Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(3): 149-152
Received: 07-03-2019
Accepted: 09-04-2019

Ishrath PK
Ph D Scholar, College of Agriculture, Trivandrum, Kerala, India

Anilkumar AS
Professor, Agronomy, College of Agriculture, Trivandrum, Kerala, India

Correspondence
Ishrath PK
Ph D Scholar, College of Agriculture, Trivandrum, Kerala, India

Nursery management practices for improving root growth potential in vetiver

Ishrath PK and Anilkumar AS

Abstract
An experiment was conducted at the Instructional farm, College of Agriculture, Vellayani to study the effect of planting materials (slips and clumps), planting systems (planting strips and troughs), enriched rooting medium (with and without the additional application of cowdung slurry) and moisture regimes (irrigation at 8 mm and 16 mm CPE) on root growth potential and root characters of vetiver. The study was carried out in factorial RBD and replicated thrice. The results revealed that, root growth potential and root characters like number, weight, length, spread and volume can be improved by planting of vetiver slips in strips with enriched rooting medium (coirpith compost: soil: cowdung (2:1:1) + Azospirillum and AM Fungi (5g as basal) and additional application of cowdung slurry at monthly intervals, along with scheduling of irrigation at 16 mm CPE.

Keywords: Vetiver, root growth potential, slips, strips

Introduction
Vetiver (*Chrysopogon zizanioides* (L.) Nash) is a tall tufted perennial grass of poaceae family. The plant is commercially grown for its thick, viscous and aromatic essential oil distilled from the roots. Vetiver roots also possess strong but most agreeable cooling and pleasant aroma. The plant is versatile, *i.e.*, tolerates wide variety of stresses such as salinity, acidic, waterlogged, xerophytic and riverine soil conditions. The fast growing nature of the deep penetrating roots helps for the binding of soil particles and leads to the stabilization of steep slopes and prevention of soil erosion. The diverse application of vetiver makes it as a miracle grass all over the world.

Proper nursery management is an important factor for the better establishment of vetiver grass. 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 root and oil yield (Shimi and Anilkumar, 2013) [1]. Timely irrigation and adequate manuring are also essential for the growth and root yield (Singh, 2007) [2]. However, studies regarding root growth potential (RGP) of vetiver is limited. Keeping this in view, the present investigation was conducted to assess the effect of different planting materials, planting systems, rooting medium and moisture regimes on root growth potential and root characters of vetiver.

Materials and Methods
The experiment 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 experimental site is red sandy clay loam (Oxisol, Vellayani series). The experiment was laid out as Factorial RBD with four factors and replicated thrice. The treatments consisted 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) [3], 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) [3]. 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 to the appropriate treatments (KAU, 2011) [4]. 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.

Saplings were uprooted after four months of planting. Subsequently root parameters were studied after thorough washing in running water. RGP is the measure of seedling's ability to rapidly produce new roots and it is a key indicator of seedling vigour and survival after planting (Ritchie and Dunlap, 1980) [5]. The RGP can be estimated as the growth rate of an average root (Thompson and Timmis, 1978) [6]. The following formula was used for RGP estimation,

$$\text{RGP} = \frac{\ln W2 - \ln W1}{(t2 - t1)},$$

Where W2 and W1 are root dry weight at time t2 and t1.

The procedure described by Misra and Ahmed (1989) [7] was followed for the study of root parameters. The root number and root weight were noted. Root length of the longest root and maximum root spread were measured and expressed in cm. Diameter of visibly thickest root was recorded at the middle point. It was expressed in mm. Volume of roots per plant was estimated by displacement method and expressed in cm^3 $plant^{-1}$.

Results and Discussion

The data with respect to the root studies of vetiver as influenced by the main effects of planting materials, planting systems, rooting medium and moisture regimes are presented in Table 1.

The planting materials had a significant effect on RGP. Slips recorded an RGP of 0.036 g $g^{-1}day^{-1}$ within 4 months. The slips and clumps didn't significantly influence the other root characters, however slips improved root weight, root length and root volume. However, clumps were the best in increasing the root number, root spread and root thickness. The effects of planting systems on RGP and root characters were spectacular. Positive and significant enhancements in RGP and root characters were observed in strips. The strips acted as a store house of nutrients, beneficial microbes and helped to maintain the moisture level without loss through percolation and seepage. Thus the plants registered significantly higher RGP (0.039 g $g^{-1}day^{-1}$), root number (114.16 number $plant^{-1}$), root weight (486.04 g $plant^{-1}$), root length (86.37 cm), root spread (67.87 cm) and root volume (300.66 cm^3 $plant^{-1}$) except thickness (0.78 mm) and the per cent increase compared to planting in troughs was 24.20, 666.62, 71.33, 191.91

