

Development of a Hydroponic Fodder System

Hydroponic fodder production is a technique of growing crops such as barley, cowpea, sorghum, wheat, maize etc. in a hygienic environment free of chemicals like insecticides, herbicides, fungicides, and artificial growth promoters. It is a well-known technique for high fodder yield year-round production and less water consumption. Fodder produced hydroponically has a short growth period of 8-12 days and requires only a small piece of land for production to take place.

Why should go for hydroponic fodder?

Required less space: Hydroponic systems require much less space and time than conventional systems, which makes the former ideal for urban dwellers with limited yard space.

Less water requirement: Hydroponic systems minimize water wastage since it is applied directly to the roots and is often recycled and used several times. It has been reported that about 1.5-2 liters are needed to produce 1 Kg of green fodder hydroponically in comparison to 73, 85 and 160 liters to produce 1 Kg of green fodder of barley, alfalfa and Rhodes grass under field conditions respectively.

Faster time to grow: Fodder production is accelerated by as much as 25% by bringing the nutrients directly to the plants, without developing large root systems to seek out food. Plants mature faster and more evenly under a hydroponic system than a conventional soil-based system. One kg of un-sprouted seed yields 8-10 kg green forage in 7-8 days.

Easy daily production: Hydroponic fodder can be produced on a regular basis throughout the year even when low water problem.

Chemicals or pesticides Can be skipped: Due to use of no soil the hydroponic fodder is not susceptible to soil-born disease, pests/fungi and it results into avoiding any use of chemicals and pesticides.



Figure: Fodder biscuits

Higher nutritive value: It is found that hydroponic fodder is full of antioxidants and vitamins. It is also a rich source of bioactive enzymes, with the highest activities in sprouts being generally between germination and 7 days of age.

Less workforce and transport cost: The system needs less workforce and transport cost cause most of the farmer grow hydroponic green fodder near to the livestock shade.

Reduce feed cost: As the fodder contains more crude protein than conventional fodder it reduces the feed cost spent on the concentrate feed to half.

Seeds can be grown as fodder

Mostly farmer uses Maize seeds to produce hydroponic fodder. In cold climatic condition wheat and oats seed are good while in hot climatic condition maize seeds are suitable for hydroponic fodder production. Yellow Maize, Cowpea, Horse gram, Sun hemp, Ragi, Bajra, Foxtail millet and Jowar has been grown successfully and received good response from the livestock as a fodder.

But it is advisable not to use pearl millet and sorghum seeds because these sprouted leaves contain poison that can harm the livestock.

Construction of a low-cost hydroponic fodder system

Housing:

The hydroponic installation needs to be housed in a simple facility that will allow for a semi-controlled environment for better fodder growth. The following are the basic environmental requirements for best fodder growth-

Ideal temperature for growth is 19-22°C. The trays should never be exposed to direct sunlight, strong wind and heavy rain.



- The housing can be made of inexpensive locally available materials. Inexpensive and durable plastic sheeting can be applied to further prevent exposure to wind, direct sunlight and rain. It will also slightly increase the humidity inside the hydroponic facility which is desirable in low

humidity environment. The size of the house depends upon the feed requirement and number of cattle.

- The facility floor must be solid (compacted earth, concrete, cobblestone or similar). The floor needs to allow for easy drainage of excess water coming from either the hydroponic installation or the water used for washing the trays, soaking the seeds, etc.
- The floor needs to be kept free of any unnecessary equipment, garbage, vessels and other objects that may serve as a hiding place for rodents and harbor other contaminants such as mold.
- The approach and entrance to the facility needs to be wide enough for ease of operation in bringing inputs in and fodder out and fitted with a light door.

Hydroponic Equipment:

1. Hydroponic Racks:

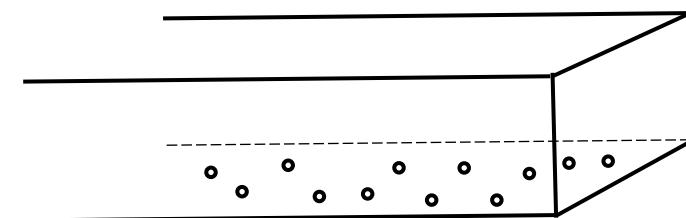
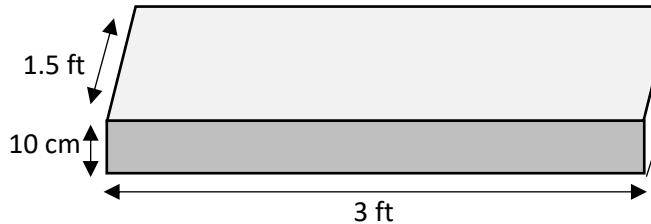
- Inside the shed, a bamboo/plastic/metal rack is built to hold the trays.
- It is recommended to build three to four layers rack but the rack should not be too high because it becomes difficult to spray water and removes the trays.
- Enough space between two layers should be kept to easily water the seeds also create slightly slope for each layer to one side of the rack this is helpful for easily and quickly water to drain from the trays.
- Make a small drainage line under the slope side of a rack to properly drain out water.



