International Journal of Advance Research in Science and Engineering
Vol. No. 5, Issue No. 08 , August 2016
www.ijarse.com
IJARSE
ISSN 2319 - 8354

# DEVELOPMENT AGRO-MAT USING TEXTILE NONWOVEN

**Veena Sindhuja.V1, Vijayakumar.P2**

[1,2] *Assistant Professor, Textile, Jaya Engineering College, Chennai,India*

**ABSTRACT:**

*In today scenario, India facing increasing water scarcity issues and challenges, there is a need to adopt water management system especially in Agro field. To save both water and energy in horticulture and agro field, we need to develop a better watering system by considering plant performance. In this paper we mainly concern with the innovation of watering system by using textile mat in agriculture field. An innovative and cost-effective fibrous structure "Agro-Mat" has been developed to solve this problem. The new generation of Polypropylene nonwoven "Drip Lined Agro-Mat" is designed to save both water and energy. It has intended to solve major run-off and environmental problems.*

*Drip lined Agro mats can provide automated irrigation to various size plants, help with water conservation and free of hand Watering. This development will surely help in reducing wastage of water in the agriculture and Horticulture industry and the concept can be extended to other applications such as storage and transportation of raw and finished goods as well. This mat gives the application for no need of pouring water very often. By the help of the Agro mat we can do agriculture even in dry land, with less manpower.*

***Keywords*: Drip Lined Agro Mat, Hand Watering, Horticulture, Irrigation , Water Management**

## I. INTRODUCTION

Today, growers and gardeners are facing more water restrictions than ever before. Although, India has 4% of the worlds water, studies show average availability is shrinking steadily. It is estimated that by 2020, India will become a water-stressed nation. As we, all know that agriculture and Horticulture is very vast sector in India and without water, this cannot survive. It is estimated that all the horticulture crops put together cover nearly 11.6 million hectares area with an annual production of 91 million tonnes. This shows that there is an urgent need to develop better watering systems to save both water and energy for the horticulture industry. It is also required to understand various watering techniques and its effect on plant performance to reduce the wastage of water.

The new generation of Polypropylene nonwoven "Drip Lined Agro-Mat" is designed to better irrigation system for both horticulture and agriculture purpose. It will be a better and efficient watering system to agriculture field. These drip lined agro mats are working by the wicking action. It may be save water from 50-70% of water than the other watering system. This is because of avoiding water evaporation and water cannot be used by the plant.

### 1.1 Water is used for Agriculture in India

To produce enough food to satisfy a person's daily dietary needs takes about 3,000 litres of water converted from liquid to vapour—about 1 litre per calorie. Only about 2–5 litres of water are required for drinking. In the future more people will require more water for food, fiber, industrial crops, livestock, and fish. But the amount of water per person can be reduced by changing what people consume and how they use water to produce food, which is the amount of water it takes each year to produce food for today's 6.5 billion people. Add 2–3 billion people and accommodate their changing diets from cereals to more meat and vegetables and that could add another 5 million kilometres to the channel of water needed to feed the world's people.

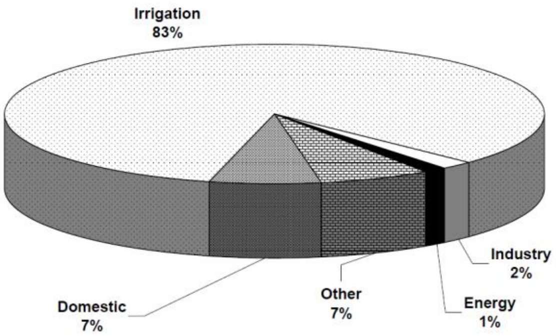



**Figure 1: Estimated Sector Wise Requirement of Water In India During 2020**

### 1.2 Importance of Water Management

Improved control of water resources is a fundamental method for mitigating he impacts of climate variability. Methods range from small scale on-farm and community based measures with local control to large scale infrastructure with institutionalized and governmental control. There are tradeoffs inherent in any selection of water management approaches at any scale. One commonly overlooked trade-off is the relationship between scale and reliability, where reliability of water supply decreases as the scale of water management intervention decreases. African countries and parts of India lack public or private infrastructure to provide storage to mitigate the variability of rainfall.

