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## Analysis of genetic divergence in menthol mint (*Mentha arvensis* L.)

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**Abstract**

Sixteen genotypes of menthol mint (*Mentha arvensis*) were evaluated for five quantitative traits namely, plant height, number of internodes, length of internodes, leaf:stem ratio and oil content at Pantnagar (Uttaranchal). These genotypes were grouped into five clusters on the basis of Mahalanobis $D^2$ analysis. The characters namely, length of internode and number of internodes had maximum contribution towards genetic divergence. The mean performance of the genotypes in each cluster and their $D^2$ values revealed that genotypes can be selected to obtain superior half-sib progenies.

**Keywords:** genetic diversity, *Mentha arvensis*, menthol mint.

Diverse parents are essential for producing high heterotic effects and more variability in segregating generations in crop improvement programmes. Multivariate analysis and cluster analysis in particular have been utilized for evaluation of germplasm when studying various traits and in a large number of accessions in various medicinal and aromatic plants such as pyrethrum (Singh & Sharma 1989), geranium (Singh *et al*. 1995), lavender (Singh *et al.* 1997) and coriander (Singh *et al.* 2002). Mahalanobis $D^2$ statistic has been employed widely to resolve genetic divergence at inter-varietal and subspecies level in classifying the crops. In the present study an attempt has been made to study genetic divergence in 16 genotypes of menthol mint (*Mentha arvensis* L.).

The materials for the present experiment comprised of 16 genotypes drawn from the large breeding stock maintained at Central Institute of Medicinal and Aromatic Plants (CIMAP) Resource Centre, Pantnagar, Uttaranchal. The selection of the 16 pure genotypes was done on the basis of their morphological and yield performances. The genotypes were planted in a randomized block design with three replications in a plot of five rows 5 m long and 60 cm apart. Recommended package of cultural practices was adopted to raise a good crop of menthol mint. The crop was irrigated at 10-15 days intervals during the crop period. Observations were recorded on plant height, number of internodes, length of internodes, leaf:stem ratio and oil content. The oil content in the plant samples of herb was estimated in Clevenger's apparatus. Genetic divergence was estimated by Mahalanobis $D^2$ statistic (Mahalanobis 1936) and the genotypes were grouped on the basis of minimum

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generalized distance using Tocher's method, as described by Rao (1952).

The range of various characters exhibited wide differences in the genotypes indicating ample scope for genetic manipulation (Table 1). Further variability can be incorporated in other characters by hybridization among distant accessions. A number of research workers have emphasized classification procedures for identifying distant genotypes which can be used as donor parents (Griffing & Lindstorm 1954; Moll *et al.* 1962; Arunachalam 1981).

The 16 genotypes were grouped into five clusters based on $D^2$ values (Table 2). Cluster II and cluster V accommodated five and four genotypes, respectively. This indicates that considerable portion of the germplasm was redundant but the intra-cluster distance was moderate, indicating sufficient diversity among them. Cluster I and cluster III accommodated three genotypes each. Cluster IV had only one genotype namely, var. Saksham, which is a high yielding variety. In these genotypes, there were three released varieties namely, Kushal, Sambhav and Saksham, but none of them were grouped together in the cluster formation. This suggested that sufficient diversity exists between them and can be utilized in future breeding programmes.

Inter- and intra-cluster distance, which provided index of genetic diversity among and within the cluster, revealed that intra-cluster distances were of lower magnitude as compared to inter-cluster distances. It suggested that genotypes of some clusters had little divergence from each other. Therefore, hybridization among the accessions of same cluster is not desirable. The intra-cluster distance ranged from 0.0 to 1.30 (Table 3). The minimum inter-cluster distance was observed between II and V (1.90) followed by I and III (2.10), I and V (2.52) and III and V (2.77). Maximum inter-cluster distance was between I and IV (4.84) followed by IV and V (4.39) and III and IV (4.10). The crosses between the genotypes from these clusters may give putative transgressive segregants. It is suggested that better recombination can be obtained by selecting genotypes with their phenotypic dissimilarity. Since the crop can be vegetatively propagated, the hybridity so generated would stay fixed under asexual propagation.

The cluster mean also substantiates this statistical distance (Table 4). Cluster V recorded highest mean for plant height and cluster III for number of internodes. Maximum mean

**Table 2.** Genotypes in each cluster of *Mentha arvensis*

| Cluster | No. of genotypes | Genotypes |
|---|---|---|
| I | 3 | Tm11, Tm24, S½ |
| II | 5 | Tm26, 125, 115, 129, Sambhav |
| III | 3 | Tm7, 34, Kushal |
| IV | 1 | Saksham |
| V | 4 | Tm29, Tm16, Tm4, Tm23 |

**Table 1.** Mean, range and coefficient of variation of different characters in *Mentha arvensis*

| Character | Plant height (cm) | No. of internodes | Length of internodes (cm) | Leaf:stem ratio | Oil content (%) |
|---|---|---|---|---|---|
| Mean | 72.51 | 18.02 | 4.30 | 0.98 | 0.56 |
| Range | 60.9–83.5 | 15.6–19.7 | 3.6–5.1 | 0.75–1.30 | 0.32–0.77 |
| Best check mean | 65.25 | 17.03 | 4.42 | 1.30 | 0.45 |
| CV | 1.72 | 2.93 | 4.15 | 1.92 | 2.95 |

**Table 3.** Average inter- and intra-cluster $D^2$ values of five characters in *Mentha arvensis*

| Cluster | I | II | III | IV | V | Genotypes in cluster |
|---|---|---|---|---|---|---|
| I | 1.01 | 3.02 | 2.10 | 4.64 | 2.52 | Tm11, Tm24, S½ |
| II | | 1.27 | 3.51 | 3.12 | 1.90 | Tm26, 125, 115, 129, Sambhav |
| III | | | 1.30 | 4.10 | 2.77 | Tm7, 34, Kushal |
| IV | | | | 0.00 | 4.39 | Saksham |
| V | | | | | 1.08 | Tm29, Tm16, Tm4, Tm23 |

**Table 4.** Cluster mean of five characters and per cent contribution by each character in *Mentha arvensis*

| Character | Cluster | | | | | Contribution by each character (%) |
|---|---|---|---|---|---|---|
| | I | II | III | IV | V | |
| Plant height (cm) | 66.47 | 74.59 | 64.73 | 64.33 | 77.03 | 16.83 |
| No. of internodes | 18.54 | 18.37 | 20.94 | 19.97 | 19.35 | 25.44 |
| Length of internodes (cm) | 4.04 | 5.14 | 3.71 | 4.67 | 4.72 | 26.05 |
| Leaf:stem ratio | 0.78 | 1.10 | 1.13 | 1.66 | 1.00 | 13.38 |
| Oil content (%) | 0.56 | 0.38 | 0.54 | 0.26 | 0.55 | 18.27 |

value for length of internode was recorded in cluster II and for leaf:stem ratio in cluster IV. The mean value for oil content was maximum in cluster I. Hence, the genotypes of outstanding mean performance from these clusters may be identified as potential parents and could be utilized in hybridization programmes through half-sib mating for developing high yielding menthol-mint varieties.

The contribution of characters towards total divergence was estimated (Table 4). Length of internode and number of internodes have highest contribution of 26.50% and 25.44%, respectively. Medium contribution was recorded by oil content (18.27%) and plant height (16.83%) and minimum for leaf:stem ratio (13.38%). The present study suggested that a judicious hybridization between chosen superior parents in unison with sexual propagation yielded superior (diversified) full-sib families in menthol mint.

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