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# Agrotechniques for quality planting material production in vetiver (*Chrysopogon zizanioides* (L.) Nash.)

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**Abstract**
Vetiver, a tall tufted perennial grass is being commercially grown for its roots and essential oil. Insufficient availability of quality planting material is one of the major constraints for its area expansion and further use among farmers. The present investigation was conducted to assess the effect of agro-techniques for quality planting material production in vetiver. The four factors tested were planting materials (2), planting systems (2), rooting medium (2) and moisture regimes (2). The experiment was laid out in factorial RBD. The results revealed that, planting of clumps could considerably improve number of tillers and gross returns, while growing of slips significantly enhanced benefit cost ratio. Trough system of planting was found to be economical in vetiver nursery, but planting strips increased crop growth potential. Similarly, additional application of cow dung slurry was effective for higher productivity and profitability in vetiver nursery.

**Keywords:** Vetiver, slips, clumps, trough, strips, crop growth potential.

## Introduction
Vetiver (*Chrysopogon zizanioides* (L.) Nash), a tall tufted perennial grass is being commercially grown for its roots and aromatic essential oil. The versatile nature of the plant *i.e.*, tolerates wide variety of stresses such as salinity, acidic, waterlogged, xerophytic and riverine soil conditions make it as a miracle grass. Proper care and nursery management is an important factor for better establishment and production of quality planting materials of vetiver. Singh (2007) [1] opined that timely irrigation and adequate manuring were essential for growth and root yield. Anusha (2013) [2] noted that single, dual and combined inoculation of bioinoculants improved sapling growth potential and vigour of vetiver nursery. Installation of subsurface drip fertigation system in vetiver with vermiwash and cow's urine and application of bioinoculants like Azospirillum, AM fungi and fluorescent Pseudomonas were beneficial for enhancing growth and yield (Shimi and Anilkumar, 2013) [3]. Keeping these in view, the present investigation was conducted to assess the effect of different planting materials, planting systems, rooting medium and moisture regimes on productivity and profitability of quality planting material production in vetiver.

## Materials and methods
The present study was conducted at the Instructional farm, College of Agriculture, Vellayani during 2017 February - May. The farm is located at 8º 5' N latitude and 76º 9' E longitude at an altitude of 29 m above MSL. The soil of the area is red sandy clay loam (Oxisol, Vellayani series). The study was laid out in Factorial RBD with four factors and replicated thrice. The treatments contained of combinations of two types of planting materials (a), two planting systems (b), enriched rooting medium with and without the addition of cowdung slurry at monthly intervals (c) and two levels of moisture regimes (d).
Slips ($a_1$) and clumps ($a_2$) were the two types of planting materials selected for the study. A slip is a stem, root, twig, *etc.* cut or broken off a plant and used for planting or grafting (Truong, 2006) [4], while clumps represents a group of slips mostly 4-5 tillers. The slips and clumps of vetiver were collected from Aromatic and Medicinal Plants Research Station, Odakkali. Two planting systems were, planting strips ($b_1$) and troughs ($b_2$). Troughs are shallow basins. The soil from the plots were removed up to 5 cm depth and filled with the rooting medium uniformly. Planting strips are the modified form of polybags.

Instead of individual bags, close spacing in specially prepared long furrow medium can facilitate transportation and planting very easy (Truong, 2006) [4]. For the preparation of planting strips, trenches of 20 cm depth were taken (2 m x 1 m x 20 cm). Transparent low density polyethylene sheets of suitable size were used for mulching each trench. The enriched rooting medium was prepared by mixing coirpith compost, soil and cowdung in the ratio 2:1:1, along with the basal application of Azospirillum and AM Fungi at 5 g each ($c_1$). Cowdung slurry prepared @ 1 kg $10^{-1}$ L ($c_2$) was used for monthly application as per appropriate treatments. The planting materials were planted in 2 m x 1 m plots at a spacing of 20 cm x 25 cm in troughs as well as in planting strips. General irrigation for a week was given to all plots for better establishment of the planting materials. The irrigation as per treatments *viz.*, 8 mm CPE (Cumulative Pan Evaporation) ($d_1$) and 16 mm CPE ($d_2$) were started after one week. Daily evaporation readings from a USWB Class A open pan evaporimeter were recorded and whenever the cumulative pan evaporation values attained the treatment values, irrigation was given. The irrigation was given with the help of a water meter. The plants were uprooted after four months of planting. The following formula was used for the estimation of Crop Growth Potential (CGP) (Anusha, 2013) [2].

$$CGP = \frac{Total\ darymatter\ production\ (g/plant)}{\left(\frac{Plant\ height\ (cm)}{Tiller\ number}\right) + Shoot{:}root\ ratio}$$

The economics of cultivation was calculated as per standard procedures based on the prevailing wage rates and market prices.

**Results and Discussion**

The data pertaining to the CGP, number of tillers and economics of vetiver nursery are presented in Table 1.

