Vetiver Hybrid Clones

By R. S. Gupta,* K. C. Trivedi, S. Verma, and S. K. Gangrade, Medicinal and Aromatic Plants Project, College of Agriculture, Indore, India

Roots of Khus plant, *Vetiveria zizanioides* (Linn) Nash, contain a highly fragrant essential oil. The oil is used in the preparation of popular scents, soaps, perfumes and cosmetics as well as for the isolation of vetiverol, vetiverone and vetiveryl acetate. It has good export potential since Indian oil has very high content of Vetiveryl esters in natural state (Arctander 1960).

Vetiver is grown over wide agro-ecological niches in the country. Ramanujam and Kumar (1964) observed considerable variation among the complexes grown in South and North India for complex qualitative and morphological characters. These workers initiated a breeding programme to improve the essential oil content. The present paper deals with variability of physico-chemical properties of essential oil extracted from thirteen hybrid clones raised at the Indore research station and also the phenotypic correlations between various attributes of oil.

Materials and Methods

A replicated trial (4 replications in R. B. D.) of 13 hybrid clones and a local vetiver type was undertaken in the years 1976-77 and 1977-78. Row to row and plant to plant spacing within the row were 75 and 30 cms respectively. Size of the plot in each replication was 2.25 x 2.4 m. The climate of the area is semi-arid with annual precipitation ranging from 750-1000 mm. The soils are 50% clay with low organic carbon, nitrogen and P_2O_5 high potash having pH 7.8 and ECe 0.5 m mhols. Fertilizer was applied basally @ 50 kg of nitrogen, 20 kg of phosphorous and 20 kg of K_2O per hectare. The harvesting of the roots was done after 18 months of sowing. Observations were recorded on 5 randomly selected plants per replication. Essential oil content in the dry root was determined by Clevenger type of apparatus on moisture free basis. Physico-chemical properties of the oil were determined as per Guenther (1950) and Indian Standard Institution, I.S. 326.

The phenotypic variances were calculated following Panse and Sukhatme (1978). The correlation coefficients for all possible combinations at phenotypic level were computed using the general formula for correlation coefficient from the phenotypic variances (Panse and Sukhatme 1978).

Table I. Analysis of Variance for Various Characters in Vetiver

Source	DF	Mean Sum of Squares: Dry Weight of Roots	Oil %	Oil Yield Lit./Hectare
Replications	3	1309.79**	0.20*	877.372*
Hybrid clones	13	387.04*	0.26**	388.570*
Error	39	193.94	0.08	182.634

* Significant at 5% level; ** Significant at 1% level.

Results and Discussion

Significant differences were observed among the 14 genotypes of vetiver for dry roots, oil per-

*Current address is R. S. Gupta, Assistant Professor, Biochemistry Department, College of Veterinary Science and Animal Husbandry, MHOW, Dist. Indore—453 446, India

0272-2666/83/0003-4101$04.00/00—

Table II. Comparative Performance of Vetiver Hybrid Clones (Average of 5 plants/replication x 4 replications)

S. No.	Khus Variety	Pedigree	Dry Weight of Roots Per Plant (gms.)	Oil % (MFB) (ml)	Oil Yield Lit./Hectare
1.	Local	-	67.5	0.77	23.22
2.	Pusa Hyb. 2	13-5 x 31	70.4	1.04	32.33
3.	Pusa Hyb. 4	50-2 x 31	73.1	1.35	44.22
4.	Pusa Hyb. 5	1-1 x 53	63.1	1.25	35.33
5.	Pusa Hyb. 6	61-1 x 53	67.4	1.26	37.56
6.	Pusa Hyb. 7	39-1 x 48-2	81.3	1.08	39.33
7.	Pusa Hyb. 8	39-1 x 48-2	87.6	1.60	62.22
8.	Pusa Hyb. 11	55-1 x 43	67.4	0.86	25.56
9.	Pusa Hyb. 12	55-1 x 43	63.4	1.56	44.00
10.	Pusa Hyb. 14	55-1 x 43	84.9	1.31	49.78
11.	Pusa Hyb. 16	55-1 x 43	90.4	0.97	39.22
12.	Pusa Hyb. 18	63-2 x 35-5	61.3	1.33	36.22
13.	Pusa Hyb. 23	55-2 x 35-5	83.7	0.99	38.45
14.	Pusa Hyb. 26	55-2 x 35-5	72.9	1.39	46.89
	SE (m)		9.84	0.20	9.56
	CD at 5%		19.68	0.40	19.13

