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Growth response of papaya (*Carica papaya* L.) to organic waste and growing media under polyhouse cultivation

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Abstract
A field experiment was conducted to study the "Effect of organic wastes and growing media on seed germination and seedling growth of papaya (*Carica papaya* L.*)* under polyhouse condition" was taken up at the instructional farm of Department of Horticulture, College of Agriculture, Rewa (M.P.) during October to November 2022. There were thirteen treatments combinations of organic wastes and growing media *viz.*T_1- Control, T_2- Cow dung 12 hours + Soil + FYM + Vermicompost T_3- Cow dung 12 hours + Soil + FYM + Cocopeat T_4- Cow dung 24 hours + Soil + FYM + Vermicompost T_5- Cow dung 24 hours + Soil + FYM + Cocopeat T_6- Cow dung slurry 12 hours + FYM + Vermicompost T_7- Cow dung slurry 12 hours +Soil + FYM + Cocopeat T_8- Cow dung slurry 24 hours + Soil + FYM + Vermicompost T_9- Cow dung slurry 24 hours + Soil + FYM + Cocopeat T_{10}- Cow urine 12 hours + Soil + FYM + Vermicompost T_{11}- Cow urine 12 hours + Soil + FYM + Cocopeat T_{12}- Cow urine 24 hours + Soil + FYM + Vermicompost T_{13}- Cow urine 24 hours + Soil + FYM + Cocopeat. Which were laid out in randomized block design with three replications.

Keywords: Papaya, organic waste, growth, plant height, leaf area

Introduction
Papaya (*Carica papaya* L.) belong to the family *Caricaceae* is an important fruit crop of tropical world and has long been known as wonder fruits of the tropic. Propagation of papaya is through seeds as a viable option. The germination of papaya seeds is slowing, erratic and incomplete. The seed is enclosed within a gelatinous sarcotesta (aril or integument). This sarcotesta is reported to prevent germination. The slow and asynchronous germination is attributed due to presence of inhibitors (mainly phenolic compounds) in the sarcotesta and seed coat (Reyes *et al.*1980) [11]. In addition to inhibitor substances about 20% of papaya seeds are embryo less (Nagao and Furutani, 1986) [6]. Dormancy is also observed in seeds from which sarcotesta has been removed (Lange, 1961) [5]. To overcome these circumstances, it was reported that use of Vermicompost increases the soil organic matter, nutrient content, improves the soil structure and increases Cation Exchange Capacity (CEC). FYM is also very important component of management and maintaining the soil fertility and production of quality plants. Cocopeat increases the porosity and water holding capacity of the media and keep the soil loose and airy which helps in better root growth, ultimately better plant growth. It is also reported that organic wastes are also improve the seed ger mination and seedling vigour. Cocopeat is an agricultural by-product obtained after the extraction of fiber from the cocopeat husk (Abad *et al.*, 2002) [1]. As a growing media, cocopeat can be used to produce a number of crop species with acceptable quality in the tropics (Yau and Murphy, 2000) [12]. Cocopeat is considered as a good growing media component with acceptable pH, electrical conductivity and other chemical attributes (Abad *et al.*, 2002) [1]. Cocopeat has good physical properties, high total pore space, high water content, low shrinkage, low bulk density and slow biodegration. Supplementing of the sand is aimed to make media more porous while the organic matter (FYM and vermicompost) is added so as to enrich adequate nutrients for the seedling. There is better relationship between the manure and rooting rather than conventional soil mix and less susceptibility of the seedling to soil borne pests and diseases (Akanbi *et al.*, 2002) [2].

Materials and Methods

The experiment has been carried out in poly house conditions from October to November 2022 at Department of Horticulture's Instructional Farm, College of Agriculture, Rewa (M.P.) Rewa is located in North Eastern region of Madhya Pradesh at latitude 24°30` North latitude, longitude 81°15` East longitude, and elevation 360.0 meters above mean sea level. The subtropical climate of Rewa, with hot and dry summers and cold winters, is the region's key characteristic. In general, the maximum and minimum temperatures are higher than 43.3 °C lower than 5 °C, respectively. The average rainfall ranges from 900 mm to 1150mm, which is received mainly in rainy season (July-September).

