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Survival and growth performance of stevia cutting under different growing media

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Abstract
This study was carried out to explore the survival and growth performance of stevia cutting under different growing media at CIMAP, Research Centre Purara, Uttarakhand. Results indicate that vermicompost + soil + FYM in ratio 1:1:1 had recorded highest survival of cutting (74.51 %), number of branches (12), plant height (17.14 cm), number of leaves/plant (35), fresh weight/plant (7.74 g), dry weight/plant (1.92 g), number of root/plant (20) and root length (14.34 cm). Finally concluded that growing media significantly influenced the survival rate of cutting, growth and development parameter of stevia sapling in which media vermicompost + soil + FYM was best media since the survival of cutting and development parameters were higher than those on the other media, therefore this result suggested that vermicompost + soil + FYM should be used as a growing media.

Keywords: Sapling, plant growth, saw dust, vermicompost, sand, FYM.

1. Introduction
Stevia (*Stevia rebaudiana* Bertoni), commonly known as “sweet weed”, “sweet leaf”, “sweet herb” and “honey leaf”, is a perennial herb belonging to the family Asteraceae. Leaves of stevia contain around 10 sweetening glycosides, of which stevioside (3–10%), rebaudioside-A (13%), and rebaudioside-B, C, D are important. The main source of sugar has for long been cane sugar with beet sugar contributing a small percentage. In India, the production of cane sugar is of the order of 240 million tonnes whereas that of beet sugar is 19500 tones. Though these sugars have sweetening qualities, they have been found to contribute to calories and are not advised for the consumption by diabetic patients [10]. For these people, the world of sweetness has seen a sweeter change in the recent past with the introduction of stevia sugar obtained from leaves of stevia containing compounds about 250 to 300 times sweeter than the table sugar. With a huge share of the Indian population being diabetic [9], non-caloric, natural sweeteners safe to diabetics will receive greater focus in future. Although there is greater interest in this plant now as a natural alternative to artificial sweeteners like saccharin, aspartame, asulfam-K. Worldwide, 32,000 hectares are covered under stevia cultivation, of which China has a major chunk of 75% area. Currently Japan is using stevia on large scale [11]. The Indian farmers have also started taking up stevia cultivation following the large demand for diabetic market here. The country’s total annual production is currently nearly 600 tonnes of dry leaf. The climatic conditions in most parts of India are quite favourable for stevia cultivation. In India farmers have started growing stevia in some parts of Rajasthan, Punjab, Uttar Pradesh, West Bengal, Madhya Pradesh, Karnataka, Chhattisgarh and West Bengal etc. Stevia is propagated either through seeds or cuttings. However, seed germination percentage is very low so, vegetative propagation is best way of multiplication for production of stevia sapling [6]. Some basic work on survival and growth performance of stevia cutting under different growing media regarding use of saw dust, vermicompost, sand and FYM in different combination to survival of cutting, sapling growth and development parameters of stevia have been carried out.

2. Material and Methods
Survival rate of cutting and sapling growth of stevia (*Stevia rebaudiana* Bertoni) were carried out at CIMAP Research centre Purara, Bageshwar (Uttarakhand) during March to May, 2014. The Experimental site is situated at an elevation of 1500-1560 m between the coordinate’s 79º 51’ 38º East and 29º 38’ 45” North in Katyur valley of Uttarakhand hills.

The valley remains hot during summer and cold during winter. The monsoon usually breaks in June and continues up to September. Experimental treatments comprised of following combinations of different growing media i.e. T_0 - control (soil), T_1 - soil + saw dust (1:1), T_2 - Soil + vermicompost (1:1), T_3 - soil + sand (1:1), T_4 - soil + FYM (1:1), T_5 - vermicompost+ soil+ FYM (1:1:1).