MFB = Moisture Free Basis

Table III. Physicochemical Properties of Essential Oil of Vetiver Hybrid Clones and Local Strain

S. No.	Hybrid Clone	Specific Gravity 30 d 30	Refractive Index 30 n D	Acid Value	Ester Value	Ester Value After Acetylation	Free Vetiverol (%)	Total Vetiverol (%)
1.	Local	0.9761	1.5200	24.26	28.88	157.80	57.32	68.65
2.	Pusa Hyb. 2	0.9736	1.5205	38.08	42.10	166.58	55.77	72.28
3.	Pusa Hyb. 4	0.9517	1.5195	31.77	20.80	163.29	63.66	71.81
4.	Pusa Hyb. 5	0.9302	1.5168	50.30	24.69	154.62	57.62	67.30
5.	Pusa Hyb. 6	0.9378	1.5192	27.81	43.54	169.59	56.62	73.69
6.	Pusa Hyb. 7	0.9810	1.5172	34.74	21.96	165.20	64.10	72.71
7.	Pusa Hyb. 8	0.9763	1.5198	22.20	24.56	161.66	61.17	70.80
8.	Pusa Hyb. 11	0.9735	1.5188	48.56	43.23	160.70	52.37	69.31
9.	Pusa Hyb. 12	1.0040	1.5200	35.58	17.62	190.16	78.89	85.80
10.	Pusa Hyb. 14	0.9892	1.5192	34.69	34.75	168.11	59.82	73.45
11.	Pusa Hyb. 16	0.9997	1.5202	35.48	27.09	174.80	66.65	77.27
12.	Pusa Hyb. 18	0.9516	1.5178	38.64	27.39	154.41	56.37	67.11
13.	Pusa Hyb. 23	0.9779	1.5180	19.34	21.42	184.92	74.42	82.82
14.	Pusa Hyb. 26	0.9453	1.5187	32.87	68.47	169.60	45.43	72.77
	Grand Mean	0.9691	1.5189	33.88	31.89	167.24	60.73	73.27
	SE (m)	0.0061	0.0014	2.36	3.64	2.78	2.29	1.45

Table IV. Phenotypic Correlations Among Eight Characters

Character	Oil Yield	Specific Gravity	Refractive Index	Acid Value	Ester Value	Ester Value After Acetylation	Free Vetiverol	Total Vetiverol
Root Yield	0.530*	0.525	0.182	-0.463	0.575*	0.273	0.259	0.276
Oil Yield	-	0.081	0.098	0.357	-0.074	0.227	0.190	0.233
Specific Gravity	-	-	0.519	0.235	-0.390	0.592*	0.647*	0.624*
Refractive Index	-	-	-	0.020	0.003	0.007	0.003	0.007
Acid Value	-	-	-	-	0.136	-0.362	-0.316	-0.368
Ester Value	-	-	-	-	-	-0.125	-0.792**	-0.251
Ester Value After Acetylation	-	-	-	-	-	-	0.699**	0.990**
Free Alcohol	-	-	-	-	-	-	-	0.785**

* Significant at 5% level; ** Significant at 1% level.

cent and oil yield (Table I) which revealed that there were significant genetic differences among the clones for these attributes. Pusa Hybrid 16 gave highest dry roots, however, it was not significantly superior than Pusa Hyb. 8, Pusa Hyb. 14, Pusa Hyb. 23 and several other clones (Table II). With respect to oil percent, Pusa Hyb. 8 appeared superior, followed by Pusa Hyb. 12 and several other clones. Nevertheless, Pusa Hyb. 8, 12, 26, 4, 18, 14 and few others were significantly superior to local for this attribute.

Singh *et. al.* (1978) reported that Hybrid 8 was superior for oil percent followed by Hybrid 12, 26, 14 and 4 at Kanpur which is in agreement with present findings. It was quoted by Virmani and Datta (1975) that the range of oil percent in dry vetiver roots grown in some countries viz. Gold Coast, Angola, Brazil and British Guiana was 2 to 4.6, whereas the oil content in vetiver roots from France was only up to 0.25%.