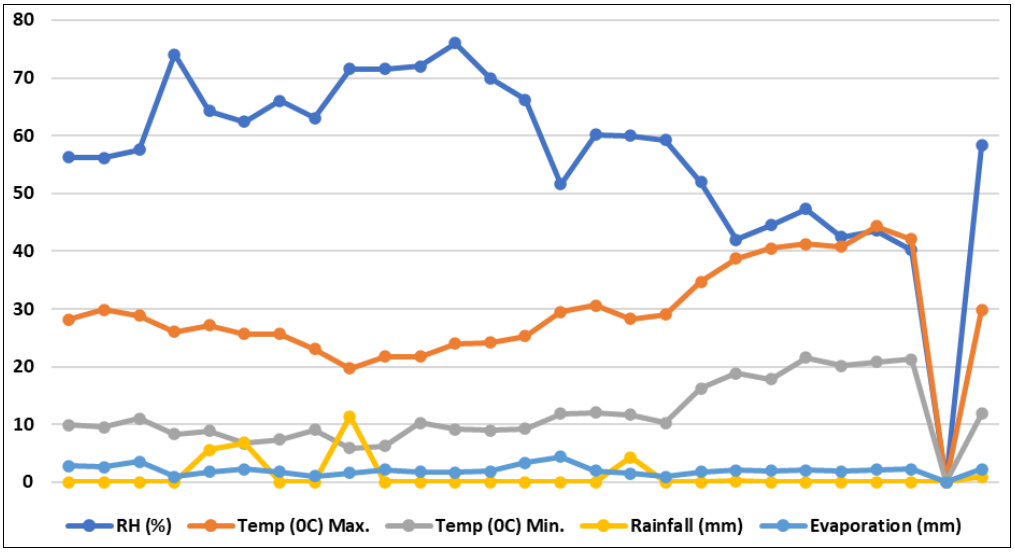

Fig 1: Meteorological data during crop growth period from the 13th November, 2022 to 1st April, 2023

Length of seedling (cm)

The height from the collar region to the tip of the shoot apex was measured for five randomly tagged seedlings in each treatment at 30, 45 and 60, DAS. The average height of plant was computed.

Diameter of seedlings (mm)

The diameter of shoot above the root collar region was measured by vernier caliper at 30, 45, 60, DAS and average diameter of plant was computed.

Number of leaves per plant: The number of leaves was measured for five randomly tagged plants each treatment was counted in 30, 45 and 60, DAS interval in each treatment.

Fresh weight of leaves per plant (gm): The fresh weight was taken from randomly selected plants from rach treatment after 45 DAS. The leaves were immediately weighed. The total leaves of a plant were put on an electrical balance. Weight of total leaves of per plant was recorded and means fresh weight of leaves of a plant was calculated.

Dry weight of leaves per plant (gm): The fresh weight of leaves was recorded and then the leaves were kept in oven to dry in appropriate temperature (60 °C) for 12 hours for removal of moisture content from the leaves. The dry weight of leaves was recorded with the help of an electrical balance after drying of leaves and average leaves weight per plant was calculated.

Leaf area: Leaf area of selected five seedlings at 45 DAS was measured with the leaf area meter and average leaf area per sq.cm was observed.

Results and Discussion

Plant height (cm)

The effect of organic waste and growing media combination was found significant for variation in length of seedlings at 30, 45 and 60 DAS. The maximum height of papaya seedlings was recorded in treatment T_5 i.e. Cow dung 24 hours + Soil + FYM + Cocopeat (15.5, 24.5 and 31.5cm, respectively during every period of measurement.) which was significantly superior to other treatments, followed by T_4 i.e. Cow dung 24 hours + Soil + FYM + Vermicompost (14.9, 24.0 and 30.7cm respectively) and T_3 i.e. Cow dung 12 hours + Soil + FYM + Cocopeat (14.7, 23.3 and 30.0cm, respectively.) while, the minimum plant height was recorded in treatment T_1 i.e. control (11.0, 18.7 and 24.0 cm, respectively).

Diameter of shoot (mm)

The effect of organic waste and growing media combination was found significant for variation in diameter of shoot (mm) at 30, 45 and 60 DAS. The maximum diameter of shoot attain in treatment T_5 i.e. Cow dung 24 hours + Soil + FYM + Cocopeat (2.8, 3.2 and 4.3mm respectively during every period of measurement.) which was significantly superior to other treatments, followed by T_4 i.e. Cow dung 24 hours + Soil + FYM + Vermicompost (2.5, 3.1 and 4.1mm respectively) and T_3 i.e. Cow dung 12 hours + Soil + FYM + Cocopeat (2.3, 3.0 and 4.0mm respectively), while, the minimum diameter of shoot recorded in treatment T_1 i.e. control (1.0, 2.1 and 3.0mm respectively).

