ASSESSMENT OF BIODIVERSITY BASED ON MORPHOLOGICAL CHARACTERISTICS AMONG WILD ROSE GENOTYPES

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Rose has always been object of great attention because of its beauty and utility and now it has great economic importance worldwide. Identification, description, conservation and utilization of natural resources is required for long term sustainable protections. Based on different morphological characteristics, wild growing rose plants were collected from five different sites in the Northern hilly areas and it was found that these plants belonged to two *Rosa* species (*Rosa webbiana* and *R. brunonii*). Detailed information of certain morphological traits of all genotypes were recorded and further relationship among samples was also explored. It was found that of *R. webbiana* collected from Nathia gali and Muree showed maximum similarity (83%) among all rose genotypes. On the other side, *R. brunonii* collected from Sunny bank and Ayyubia showed almost same (80%) similarity level. It reflected that genotypes collected from different geological conditions did not posses much difference within species, but there was slight difference because of variations in environmentally influenced charters like, leaf length, plant height and fruit length. Plants of these two species did not show much diversity i.e., less than 50%, which gives an opportunity to uses them in further breeding program for the crop improvement. Soil samples were also collected from sites of plant collection and analyzed for different characteristics. A little difference was found in soil samples so it can be said that soil have no affect on distribution of roses in the areas.
Keywords: Wild roses, biodiversity, morphological characters

INTRODUCTION

Biodiversity in relation to plant kingdom has far reaching economic, environmental, ecological and social consequences for the mankind. The most popular ornamentals of the family, and among the most esteemed of all cultivated plants, are the true roses. From many of the wild species have been developed the large number of cultivated varieties and hybrids having single or double blossoms that range in color from white and yellow to many shades of pink and red. Since many species are highly variable and hybridize easily (Yan *et al.*, 2005), the classification of *Rosa* is sometimes difficult, and the wild type of some modern forms is not always known (Wissemann, 2000).

The genus *Rosa* includes more than 100 species in the temperate and subtropical zones of the northern hemisphere. The genus *Rosa* belongs to the family Rosaceae. It is divided into four subgenera; *Hulthemia*, *Platyrhodon*, *Hesperhodos* and *Eurosa* (Rehder, 1940; Jan, 1999) The first three subgenera include only few species. The subgenus *Eurosa*, (or with more modern nomenclature: *Rosa)*, comprises 10 sections. The sections *Caninae* and *Cinnamomeae* are the largest and comprise about 50 and 80 species, respectively (Wissemann, 2003). In *Rosa,* about 25 species have been reported growing in the wild and many of them have contributed to the development of modern ornamental roses. Some of these species have been reported growing wildly in northern areas of Pakistan. These wild roses are hardy and adaptable plants which grow in temperate to arid regions. Apart from ornamental purpose, such disease resistant species are expected to promote rose production with less environmental impact. Conservation and utilization of these resources is required for long term sustainable protections (Tabaei-Aghdaei *et al.*, 2007). To fetch all these attributes, it is required to find out the critical identification, description of these species and their relationship with each other.

MATERIALS AND METHODS

Based on different morphological characteristics, wildly growing rose plants were collected from five different sites in the Northern hilly areas of Pakistan including Muree foot hills, Sunny bank, Ayyubia, Nathia gali and Bansra gali. Three plants were selected at random per site on the basis of apparent morphological differences. The experimental material including flowers, leaves and rose hips were collected from wildly growing plants during summer and autumn seasons while plant length was measured on the actual site. The plant samples so collected were brought to laboratory and identified by comparing their phenotypic features with plants in the herbarium of the Department of Botany, U.A.F. After comparative studies, it was found that these plants

belonged to only two *Rosa* species (*Rosa webbiana* and *Rosa brunonii*). After initial identification of the individual species, detailed studies of morphological features of collected samples were made as mentioned in Table 2.

