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IDENTIFICATION OF SOME *HIBISCUS* GERMPLASM THROUGH NUMERICAL ANALYSIS

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Abstract

Numerical analyses of 68 morphological characters of 12 varieties/forms belonging to four species of *Hibiscus* were carried out by calculating Sørensens and Sneath and Sokal similarity coefficients followed by cluster analysis and construction of dendrograms for visual appreciation of taxonomic relationship within this family. The Sørensens similarity coefficient varied between 0.211 and 0.919 and Sneath and Sokal similarity coefficient ranged between 0.142 and 0.890, indicating much variation between the species.

Introduction

The genus *Hibiscus* Medik. of family Malvaceae exhibits considerable taxonomic complexity. In Bangladesh, *Hibiscus cannabinus* L. (Deccan hemp or Kenaf) and *H. sabdariffa* L. (Rosella or Mesta), are cultivated and *H. acetosella L.* and *H. radiatus* L. are wild. In recent years *H. cannabinus* and *H. sabdariffa* are getting much attention and grown commercially for paper-pulp production in many countries (Andrew and Piters 1980, Nieschlag *et al*. 1960). In Bangladesh, paper and pulp mills have recently introduced Kenaf (*H. cannabinus*) along with jute whole stem as raw materials for paper and pulp making (Anonymous 1993). This new use has led to investigate about the component characters contributing to biomass production of the above four species. The fibre of jute (*Corchorus capsularis* and *C. olitorius*), Kenaf (*H. cannabinus*) and Mesta (*H. sabdariffa*) are considered as economic yield for textile purpose, while air dry whole stem is considered as biomass in paper-pulp industries (Kalder 1991).

Despite the high socio-economic significance no major breakthrough has been achieved in research relating to these above species. Numerical approaches have not been utilized for taxonomic purposes among other taxa of the Malvaceae even though there seems to be ample scope for an examination of the applicability of these techniques to an assessment of the taxonomic relatedness of the taxa belonging to this family. The present investigation was, therefore, undertaken to determine the taxonomic relationship by using numerical analyses of 12 taxa at intraspecific and infraspecific levels.

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Materials and Methods

Three cultivars of *Hibiscus cannabinus* viz., HC-95, HC-2 and CP1 72126/1; four of *H. sabdariffa* viz., var. HS 24, breeding line 300M, cultivar 2065 and cultivar Samu 93; three forms of *H. acetosella* viz., Green Foliage Yellow Flower (GFYF), Green Foliage Magenta Flower (GFMF) and acc. Red Foliage Crimson red flower (RFCRF) and two forms of *H. radiatus* viz., Tall with magenta flower and Dwarf with yellow flower were taken. The experiment was conducted at central station of BJRI, Dhaka. The experiment was laid out in a randomized complete block design (RBD) with three replications in each case. Recommended doses of fertilizers, irrigation, weeding, mulching and other cultural practices were performed as and when required.

Hierarchical cluster analysis for qualitative characters was performed following Binary Euclidian distance and Dendrogram was drawn using average linkage (between groups). Among the various morphological features qualitative characters of plant were used in cluster analysis and constructing dendrograms. Sixty-eight morphological characters were selected without any prejudices for each variety (Table 1). The similarity coefficients of different OTU's were measured according to Sørensens (1948) and Sneath and Sokal (1973). The coefficients were clustered by UPGMA method as outlined by Sneath and Sokal (1973). All the analyses were computed using the software SPSS 10.0.1 standard version (Statistical Package for Social Sciences) released in 1999. The program was run through Windows 98 operating system, in a Pentium III model computer.

Results and Discussion

Based on 68 qualitative characters (Table 1), the similarity coefficients for each pair OTU's (operational taxonomic units) were calculated separately according to both Sørensens (1948) and Sneath and Sokal (1973) similarity measure and the data matrices were prepared. Based on these matrices dendrograms were constructed.

In both similarity matrices prepared from the values of the taxa examined showed that a few of the taxa have similarity coefficient greater than 0.50 with respect to the other taxa. The Sørensens's similarity coefficients varied between 0.211 and 0.919 while the Sneath and Sokal similarity coefficients ranged between 0.142 and 0.890 (Table 2). The Sørensens's similarity coefficient for within species ranged between 0.595 and 0.919, 0.211 and 0.595, 0.378 and 0.667 and 0.619 for *H. cannabinus, H. sabdariffa, H. acetosella* and *H. radiatus* respectively. Whereas the Sneath and Sokal similarity coefficient ranged for the above-mentioned case were 0.499 to 0.890, 0.142 to 0.501, 0.285 to 0.580 and 0.506 respectively (Table 2).