Number of leaves

The effect of organic waste and growing media combination was found significant for variation in number of leaves per seedlings at 30, 45 and 60 DAS. The maximum number of leaves in treatment T_5 i.e. Cow dung 24 hours + Soil + FYM + Cocopeat (6.0, 10.0 and 16.0 respectively during every

period of measurement.) which was significantly superior to other treatments, followed by T_4 i.e. Cow dung 24 hours + Soil + FYM + Vermicompost (5.3, 9.1 and 15.5 respectively) and T_3 i.e. Cow dung 12 hours + Soil + FYM + Cocopeat (5.0, 9.0 and 14.9 respectively), while, the minimum number of leaves recorded in treatment T_1 i.e. control (1.4, 4.0 and 10.1 respectively).

Fresh weight of leaves (gm)

The effect of organic waste and growing media combination was found significant for variation in fresh weight of leaves. The maximum fresh weight of leaves in treatment T_5 i.e. Cow dung 24 hours + Soil + FYM + Cocopeat (4.3gm) at 45 DAS. Which was significantly superior to other treatments, followed by T_4 i.e. Cow dung 24 hours + Soil + FYM + Vermicompost (4.0gm) at 45 DAS. and T_3 i.e. Cow dung 12 hours + Soil + FYM + Cocopeat (3.9gm.) at 45 DAS. While the minimum fresh weight recorded in treatment T_1 i.e. control (1.0gm).

Dry weight of leaves (gm)

The effect of organic waste and growing media combination was found significant for variation in dry weight of leaves. The maximum dry weight of leaves in treatment T_5 i.e. Cow dung 24 hours + Soil + FYM + Cocopeat (0.57gm) at 45 DAS. which was significantly superior to other treatments, followed by T_4 i.e. Cow dung 24 hours + Soil + FYM + Vermicompost (0.54gm) at 45 DAS. and T_3 i.e. Cow dung 12 hours + Soil + FYM + Cocopeat (0.51gm.) at 45DAS., while the minimum dry weight recorded in treatment T_1 i.e. control (0.16gm).

Leaf area (cm^2)

The effect of organic waste and growing media combination was found significant for variation in leaf area. The maximum leaf area in treatment T_5 i.e. Cow dung 24 hours + Soil + FYM + Cocopeat (44.1cm^2) at 45 DAS. Which was significantly superior to other treatments, followed by T_4 i.e. Cow dung 24 hours + Soil + FYM + Vermicompost (42cm^2) at 45 DAS. and T_3 i.e. Cow dung 12 hours + Soil + FYM + Cocopeat (41.7cm^2). at 45 DAS, while the minimum leaf area recorded in treatment T_1 *i.e.* control (30.3cm^2).

Discussion

(Table 1.) display the influence of pre-soaking treatment on papaya developmental and growth measure. Seedling height is one of the really crucial feature views to seedling growth aspect. At 30, 45and 60 DAS, treatment T_5 Cow dung 24 hours + Soil + FYM + Cocopeat attained maximum length (15.4cm, 24.5cm and31.2cm respectively) of seedling, in comparison to the T_1 control, which had the minimum (11.0cm, 18.7cm and24.0cm respectively). it was due to seed soaking for 24 hrs. with cow dung in combination with FYM and cocopeat, activated α-amylase which digested the available to faster the growing of seedling. The outcome from present research were accordance another's Palepad *et al*. (2016) [8] and Parmar *et al*. (2016) [9]. The circumference of the shoot of papaya seedling was expanded to the maximum level at 30, 45, and 60 DAS. The seedling shoot diameter were maximum gaining measured in treatment T_5 Cow dung 24 hours + Soil + FYM + Cocopeat (2.8mm, 3.2mm, 4.3mm respectively) and minimum was eventually noted in the control (1.0mm, 2.1mm, 3.0mm respectively) at mentioned intervals. It was probably due to cell elongation and quicker multiplication of cells after the germination. The outcome from present research were accordance another's Palepad *et al*. (2016) [8] and Parmar *et al*. (2016) [9]. The leaf, from a physiological perspective, is the plant's most prominent photosynthetic region and even the power source for the plant's cellular reactions. The principal objective of leaves is carbon assimilation. When it comes here to number of leaves per seedling, at 45 DAS maximum numbers (16.0) of leaves emerged in treatment T_5 Cow dung 24 hours + Soil + FYM + Cocopeat. And minimum emergence in T_1 control (10.1). The outcome from present research were accordance another's Palepad *et al*. (2016) [8] and Parmar *et al*. (2016) [9]. In perspective of leaf area, treatment T_5 Cow dung 24 hours + Soil + FYM + Cocopeat. Seedling gain the maximum (44.1cm^2) compared to treatment T_1 control (30.3cm^2). similarly, seeds soaked with T_5 Cow dung 24 hours + Soil + FYM + Cocopeat had maximum (4.3 gm and 0.57 gm respectively) fresh weight and dry weight of leaves and minimum (1.0g and 0.16g respectively) observed in untreated check T_1 control because of its cell elongation and cell multiplication function. The outcome from present research were accordance another's Palepad *et al*. (2016) [8] and Parmar *et al*. (2016) [9].

