

H Y D R O

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photos by J. Blom

After more than ten years experience with the hydroponic green foder system, Yeguada Ferrero obtains a natural, nutritive and vitaminic feed for their horses, 365 days a year with a homogeneous production and consistent quality. Apart from the aforementioned advantages, it is appetising for the Yeguada Ferrero animals. The grass contained in a balanced diet has on countless occasions proved to be the perfect supplement for digestion, growth, reproductive processes, as well as the general exterior aspect of the horses, which boast fine, shiny hair.



What is Hydroponics?

When we water a plant, we are making it possible for the roots of the plant to use mineral elements in the soil. The plants feed off the nutritive solutions that surround them.

Consequently, whenever water falls onto the ground, nutritive solutions are created. As can be immediately seen, this depends on innumerable factors:

Quantity of water; temperature of the soil, the composition of the same, added fertiliser, etc. Moreover, there are considerable variations over time, as the soil solution concentrates as the plants extract water from the same. At different times of the day, month and year, a plant will be exposed to different solutions, which do not always coincide with that required for optimum development.

To remedy this situation, we water and use fertiliser in excess, with the aim of obtaining the appropriate nutritive solutions for the longest time possible.

If we do without the soil and place the plant in an inert substrate, providing its root system with pre-prepared nutritive solutions, we will achieve the following:

- **Saving of water:**
- **Saving of fertiliser:**

This is hydroponics: the cultivation of plants without soil, fed with pre-prepared nutritional solutions.

Innumerable techniques have been developed over the last 50 years in this field, with good results being achieved:

- * **Greater production per m² of land**
- * **Cultivation in areas with infertile soil**
- * **Higher production per plant**
- * **Greater control of plagues and illnesses**

Using the hydroponic principle, Yeguada Ferrero has developed a system that permits the germination and cultivation of cereals and leguminous plants, producing green fodder from seed in cultivation cycles of eight days. The equipment allows continuous production throughout the whole year, achieving consistent quality and composition of the green fodder.

Hydroponic Green Fodder

In the germination process of a seed a series of very important qualitative and quantitative transformations occur.

The germ, which is the embryo of the future plant, from a store of energy in the form of carbohydrates or lipids, is capable of transforming itself into a plantlet with the

capacity to absorb solar energy (photosynthesis) and absorb mineral elements from the nutritive solution.

In this state, the plant, with respect to both its exposed area and root system, is in accelerated growth, possessing little fibre content and a high protein content, part of which is in a state of new formation. Consequently, the majority of the amino acids are in a free form and more easily useable by the animals that consume them.

This is why hydroponic green fodder is a product with special nutritional characteristics, among which are included:

1. It is live

Of course, unlike any other type of fodder not directly consumed by mouth in a meadow, this is a product that goes into the animal's mouth alive, in full growth, thus conserving all the vitamins and digestive enzymes, which are so important for livestock.

2. It is complete and compound

This fodder is different from other types, as the animal consumes the shoots, the first green leaves with the remains of the seed with the starch in a mobile state and the root system rich in sugars and proteins. The result is a balanced product, with a complete and constant composition, providing livestock with nutrients in an optimum fashion.

3. It is natural

In its production, only the germinative power of the seed is exploited, there being no artificial process or manipulation in its development.

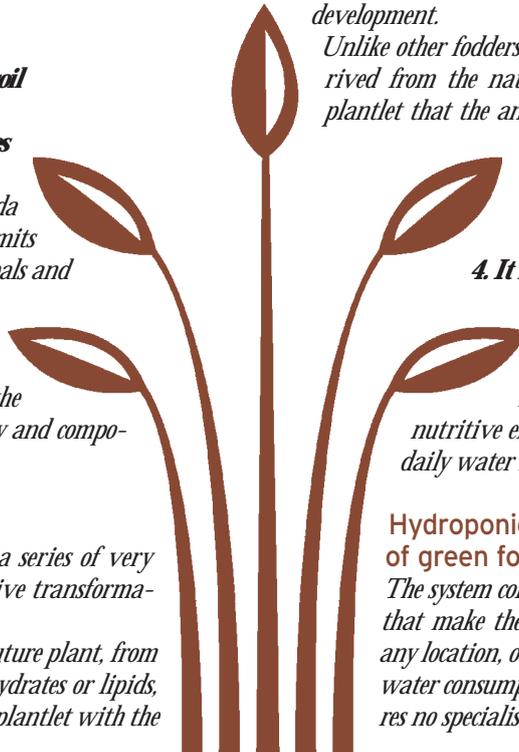
Unlike other fodders or feeds, hydroponic green fodder is derived from the natural germination and formation of a plantlet that the animal eats whole. The same factors that produce the rapid growth of the plant are transmitted to the animal's metabolic process.

