

HYDROPONIC GREEN FORAGE

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SUMMARY

In 27 rural localities throughout the state of Chihuahua, México, we have used a typical 144m² greenhouse unit containing 1790 trays stacked on shelves that hold grain. The trays are tilted and have holes in one side. The contents are fed as food and grain. The trays are under controlled environmental conditions in a typical 10-day cycle. The grain develops roots and green shoots to form a dense mat at an average of 1200 kilograms per day with only 800 to 1000 liters of water consumption. This amount of fodder can be used to supplement feed for 100 head of cattle per day or 500 goats and/or sheep. The water use difference is approximately 50:1 over the hay that the forage replaces. The use of these 27 greenhouses in the state of Chihuahua then conserves over 10,000 acre feet of water per year by eliminating the need for open field alfalfa or corn for silage. There are many others built in neighboring states.

The objective of this talk is to present the technical and operational details of growing forage hydroponically in a greenhouse for water conservation. Recently, an analysis of using the forage to fatten cattle in Mexico was conducted. The results of this analysis are below:

Greenhouse cost: \$15K concrete platform: \$5K Total: \$20K

Forage production - 179 trays per day

1 kg corn/tray (15 cents), .1 kg wheat/tray (0.9 cents) = \$28.4/day

water: 2300 l at .04 cents/l = \$10/day

miscellaneous: \$3/day

labor: 1.5 people = \$15/day

Total daily cost of forage production: \$57 = \$3.4K

Cattle come in at 145kg, leave at 205 kg: 1kg/day growth

109 cows for 60 days purchased for \$27K

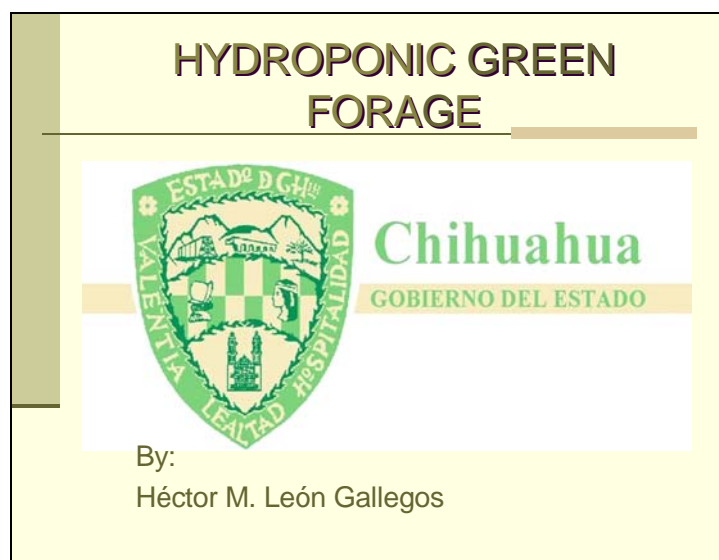
1342 kg forage (7.6kg/tray) – feed 109 cows 12.3 kg/day.

