minimum and maximum average daily temperatures above 0°C, starting on January 1st. The calculation is available on Arvlis website : date N'Prairie . If you are looking for early production, be careful as this supposes being able to use the grass for grazing, in the month following fertilisation. This means that soil enrichment on a plot with low carrying capacity, is of little benefit early in the season.

Subsequent soil enrichments : after a grazing cycle, or after mowing, wait for new green shoots to emerge (at least 48h) before spreading a nitrogen fertiliser. The young shoots are actively growing and need high levels of nutrients.

To be efficient, 15 to 20mm of rain in the two weeks following fertilisation prevents loss through volatilisation, and favours transfer of nutriens to the roots.

What quantities should be provided ?

For fiels used for grazing and /or forage crops, the quantity of nitrogen fertiliser should take into accout :

- **Total « exports** » : quantity of DM ingested or harvested. This depends on whether the grass is used intensively : fast rotational grazing, or extensive : late harvesting of hay.
- **The supplies in the soil** : organic matter added, frequency of soil-enrichment, and ratio of leguminous plants.
- **Restitutions to the fields** : quantities of fertilising droppings, or the number of days and number of animals grazing.

Examples of nitrogen fertiliser quantity with regard to the expected yield, or for a spring grazing load

Yield expected for the field in tonnes of DM/Ha	Nitrogen input (N units)	Spring grazing load (in 100m2 per LSU)	Required dose of nitrogen (N units)
5	0 to 25	>40	0
6	25-50	<40	40
7	50-75	<30	70

Example for the calculation of a dose of nitrogen fertiliser to be used, taking into account the characteristics of the plot (simplified nitrogen fertiliser assessment)

Nitrogen input dose required= (expected yield x 25) -(Organic matter restitution + supplies in the soil + organic matter input)				
Expected yield expressed in tonnes DM x 25	Restitution au pâturage ▪ Pâturage : 40 unités d'N/ha/an pâturage ▪ Pâturage + fauche : 20 unités d'N/ha/an	Fournitures du sol ▪ 30 unités d'N/ha en sols superficiels ▪ 90 unités d'N/ha en sols profonds	Apports de matières organiques en N Exemple d'un compost : 15 unités d'N disponibles)	Dose (en unités d'N/ha) à apporter à la parcelle
6X25 = 150	20	60	15	150-(20+60+15)=55

Is enriching the soil with nitrogen harmful for horses ?

There is a preconceived idea that nitrogen enriched grass is bad for horses, and induces metabolic diseases.

Comparison of Total Nitrogenous matter of grass on a fertilised or non fertilised field

	Average nutritional value of fertilised or unfertilised pastures (Delaby, 1999)			**Values of grass at different vegetation stages (INRA, 2012)**		**Values measured on pasture areas with a predominance of white clover (Manteaux, 1996)**	
	No nitrogen	Input of 100 N units	Input of 300 N units	Leafy stage	Flowering stage	15%	60%
Value of Total nitrogenous Matter (g/kg DM	120 to 180	160 to 180	200 to 225	215	92	200	350

The horse is adapted to ingesting grass with a high nitrogen content. However, it is a good idea to respect a transition period towards rich grass in the spring. Fertilised grass (leafy stage) is adapted for 100 % feeding, without any need for supplements, for animals with high needs (lactating mares, growing foals)

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