### 1.3 Water Scarcity—Water Management

Successful agriculture is dependent upon farmers having sufficient access to water. Without better water management in agriculture the Millennium Development Goals for poverty, hunger, and a sustainable environment cannot be met. Access to water is difficult for millions of poor women and men for reasons that go beyond the physical resource base. In some places water is abundant, but getting it to people is difficult because of lack of infrastructure and because of restricted access as a result of political and sociocultural issues. Energy affects water management now and will do so even more in the future. Energy prices are rising, pushing up the costs of pumping water, manufacturing fertilizers, and transporting products. This will have implications for access to water and irrigation.

## II. IRRIGATION SYSTEM AND ITS TYPES

Irrigation is the artificial application of water to the land or soil. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and revegetation of disturbed soils in dry areas and during periods of inadequate rainfall. Various types of irrigation techniques differ in how the water obtained from the source is distributed within the field. In general, the goal is not to supply the entire field uniformly with water, so that each plant has the amount of water it needs, too much nor too little. The modern AGROMAT methods are efficient enough to achieve this goal.

### 2.1 Drip Irrigation

In this system waterfalls drop by drop just at the position of roots. Water is delivered at or near the root zone of plants, drop by drop. This method can be the most water-efficient method of irrigation, if managed properly, since evaporation and runoff are minimized. Deep percolation, where water moves below the root zone, can occur if a drip system is operated for too long or if the delivery rate is too high. Drip irrigation methods range from very high-tech and computerized to low-tech and labour-intensive. Although it is difficult to regulate pressure on steep slopes, pressure compensating emitters are available, so the field does not have to be level. High-tech solutions involve precisely calibrated emitters located along lines of tubing that extend from a computerized set of valves.

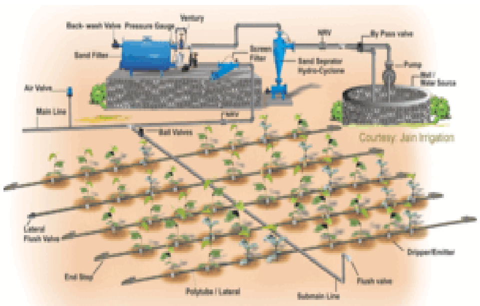


**Figure 2: Drip irrigation**

### 2.2 Center Pivot

Center pivot irrigation is a form of sprinkler irrigation consisting of several segments of pipe (usually galvanized steel or aluminium) joined together and supported by trusses, mounted on wheeled towers with sprinklers positioned along its length The system moves in a circular pattern and is fed with water from the pivot point at the centre of the arc. These systems are found and used in all parts of the world and allow irrigation of all types of terrain.

**2.3 Sprinkler**

**Figure 3: A travelling sprinklers**

In sprinkler or overhead irrigation, water is piped to one or more central locations within the field and distributed by overhead high-pressure sprinklers or guns. A system utilizing sprinklers, sprays, or guns mounted overhead on permanently installed risers is often referred to as a solid-set irrigation system. Higher pressure sprinklers that rotate are called rotors and are driven by a ball drive, gear drive, or impact mechanism. Rotors can be designed to rotate in a full or partial circle. Guns are similar to rotors, except that they generally operate at very high pressures of 40 to 130 lbf/in² (275 to 900 kPa) and flows of 50 to 1200 US gal/min (3 to 76 L/s)

**2.4 Manual Using Buckets Or Top Watering:**

These systems have low requirements for infrastructure and technical equipment but need high labour inputs. Irrigation using watering cans is to be found for example in peri-urban agriculture around large cities in some African countries. Top watering is accomplished by pouring water directly onto the surface of the soil or potting mixture with a watering instrument. For top watering to be effective, a grower must ensure that sufficient quantities of water are added to adequately wet the land. When and where top watering is utilized, growers must avoid "swamp to desert" conditions by balancing their watering schedule such that a plants soil is constantly moist rather than too wet or too dry.