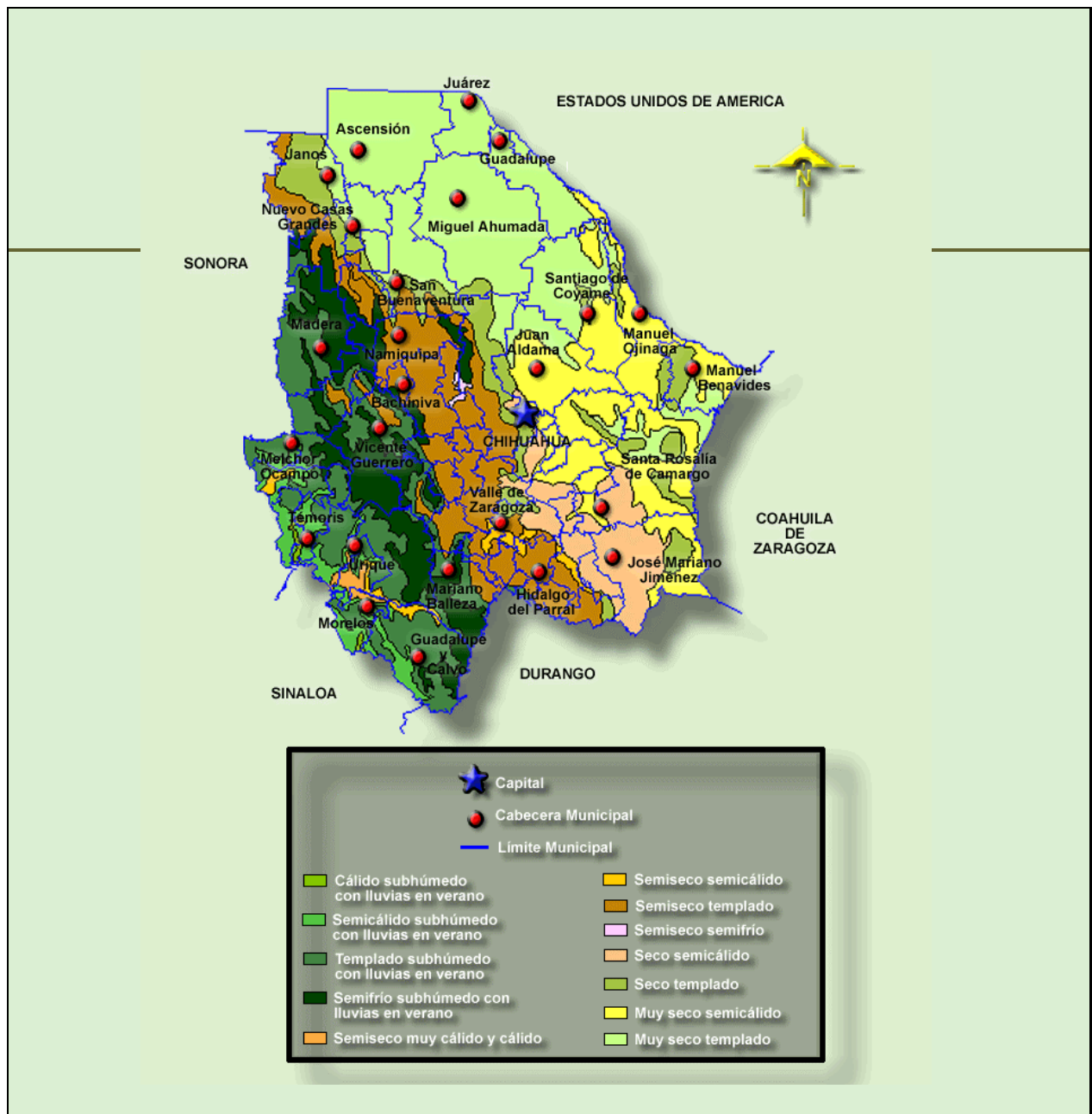
Assuming 15% dry matter, 1.845kg DM = 1.3%BW (145kg cow) or 0.9%BW (205kg) supplement forage with 0.4kg corn meal, 1.5kg stubble and .1kg mineral (\$0.21/day/cow) = \$1.4K

vet and supplies: \$350/60days = \$0.05/day/cow = \$0.3K

Assume 2 die, sell 107 for \$37K

Profit (\$K): 37-27-3.4-1.4-0.3 = \$4K U.S. every 60 days.