Considering the OTU's coefficient of similarity matrix, *H. sabdariffa* showed little intervarietal relationship. The cult. CPI 72126/1 and var. HC 2 of *H. cannabinus* showed maximum coefficient value (0.890) and was followed by 0.741, 0.658 for cult. Samu 93

and var. HC 95, and breeding line 300M and var. HC 95 of *H. sabdariffa* and *H. cannabinus*, respectively (Table 2).

Table 1. Characters used for construction of matrix of similarity coefficient among 12 taxa of *Hibiscus* (including varieties/forms) of Malvaceae family.

Characters	Variations	Characters	Variations
1. Stem color:	Green	12. Leaf shape:	Entire
	Full green		Partially lobed
	Red		Deeply lobed
	Green pigmented	13. Leaf pubescence:	Present/Absent
2. Leaf lamina color:	Green	14. Leaf pubescence types:	Not prickled
	Full green		Sparsely prickled
	Red	15. Pigmentation of flower buds:	Green
	Green pigmented		Green pigmented
3. Leaf vein color:	Green		Red
	Full green	16. Flower petal color (Outer):	Yellow
	Red		Magenta
	Green pigmented		Pink
4. Leaf petiole color:	Green		Crimson red
	Full green	17. Flower color (Inner):	Yellow
	Red		Magenta
	Green pigmented		Pink
5. Stipule +/-:	Stipulate/Exstipulate		Deep magenta
6. Stipule shape:	Foliaceous		Yellow lower center red
	Scally		Pink lower center red
	Filiform	18. Pigmentation of fruit:	Green
7. Stipule color:	Green		Green pigmented
	Full green		Red
	Red	19. Fruit pubescence:	Smooth
	Green pigmented		Hairy
8. Stem pubescence:	Present/Absent		Bristle
9. Stem pubescence type:	Smooth	20. Seed dispersal mechanism:	Dehiscent/ Non-debiscent
	Hairy	21. Seed coat color:	Brown
	Prickly		Brownish grey
10. Branching habit:	Branched		Grey
	Unbranched		
11. Branching habit type:	No branching		
	Weak		
	Intermediate		
	Strong		
	Very strong		

Table 2. Range of coefficients of similarity matrix following Sneath and Sokal similarity measure among four species of *Hibiscus*.

Sources of variation		*H. cannabinus*	*H. sabdariffa*	*H. acetosella*	*H. radiatus*
Intraspecies (within varieties and forms)		0.595-0.919 (0.499-0.890)	0.211-0.595 (0142-0.501)	0.378-0.667 (02.85-0.580)	0.619 (0.506)
Interspecies (between species)	*H. cannabinus*	-	0.222-0.800 (0.156-0.741)	0.162-0.541 (0.142-0.442)	0.410-0.500 (0.308-0.407)
	H. sabdariffa	-	-	0.205-0571 (0.135-0.481)	0.205-0.634 (0.136-0.527)
	H. acetosella	-	-	-	0.462-0.615 (0.356-0.516)
	H. radiatus	-	-	-	-

Note: Data in parenthesis are coefficients resulted from Sneath and Sokal similarity measure. Coefficients calculated following Sørensens similarity measure.

While the minimum coefficient value was observed between form RFCRF of *H. acetosella* and breeding line 300M of *H. sabdariffa*. However, some of the intervarietal similarity coefficients were found between 0.501 and 0.582, but maximum of them ranged between 0.135 and 0.481. At the intervarietal level, similarity coefficients value greater than 0.50 recorded in comparisons involving cult. CP1 72126/1 and var. HC 95, breeding line 300M and cult. Samu 93, form RFCRF and cult. 2065, form Dwarf and breeding line 300M, GFYF and GFMF forms, Tall and GFMF forms, and Tall and Dwarf forms. Here, comparisons were based on Sneath and Sokal's similarity coefficient values. Sørensens's similarity coefficients always gave relatively higher values in each case.

The phenetic relationship among the taxa studied can be visualized in the dendograms. The patterns of dendrograms prepared according to Sørensen's measure were found to be almost identical with Sneath and Sokal's one with minor exceptions.

In all the approaches var. HC 2 and cult. CPI 72126/1 of *H. cannabinus* exhibited the highest similarity and clustered together (Figs.1 and 2). Similar kinds of clustering were also observed between var. HC 95 of *H. cannabinus* and cult. Samu 93 of *H. sabdariffa*. Similarity between GFYF and GFMF forms of *H. acetosella* was greater than those observed between Tall and Dwarf forms of *H. radiatus*. Cultivar 2065 of *H. sabdariffa* and form RFCRF of *H. acetosella* clustered further away apart from the members of their respective species.