4. It is appetising

Its appearance, colour, taste and texture attract the animal which finds that green fodder is a genetically familiar food to it, and which, besides the nutritive elements listed above, contains part of its daily water requirement.

Hydroponic module for the production of green fodder

The system combines a series of technical achievements that make the production of green fodder possible in any location, over a reduced surface area, and with low water consumption and little manpower. It also requires no specialist knowledge.





1. Stage 1 grain ready to sow in trays
2. Stage 1 close-up of grain
3. Hidroponic showing the layout of the trays



2



3

4. Day 1



4

Description

- Germination:

This takes place over plastic receptacles, thus facilitating the soaking and the subsequent aeration of the seeds in a second stage.

The receptacles are mounted over mobile containers that facilitate the task of sowing in the cultivation trays.

- Cultivation:

This is carried out in anti-impact plastic trays. These are distributed over galvanised steel shelving units, thus achieving, due to their stacked position, optimum benefit from available space. This is compatible with the user-friendliness of the system, which is an aspect that is central to the design of all elements of the equipment.

- Irrigation:

The process of irrigation and drainage is completely automatic. A system of sub-irrigation through automatic hydro-valves is used, which achieves a perfect moistening and drainage, while at the same time renewing the atmosphere existing in the root system, by oxygenating it after each irrigation cycle.

The installation employs vertical valve towers, which supply each tray, through their own individual irrigation connections that feature a filter and water diffuser.

The saving of water and simplicity of use has led to the current design. The automatic mechanisms are virtually maintenance-free and are highly reliable in operation.

A self-priming electrical pump is used as a propelling element and a general filter is fitted to the water outlet.

- Climate control:

A climate control unit is fitted to each installation, proportional to the size of the cultivation premises. This allows the control of temperature, humidity and air renewal, and achieves an optimum climate for the plant's vegetative period.

Thanks to a thermostat we can set the "appropriate temperature" and the heat or cold unit will activate accordingly and at the appropriate time.

Lighting:

Lighting is based on fluorescent tubes fitted into sealed light fittings.

The illumination cycle (12 hours per day) is controlled by an electronic timer that automatically turns all the lights on and off.

- Installations:

The system is completed by an electrical installation with a general supply board that includes protection and control mechanisms. The whole installation is watertight and complies with current laws. Similarly, the installation of the complementary plumbing is included.

Operation

The following elements are required:

- Seeds

A multitude of seeds can be used, both cereals and leguminous plants, although excellent results are obtained by using brewers barley. The ratio is 1 to 6, which means that for every kg of seeds used in the installation, 6 kg of hydroponic green fodder is produced. It is best that the seeds have a high germination level (95% in 48 hours), and that they are as free as possible from impurities or fungus spores.