The plant descriptors for the *Rosa* species are not very well defined. Based upon the previous studies (Roger *et al.*, 1977; Nasir and Robina, 1995) different characteristics were considered important for the morphological studies of the roses. The data were recorded on the selected traits where plant height was measured right form the base above soil surface to the tip of the branch. Average of five longest branches was recorded.

Along with that five fully developed leaves from middle to bottom regions of plants were collected in August-September from a shoot of the current year's growth. Total leaf length (cm) from the apex to the base of the leaf was measured along with leaflet length, its number and leaf colour was determined by comparing it with colour chart. Rest of the leaf features, were examined and studied as per description given by Bell and Alan (1991) and Subrahmanyam (1999) including leaflet shape, leaflet margin, leaf hairiness, stipule shape and petiole pubescence. In branches, twig hairiness and prickle shapes were studied.

Flowers were collected from each plant when in full bloom and different characters, including flower colour, inflorescence type, calyx shape and corolla shape were recorded. Fruits from different rose plants were collected and fruit shape and fruit length were measured, while fruit colour was examined by comparing it with colour chart. The both species collected from different parts of northern hilly areas were finally identified (Table 1).

Table 1. Names of species and sites of plant collection

Names of Species	Sites of collection
Rosa brunonii	Sunny bank
Rosa brunonii	Ayyubia
Rosa brunonii	Bansra gali
Rosa webbiana	Nathia gali
Rosa webbiana	Murree

Soil samples were also collected from the rhizosphere of the plants of each site of which experimental material was collected to see if there is any difference in soils of particular site of collection. Soil samples were collected from top soil, 0-15cm, 15-30cm and 30-45cm depth. These samples were collected and analyzed for various physico-chemial properties i.e., texture (Moodie *et al.,* 1959, International Soil Science Society (ISSS) triangle), pH, EC_e, organic matter percentage and $CaCO_3$ contents (Page *et al.,* 1982).

DATA ANALYSIS

To explore the diversity and relationship among thirteen rose genotypes their vital morphological characteristics were studied by the multi variance study. The determination of the states of the morphological characters was carried out on sample collection of these genotypes. Therefore, data was analyzed by using multivariate technique "Cluster Analysis" with the help of statistical software Minitab (Version 13.1). Method of coding of characters followed was that of Boratynski and Davies (1971). The criterion for the finding similarities among thirteen genotypes on the basis of their morphological characteristics was applied using hierarchical method of clustering to obtain dendrogram by a complete linkage (fastest neighbour) clustering algorithm (Afifi and Clark 1996; Hair *et al.*, 2005).

RESULTS AND DISCUSSION

Morphological descriptions showed that flower colour was white in all genotypes while inflorescence types, calyx and corolla shapes were found different among the two species but same within each species (Table 2). Similarly difference was also observed in leaves of all genotypes. There were variations in leaflet numbers and leaflet shapes in individual plant samples, which can not be only because of environmental factors, rather some genetic changes seem to be involved. Rest of the leaf characteristics were almost similar among the plants of same species but different from the other. On the other side, difference in leaf length, plant height and fruit size seems very much influenced by the environment. Other characters like, fruit colour, fruit shape, twig hairiness and pickle shapes were species specific. All this showed that, most of the characteristic were specific for a particular species but there are few changes may be because of genetic makeup but they can not be considered as different species. Furthermore these descriptions can help for further morphologic studies in other rose species but further need to be explored genetically.