**2.5 Problems In Above Irrigation Systems:**

1. Competition for surface water rights.
2. over drafting (depletion) of underground aquifers.
3. Over irrigation because of poor distribution uniformity or management wastes water, chemicals, and may lead to water pollution.
4. Deep drainage (from over-irrigation) may result in rising water tables which in some instances will lead to problems of irrigation salinity requiring water table by some form of subsurface land drainage.

## III. AGROTEXTILES

These areas of agro-textile application can be broadly identified as Agro-textiles for Crop

Production, Agro-textiles for Horticulture, Floriculture and Forestry, Agro-textiles for Animal Husbandry, Aquaculture and Agro-textiles for Agro-Engineering related applications. Textiles in different forms are extensively used for many agriculture end uses that include knitted, woven, non-woven, extruded sheet, moulded product, ropes, belt, etc. The uses of non-woven especially spun-bonded and needle punched fabrics are increasing. Few of the popular agro-textile products are shade nets, harvesting nets, nets for crop protection, mulch mats, Agro mats, textiles for food packaging, fishing nets, tarpaulins and their likes. Few of the other technical textiles that aid agriculture are geo-textiles (soil covers), protective textiles (agriculture work wear) and industrial textiles (belts, hoses and filters).

### 3.1 Development of Drip Lined Agromat

The new generation of Polypropylene nonwoven "Drip Lined Agro-Mat" is designed to better irrigation system for both horticulture and agriculture purpose. It will be a better and efficient watering system to agriculture field. These drip lined agro mats are working by the wicking action. It can be save water from 50-70% of water than the other watering system. This is because of avoiding water evaporation and water cannot be used by the plant.

### 3.2 Raw Material Used

This agro mat can be made from 100% polypropylene fibre. Needle punched non woven fabrication method is used in this project. Polypropylene is a major polymer used in nonwovens, with over 50% used for diapers or sanitary products where it is treated to absorb water (hydrophilic)and wicking properties rather than naturally repelling water (hydrophobic). We use polypropylene for the properties like good bulk and cover, very light weight, high strength (wet or dry), Resistant to deterioration from chemicals, mildew, insects, perspiration, rot and weather. Polypropylene has low moisture absorption and its moisture regain value is less than 0.1%. These fibres having very good wicking property than any other fibres

### 3.3 Development of Agro Mat:

The final agro mat fabric can be produced by 100% polypropylene fibre by using needle punched non woven method.

### 3.4 Structure of Drip Lined Agromat:

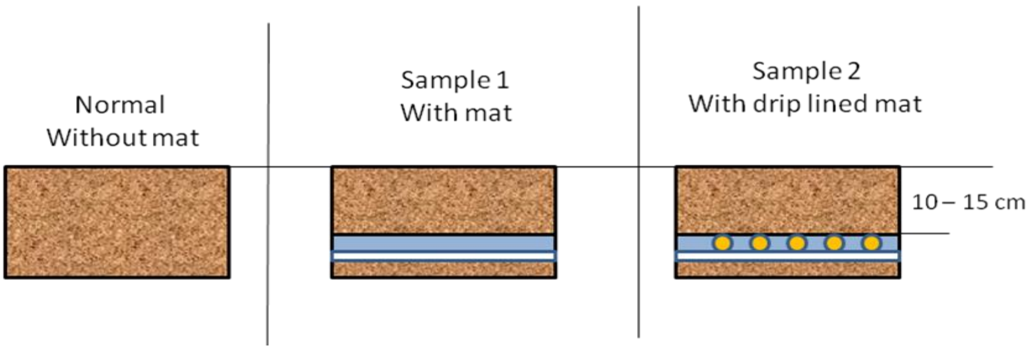



**Figure 4: Structure of Drip Lined Agromat**

IJARSE
ISSN 2319 - 8354

By taking two layer of needle punched polypropylene nonwoven fabrics and its seamed together with drip lined PVC hoses by means of strong interlocking. Polyethylene sheet as a bottom layer of agromat for water repellent below the soil. The following figure shows the agro mat construction. These drip lined agro mats are providing water to the roots of plant. These agro mats can be kept below 10-15 cm from the ground surface (It may vary depends upon the type of crops or depth of root of the plant). The water can be passed to the roots of plants through the holes present in the water hoses. The pipe line can be connected with the water tap line. When the soil would be dry then the water can be easily transferred to the soil which is near from the root. By using this agro mat we can maintain the plant in wetting and no man power is needed for water supply. And polyethylene sheet provided in the bottom layer is used to prevent water wasted below the mat.