Pusa Hyb. 8 gave significantly more yield of oil than the local and several other clones. But it was *at par* with Pusa Hyb. 14, 26, 4 and 12. It should, however, be noted that yield of oil from roots depends upon various factors (Virmani and Datta 1975). Murti and Moosad (1949) found that oil content increased progressively only up to 21 months and observed that harvesting of vetiver roots before a minimum maturity of 15 months as well as after 21 months was uneconomical. Harvesting, therefore, in the present study was done after 18 months of transplanting and the roots were cut into pieces of 5-8 cms and were soaked in water for 24 hrs before distillation which is reported to be optimum condition for oil yield (Virmani & Datta 1975).

Table III presents physico-chemical properties of the oil distilled from local strain and Pusa Hyb. clones. Physico-chemical properties of the oil are in agreement with those reported earlier in this crop (Guenther 1950, Dhingra *et. al.* 1956 and Sadgopal 1966). Similar properties have been reported earlier by Singh *et. al.* (1978) in some of the Hyb. clones.

Vetiver oil having high specific gravity, esters and free alcohols should be identified as best vetiver oil (Sadgopal 1966). Considering these important attributes the quality of some of these Hyb. clones viz. Pusa Hyb. 12, 23, 14, 16 and 26 appears to be superior than the local vetiver type.

Phenotypic correlation co-efficient between ester value and root yield was observed to be significant and positive (Table IV) which suggested that quality of oil will improve as yield of root increases. This is in agreement with the report of Sadgopal (1966). The oil yield was significantly correlated (marginally) with root yield. Sadgopal (1966) further reported that oil having higher specific gravity, ester value and vetiverol should be recognized as the best oil. In the present study specific gravity was found to be positively and significantly correlated with ester value after acetylation, free vetiverol and total vetiverol. This is a pleasant situation since improvement of specific gravity will improve the quality of oil.

Significant negative correlation was observed between ester value and the free vetiverol indicating that as the ester value increases the quantity of free vetiverol will decrease. However, free vetiverol was significantly and positively correlated with ester value after acetylation and thus the quality of the oil will continue to improve with increase in free vetiverol in the present set of material. Total vetiverol was also significantly and positively correlated with ester value after acetylation. Free alcohol was found to be positively and significantly correlated with total vetiverol which suggested that free vetiverol shall increase with increase in total vetiverol.

Acknowledgement

Authors wish to thank Dr. Rajendra Gupta, Project Co-ordinator Medicinal and Aromatic Plants and Dr. K. L. Sethi, Plant Breeder N.B.P.G.R., I.A.R.I., New Delhi, for providing root slips of Pusa Hyb. clones. We are also thankful to Mr. V. D. Vairagi for his assistance in the work.

References

Arctander (1960) Perfume and Flavour Materials of Natural Origin, Elizabeth, N.J. U.S.A., pp. 649-653

Dhingra, D. R., Gupta, G. N. and Ganesh Chandra (1956) Indian Vetiver oil. Indian Soap J., **21,** 216

Guenther, E. (1950) The Essential Oils, Vol. IV. (D. Van Nostrand Company Inc. New York), pp. 156-180

Murti, K. S. and Moosad, C. R. (1949) South Indian vetiver root study. Am. Perfum. Ess. Oil Rec., **54,** 113-115

Panse, V. G. and Sukhatme, P. V. (1978) Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi, pp. 102-105

Ramanujam, S. and Sushil Kumar (1964) Metroglyph analysis of geographical complexes in Indian vetiver, Indian J. Genet. Pl. Breed. **24,** 144-150

Sadgopal (1966) Exploratory studies in the development of essential oils and their constituents in aromatic plants. Part III. Oil of vetiver. Soap Perfum. Cosm., 298-310

Singh, I., Singh, J. P. and Chaturvedi, O. P. (1978) Studies on essential oil of Khus (Vetiveria zizanioides Stapf) *Indian Perfumer,* **22,** 218-220

Virmani, O. P. and Datta, S. C. (1975), Vetiveria Zizanioides (Linn.) Nash., Indian Perfumer. **19,** 35-73