Table 1: RGP and root characters of vetiver in nursery as influenced by main effects of planting materials, planting systems, rooting medium and moisture regimes

Treatments	RGP (g $g^{-1}day^{-1}$)	Root number (number $plant^{-1}$)	Root weight (g $plant^{-1}$)	Root length (cm)	Root spread (cm)	Root Thickness (mm)	Root volume (cm^3plant^{-1})
Planting materials							
Slips (a_1)	0.036	102.16	286.88	68.91	44.91	1.06	186.14
Clumps (a_2)	0.024	103.91	262.56	67.87	46.20	1.09	181.74
SEM	0.0003	1.99	11.32	1.09	0.85	0.042	2.502
CD (P < 0.05)	0.001	NS	NS	NS	NS	NS	NS
Planting systems							
Planting strips (b_1)	0.039	114.16	486.04	86.37	67.87	0.78	300.66
Troughs (b_2)	0.021	91.91	63.40	50.41	23.25	1.38	67.21
SEM	0.0003	1.99	11.32	1.09	0.85	0.042	2.502
CD (P < 0.05)	0.001	5.765	32.696	3.174	2.464	0.087	7.227
Rooting medium							
Enriched rooting medium (c_1)	0.030	98.33	255.77	68.83	45.66	1.05	185.91
c_1 + cowdung slurry @ monthly intervals (c_2)	0.030	107.75	293.67	67.95	45.45	1.11	181.97
SEM	0.0003	1.99	11.32	1.09	0.85	0.042	2.502
CD (P < 0.05)	NS	5.765	32.696	NS	NS	NS	NS
Moisture regimes							
8 mm CPE (d_1)	0.030	98.83	290.52	69.33	45.37	1.12	185.55
16 mm CPE (d_2)	0.030	107.25	258.91	67.45	45.75	1.04	182.33
SEM	0.0003	1.99	11.32	1.09	0.85	0.042	2.502
CD (P < 0.05)	NS	5.765	NS	NS	NS	NS	NS

SEM- Standard Error of the Mean, CD (P< 0.05) - Critical Difference at 5 % probability, NS- Not Significant

Table 2: RGP and root characters of vetiver as influenced by interaction effects of planting materials, planting systems, rooting medium and moisture regimes at 4 MAP

Treatments	RGP ($g\ g^{-1}day^{-1}$)	Root number (number $plant^{-1}$)	Root weight ($g\ plant^{-1}$)	Root length (cm)	Root spread (cm)	Root thickness (mm)	Root volume ($cm^3\ plant^{-1}$)
a x b x c x d							
$a_1b_1c_1d_1$	0.047	105.67	514.67	92.00	73.00	0.77	322.00
$a_1b_1c_1d_2$	0.045	114.67	404.00	83.67	65.67	0.75	288.40
$a_1b_1c_2d_1$	0.045	112.67	587.00	84.00	61.67	0.80	288.27
$a_1b_1c_2d_2$	0.047	124.67	525.91	86.33	71.67	0.68	321.67
$a_1b_2c_1d_1$	0.026	81.67	63.78	50.67	20.33	1.40	66.43
$a_1b_2c_1d_2$	0.027	87.67	58.00	53.33	20.00	1.30	68.10
$a_1b_2c_2d_1$	0.027	90.67	72.45	51.00	21.67	1.45	70.17
$a_1b_2c_2d_2$	0.027	99.67	69.23	50.33	25.33	1.37	64.10
$a_2b_1c_1d_1$	0.034	105.33	457.33	83.33	71.00	0.72	304.97
$a_2b_1c_1d_2$	0.034	114.33	434.00	89.67	67.33	0.72	303.73
$a_2b_1c_2d_1$	0.033	111.67	498.33	88.67	65.67	0.90	293.70
$a_2b_1c_2d_2$	0.033	124.33	467.12	83.33	67.00	0.87	282.60
$a_2b_2c_1d_1$	0.016	86.67	61.33	53.67	24.67	1.43	74.47
$a_2b_2c_1d_2$	0.014	90.67	53.00	44.33	23.33	1.33	59.20
$a_2b_2c_2d_1$	0.014	96.33	69.34	51.33	25.00	1.47	64.40
$a_2b_2c_2d_2$	0.015	102.00	60.00	48.67	25.67	1.33	70.87
SEM	0.001	5.64	32.02	3.10	2.41	0.12	7.07
CD (P < 0.05)	0.002	NS	NS	8.977	NS	NS	20.442

SEM- Standard Error of the Mean, CD (P < 0.05) - Critical Difference at 5 % probability, NS- Not Significant

and 347.34 % respectively. Enriched rooting medium consisting of coirpith compost, soil and cowdung in the ratio 2:1:1 and basal application of Azospirillum and AM Fungi provided sufficient inputs, *viz*, nutrients and moisture resulting in better performance of plants after four months. Apart from the enriched rooting medium, additional application of cowdung slurry at monthly intervals was found to be very effective in improving the root number (107.75 number $plant^{-1}$) and root weight (293.67g $plant^{-1}$) by 9.57 and 14.81 % respectively. Shimi (2011) [8] and Anusha (2013) [9] noted improvement in root parameters of vetiver with the application of enriched growing medium. Irrigation at 16 mm CPE recorded higher root number as well as root spread due to prolonged moisture stress compared to 8 mm CPE. Irrigation at 16 mm CPE is sufficient in the nursery to improve root characters compared to 8 mm CPE. Similar results were reported by Pareek *et al.* (1992) [10] and Nataraja (2007) [11].