- Water

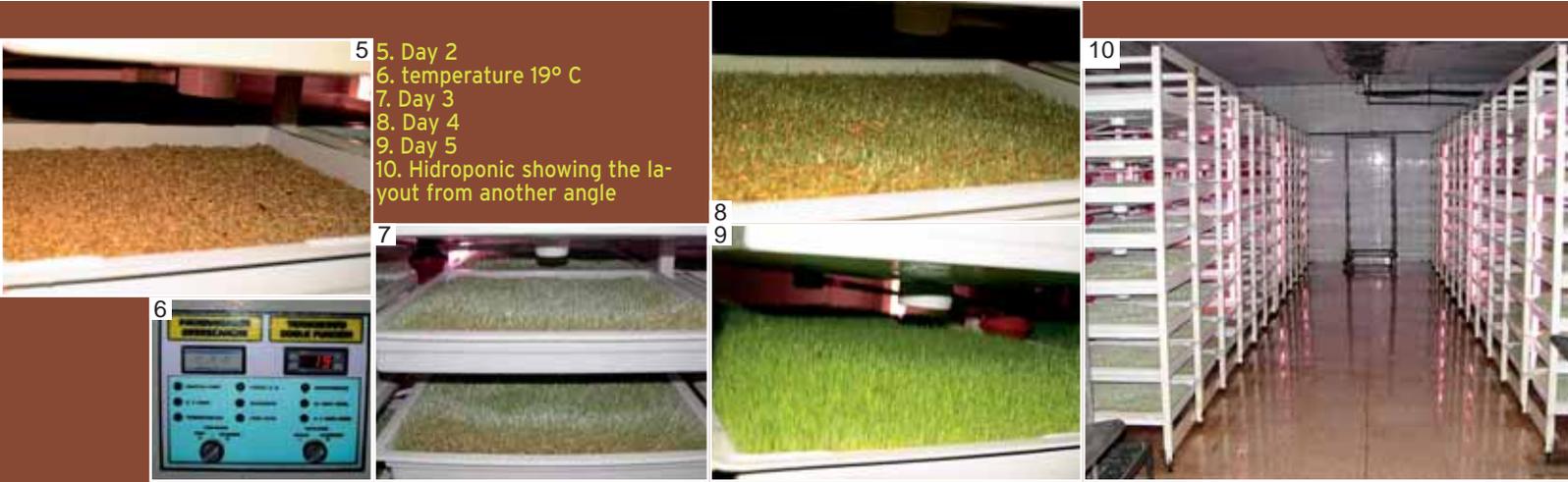
The installation requires two litres of water per kg. of green fodder produced.

- Fertiliser

In order to ensure the maximum nutritive level of the product and to allow the plant to develop in the right conditions, a nutritive supplement is added to the irrigation water. The solution contains the exact proportions of nutrients required to achieve this.

- Light

Allows the induction of certain compounds in the plant (carotenes, chlorophylls, etc.) which complete their nutritive properties and improve the appetite of the animal, while facilitating work operations on the premises.



5. Day 2
6. temperature 19° C
7. Day 3
8. Day 4
9. Day 5
10. Hidroponic showing the layout from another angle

Conclusions

The result obtained will be a very peculiar product, as the seeds placed in trays without substrate, start to root over other, forming a dense carpet that facilitates the subsequent manipulation of the material for its distribution among the animals.

Advantages of the Hydroponic Cultivation System for the production of green fodder.

1. Homogeneous results

Whatever the climate, the livestock farmer can provide the same type of green fodder, on both hot, dry summer days, and the cold days of winter. Meeting the live green fodder needs of your livestock all year round.

2. Considerable saving on water

As we have already mentioned, just two litres of water is required per kg of green fodder produced. This figure is insignificant in comparison with the water required to obtain one kg of irrigated alfalfa (400 l of water per kg of alfalfa produced).

3. Considerable saving on surface

20 kg of hydroponic green fodder is produced daily on one m² of surface (20 kg per day/m²).

Thus, 50 m² dedicated to the cultivation of hydroponic green fodder produces the same annual quantity in kilos as 6 hectares of alfalfa.

In terms of fodder units, the same 5 m² of hydroponic barley cultivation would produce the same quantity of fodder units as 12 hectares of alfalfa.

6. Simplicity of operation

The system requires no special technical knowledge and the design and materials chosen for its construction make it easy to use.

7. Modular

The installations are modular thus allowing for expansion. And, should you wish, changing premises is no problem. Moreover, daily production can be adapted according to the needs of the livestock farmer at any given time.

Summary

The livestock farmer can “manufacture” green fodder on his/her farm all year round, with considerable savings on water, surface area and labour.