2. The Hydroponic Trays:

- To grow hydroponic fodder, a medium size tray is required of about 1.5 x 3 Ft. They must be made up of good plastic and strong enough to hold the weight of the fodder.
- The seeds must be kept moist so it is advised to avoid metal trays because they easily rust.

- Bottom of the tray needs to be perforated with 15-20 of 2mm holes for water drainage for any excess water.



Procedure for fodder production:

1. Seed storage and preparation:

- This is recommended to dry the seeds under direct sunlight one day prior to seed washing.
- Broken seeds to be removed and dirt's from the seeds.
- Store seeds in a dry and safe place.

2. Seed washing:

- Take good quality seeds in a washing chamber and add water.
- Wash the seeds with proper scrubbing by hand.
- Keep for settling for 5 minutes.
- Remove the light weight floating seeds.
- Drain out water and again add water.
- Stir manually by wooden stick for 5 minutes, keep settling for 5 minutes. Drain water.
- Repeat the above steps till dirt and dead seeds are removed completely.

3. Seed Cleaning:

- Prepare 0.1% cleaning solution in a plastic chamber.
- Add washed seeds to this 0.1% cleaning solution.
- Stir manually by wooden stick for about 5 minutes.
- Keep for 1 hour.
- Drain the cleaning solution.



4. Soaking the seed:

- Soak the seed to be used for 12 - 24 hours in a 1 - 1.5% bleach solution on the day before seeding it in the trays.
- For one tray with a surface of 0.9 m^2 need 4.5 to 5.5 kg of seed.
- Seed quality, germination rate and growing conditions will affect the amount of seed required. Adjust quantity as needed.
- Seed is best soaked if it is placed in a sack made of old mosquito net and submerged into a bucket containing the bleach solution overnight. That will allow for easy drainage after soaking.



5. Seed germination:

- Cover/ place the “After soaking seeds” with the clean dry fumigated gunny bag.
- Keep the seeds loaded gunny bags away from direct sunlight.
- Keep the lid open & keep for germination for number of hours as mentioned for the given seed in the table below.
- Sprinkle water on gunny bag every 2-3 hours so that the gunny bag remains wet.
- After given hours, remove the seeds from gunny bag take weight.
- About 35 to 40% increase in weight happen with about 90+% seed germination.



6. Transferring seeds into trays:

- The seed that has soaked for 12 - 24 hours is spread in the tray with a maximum height of 1cm. You can allow 2 - 3 cm between the seedbed and the ends of the channel to allow room for expansion as the seeds and swell from the water and sprout into a mat.
- Before using tray wash them properly and check all holes if they blocked or not if there is blockage remove the blockage.

- Transfer sprouted seeds from the gunny bags to trays and evenly spread them and place these trays on the rack.
- Every day gives light water (sprinkle) to sprouted seeds. To provide water, watering cans or sprinklers system can be used.
- In hot weather conditions give water after every two hours, and in cold weather condition after 4 hours it helps to maintain moisture.
- After seeding the tray, return it into position on the hydroponic rack so its irrigation can start.
- Trials show that one tray can produce 25 - 30 kg of fodder in 8 days cycle.



Feeding livestock with hydroponic fodder:

Hydroponic fodder should be used as feed supplement. The recommended amounts of fodder that can be fed daily to a single animal depending of body weight using the rule that an animal can eat up to 1 - 1.5% of its weight of hydroponic fodder daily:

Cattle live weight 300 - 400 kg, approximately 3 - 5 kg/day

Animals should not be fed this fodder in the morning. They should be given this supplement fodder ration after they return from the pasture in the evening. Animals need to get used to the fodder gradually over a 4-5-day period it's gradual increase in the daily ration.

Maintenance of hygiene of the hydroponic system area:

1. Cleaning the hydroponic trays:

- Clean the trays regularly after final fodder removal.
- After removal of final fodder, clean the tray with fresh water
- After cleaning the trays wipe the trays using 0.5% cleaning solution or disinfectants.