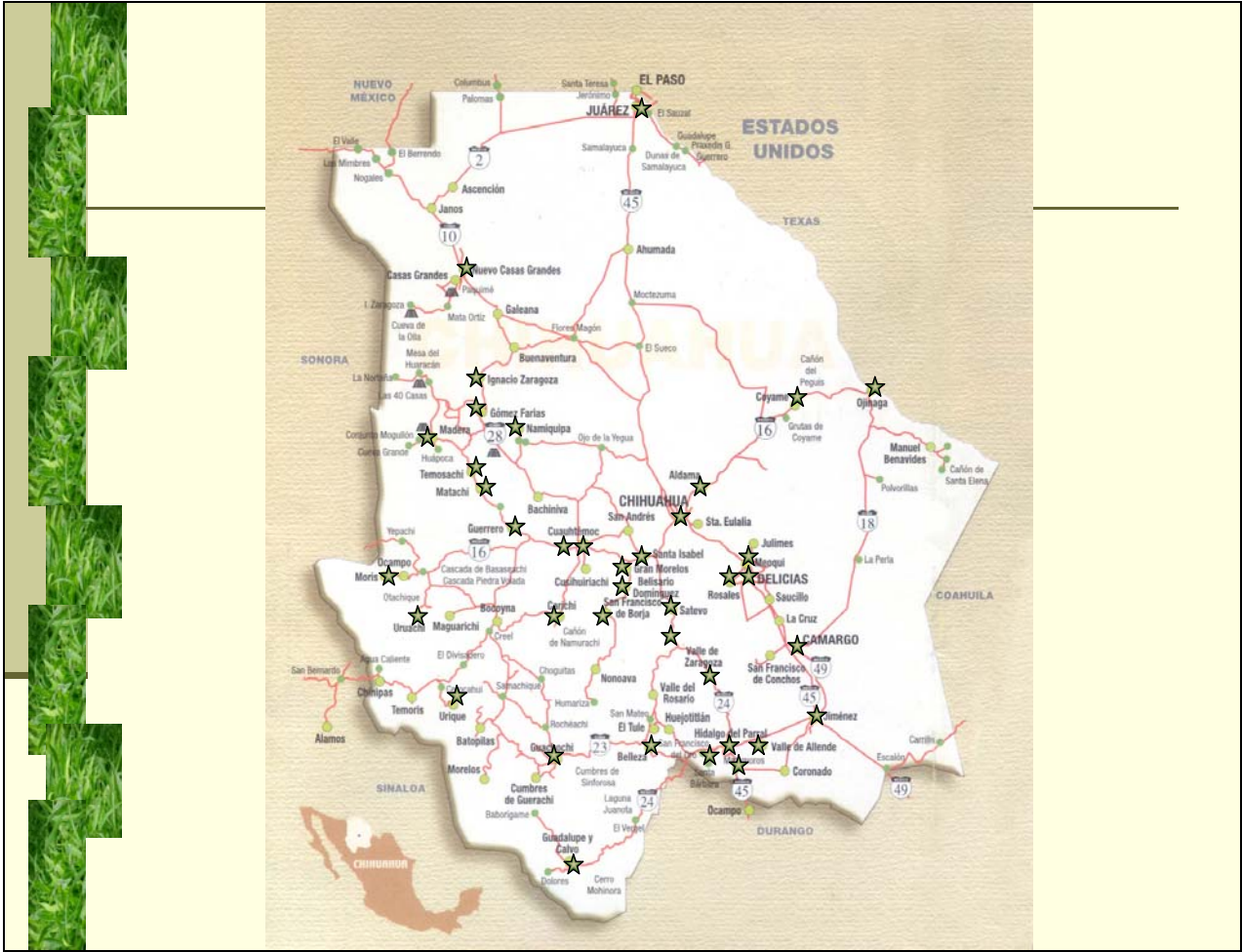




Climate in Chihuahua.

GREEN HOUSE LOCATIONS

IN CHIHUAHUA



Locations of the forage greenhouses in Chihuahua.



The greenhouse, 8 m wide and 18 m long, is formed with arches of pipe of 2" of diameter, installed 3 m apart, and strengthened with crosspieces that support loads of 25 kg/m². The greenhouse cover is of polyethylene 150 microns in thickness; the sides of the greenhouse are wound to allow better ventilation. The covered area is protected with mesh anti-trips. The structure supports wind speeds of 150 km/hr.



System of production of Hydroponic Green Forage: Using a hothouse of 144m² equipped with a hydroponic watering system without inert material or soil for the process of germination of grains of cereals and legumes (corn and wheat), during one period of 8 to 12 days. For each kilogram of germinated grain, one obtains 9 or more kilograms of forage of high nutritious value.