The four factor interactions were significant in RGP, root length and root volume (Table 2). The remarkable effect of planting strips was evident in all the treatment combinations. Maximum RGP was observed in $a_1b_1c_2d_2$ (0.047 g $g^{-1}day^{-1}$) and $a_1b_1c_1d_1$ (0.047 g $g^{-1}day^{-1}$). Similarly, maximum root number of 124.67 and maximum weight of 587.00 g was recorded by $a_1b_1c_2d_2$ and $a_1b_1c_2d_1$ respectively. The treatment combination $a_1b_1c_1d_1$ recorded the maximum length of 92.00 cm, root spread of 73.00 cm and root volume of 322.00 cm^3 $plant^{-1}$ at 4 MAP. It was at par with $a_2b_1c_1d_2$ (89.67 cm), $a_2b_1c_2d_1$ (88.67 cm), $a_1b_1c_2d_2$ (86.33 cm), $a_1b_1c_2d_1$ (84.00 cm), $a_1b_1c_1d_2$ (83.67 cm), $a_2b_1c_2d_2$ (83.33 cm) and $a_2b_1c_1d_1$ (83.33 cm) in root length. While $a_1b_1c_2d_2$ (321.67 cm^3), $a_2b_1c_1d_1$ (304.97 cm^3) and $a_2b_1c_1d_2$ (303.73 cm^3) were on par in root volume. However $a_2b_2c_2d_1$was found to be the best in increasing root thickness (1.47 mm).

Hence, it can be concluded that the RGP and root characters of vetiver like number, weight, length, spread and volume can be improved by planting of slips in strips of specified dimensions with enriched rooting medium and additional application of cowdung slurry at monthly intervals, along with the scheduling of irrigation at 16 mm CPE.

Acknowledgement

We acknowledge Department of Science and Technology for awarding Inspire fellowship and Kerala Agricultural University for providing all the facilities for the completion of research work.

References

1. Shimi GJ, Anilkumar AS. Root parameters and root dry matter production of vetiver (*Vetiveria zizanioides*) in relation to planting methods, fertigation and bioinoculation. Curr. Adv. Agric. Sci. 2013; 5(2):285-286.
2. Singh J. Medicinal and aromatic plants. Aavishkar Publishers and Distributors, Jaipur, 2007, 266-275.
3. Truong P. Vetiver Propagation: Nurseries and Large Scale Propagation. Workshop on Potential Application of the VS in the Arabian Gulf Region, Kuwait City, 2006.
4. KAU [Kerala Agricultural University]. The adhoc Package of Practices Recommendations for Organic Farming. Kerala Agricultural University, Thrissur, 2009, 209.
5. Ritchie GA, Dunlap JR. Root growth potential: Its development and expression in forest tree seedlings. New Zealand J For. Sci. 1980; 10 (1):218-249.
6. Thompson BE, Timmis R. Root regeneration potential in Douglas-fir seedlings: effect of photoperiod and air temperature on its evaluation and control. Proc. IUFRO Symp. on Root Physiol. and Symbiosis, Nancy, France, 1978.
7. Misra RD, Ahmed M. Manual on Irrigation Agronomy. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi, 1989:410.
8. Shimi GJ. Rhizosphere management for enhancing root productivity and oil yield in vetiver (*Vetiveria zizanioides* (L.) Nash), M.Sc. (Ag.) Thesis, Kerala Agricultural University, Thrissur, 2011, 152.
9. Anusha AN. Multiple cropping and microsite enrichment in vetiver (*Chrysopogon zizanioides* (L.) Nash, M.Sc. (Ag.) Thesis, Kerala Agricultural University, Thrissur, 2011, 150.

10. Pareek SK, Maheshwari ML and Gupta R. Recent advances for improving vetiver *(Vetiveria zizanioides)* cultivation in India. Indian Perfum. 1992. 36(4):265-271.
11. Nataraja A. Studies on effects of moisture regimes, INM and stage of harvest on growth, yield and quality of vetiver *(Vetiveria zizanioides* (L.) Nash), Ph D. Thesis, University of Agricultural Sciences, Bangalore, 2007, 154.