2. Cleaning the tools:

- Clean seed washing and soaking chamber, aluminum stool, gunny bag etc. regularly after every soaking and germination cycle.
- Clean the equipment with fresh water.
- After cleaning with fresh water, clean using 0.5% cleaning solution or disinfectants.

Protocol for the hydroponic area maintenance:

- Have foot bath at the entrance of the unit.
- Fill the foot bath with disinfectants.
- Change the disinfectant daily.
- Follow separate way for the entry and exit for workers.
- Avoid stray animals' entry into the unit.
- Avoid rodents' entry into the unit as well as the seed storage room.
- Keep the area clean.
- Avoid frequent entry of visitors into the unit and the working area.



Foot bath

Personal hygiene for workers:

- Disinfect the apron, rubber gloves and chapels with disinfectant solutions before starting the work and entering into the unit.
- Do not use the same gloves for shifting trays that has been used for loading seeds as seeds may contain some fungal spores that would spoil the fodder production.
- Do not enter into seed storage room before working necessary.
- Only one person is advisable to work inside the hydroponic area to minimize the microbial load.
- Another person from outside the area should assist the worker inside the hydroponic chamber in removing the grown fodder and in shifting the trays.



Organic fungicidal treatments:

These recipes are safe for animals.

Recipe: 1

- Mix 20 - 25 g of baking soda into 3.78 litres of water.
- Spray onto the seeds and infested plant parts.

Recipe: 2

- Mix 20 g of Potassium bicarbonate into 3.78 litres of water.
- Spray onto the seeds and infested plant parts.

Biological fungicide:

- Selected strains of *Bacillus subtilis* are used as biological fungicide.
- It works both as a fungicide and a plant promoting rhizosphere bacteria.

Mode of action:

- Substrate competition for space and nutrients.
- Mycoparasitism
- Enzyme production.

Usage:

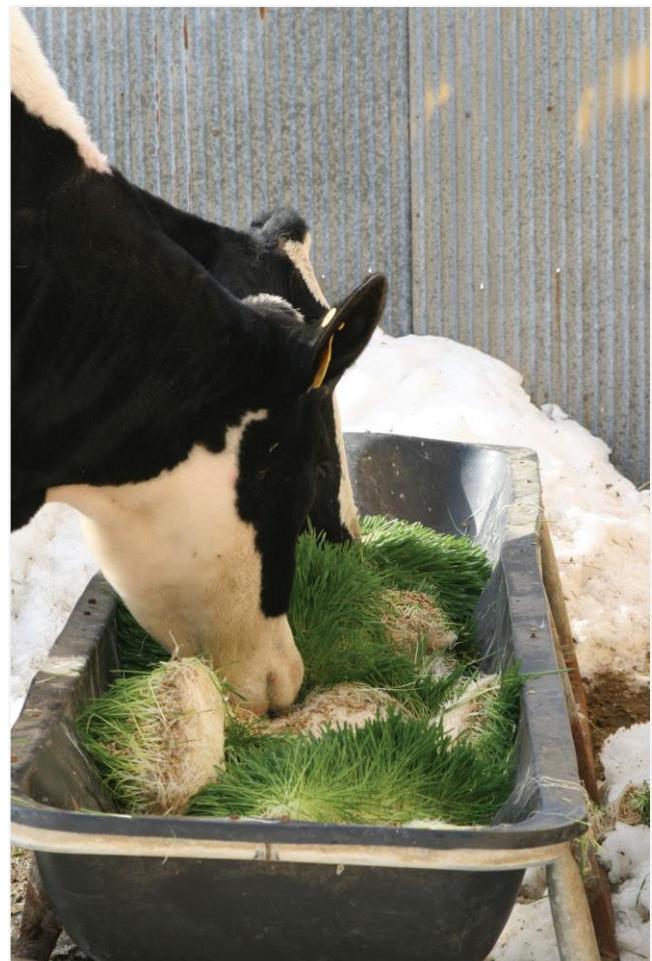
Mix 10 g of the wettable powder of Bacillus subtilis 1x 10⁸ CFU/g in one liter of water.

Spray over the infested plant parts.

Can be re - sprayed at an interval of 8 – 9 days.

*Bacillus subtilis is approved for use as feed ingredient for animals by Association of American Feed Control Officials and The Canadian Food Inspection Agency. However, trials have been planned to study the actual effectiveness and the effect the above organism on animals.

The entire fodder biscuit is edible, roots and all. It represents a good source of digestible protein and other nutrients and can be fed to all domestic animal species after a period of gradual adaptation. Fodder produced in this way usually exerts lack of calcium if fed to dairy cows, dairy goats and egg producing chicken. This calcium deficit should be supplemented with calcium rich mineral supplement or calcium rich feeds.



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