Using this method, one can obtain a product with exceptional nutritional characteristics, which will result in greater livestock production.

Comparative Study of Hydroponic Green Fodder Technical Data

NUTRITIONAL ANALYSIS	
DRY MATTER	18.6 %
PROTEIN	16.8 %
METABOLISABLE ENERGY	3.216 Kcal. /kg of DM
DIGESTIBILITY	81.6 %
VITAMINS	
CAROTENE	25.1 iu/kg
VITAMIN E	26.3 iu/kg
VITAMIN C	4.5 mg/kg
MINERALS	
CALCIUM	0.104%
PHOSPHOROUS	0.470%
MAGNESIUM	0.140%
MANGANESE	30.000 ppm
ZINC	34 ppm
COPPER	8.0 ppm

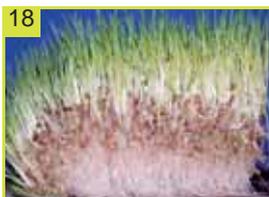
Nutritional Considerations

This laboratory analysis carried out on dry matter, does not consider the usable energy value of a living organism in accelerated biological evolution, destined to be consumed in a fresh state and whose catalytic action over the remaining elements of the portion, can only be experimentally examined using the real equivalence substitution method.

This method, practically validated in a significant number of cases, always gives us the same result.

All vitamins are found to be free and soluble, and can thus be directly assimilated. Vitamin E, is found in a state that can be completely assimilated and in free circulation in the young plant, while in dry grain form, it is found to be covered in its cuticular covering and is expelled by animals in their excrement. Laboratory analysis has shown that the faeces of animals fed on green fodder contain no vitamin E, which demonstrates its complete assimilation. Vitamin E has considerable importance in terms of

11. Grain soaking inside tray
12-18. Different Stages of growth



Fertility and green fodder contains 16% more than that existing in the seed. Vitamin C, a key element in the vitaminic system, replaces vitamin A in cases of deficiency and acts on the germinative epithelia, demonstrating its value to studs. Due to its action on the ante-hypophysis, the reaction of the stimulating hormones of the digestive glands in the pancreas, stomach and intestine is activated.

Comparative Study of Hydroponic Green Fodder

	H.G.F. FEED HAY		
DRY MATTER gr/kg feed	186	870	850
METABOLISABLE ENERGY Kcal./kg D.M.	3216	2900	1600
METABOLISABLE ENERGY Kcal./kg Fresh	0,598	2,52	1,36
DIGESTIBLE PROTEIN gr/kg feed	32	125	50

These values do not mean that one should substitute one feed for another, simply because of providing one or more nutrients at a lower cost. Hydroponic green fodder, offers an extremely favourable nutrient/cost relationship compared to traditional feeds, but in practical use, its main function is not one of substitution but of improving digestion.

The savings that can be made by using hydroponic green fodder are due to two causes: Its cheap provision of nutrients, as demonstrated, and the increase in digestibility provoked in the remaining components of the portion, when it is administered correctly throughout the day.

In the continuous experience of animal feed rationing, it has been found that 3 kg of hydroponic green fodder, substitutes approximately 1 kg of concentrate.

The fibre content of hydroponic green fodder is very low, but due to its potentiating effect on the

digestibility of crude fibre, the percentage of fibre in cheap products can be much greater.

When the livestock farmer feeds his/her animals with hydroponic green fodder, the economic benefit is considerable and results in a quick return on the investment made.

Hydroponic Green Fodder in Animal Feeding General Details

The majority of the basic feeds used in animal nutrition, for example: hay, grain, silage, etc. are sufficient in terms of content with respect to one or more required factors; but they are poor sources of important vital factors still not perfectly determined.

These unknown factors are responsible for the growth and good development of animals, and are present in green grass, fish flour, hemp and alfalfa flour and dry soluble derivatives from distilleries.

Researchers have not been able to arrive at an agreement regarding the number of the different essential factors, its chemical profile or the relative quantities that the various natural sources, where they are found, contain.