Transplanting of cutting was done in first week of March, 2014 in different media filled in polybags, prepared as per treatments. The polybags were irrigated immediately after seed sowing and repeated every day till the final emergence. For survival of cutting and sapling growth experiment, treatments of the experiment were conducted in CRD with three replications. Each treatment was composed of 100 polybags saplings. All the observation on survival of cutting were recorded at the time of root initiation and growth parameter at the time of transplanting from 100 cuttings for survival percentage and randomly selected 10 saplings for growth parameters. The data on survival percentage of cuttings was recorded according to mortality percentage in cuttings. The survival percentage was calculated as the per cent of mortality cuttings starting from the first mortality to no further mortality. Survival percentage was calculated by number of established sapling devised by the total number of cuttings transplanted in polybags and multiplied by 100. Recorded plant height was measured from polybags top soil surface up to the highest leaf tip by straightening all leaves. Number of root, root length was measured by destructive method of uprooting the plants and taking measurement by standard method. Plant fresh weight and number of leaves were recorded at the time of transplanting. Dry weight of the plant was recorded after reduction of moisture from the plant. All data was subjected to analysis of variance (ANOVA) to determine significant differences and comparison of mean at significant level of 5%.

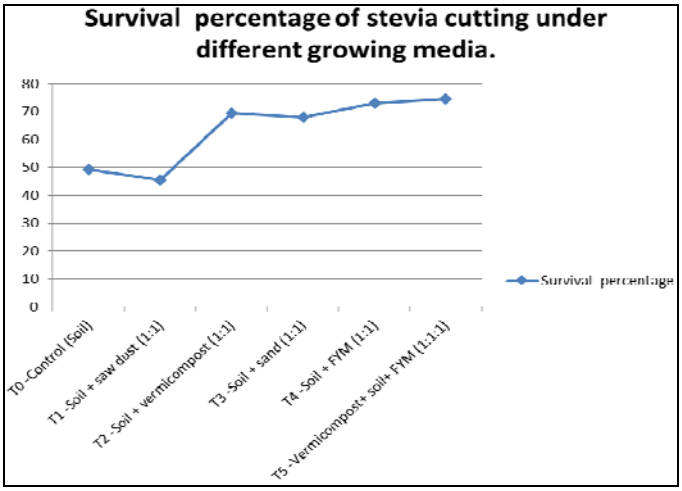
3. Results and Discussion

Results of present study have been presented in Table 1. It is evident that the treatment T_5 was found to best followed by T_4. Highest survival percentage of cutting (74.51) was obtained in T_5. The reason for the best performance of vermicompost with the FYM and soil are high organic matter content, which increases the water and nutrient holding capacity of the medium, which improve water utilization capacity of the plant. The higher available well decomposed organic matter (Vermicompost) may preserve soil humidity, increase nutrient content and improve soil structure which increase water absorption and maintain the cell turgidity, cell elongation and increase respiration at optimum level, leading to favorable root initiation in cuttings. Vermicompost + soil + FYM (1:1:1) affects the properties of soil physics, chemistry and biology, since organic matter acts glue for soil aggregate and source of soil nutrient [5]. Vermicompost granules may develop soil aggregate and its granulating. Soil aggregation will improve permeability and air flow in the polybags. Vermicompost may decrease fluctuation of soil temperature further root initiation and root growth become easier to the particular depth so that plant grows well and may absorb more water and nutrients [3]. Organic matter may also improve nutrient availability and improve phosphorus absorption [4]. All these factors are favorable for root initiation in cutting and ultimate by increase survival percentage, application of vermicompost+ soil+ FYM (1:1:1) in the treatment T_5 showed significant effect on the survival percentage probably due to the synergetic combination of both factor in improving physical condition of the medium and nutritional factors [7, 8]. This treatment combination is also helpful in reducing fungus disease in stevia sapling due to proper aeration in root zone of sapling and produced highest survival percentage (74.51) in treatment T_5, because of the better physical properties and enhanced nutrient level. Growth of the sapling was also fast and minimum days required for gaining transplanting stage was recorded in this treatment. The improvement of soil porosity, water content, drainage, soil permeability and water availability, with decrease in soil and water availability with decrease in soil density, due to presence of vermicompost and FYM in growth media have provided support for fast growth cutting due to availability of better nutrition with water and air in root zone. Therefore, good physical and biological condition in vermicompost + soil + FYM (1:1:1) had positive effect on root development, which was also helpful in increased survival percentage of sapling in main field after transplanting.