Table 1: Effect of organic waste and growing media on plant height (30, 45 and 60 DAS), diameter of shoot (mm) (30, 45 and 60 DAS), number of leaves (30, 45 and 60 DAS), Fresh weight of leaves (gm), Dry weight of leaves (gm) and leaf area (cm^2)

Treatment	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	Fresh weight (gm)	Dry weigh (gm)	leaf area (cm^2)
Control (T_1)	11.0	18.7	24.0	1.0	2.1	3.0	1.4	4.0	10.1	1.0	0.16	30.3
Cow dung 12 hours + Soil + FYM + Vermicompost (T_2)	14.0	23.0	29.4	2.3	2.9	3.8	4.7	8.8	14.7	3.7	0.50	41.5
Cow dung 12 hours + Soil + FYM + Cocopeat (T_3)	14.7	23.3	30.0	2.3	3.0	4.0	5.0	9.0	14.9	3.9	0.51	41.7
Cow dung 24 hours + Soil + FYM + Vermicompost (T_4)	14.9	24	30.7	2.5	3.1	4.1	5.3	9.1	15.5	4.0	0.54	42.0
Cow dung 24 hours + Soil + FYM + Cocopeat (T_5)	15.4	24.5	31.2	2.8	3.2	4.3	6.0	10.0	16.0	4.3	0.57	44.1
Cow dung slurry 12 hours + FYM + Vermicompost (T_6)	12.8	22	28.2	1.5	2.5	3.4	3.1	7.0	13.0	3.1	0.41	36.0
Cow dung slurry 12 hours +Soil + FYM + Cocopeat (T_7)	13.2	22.2	28.3	1.7	2.55	3.6	3.3	8.1	13.9	3.3	0.47	37.5
Cow dung slurry 24 hours + Soil + FYM + Vermicompost (T_8)	13.5	22.5	28.5	1.9	2.6	3.8	3.6	8.2	14.2	3.4	0.48	38.7
Cow dung slurry 24 hours + Soil +	13.8	22.9	28.8	1.9	2.8	4.0	4.0	8.5	14.5	3.6	0.49	40.2

FYM + Cocopeat (T_9)												
Cow urine 12 hours + Soil + FYM + Vermicompost (T_{10})	11.8	21	26.9	1.2	2.3	3.3	2.0	4.4	10.3	1.7	0.28	32.0
Cow urine 12 hours + Soil + FYM + Cocopeat (T_{11})	11.5	21.8	27.8	1.4	2.4	3.3	2.1	4.8	10.8	2.0	0.38	33.0
Cow urine 24 hours + Soil + FYM + Vermicompost (T_{12})	12.4	22.1	28.1	1.5	2.5	3.5	2.3	5.0	11.0	2.5	0.40	34.2
Cow urine 24 hours + Soil + FYM + Cocopeat (T_{13})	12.3	22	28	1.6	2.5	3.5	2.5	6.3	12.3	2.7	0.40	35.0
S. Em±	0.049	0.12	0.10	0.064	0.082	0.10	0.044	0.074	0.066	0.033	0.003	0.11
C.D. at 5%	0.14	0.35	0.29	0.188	0.24	0.29	0.129	0.217	0.192	0.096	0.009	0.34

