Evaluation of Low Cost Pyramid Type Solar Structure for Observations of Growth Parameters of Wheatgrass

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Abstract— The maximum average temperature was observed during no load test inside the developed pyramid structure was 37.6 °C at 12 p.m. and the same time solar intensity was 710 W/m², relative humidity was 36.5 % and outside relative humidity was 33 percent. The maximum average temperature was observed during load test in pyramid structure was 36.2°C at 1 p.m. and the same time solar intensity was 315 W/m2, ambient temperature was 31.6°C, average humidity was 35.9 % and outside relative humidity 31.5 percent. Various growth parameters for wheat grass like height, temperature, solar intensity, relative humidity were observed under pyramid structure. Wheatgrass took 16 days to gain a height of 7'' in tray inside pyramid structure while outside tray it took 20 days and It was observed that outside tray is many seed loss compared the inside tray of pyramid structure while germination was observed so early in pyramid structure compare to outside condition and it was found as within two days germination in pyramid structure and it may due to high temperature and humidity inside the structure whereas in outside condition required double time. It means outside wheatgrass require many days for fully grown as compared to inside structure.

Key words: Wheatgrass, Solar Pyramid Structure, Growth Parameter

I. INTRODUCTION

In the developing countries, many low income families relies on a simple diet which mainly consist of staple food crops such as wheat, maize and rice that are poor sources of various nutrients and minerals. Wheatgrass has been identified as a complete food providing all the nutrients than provided by any other foods. It is reported that "fifteen pounds of wheatgrass is equal in overall nutritional value to 350 pounds of ordinary garden vegetables", as it contains various essential and non-essential amino acids, vitamins, minerals, chlorophyll, and enzymes. (4).Wheatgrass juice also provides multiple health's and wellness benefits for the human like in resolving digestion related Problems, purifying blood, strengthening immune system, etc. wheatgrass was also reported to be helpful in curing certain diseases such as thalassemia & distal ulcerative colitis (4). At present, the wheatgrass is available in the form of products such as health supplements (powders, extracts) and medicines tablets. In India, only few outlets are present which sell wheatgrass drinks, and that too very high price. One ounce (29.5mL) of wheatgrass juice contains 103 vitamins, minerals and amino acid. But wheat grass growing under open yard is difficult related to germination, height, colour and hence study was undertaken for observation of growth parameter under low cost structure with objective (i) Development of low cost structure for growing of wheat grass (ii) Observe the growth parameter of wheat grass under developed structure.

II. MATERIALS & METHODS

A. Structure Development

Structure was developed for growing of wheat under five trays keeping in triangular shape structure. Structure made in 1.1 m x 1.5 m in size along with two base frame for keeping five plastic trays with 50 cm gap for height of grown wheat grass. After completion of frame it wrapped with UV stabilized 200 micron plastic to enhance the germination in starting period depicted in Fig. 1.

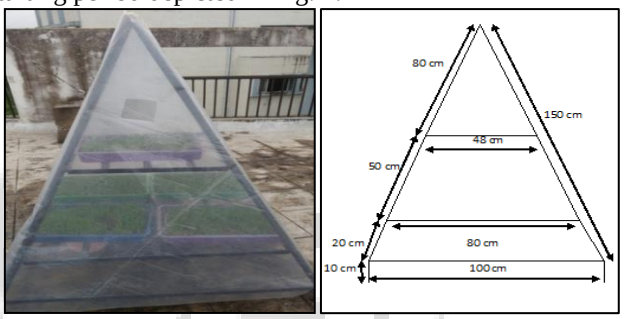


Fig. 1: Low Cost Structures for Growing of Wheat Grass Structure for Wheat Grass Grow

B. Sowing Methods

Sowing methods was completed in five steps (1)100 gram of wheat seeds for one tray was selected likewise total 600 gm of seed for six trays were selected and soaked in water for about 18 hours in plastic container. (2) Soil was prepared with mixing cow dung in proportion of 2:1 in drip through growing tray by putting about one and one half inches of organic soil in growing tray.(3)Pre-soaked wheatgrass seeds were spread on to the top of prepared organic in growing tray. Wheatgrass grows best with warm days mostly sunny with medium humidity and cool nights. (4)Sprinkle a light coating of organic soil on top of freshly spread out wheatgrass seeds. Lightly moisten the fresh coating of cover soil cover seed growing tray with a vented or upside down tray or board to keep the seeds dark until seedlings sprout into light green new wheat grass. (5)In this step day by day observation was recorded to observe the height and colour of wheat grass. (6)After reaching the 7 inch height of wheat grass it was harvested for preparation of juice or drying for making its powder.

C. M.C Determination Method (Air Oven Method)

The moisture content of the samples at every stage of the process was determined by hot air oven method. Weighed test sample (10 gm approximately) was kept in hot air electric oven at temperature of desiccators for cooling to ambient

temperature and the change in weight (measured using electronic weighing balance with least count of gm) was noted. The moisture content was expressed either by kg moisture/kg wet matter (wet basis, wb) or kg moisture/ kg dry matter (dry basis, db). Mean of the four samples was reported throughout the course of study.

$$MC\ (\%\ wb) = \frac{W1-W2}{W1} \times 100$$

Where, W1= initial weight of the test sample (g); W2= Final weight of the test sample (g)

D. Drying of Tender Wheatgrass

Harvested wheat grass was dried in solar tunnel dryer for observing the various parameters. Initial moisture content and final moisture were carried out for wet and dry sample of wheat grass. After drying the powder was prepared of tender wheat grass.

