Softboard as a Novel Wood Fibre-Based Substrate for Hydroponic Systems - A Preliminary Study

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Abstract- **Hydroponics or the soilless cultivation is a popular and fast growing sector of agriculture and it has many advantages over soil-based system. It offers opportunities to provide optimal conditions for plant growth and therefore higher yields can be obtained compared to open field cultivation. In the aggregate system of hydroponics, different substrates are currently being used as support to the root system of plants under soilless cultivation. Substrates can be organic such as peat, pine bark, sawdust, rice hulls, etc. They can be petroleum based such as polymeric foams or plastic beads or they can be inorganic mineral based such as sand, gravel, perlite and stone wool. There are reasons for using substrates to support the root system. An effective substrate should possess certain qualities. Still works are underway to find more suitable ones having several advantages over the existing ones.**

The present studies were undertaken with the objective of establishing the suitability of Softboard, a commercial Low Density Fibreboard product, manufactured from locally available hardwood fibres, as a suitable substrate for seed germination and seedling growth of two vegetable crops, Green gram (*Phaseolus aureus*) and Fenugreek(*Trigonella foenum-graecum*). The purpose of this study was to investigate whether a novel hydroponic substrate based on hardwood fibres could perform similarly to the existing materials. During this work, the author has compared the results obtained using the softboard with that of two commonly used substrates i.e., coirpith and sawdust. The article has also attempted to highlight all the advantages of this novel growing medium when compared to the known items.

Keywords: **Hydroponics, Substrates, Wood fibre-based Softboard, Green gram, Fenugreek, seed germination and seedling growth**

I. INTRODUCTION

Soilless cultivation is a popular and fast growing sector of agriculture and it has many advantages over standard agricultural practices: a) weed and soil diseases are not a problem in soil-less culture b) high quality yield c) cultivating crops in any region even in regions where poor soil conditions prevail d) controlling the root environments and prevention of compaction and increasing water and nutrient use efficiency.

Soilless culture imitates soil- base gardening by using many kinds of growing media as for example inorganic substance, organic substance and synthetic substrates [1].In the aggregate system of hydroponics, different substrates are currently being used as support to the root system of plants under soilless cultivation[2].There are four functions that substrate must serve in order to support good plant growth: It must serve as a reservoir for plant nutrients, it must hold water in a way that makes it available to the plant, it must provide plants with gases and water at the same time and it must support the plant. Some of the desirable properties of these growing media identified through research include organic matter, bulk density, porosity, aeration and pH.

Softboard or Fibre Insulation Board is a multipurpose Low Density Fibreboard manufactured from wood fibres, having a variety of uses. It is produced by reducing the hardwood to fibres which are then felted to form a continuous sheet. Softboard is hygroscopic in nature and because of the porous nature, it readily absorbs water. The present study aims at the exploring the possibility of using this eco-compatible substrate- Softboard, a commercial product of The Western India Plywoods Ltd, for substituting two well-known substrates, coirpith and sawdust and to verify the suitability of this new material.

II. MATERIALS AND METHODS

1) Substrates

Growth media used for the present works were:

A. Coirpith: Available in the form of briquettes in the local market

B. Sawdust: Collected from the Kohinoor Saw mills of The Western India Plywoods Ltd, Baliapatam

C. Softboard: Samples of thickness (3 mm and 5 mm) collected from the Warehouse unit of the Fibreboards Division of The Western India Plywoods Ltd, Baliapatam. Pegboards of 3mm thickness were also used on top of the Softboards to provide proper spacing and to avoid making pits for placing the seeds.

2) Experimental set-up

Seeds of Green gram (*Phaseolus aureus*) and Fenugreek (*Trigonella foenum-graecum*) obtained from VFPCK, Kannur were used for the experiments. Seed germination was recorded by counting the number of seeds emerged at twenty four (24) hours interval immediately after sowing. The criterion used for seed germination was taken as emergence of 2 mm radicle at the time of observation [3]. The germinated seeds were counted after two weeks to calculate the germination percentage (GP) as the following:

(GP %) = g x100/20 As g is the number of germinated seeds and 20 is the total number of seeds

For determination of seedling vigour index 10 seedlings were randomly selected from each treatment and their individual shoot and root length were measured. The vigour of the seedlings was determined by following the formula of Abdul-Baki and Anderson [4].