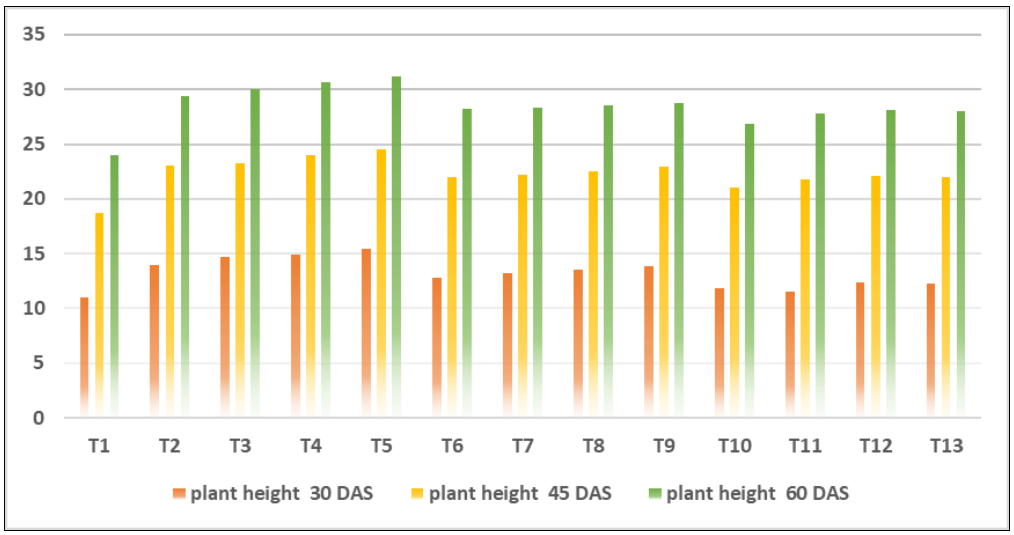

Fig 2: Effect of organic waste and growing media on plant height of Papaya at 30, 45 and 60 DAS of papaya (cm)

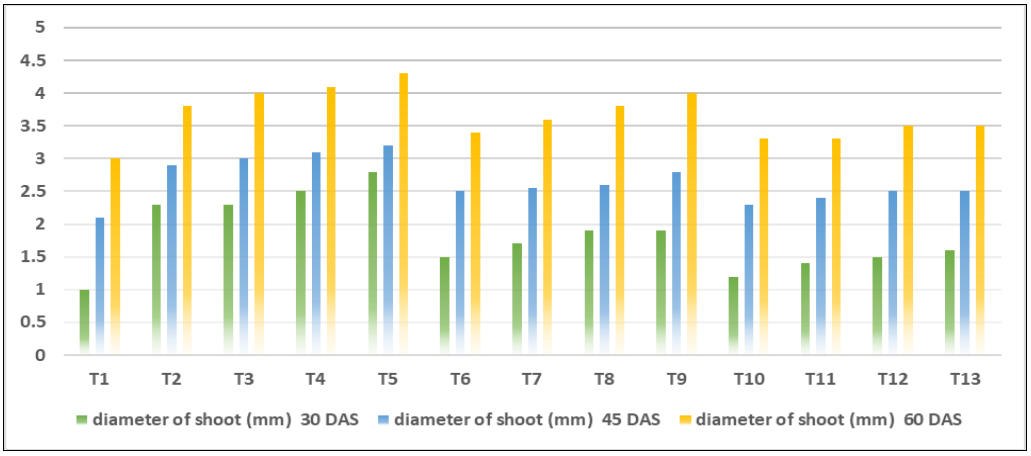

Fig 3: Effect of organic waste and growing media on diameter of shoot (mm) of Papaya at 30, 45 and 60 DAS