All the three members of *H. cannabinus* together with cult. Samu 93 and breeding line 300M of *H. sabdariffa* formed a cluster equal to the distance of the cluster formed by GFYF and GFMF forms of *H. acetosella* and Dwarf and Tall forms of *H. radiatus*. Var. HS 24 of *H. sabdariffa* exhibited different type of grouping with the other members of *Hibiscus*.

Fig. 1. Dendrogram using Sørensen's measure with average Linkage (between groups).

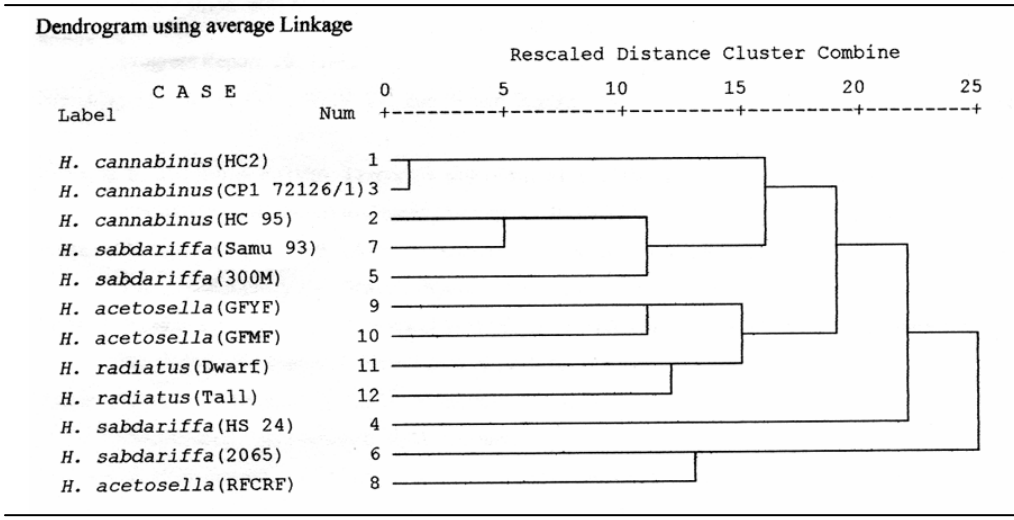
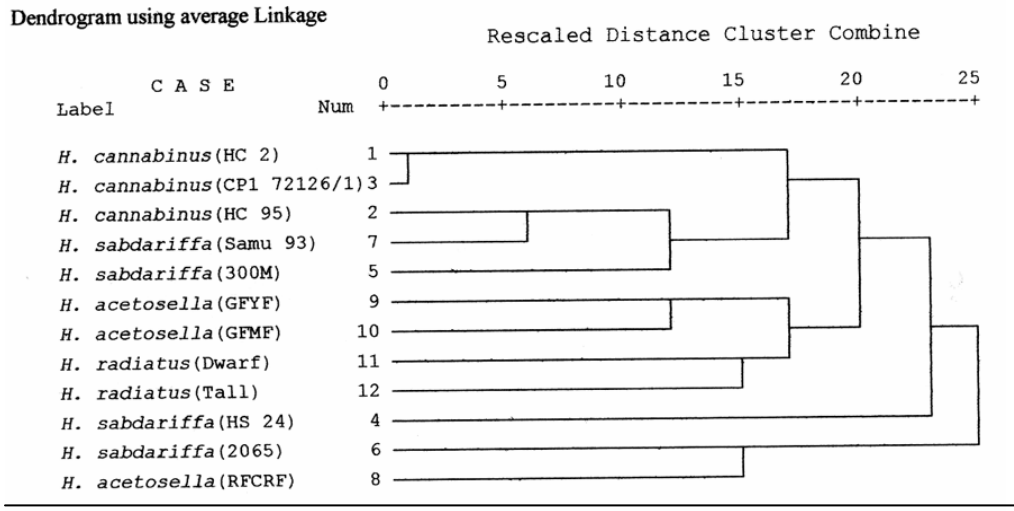


Fig. 2. Dendrogram using Sneath and Sokal similarity matrix with average Linkage (between groups).



In all the three approaches of clustering (namely Sørensen's and Sneath and Sokal), var. HS 24 of *H. sabdariffa* grouped with the cluster formed by the rest at distance greater than 20 and later joined with the cluster formed by cult. 2065 of *H. sabdariffa* and form RFCRF of *H. acetosella* at distance 25 (Fig. 1 and 2). Pasha and Sen (1986, 1995, 1997) also worked on several taxa of Cucurbitaceae. In numerical analysis they have

constructed dendrograms on the basis of Jaccards (1908) and Sørensen's (1948) similarity coefficient of 143 characters. The similarity coefficient of the 22 taxa varied between 0.36 and 0.91 indicated different levels of diversity among those species.

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