E. Preparation of Powder from Dried Wheatgrass

The dried wheatgrass sample was taken equivalent to half depth of the grinding bowl. The grinder with sample was kept inside the refrigerator for 10 to 15 min in order to lower down its temperature. Then grinding was done for 10 to 15 s. Further increase in grinding duration indicated little heating of grinding sample. Therefore, grinding was restricted for 10-15 s. Further, the rest for 10 to 15 min was rendered so as to cool down the grinder and sample. This process was repeated for 10-12 times or till the complete grinding was ensured. The ground matter was sieved through fine mesh (106 µ). The 60 to 70 % fine powder was obtained from a sample of dried wheatgrass. The samples of fine powder were packed in airtight 100 g HDPE bags.

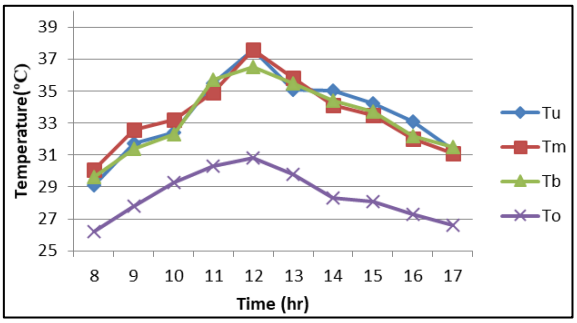
III. Results & Discussion

A. Growing of Wheatgrass

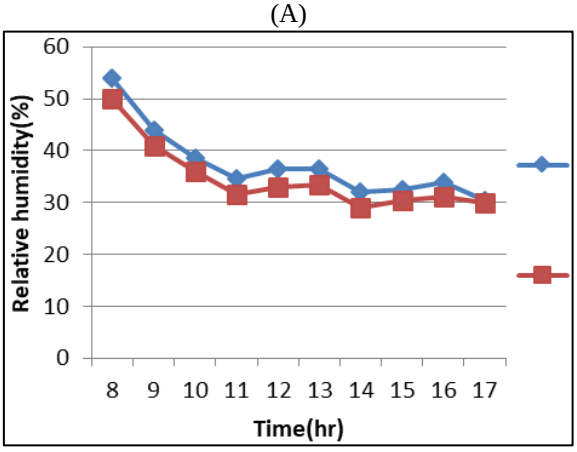
Economically and health point of view, feasibility of developed pyramid structure having size of 1 x 1.5 m (1 m² base area and 1.5 m height) was evaluated for growing of wheat grass. In this study, height and colored were observed with comparing the growing wheat grass inside and outside the structure. Pyramid structure has two shelves as the bottom shelves capacity was four trays and upper shelves capacity was tray. The tray size was 40 cm x 28 cm. trays were filled with prepared soil mixture with 3-4 cm in depth. Soaked wheat seeds were spread over the soil mixture inside the tray as without overlapping to each other followed by spreading soil sufficient to cover the seeds.

1) No Load Testing of Structure

The maximum average temperature was observed during no load test in pyramid structure was 37.6 °C at 12 pm and same time solar intensity was 710 W/m², relative humidity was 36.5% and outside relative humidity was 33 percent. The trend obtained in no load test during performance test is as shown in Fig. 2(a, b). It clear from Fig. 2(a) that the temperature inside pyramid structure increases with solar intensity increased up to 12 pm and then decline as day progressed.



(A)

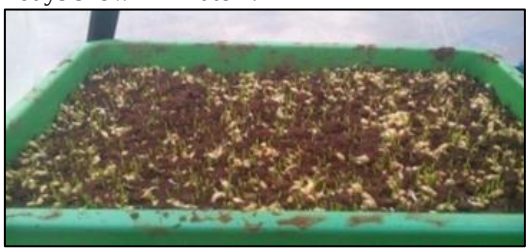


(B)

Fig. 2(A, B): Thermal Profile of Pyramid Structure under No Load Test Growth Parameter

B. Load Test

As the seed sown, germination was observed so early in pyramid structure compare to outside condition and it was found as within two days germination in pyramid structure and it may due to high temperature and humidity inside the structure whereas in outside condition required double time as four days shown in Plate 1.



Inside Wheatgrass

Outside Wheatgrass

Plate 1: Seed Germination Inside & Outside the Structure

After that day by day inside and outside height of wheat grass was observed and depicted in fig. 3. Wheatgrass took 16 days to gain a height of 7 inch in tray inside pyramid structure while outside tray it took 20 days. Thus, variation in growth could be seen with changing condition and four environmental parameters were considered important for the growth of wheatgrass, namely temperature, humidity, solar

radiation and time taken to reach a target height shown in Fig. 3 to5. It was observed that more seed loss in outside tray compared to inside tray of pyramid structure. After the wheatgrass attained a height up to 7 inches, the wheatgrass was ready for harvesting as nutrients were at peak at this stage.