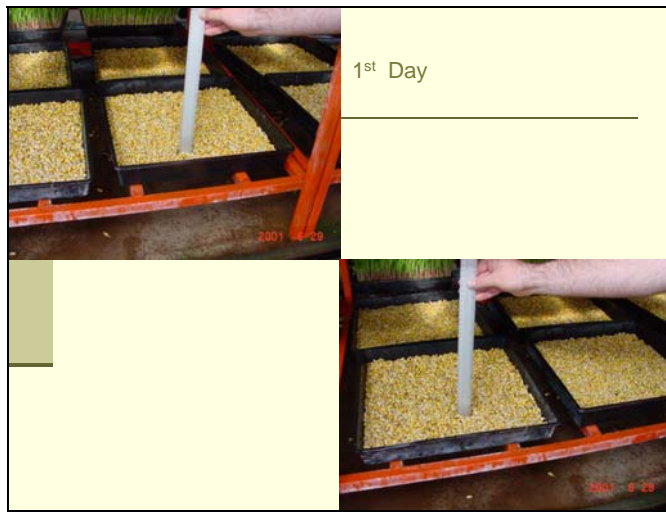


Seed selection: The seed of cereals should be used or legumes without overgrowths and free of plagues and illnesses, to avoid transmission. They should not come from lots exposed to insecticides or fungicide. The desirable humidity is 12% and the seed should have had a rest so that it has fulfilled the requirements of physiologic maturity. The most common crops are corn and wheat. Washing: The seed is soaked in water, with the purpose of eliminating the whole material that floats, then drained and soaked in water with 2% sodium hypochlorite for 15 minutes. After this soaking, the seed is drained again, given a quick washing, and sent to the pre-germination area.

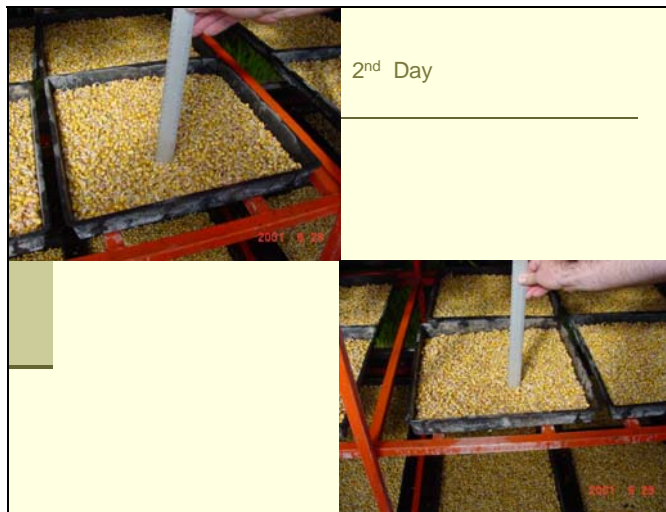
The process of sowing the seed in the trays is done very carefully to avoid damage to the grain, which should already have four raicillas (roots). The density of sows depends on the type of grain sown.