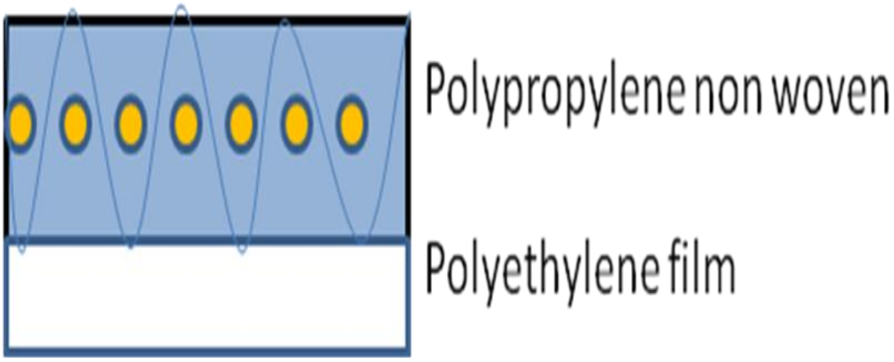



**Figure 5: Layers of Agromat**

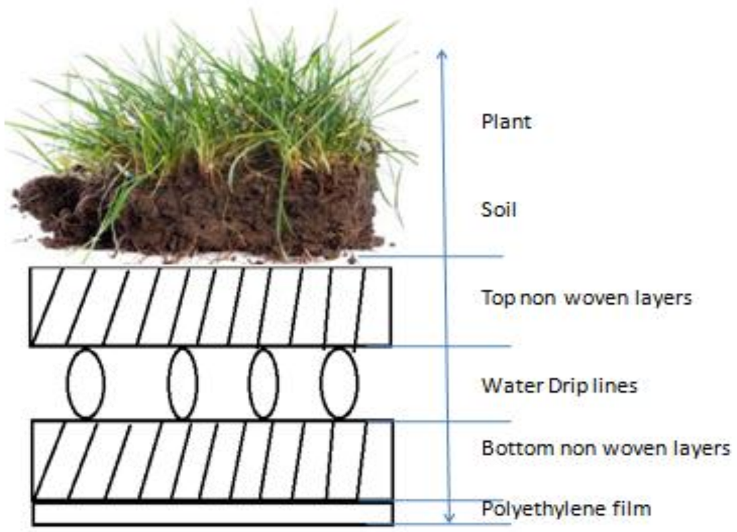



**Figure 6: Model of Drip Lined Agromat**

## IV. RESULTS AND DISCUSSIONS

### 4.1 wicking rate

From the wicking test results Sara Lee Method of 15*3 cm sample we can suggest that the vertical wicking rate double than the horizontal. By the comparison of single layer fabric test with double layer the wicking time and rate is faster than the single layer. The results of the wicking rate of sample are given below;

| CMS CROSSED | VERTICAL WICKING TIME (MINS) | | HORIZONTAL WICKING TIME (MINS/CM) | |
|---|---|---|---|---|
| | SINGLE LAYER | DOUBLE LAYER | SINGLE LAYER | DOUBLE LAYER |
| 1 | 0.05 | 0.02 | 0.03 | 0.02 |
| 2 | 0.13 | 0.06 | 0.07 | 0.05 |
| 3 | 0.25 | 0.12 | 0.11 | 0.09 |
| 4 | 0.42 | 0.22 | 0.20 | 0.14 |
| 5 | 1.03 | 0.36 | 0.31 | 0.19 |
| 6 | 1.29 | 0.51 | 0.42 | 0.26 |
| 7 | 1.58 | 1.11 | 0.58 | 0.37 |
| 8 | 2.40 | 1.40 | 1.12 | 0.41 |
| 9 | 3.26 | 2.17 | 1.39 | 0.53 |
| 10 | 4.02 | 2.56 | 1.57 | 1.05 |