Based on morphological characters, diversity among all genotypes is clear from dendrogram (Fig.1) consisting five genotypes belonging to two different species but collected from different areas using complete linkage method it showed that at 50% similarity level there are two clusters. One of that clusters contained two genotypes of *R. webbiana* collected from Nathia gali and Muree, while the other cluster contained three genotypes of *R. brunonii* collected from Sunny bank, Ayyubia and Bansra gali. It is further noted that plants of *R. webbiana* collected

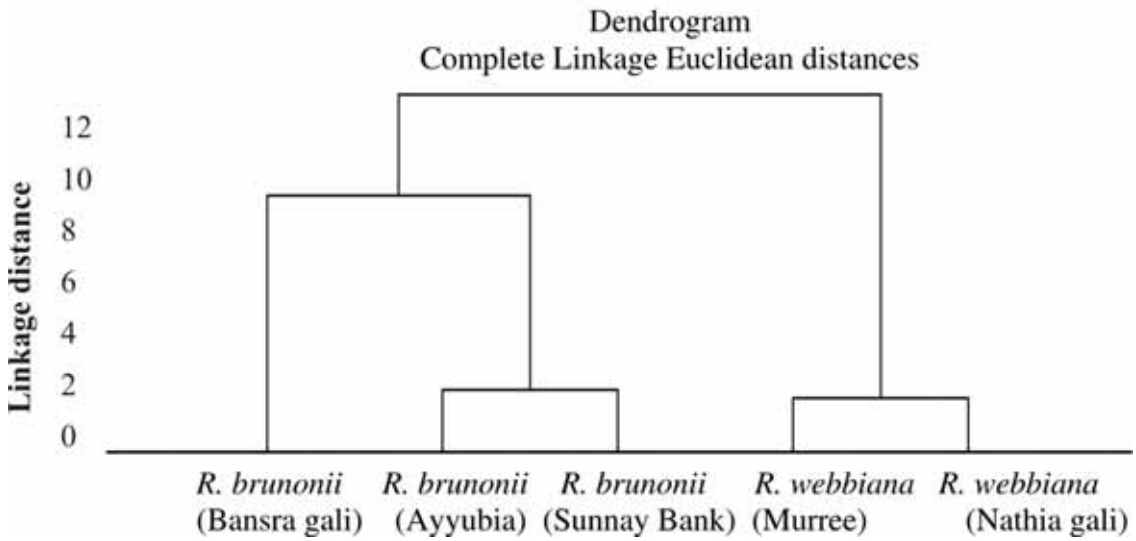
Table 2. Morphological descriptions of rose genotypes

Taxonomic characters	*Rosa webbiana* (Nathia gali)	*Rosa webbiana* (Murree)	*Rosa brunonii* (Sunny Bank)	*Rosa brunonii* (Ayyubia)	*Rosa brunonii* (Bansra gali)
Flower color	White	White	White	White	White
Inflorescence type	Solitary	Solitary	Compound corymb	Compound corymb	Compound corymb
Calyx shape	Bristly with dilated tips	Bristly with dilated tips	Lanceolate,pubescnt	Lanceolate,pubescent	Lanceolate, pubescent
Corolla shape	Obcordate	Obcordate	Obovate	Obvate	Obovate
Leaflet number	7-9	7-9	7-9	5-7	7-9
Leaflet length	5.5-6.5 cm	5.5-6.5 cm	5.5-6.5 cm	5.5-6.5 cm	5.5-6.5 cm
Leaflet shape	Narrowly ovate to lenceolate	Lencelate	Ovate oblong	Ovate oblong	Oblong
Leaflet margin	Doubly serrate	Doubly serrate	Serrate	Serrate	Serrate
Leaf hairiness	Glabrous, pubescent beneath	Glabrous, pubescent beneath	Glabrous, pubescent	Glabrous, pubescent	Glabrous, pubescent
Leaf length	16-17.5 cm	13-15 cm	13-15 cm	13-15 cm	13-15 cm
Petiole pubescence	Pubescent	Pubescent	Pubescent	Pubescent	Pubescent
Stipule shape	Adnate to petiole, free parts ovate, margin glandular, acute	Adnate to petiole, free parts ovate, margin glandular, acute	Adnate to petiole, free parts ovate, margin glandular, apex shortly acuminate	Adnate to petiole, free parts ovate, margin glandular, apex shortly acuminate	Adnate to petiole, free parts ovate, margin glandular, apex shortly acuminate
Fruit color	Red	Red	Dark red	Dark red	Dark red
Fruit shape	Globose	Globose	Ovoid	Ovoid	Ovoid
Fruit length	3-4cm	3-4cm	1-1.5cm	1-1.5cm	1-1.5cm
Plant height	1-3 m	1 m	4-6 m	4-6 m	4-6 m
Twig hairiness	Glabrous	Glabrous	Pubescent	Pubescent	Pubescent
Prickle shape	Copious, curved	Copious, curved	Curved, flat, gradually tapering to broad base	Curved, flat, gradually tapering to broad base	Curved, flat, gradually tapering to broad base