It is clear that green plants are better nutritional sources than the same plant once harvested, prepared and stored so as to be subsequently used as feed dried alfalfa, for example, will never contain as much carotene or protein as the green plant did during its development and before being cut.

The loss of vitamins, minerals and hormones during the harvesting, preparation and storage is high.

There is considerable evidence that demonstrates that grass is the perfect nutritional complement for livestock feeding. Studies have repeatedly demonstrated that the nutritive value of the green plant reaches its maximum level four days after germination and begins to decline thereafter.



19. Day 6
20-24. Day 7 (ready to eat)



Effects of Maturity on the Composition of Green

HEIGHT IN cm	PROTEIN	FIBRE	CALCIUM	PHOSPHOROUS	CAROTENE
13.2	19.5 %	18.0 %	0.35 %	0.44 %	320
18.1	16.6 %	20.09 %	0.40 %	0.38 %	290
24.8	14.5 %	23.9 %	0.42 %	0.34 %	209
48.7	10.2 %	29.1 %	0.34 %	2.26 %	174
65.5	8.8 %	30.0 %	0.34 %	0.24 %	130
66.5	7.4 %	29.1 %	0.32 %	0.22 %	96

Grass From the above, we can deduce that hydroponic green fodder at seven days can be considered as a magnificent source of these principal nutrients, providing the additional benefit of distribution to livestock all year round.

If we compare a seed with the product of its germination, after seven days, we can see the significant changes that have occurred. During this transformation, the carbohydrates stored in the seed, mainly starches and sugars, act as sources of energy, so that the grass, in its developmental process, produces a significant quantity of vitamin complexes, enzymes, hormones and unidentified growth factors, in addition to protein, fat and fibre, which are the natural components of said grass.

The seeds, with their potent germinative latency, have been easily analysed and their constituents established. However, once transformed into grass, the problem becomes more complicated and not all factors have been isolated for individual identification.

These factors are extremely important in certain metabolic routes of the animal, being essential for its correct development.

Comparative Chemical Analysis of Seed and Grass

SEED GRASS	CAROTENE (ppm) A	VITAMIN C
PROTEIN (%) 11.39 - 16.80	0.00 - 33.136	0.00 - 4.500
ETHER EXTRACT (%) 3.76 - 4.41	VITAMIN E (ppm)	UNKNOWN FACTORS
MINERALS (7.) 2.87 - 3.31	1.60 - 414	0.00 - + +
CALCIUM (%) 0.056 - 0.202	RIBOFLAVIN (ppm) B2 175 - 1.981	TRACE ELEMENTS
PHOSPHOROUS (%) 0.32 - 0.43	THIAMINE (ppm) B1 280 - 1.091	0.00 - + +
	NIACIN (ppm) B3 640 - 8.818	ENZYMES
		0.00 - + +

More than 60% of veterinary practice is taken up with the treatment of non-infectious diseases more or less related to nutritional deficiency due to unbalanced diets. Diets that lack many of the essential factors present in hydroponic green fodder.

MAGNESIUM 30.000
ZINC 34

Recommendations for Supplementing Current Diets with Hydroponic Green Fodder

The addition of green grass, succulent and fresh, produced hydroponically, improves the effectiveness of any type of feed.

2. The use of hydroponic green fodder can help to avoid the need to use synthetic vitamins or any other nutritional supplement. Moreover, the quantity of grain in the feed can be reduced.

3. Due to its vitamin E, C and A content, it has a marked effect on reproductive processes and achieves an increase in the fertility and fecundity of animals.

4. These vitamins and trace elements result in an improved general condition of animals, and influence the regeneration of epithelia and a better exterior appearance, due to their influence over the condition of hair.

5. What is more, a beneficial effect is achieved by providing livestock with the same feed every day during the reproductive cycle, with no risk of digestive problems caused by changes in composition or origin of feed, which is common in livestock farming.

6. In spite of the fact that due to its appearance and origin, we call it hydroponic green fodder, it would be more correct in use to consider it as a "Feed" on account of its richness and composition.