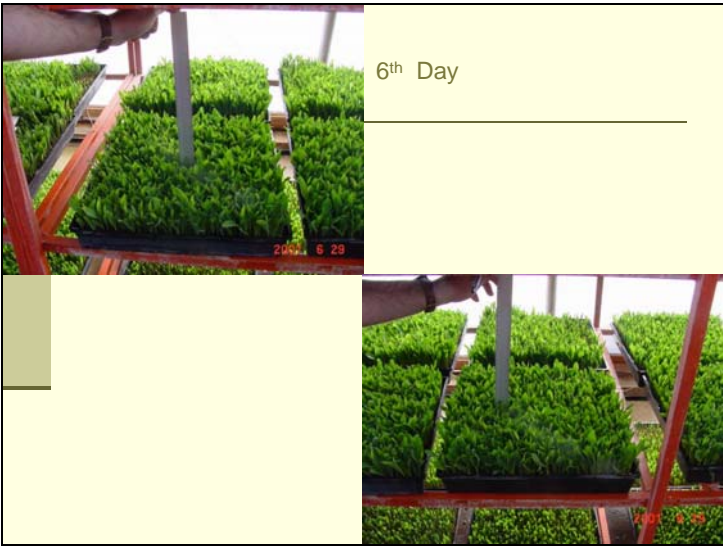
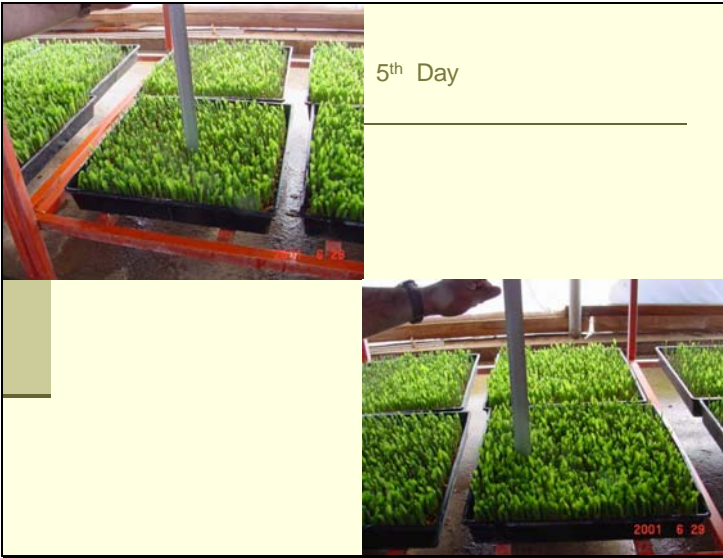
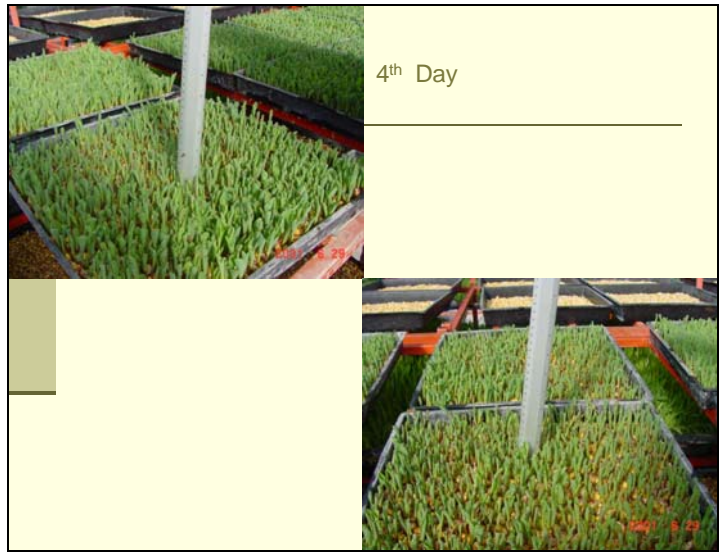


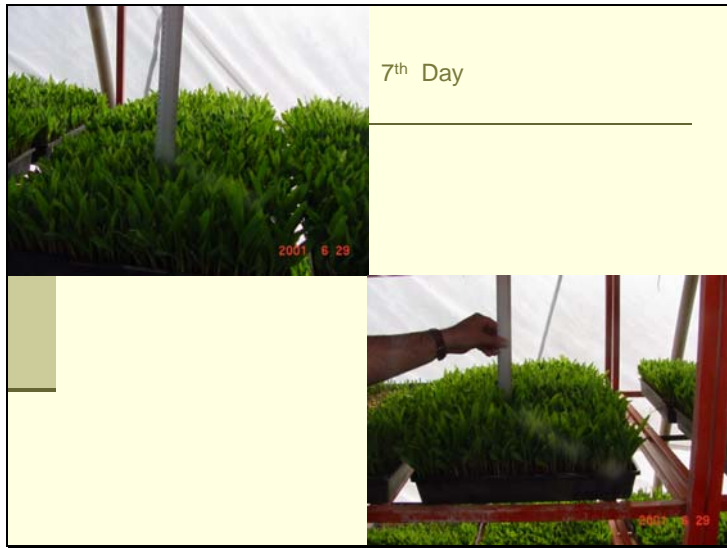
Each of the four shelf modules holds 448 trays for a total of 1792 trays, with dimensions of 43.18 cm. x 43.18 cms. and a depth of 5 cm. The densities of corn sown, is 670 grains per tray.