The planting materials had a significant effect on number of tillers, gross returns and B:C ratio. Number of tillers and gross returns were significantly improved by clumps to the tune of 10.27 and 10.27 % respectively. Clumps are the group of 4-5 tillers. Each tiller could facilitate production of more number of tillers in association with the other factors like planting systems, enriched rooting medium and moisture regimes. Xia (2003) [5] also observed a maximum of 51 tillers from triple tiller planting in a two month study, whereas Moula and Rahman (2008) [6] recorded a maximum of 81 tillers from double tillers. An increase of 23.65 % in B:C ratio was observed with planting slips in the nursery. The slips and clumps didn't significantly influence the CGP and net returns. The remarkable effects of planting systems on the production of quality planting materials, net returns and B:C ratio was observed in the nursery. Planting strips produced quality planting materials of highest CGP (36.40). Similarly, its capacity to store nutrients and moisture leads to the improvement in CGP to the tune of 67.22 % over troughs. However, the highest net returns (₹. 9.22 lakhs $ha^{-1}$) and B:C ratio (3.01) could be achieved with planting in troughs. Enriched rooting medium with coirpith compost, soil and cowdung and basal application of Azospirillum and AM Fungi was sufficient to meet crop requirements. While, enrichment of rooting medium with cowdung slurry at monthly intervals had a positive and significant enhancement in number of tillers (14.50 lakhs $ha^{-1}$), gross returns (₹.14.50 lakhs $ha^{-1}$), net returns (₹.9.54 lakhs $ha^{-1}$) and B:C ratio (3.01) by 14.06,14.06, 21.38 and 14.28 % respectively. Shimi (2011) [7] and Anusha (2013) [2] also noted an improvement in growth parameters of vetiver with the application of enriched growing medium. The two moisture regimes didn't significantly influence the productivity and profitability of vetiver nursery after four months of planting. However, irrigation at 16 mm CPE recorded higher CGP, net returns and B:C ratio. Hence, irrigation at 16 mm CPE is sufficient in the nursery to improve productivity and profitability compared to 8 mm CPE. As the vetiver is very hardy and tolerant to extreme conditions, similar results in irrigation management were reported by Pareek *et al.* (1992) [8] and Nataraja (2007) [9]. Hence, it can be concluded that, clumps were suitable for improving number of tillers and gross returns, while growing of slips significantly enhanced benefit cost ratio. Among the planting systems, planting strips improved crop growth potential, but trough system of planting was found to be economical for vetiver nursery. Similarly, additional application of cowdung slurry was helpful for higher productivity and profitability. The two moisture regimes didn't influence the productivity and profitability of vetiver nursery. Hence, 16 mm CPE can be adopted for irrigation scheduling in vetiver.

**Table 1:** Productivity and economics of vetiver nursery as influenced by effects of planting materials, planting systems, rooting medium and moisture regimes

| Treatments | Crop Growth Potential (Plant$^{-1}$) | Number of tillers (No. Lakhs ha$^{-1}$) | Gross returns (₹. Lakhs ha$^{-1}$) | Net returns (₹. Lakhs ha$^{-1}$) | B:C ratio |
|---|---|---|---|---|---|
| ***Planting materials*** | | | | | |
| Slips ($a_1$) | 22.63 | 12.75 | 12.75 | 8.71 | 3.17 |
| Clumps ($a_2$) | 25.69 | 14.21 | 14.21 | 8.33 | 2.42 |
| SEM | 1.14 | 0.36 | 0.36 | 0.36 | 0.07 |
| CD (P < 0.05) | NS | 1.039 | 1.039 | NS | 0.219 |
| *Planting systems* | | | | | |
| Planting strips ($b_1$) | 36.40 | 12.96 | 12.96 | 7.82 | 2.58 |
| Troughs ($b_2$) | 11.93 | 14.00 | 14.00 | 9.22 | 3.01 |
| SEM | 1.14 | 0.36 | 0.36 | 0.36 | 0.07 |
| CD (P < 0.05) | 2.329 | NS | NS | 1.039 | 0.219 |
| *Rooting medium* | | | | | |
| Enriched rooting medium ($c_1$) | 23.41 | 12.46 | 12.46 | 7.50 | 2.58 |
| $c_1$ + cowdung slurry @ monthly intervals ($c_2$) | 24.92 | 14.50 | 14.50 | 9.54 | 3.01 |
| SEM | 1.14 | 0.36 | 0.36 | 0.36 | 0.07 |
| CD (P < 0.05) | NS | 1.039 | 1.039 | 1.039 | 0.219 |
| *Moisture regimes* | | | | | |
| 8 mm CPE ($d_1$) | 24.06 | 13.53 | 13.53 | 8.44 | 2.72 |
| 16 mm CPE ($d_2$) | 24.27 | 13.43 | 13.43 | 8.61 | 2.87 |
| SEM | 1.14 | 0.36 | 0.36 | 0.36 | 0.07 |
| CD (P < 0.05) | NS | NS | NS | NS | NS |

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