**Table 1: Wicking Test Results**

The results obtained from the wicking tests are shown in Table 1 shows that there was rapid wicking for the first 2-5 centimeters in both the horizontal and vertical directions and then a significant decrease to a slow rate with the lapse of time. Same wicking rate of horizontal and vertical wicking properties are given below as a chart form. From this we can easily analyze the single and double layer wicking rate respect to horizontal and wicking time values.

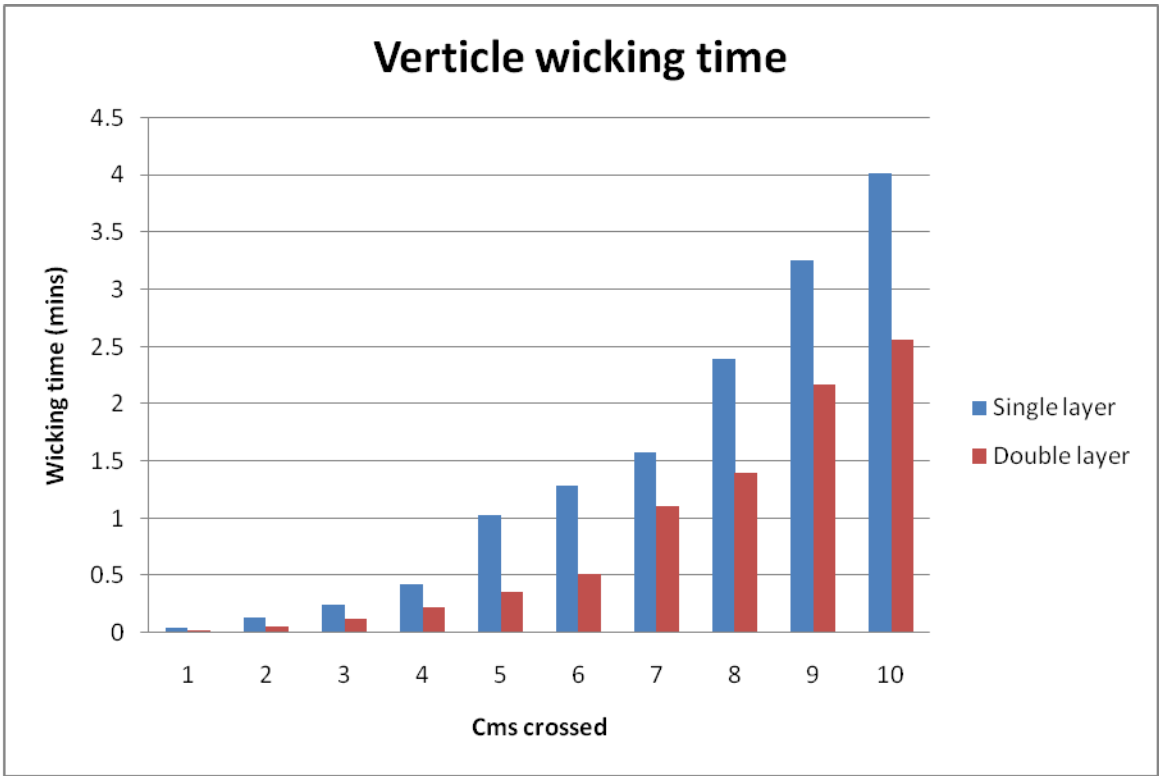



**Figure 7: single and double layers vertical wicking**

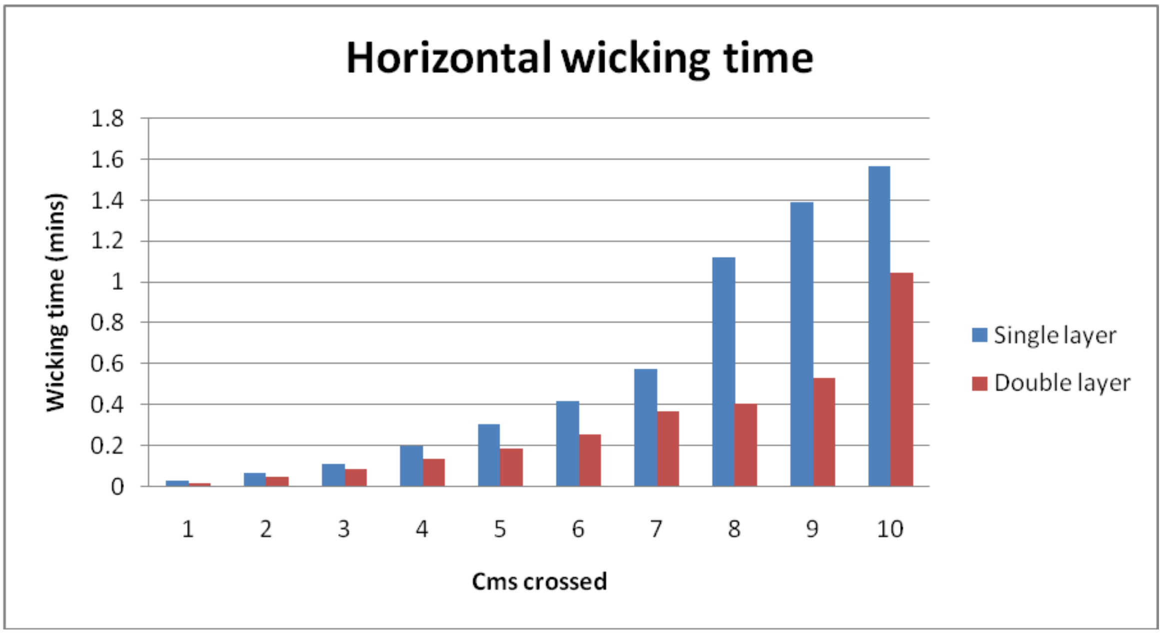