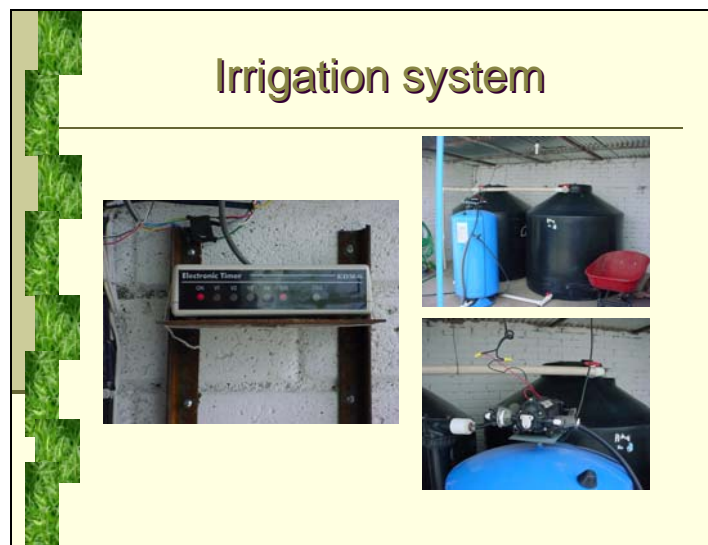


Growth: The environmental factors that influence in the forage production are light, temperature, humidity, oxygenation, and carbon dioxide gas. The duration of daylight influences vegetative development. Solar light should not be excessive since it causes burns on the upper trays. The ideal temperature is 21° C, and it should be as constant as possible.