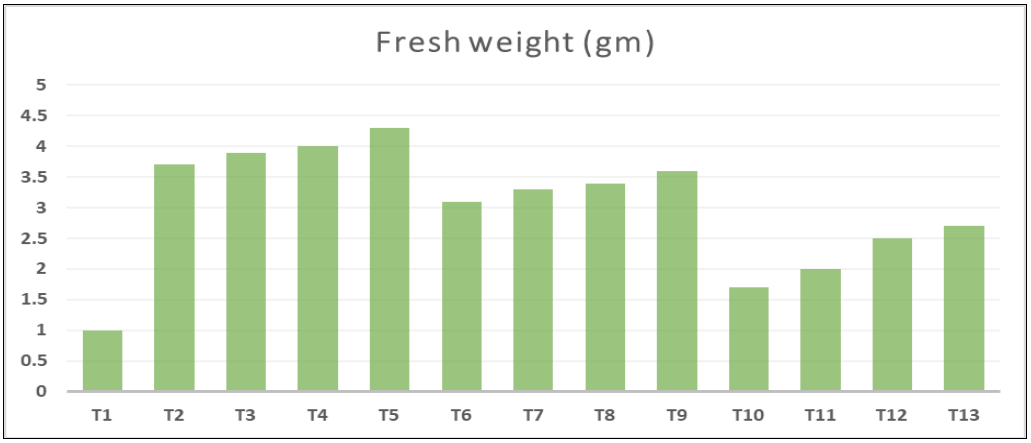

Fig 4: Effect of organic waste and growing media on fresh weight (gm)

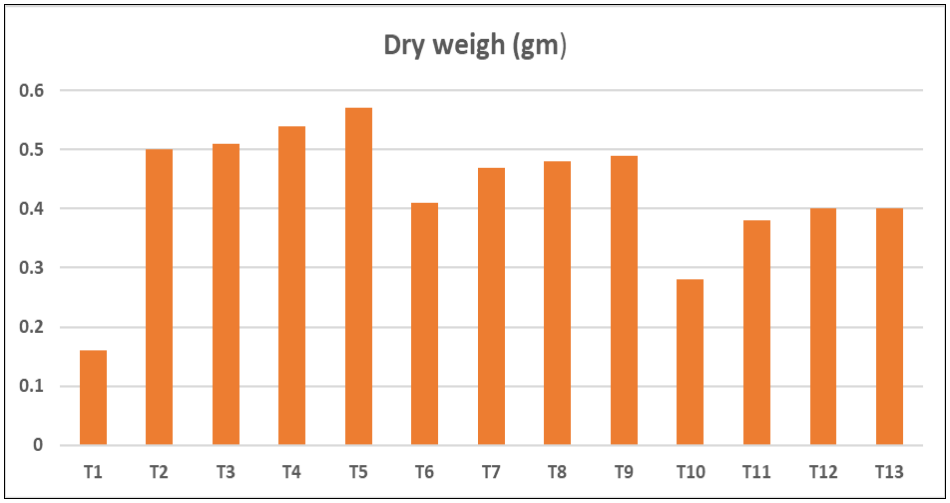

Fig 5: Effect of organic waste and growing media on dry weight (gm)

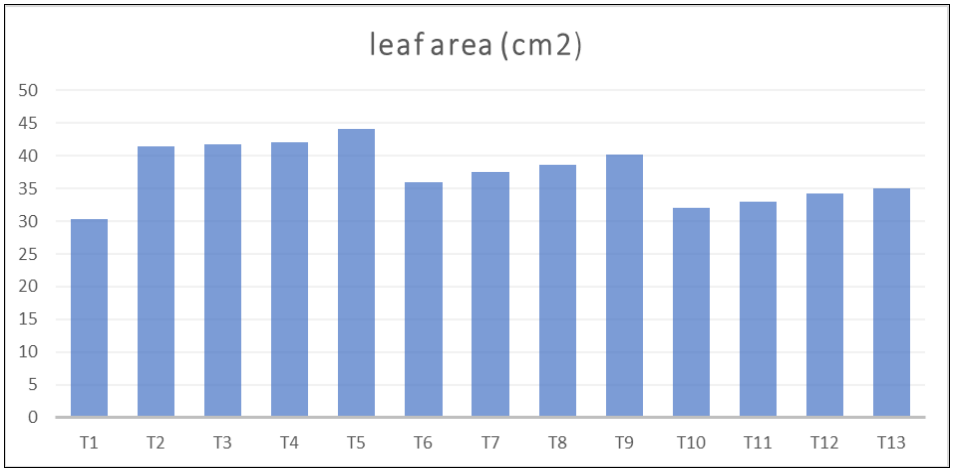

Fig 6: Effect of organic waste and growing media on leaf area (cm^2)

Conclusion

Result concluded that the seeds soaked with organic waste and growing media of cow dung for 24 hours in combination with Soil + FYM + cocopeat treatment was superior over all other treatments in relation to germination and physiological parameters as well as root characters and minimum values found in control. However, these results are only indicative and require further experimentation to arrive at more consistent and final conclusion to be passed on to growers.

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