**Figure 8: single and double layers horizontal wicking**

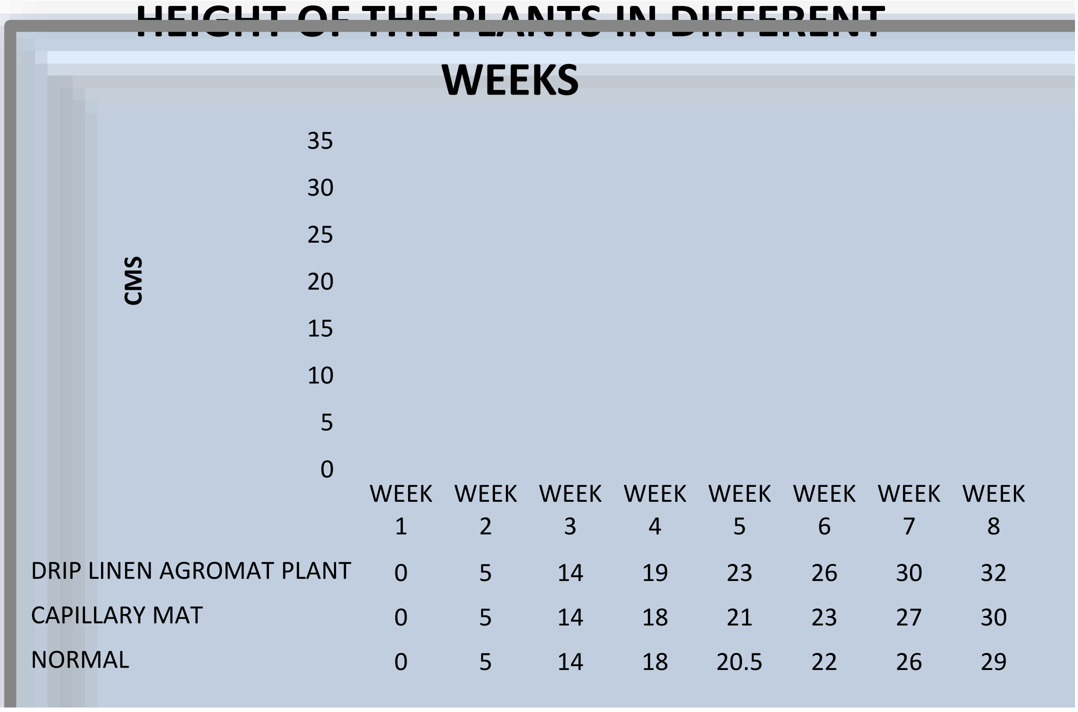
### 4.2 Plant performance

The main objective of the Driplined Agromat is to reduce water consumption and to provide better irrigation. The average water consumption of each plant has measured and tabulated. Same the height of the plant has measured to find the growth and maturity of the plant. The values of the height of the plant and water consumption were measured and tabulated below;

| NO OF WEEKS | HEIGHT OF THE PLANT (CMS) | | | WATER CONSUMPTION (AVG LITRES) | | | TEMPERATURE (AVG °C) |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 1 | 2 | 3 | |