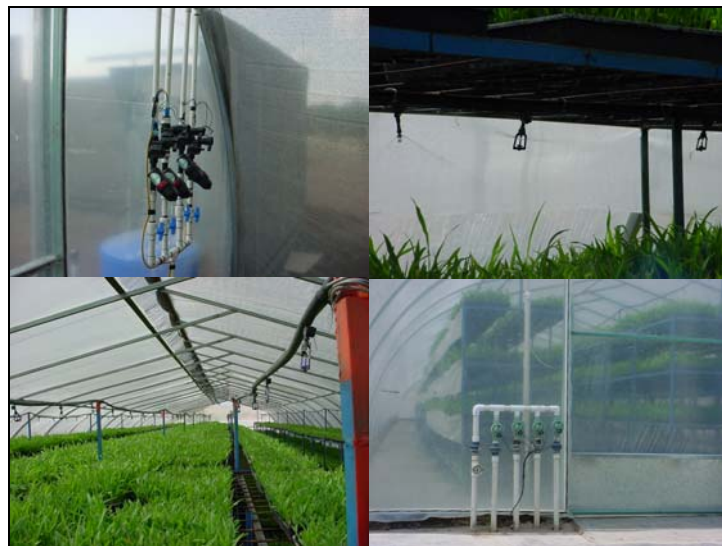




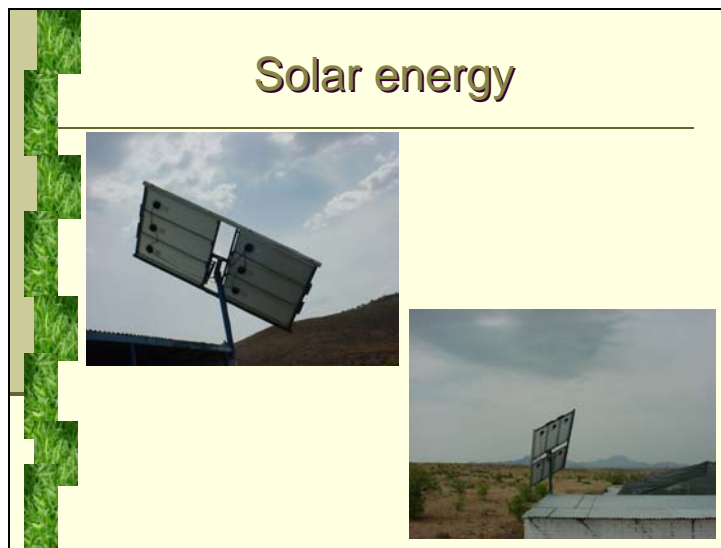




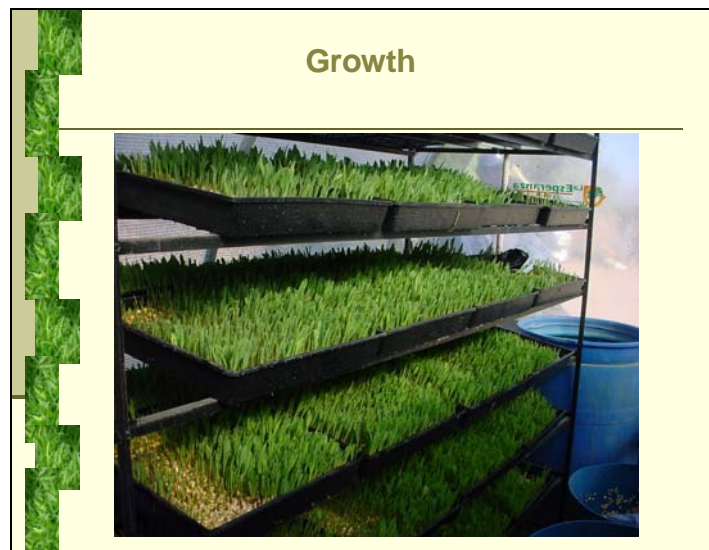
The watering system is electronically controlled and delivers water at the optimum rate



The sprinkler systems are shown here with the latest in filters and dispensing nozzles.



Solar power can be used in remote locations. The electrical requirements of the greenhouse are very little.



A close-up of the grass is pictures here.



A full row of grown forage is seen here.



Recently, styrofoam trays are being used for better insulation.



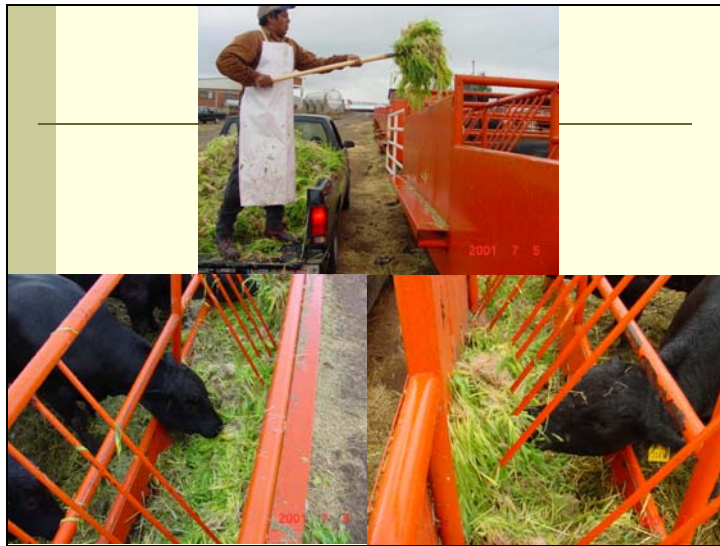
As consequence we will obtain a great root mat, since the roots intersect some with others for the high density of sows. This Mat this formed by the seeds that don't reach to germinate, the roots and the air part 25 centimeters or more than height.



HARVESTS This it is made when the PLANT has reached a height average of 25 cms. This development delays from 8 to 12 days, depending on the temperature, the environmental conditions and the frequencies of the watering.



Cows love the forage as a supplement to their normal rations.




FEEDING OF LIVESTOCK It provides daily food for 120 heads of bovine livestock.

HYDROPONIC GREEN FORAGE PROVIDE PROTEINS, MINERAL,
ALL FREE AND DISSOLVE VITAMINS.

Chart 1. Analysis of wheat sample to different stages.

Wheat sample (Growth)	% Humidity	% Wet base protein	% Dry base protein
10 days	86.82	2.53	20.33
12 days	88.12	2.40	20.22
14 days	92.07	1.86	22.90
16 days	90.70	2.24	24.08

The optimum time of growth is 10 days as indicated by these longer growth periods.




AMOUNT OF HGF

a) FOR SUPPLEMENT 5% OF ANIMAL WEIGHT:
15kgs OF HGF (COW 300 kgs) TO FEED 80 ANIMALS PER DAY.

b) IN A FEED LOT INCREASE TO 10% :
12 kgs OF HGF (COW 120 kgs) FOOD TO 100 ANIMALS PER DAY.

For adding animal weight or as just a supplement, the number of cows varies and depends on the size of the animals.



RESUME

Green house 144 m² with 1,792 trays

Unit cost \$13,000.00 US dlls

Average day production 1,200 kgs. (6 kgs. per tray/day of HGF)

A summary of the cost of the greenhouse is given in this slide.