from Nathia gali and Muree showed maximum similarity (83%) among all rose genotypes. On the other side *Rosa brunonii* collected from Sunny bank and Ayyubia showed almost same (80%) similarity level. Therefore as Floriculturist on basis of nineteen morphological characteristics (Table.1), I suggest that genotypes of a species collected from different geological conditions did not posses much difference, but a slight difference because of variations in environmental influenced charters like, leaf length, plant height and fruit length.

Variations based on morphological based markers that are generally used for classification of the members of family Rosaceae are relatively high as compared to other families (Dickinson and Campbell, 1991) in sun-family Maloideae, Jan *et al.*, 1999 in *Rosa,* Amsellem *et al.*, 2000 in *Rubus alceifolius*, Hancock *et al.*, 2004 in *Fragaria*, Bortiri *et al.*, 2006 in *Prunus,* Depypere *et al.*, 2006 in *Crataegus*, Chang *et al.*, 2007 in *Prunus serrulata* complex, Evans *et al.*, 2007 in *Rubus* taxa). Therefore, diversity of morphological-based markers for genetic diversity of wild *Rosa* species and interaction of environment are expected to be quite high and this can efficiently used for future breeding programmes as reported by Debener *et al.*, (1996), Joublan *et al.*, (1996), Mohapatra and Rout (2006), and Yan *et al.*, (2005).

Fig. 1. Complete Linkage Dendrogram for similarities among thirteen *Rosa* genotypes.



Analysis of soil samples collected from five rose plant collection sites showed that the soils were predominantly sandy loam in texture and well drained throughout the entire root zone. These soils were generally rich in organic matter, which is much higher than the major soil series of Pakistan. All sites were non saline calcareous soils with pH ranging from 6.23 to 7.5. However, there was always an acidic horizon in the root zone at all sites. So it can be said that soil does not have any affect on distribution of roses in the areas, however, other climatic factors may play crucial role in its distribution pattern, as reported by Yan *et al.* (2005).

CONCLUSION

It can be concluded, that along with environmentally influenced characters there were certain variations among genotypes which seemed due to changes in genetic makeup of individuals. Diversity based on morphological characters were less than 50% and gives the opportunity to uses these species together for further breeding program and can be very useful tool in rose crop improvement. Apparently, there was no relationship between the soils characteristics and presence of a particular *Rosa* species in any site. Furthermore, genetic based information of these species is appropriate for further studies. Apparently, there was no relationship between the soils characteristics and presence of a particular *Rosa* species.

REFERENCES

Afifi, A. A. and V. Clark. 1996. Computer-Aided Multivariate Analysis. 3rd ed. Champan and Hall, 2-6 Boundary Row, London, U.K.

Amsellem, L., J.L. Noyer, T. Le Bourgeois and M. Hossaert-Mckey. 2000.Comparison of genetic diversity of the invasive weed *Rubus alceifolius* Poir. (Rosaceae) in its native range and in areas of introduction, using amplified fragment length polymorphism (AFLP) markers. Mol. Ecol., 9: 443–455.

Bell, A. D. and B. Alan. 1991. Plant Form: An illustrated guide to flowering plant morphology. Oxford University Press. Timer printers Ltd. Singapore.