Vigour index = [mean of root length (cm) + mean of shoot length (cm)] × percentage of seed germination.

After 14 days, the growth parameters were estimated after uprooting and cleaning the seedlings. The fresh weight and dry weight (in grams per 20 seedlings) was measured with a digital weighing balance.

III. RESULTS AND DISCUSSION

The observations on the seed germination, seedling growth and development of the two vegetable crops, Green gram (*Phaseolus aureus*) and Fenugreek (*Trigonella foenum-graecum*) using softboard produced from hardwood fibres (Fig.1), coirpith and sawdust are summarized below:

1) Seed germination

There were remarkable differences in the percentage of seed germination of the vegetable seeds of Green gram (*Phaseolus aureus*) and Fenugreek (*Trigonella foenum-graecum*) on the three different substrates. Highest percentage was obtained with the Sawdust when compared to Softboard and Coirpith (Table 1&2) .This observation is contrary to the earlier work on a novel organic substrate based on hemp- (*Cannabis sativa*), or flax (*Linum usitatissimum*) bast fibres by Rossouw,S.J [5] where the germination tests showed no statistical difference in either mean germination time, nor total germination frequency.

2) Plant height & Biomass

The changes in shoot length and root length are presented in Table 1 and Table 2. Observations recorded at 3 days interval up to 14 days showed that there were significant differences in growth parameters between the substrates. Seedlings grown on sawdust showed better growth than Softboard and Coirpith-based media. In this case, enhancement in shoot length was very high at 14 days of growth in green gram in sawdust as compared to other substrates.

Similar studies were reported by Ehret, D. L. and Helmer, T [6] where they recorded the successful use of red cedar and yellow cedar sawdust as growing substrate for hydroponic tomato and pepper production in comparison with coir.

In 2014, El Sharkawi, et al [7] also reported the performance and suitability of different substrates for the soilless culture of cucumber plants (*Cucumis sativus* L. cv.Bringy) over a two growing seasons under greenhouse condition.The positive impact on the growth and development of different crops using different substrates was illustrated by earlier studies of Dannehl, D et al [8]. Studies by Woodard, M.A. et al [9] showed that coal bottom ash and pine wood peelings could be used as root substrates in a Circulating Nutriculture System.

Table 1: Effect of substrates on seed germination and seedling growth of Green gram (*Phaseolus aureus*)

Substrate	Germination%	Shoot length (cm)	Root length (cm)	Vigour Index	Fresh Weight (g)	Dry Weight (g)
Sawdust	94.0	16.0	9.0	864.0	0.616	0.227
Coir pith	76.3	6.8	4.0	312.0	0.422	0.085
Softboard	93.0	13.3	7.8	738.7	0.984	0.546

Fig.1: Growth and development of Green gram (*Phaseolus aureus*) and Fenugreek (*Trigonella foenum-graecum*) seedlings on Softboard

Table 2: Effect of substrates on seed germination and seedling growth of Fenugreek (*Trigonella foenum-graecum*)

Substrate	Germination %	Shoot length(cm)	Root length(cm)	Vigour Index	Fresh Weight(g)	Dry Weight(g)
Sawdust	92.6	16.0	9.0	849.4	0.616	0.170
Coir pith	69.3	6.0	3.0	623.7	0.426	0.080
Softboard	96.5	13.3	7.8	766.0	0.964	0.444

IV. CONCLUSIONS

The thrust of this investigation was to make use of the potentials that abound in natural biodegradable materials and products as plant growth media. Results of the present study revealed that the softboard has several qualities and advantages for placing it as a promising substrate among the long list of known substrates for hydroponics. By identifying and working on the substrate, the author attempted to introduce a new substrate hitherto unknown to the field of hydroponics, with the following characteristics:

1. It is biodegradable
2. It is readily available in the market
3. Free from pathogens and unwanted seeds
4. Organic material harvested sustainably from a renewable resource or local resource
5. Heavy enough to aid in anchoring the plants
6. Light enough to facilitate shipping and handling

Despite the above good characteristics and encouraging results obtained, the author feels that during this preliminary work, the softboard substrate did not perform fairly similar to sawdust in many regards. Hence, it is recommended to undertake further research and refinement before considering it as a competitive horticultural substrate.

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