| 1 | - | - | - | 8.4 | 9.1 | 9.4 | Max 30<br>Min 18 |
| 2 | 5 | 5 | 5 | 10.5 | 11.2 | 13.3 | Max 31<br>Min 20 |
| 3 | 14 | 14 | 14 | 12.6 | 13.3 | 17.7 | Max 29<br>Min 19 |
| 4 | 19 | 18 | 18 | 13.9 | 14.9 | 21.1 | Max 30<br>Min 19 |
| 5 | 23 | 21 | 20.5 | 14.8 | 15.8 | 24.7 | Max 29<br>Min 20 |
| 6 | 26 | 23 | 22 | 15.9 | 17 | 28.5 | Max 31<br>Min 21 |
| 7 | 30 | 27 | 26 | 17.2 | 18.3 | 30.8 | Max 31<br>Min 20 |
| 8 | 32 | 30 | 29 | 18.4 | 19.7 | 32.1 | Max 30<br>Min 21 |

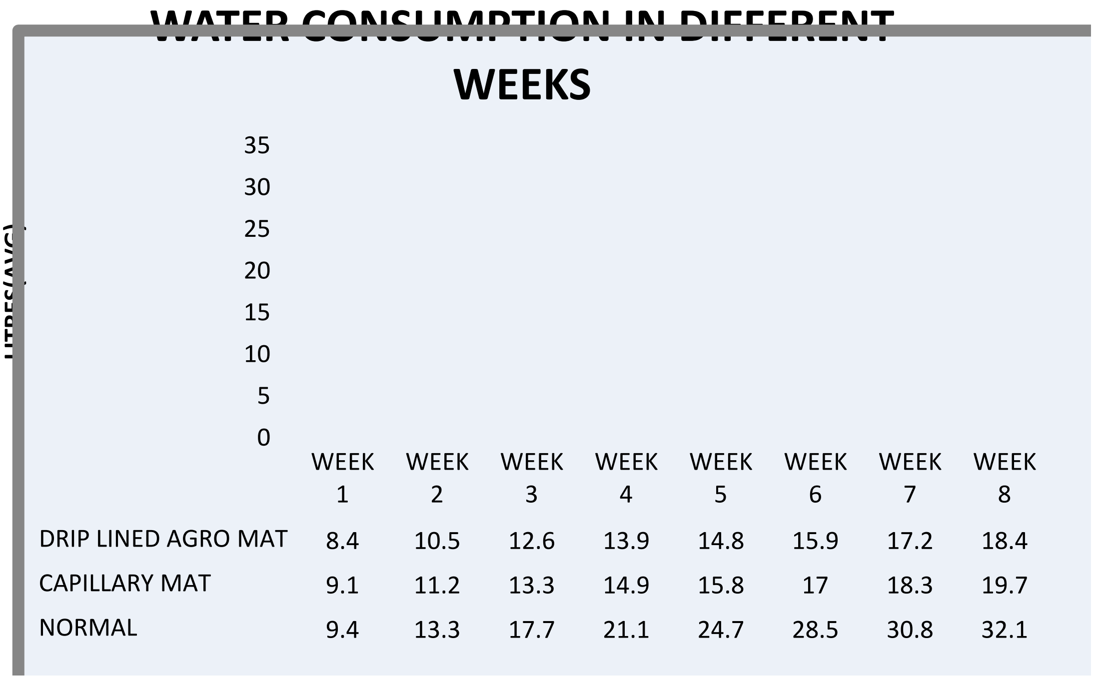
**Table 2: Height of The Plant And Water Consumption In Different Weeks**