Significant differences were also observed among the different treatments with regard to sapling growth characters. Maximum number of leaves (35) was observed in T_5 followed by T_4. Vermicompost provide adequate nutrients and enhances both the physical properties and the water holding capacity [13]. Similar result was also reported by Supriyant *et al*. (1990) [12] working on an orange seedling where media contenting manure produced growth and root better than those containing sawdust and sand. Combined application of vermicompost and FYM in the T_5 showed significant effect on sapling growth parameter and plant biomass probably due to the synergistic combination of both factors in improving the physical condition of media and nutrient factor [7, 8]. This result is akin to the findings of compos [2] who suggested that since cure dust is low in nutrients when mix with vermicompost provides better growth medium for plant establishment. However, the air filled porosity (AFP), easily available water (EAW) and aeration of vermicompost and FYM were not at the recommended level, which in turn limit the root growth and lowered the water holding capacity therefore, the medium with vermicompost and FYM is more suitable because of the better physical properties and enhance nutrient level [1]. Significant differences are also observed among the different treatments with regard to sapling growth characters. Maximum height of the plant (17.14 cm) was recorded in T_5 followed by T_4, maximum fresh weight of the plant (7.74 g) was recorded in T_5 followed by T_4, maximum dry weight (1.92 g) was recorded in T_5 followed by T_4, maximum number of root/plant (20) was recorded in T_5 followed by T_4 and maximum number of root length (14.34) was recorded in T_5 followed by T_4 treatment. T_5 treatment was significantly superior as compare with other treatments.

Table 1: Survival and growth performance of stevia cutting under different growing media.

Treatment	Survival (%)	Number of branches	Height of the plant(cm)	Number of leaves per plant	Fresh weight of the plant (g)	Dry weight of the plant(g)	Number of root per plant	Root length (cm)
T_0 -Control (Soil)	49.15	3.17	6.9	14.27	2.26	0.57	4.40	6.09
T_1 -Soil + saw dust (1:1)	45.36	5.00	8.00	22.14	1.02	0.25	3.28	4.36
T_2 -Soil + vermicompost (1:1)	69.53	11.2	16.14	30.47	7.12	1.78	18.34	13.34
T_3 -Soil + sand (1:1)	68.07	6.24	10.25	28.13	4.13	1.02	12.29	11.45
T_4 -Soil + FYM (1:1)	72.89	10.36	17.00	32.14	6.28	1.56	17.13	12.22
T_5 -Vermicompost+ soil+ FYM (1:1:1)	74.51	12.00	17.14	35.00	7.74	1.92	20.00	14.34
SEM ±	0.551	0.423	1.221	0.551	0.524	0 .006	0.580	0.578
CD at 5%	1.699	1.304	3.762	1.697	1.614	0.018	1.786	1.718



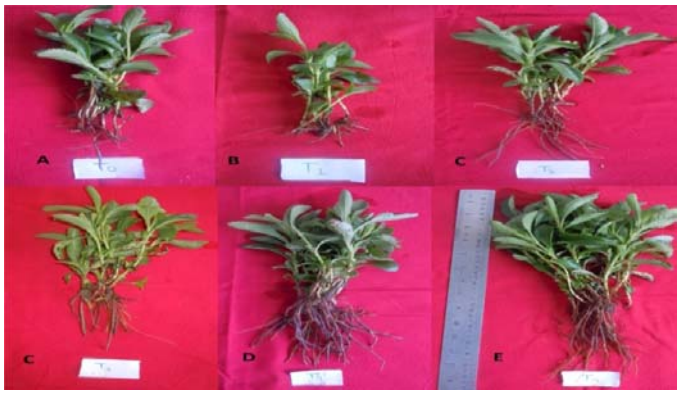


Plate 1: (A) Soil (B) Soil + saw dust (1:1) (C) Soil+ vermicompost (1:1) (D) Soil + sand (1:1) (E) Soil + FYM (1:1) (F) vermicompost + soil + FYM (1:1:1)

4. Conclusion

Conclusively, it emerges that growth media significant influenced the survival rate, growth and development parameters of stevia saplings and vermicompost + soil + FYM (1:1:1) was best media since survival of cutting, sapling growth and development were better in this media than other. Thus, vermicompost + soil + FYM (1:1:1) is recommended as growing media for successful production of stevia sapling.

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