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Short communication

Stability analysis for essential oil yield and quality traits in Japanese mint

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Crop varieties are known to differ genetically for their adaptation reactions across the environments. An ideal variety must show yield and stability of performance. The regression analysis (Finlay and Wilkinson, 6; Eberhart and Russell, 5; Breese, 2) is often used for the analysis of genotype × environment interaction. The objective of the present study was to investigate the changes of adaptation reaction of different cultivars of the major aromatic crop Japanese mint/corn mint (*Mentha arvensis* L.; major source of menthol) in two contrasting environments of two places: Lucknow (a semi-arid sub-tropical plain) and Pantnagar (a humid sub-tropical foot-hill area) and to select a better corn mint cultivar for the two places. The results obtained from the study are reported in this paper.

The material for the present study comprised eight established varieties namely, Kosi, Himalaya, Damroo (Accession No. 4-6-125), Sambhav, Saksham, Shivalik-88, Kalka (Hy-77) and MAS-1 and two promising strains: accession No. 13-2-125 (very early flowering genotype) and accession No. 10-11-45 (Kosi type). The experiments were conducted during 2000 to 2002 at CIMAP, Research Farm, Lucknow with semi-arid sub-tropical climate and CIMAP Resource Centre, Pantnagar (a foot-hill area) with humid sub-tropical climate. The soil of the experimental fields at Pantnagar and Lucknow was clay loam and sandy loam in texture respectively, well drained having pH of 7.8-8.2 with excellent fertility. Experiments were laid out in randomized block design with three replicates in both the locations. Planting was done in February 2000 and 2001 and the spacing between rows was kept at 60 cm. The plot size was 5 m x 4 m. Standard recommended agronomic practices were followed for raising a good crop. Observations on the four characters: oil yield and three quality traits were recorded on maturity of the crop, i.e. 110 days after planting on five randomly selected plants in each replicate. Oil content determination was done through Clevenger apparatus by distilling 200 g of fresh herbage. Observations on the three quality traits *viz.,* menthone, menthyl acetate and menthol were recorded through gas liquid chromatography on HP-5890 model using a DB-WAX capillary column (30 m x 0.53 mm x 0.2 µm film) with temperature programme from 60°C to 220°C @ 3°C/m, initial hold 4 minutes and hydrogen as carrier gas. Injector and FID temperatures were of 220° and 240°C, respectively. The data were processed on AIMIL chromatography data system. The stability parameters were estimated using the model proposed by Eberhart and Russell (5).

The pooled analysis of variance showed significant mean squares for genotypes (G) as well as their interaction with the environment (G x E component) but not for the environment (E) for oil yield, menthol, menthone and menthyl acetate contents. It was thus, evident that the variations in adaptation reactions of the genotypes across the environments were largely due to their genotypic differences but not due to diversity in the environments. Significant genotype × environment (linear) and pooled deviation M.S. (non-linear component) for the three oil quality traits indicated that these components were important for these traits. The significance of linear G x E component further indicated possibilities of prediction across environments when its value is known in one of them. The linear components of G x E interaction were relatively greater than the non-linear components for all the traits indicating that the performance of the genotypes for all the four traits could be reliably predicted. These results of dominance in linear components are in agreement with the earlier reports on a wide range of plant materials in conventional crops (Finlay and Wilkins, 6; Breese, 2; Perkins and Jinks, 8; Tomar and Singh, 11; Chhina and Phul, 3; Arvindakumar *et al.*,1; Thirugnana Kumar *et al.*,10).

The mean and two stability parameters *viz.,* regression coefficient (bi) and deviation from regression (s^2 di) for the studied four traits are presented in Table-1. High heterogeneity between the slopes of linear regression was recorded. Therefore, it would be difficult to decide about the criteria for selection. A genotype with high mean, unit regression and least deviation from regression is considered to be superior (Eberhart and Russell, 5; Breese, 2; Samuel *et al*., 9; Kaw, 7). In crop improvement programme, it is usually desired to identify promising genotypes suitable for high, medium and low yielding environments (Kaw, 7). In the present study, the variety Himalaya could be utilized for cultivation under high yielding environments. It has high mean oil

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Table 1. Stability parameters of essential oil yield and quality traits in Japanese mint.

Variety/	Oil yield			Menthone			Menthyl acetate			Menthol		
Acc.No.	Mean	Bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di
Kosi	255.00	1.02	0.02	6.59	-1.28	0.61**	2.34	-0.21	0.20**	76.85	1.04	0.01
Himalaya	191.17	1.65	-40.87	10.74	0.02	0.01	2.32	-0.40	0.12**	77.79	-0.12	0.10**
Damroo (Ac. No. 4-6-125)	179.50	-0.77	-25.65	7.77	4.95	0.28**	1.95	2.97	0.07**	74.21	1.02	0.08**
Sambhav	145.42	0.36	28.90	10.87	7.11*	0.36**	1.65	1.40	0.02**	72.59	0.77	0.28**
Saksham	226.33	1.04	0.03	4.97	1.32	0.18**	2.12	2.27	0.11**	78.75	1.06	0.02
Shivalik	100.60	0.80	-14.99	7.80	-0.82	0.68**	1.66	-1.00	0.06**	70.20	-0.45	0.14**
Kalka (Hy-77)	189.00	-0.15	254.34*	6.87	6.52*	6.23**	6.22	9.46**	3.16**	78.00	6.27**	2.31**
MAS-1	76.67	-0.01	1148.85**	2.65	-1.31	0.02**	1.05	1.26	0.01**	82.90	-0.14	0.06
Ac. No. 13-2-125	193.92	3.29*	2335.88**	6.48	-3.34	1.21**	2.98	-1.01	0.40**	74.40	2.42**	0.16*
Ac. No. 10-11-45 (Kosi type)	225.08	2.31	322.32**	6.70	-3.32	1.17**	2.68	-4.74	0.80**	75.91	0.49	0.15*
X ± SE	178.27±12.86			7.14±0.58			2.50±0.41			76.16±0.35		
CD (5%)												

yield (191.2 kg against 100.6 kg of the most widely cultivated variety Shivalik with 100.6 kg oil/ha) with the regression value more than 1.0. The varieties Kosi and Saksham, owing to their higher mean oil yields, unit regression (average stability) and deviation of regression approaching '0', may be recommended as the most stable genotypes, suitable for medium yielding environments. The genotype suitable for low yielding environments could be the variety Damroo. Although of the rest genotypes 13-2-125 (very early flowering type) and 10-11-45 (Kosi type) have high to moderately high mean oil yield and regression values more than 1.0 indicating their suitability for the high yielding environments. They are nonetheless, unstable due to their significantly high values for deviation from regression.

Of the 4 exceptional cases, 2 pertaining to Himalaya and MAS-1 revealed more or less similar trend in results, where in the high averages of menthol/ menthone are associated with regression and S^2di. This gave an indication that the high mean performances of Himalaya for menthone and MAS-1 for menthol are achievable only under low yielding environments. It was thus ascertained that both Kosi and Saksham have wider adaptation for menthol content and hence can be grown in medium yielding environments. From the above results, it could be concluded that no single genotype is stable for oil yield and all the quality traits. This is in consonance with studies of Wani (12, 13), and Dhillon *et al.* (4) as they observed that no single genotype showed stability for all the traits under different environment. Even so, in considering the adaptive performances of the 10 genotypes in relative terms, it clearly stands that among them the varieties like Kosi and Saksham have registered stability for oil yield as well as the major quality trait menthol content. Accordingly, these two varieties can be utilized as the superior genotypes with wider adaptatibility.

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