From the measured values we can notice that Agromat irrigation system can reduce the water around 50% than normal irrigation method. But not much different in the plant growth. The same values of the height of the plant and water consumption were charted below




| | WEEK 1 | WEEK 2 | WEEK 3 | WEEK 4 | WEEK 5 | WEEK 6 | WEEK 7 | WEEK 8 |
|---|---|---|---|---|---|---|---|---|
| DRIP LINEN AGROMAT PLANT | 0 | 5 | 14 | 19 | 23 | 26 | 30 | 32 |
| CAPILLARY MAT | 0 | 5 | 14 | 18 | 21 | 23 | 27 | 30 |
| NORMAL | 0 | 5 | 14 | 18 | 20.5 | 22 | 26 | 29 |

**Figure 9: Height of the plants in different weeks**




| | WEEK 1 | WEEK 2 | WEEK 3 | WEEK 4 | WEEK 5 | WEEK 6 | WEEK 7 | WEEK 8 |
|---|---|---|---|---|---|---|---|---|
| DRIP LINED AGRO MAT | 8.4 | 10.5 | 12.6 | 13.9 | 14.8 | 15.9 | 17.2 | 18.4 |
| CAPILLARY MAT | 9.1 | 11.2 | 13.3 | 14.9 | 15.8 | 17 | 18.3 | 19.7 |
| NORMAL | 9.4 | 13.3 | 17.7 | 21.1 | 24.7 | 28.5 | 30.8 | 32.1 |

**Figure 10: Water consumption of the plants in different weeks**

**4.3 Advantages Of Drip Lined Agromat Watering System**

1. It should be achieve Water minimization
2. Utilization of resources
3. Application towards farmers
4. Reduce the man power
5. Effective horticulture applications

## VI. CONCLUSIONS

As per the studies conducted, we have concluded that the newly developed Drip lined Agro-Mat can reduce wastage of water in the horticulture and agriculture industry by saving up to 50-52% of water in comparison to that of conventional irrigation methods. These mats can be bottom lined with several layers of needle punch nonwovens to increase the wicking behaviour. By using these mats we can do the agriculture in a dry land. And a pot is enough to do the agriculture by using these drip lined agro mats. It avoids watering soil in between plants, thus reducing water use and weed growth and Saves time, money, and water due to higher efficiency. These Driplined Agromat Provides a more even soil moisture than the other irrigation methods. By this Soil erosion is minimized and soil type plays less important role in frequency of irrigation. From this water application efficiency is high. Fertilizer and nutrient loss is minimized due to localized application and reduced leaching and foliage remains dry, reducing the risk of disease.

## REFERENCES

1. Haydu, J.J, R.C Beeson, and J.Caron.2004. “Economics of five irrigation technologies for container growth-Viburnum odoratissimum”. Acta Hort. 664, pg 309-315
2. S K Basu: Agricultural and Horticultural Applications of Agro Textiles, The Indian Textile Journal, Vol. 121 Issue 12, pp 141-148, September 2011
3. Sankhe Manoj, R S Chitnis: Textile Structures and their Application in Agriculture, The Indian Textile Journal, Vol CXIII, No 3, December (2002).
4. Sengupta S, Indian journal of Fibre & Textile Research, Vol.34, December 2009, pp 345-35
5. V Subramaniam, G R Poongodi and V Veena Sindhuja: Agro-textiles: Production, Properties & Potential, The Indian Textile Journal, Vol. 119 Issue 7, pp 73-77 April, 2009.