The wheat seeds soaked for 18 h could be well germinated and grown in pyramid structure of 1m² base areas and 1.5m height. The wheatgrass was successfully growth in pyramid structure and control environment condition. This structure utilize half shadow area because the wheatgrass required early morning's solar radiation (I= 300-740 W/m²) and temperature 28-38 °C. Because the afternoon hours high temperature inside the developed structure upto 45 °C which resulting burning of wheatgrass. The high temperature above 45 °C and high relative humidity could not comfortable for growing wheatgrass. Grinding operation for preparation of wheatgrass powder could be well carried out under the cool condition to maintain the temperature of dried wheatgrass powder. The grinder was operated for 10-15 s and rest for next 5-10 min to cool the grinder temperature. This step was required to repeat till fine powder was not obtained.

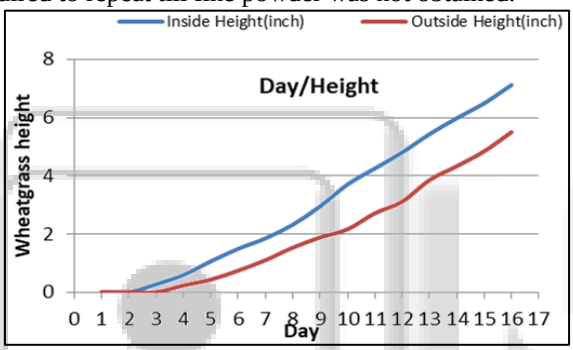


Fig. 3: Inside & Outside Height Obtain for Wheat Grass

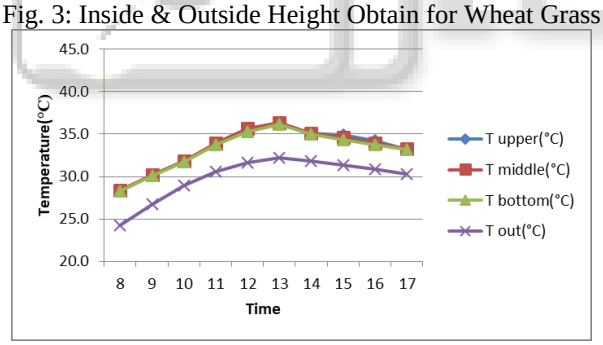


Fig. 4: Relation between Temperatures & Time

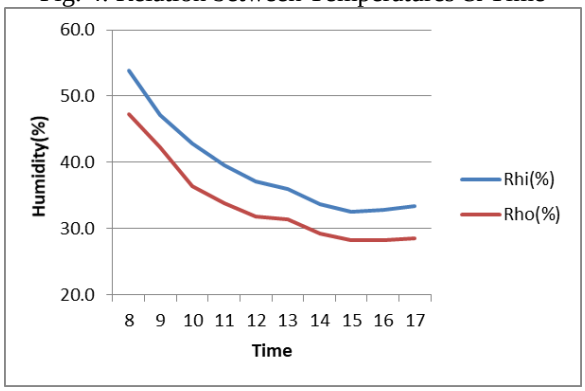


Fig. 5: Relation between Humidity & Time

C. Drying of Wheatgrass

The different drying methods like solar tunnel drying and conventional tray drying were studied for drying of wheatgrass. The sample of wheatgrass was spread uniformly in trays. The observations like weight, temperature, relative humidity etc were measured at regular interval throughout the experimentation.

D. Solar Tunnel Dryer

The Solar Tunnel drier was placed in East West Direction. Parameters like temperature, humidity, weight etc. were measured at one hour interval. The maximum temperature was achieved in solar tunnel dryer was 49.6 ^{0}C whereas outside temperature was 36.5 ^{0}C. The maximum observed inside and outside humidity were 42 % and 62 % in morning hours and minimum in noon hours. The maximum solar intensity was 775 W/ m^2 at 14 hours.

E. Drying Rate

The drying rate (g/h/100g of bone dry weight) of green leaves sample during drying period was determined as follows,

$$\text{Drying rate (D.R.)} = \frac{\Delta W}{\Delta T}$$

Where,

ΔW = weight loss in one hour interval (g/100g of bone dry wt)

ΔT= difference in time reading (h)

Wheat grass harvested from inside and outside structure was dried inside the solar tunnel dryer. The weight loss, moisture content, drying rate was observed up to constant weight loss was not observed. Initially moisture removal, drying rate was found high and then gradually decreases.

F. Conventional Tray Dryer

The wheat grass was spread in tray without overlapping. Then the tray placed in conventional dryer and dried at low temperature (50°C). Weight of wheatgrass was measured at 30 min interval. The wheatgrass was dried when constant weight achieved.

IV. CONCLUSIONS

The wheat seeds soaked for 18 h could be well germinated and grown in developed pyramid structure of 1m² base areas and 1.5m height with utilizing half shadow area up to solar radiation 300-740 W/m² and temperature 28-38 °C.

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