Boratynski, K. and R. G. Davies. 1971. The taxonomic value of male Coccidea (Homoptera) with an evaluation of some numerical techniques. *Bio J Linn Soc*. 3: 57-102.

Bortiri, E., B.V. Heuvel and D. Potter. 2006. Phylogenetic analysis of morphology in *Prunus* reveals extensive homoplasy. Plant System. Evol., 259: 53-71.

Chang, K.-S., C.-S. Chang, T.Y. Park and M.S. Roh. Reconsideration of the *Prunus serrulata* complex (Rosaceae) and related taxa in eastern Asia. Bot. J. Linn. Soc., 154: 35-54.

Debener, T., C. Bartels and L. Mattiesch. 1996. RAPD analysis of genetic variation between a group of rose cultivars and selected wild rose species. Mol. Breed., 2: 321-327.

Depypere, L., K. Vander Mijnsbrugge, K. De Cock, P. Verschelde, P. Quataert, J. Van Slycken and P. Goetghebeur. 2006. Indigenous species of *Crataegus* (Rosaceae-Maloideae) in flanders (Belgium). An explorative morphometric study. Belgian J. Bot., 139 : 139-152.

Dickinson, T.A. and C.S. Campbell. 1991. Population structure and reproductive ecology in the Maloideae (Rosaceae). System. Bot., 16: 350-362.

Evans, K.J., D.E. Symon, M.A. Whalen, J.R. Hosking, R.M. Barker and J.A. Oliver. Systematics of the *Rubus fruticosus* aggregate (Rosaceae) and other exotic *Rubus* taxa in Australia. Aust. System. Bot., 20: 187–251.

Hair, J. F., R. E. Anderson, R. L. Tatham and W. G. Black. 2005. Multivariate Data Analysis. 5th ed. Pearson education, Singapore.Moodie, C. D., W. H. Smith and R. A. McCreery. 1959. Laboratory mannual of soil fertility. Dept. Agron., State College of Washington, Pullman. p. 31-39.

Hancock, J.F., S. Serc e, C.M. Portman, P.W. Callow and J.J. Luby. 2004, Taxonomic variation among North and South American subspecies of *Fragaria virginiana* Miller and *Fragaria chiloensis* (L.) Miller. Can. J. Bot., 82: 1632-1644.

Jan, C.H., D.H. Byrne, J. Manhart and H. Wilson. 1999. Rose germplasm analysis with RAPD markers. ASHS Northeast Region Annual Meeting, Cambridge, Mass. , ETATS-UNIS, 34: 206-209.

Joublan, J.P., M.B. Humberto Serri, R. Wilckens, F. Hevia and I. Figueroa. 1996. Wild rose germplasm evaluation in Chile. p. 584-588. In: J. Janick (ed.), Progress in new crops. ASHS Press, Arlington, VA.

Mohapatra, A. and G.R. Rout. 2006. Optimization of primer screening for evaluation of genetic relationship in rose cultivars. Biol. Plant., 50: 295-299.

Moodie, C. D., W. H. Smith and R. A. McCreery. 1959. Laboratory manual of soil fertility. Dept. Agron., State College of Washington, Pullman. p. 31-39.

Nasir, Y. J. and A. R. Rubina. 1995. Wild flowers of Pakistan. Oxford University Press. 5-Bangalore Town, Sharae Faisal, Karachi, Pakistan.

Page, A. L., R.H. Miller and D. R. Keeney. 1982. Methods of soil analysis. Part II 2nd ed. Am. Soc. Agron. No. 9. Madison, Wisconsin, USA. Pp.1159.

Rehder, A. 1940. Manual of cultivated trees and shrubs, 2nd edn. McMillan, New York, pp 452–481.

Roger, P., G. Sheila and T. Wellsted. 1977. Wild flowers of Britain. Pan books Ltd., Cavaye Place, London, U.K.

Subrahmanyam, N. S. 1999. Laboratory manual of plant taxonomy. Second revised adition. Vikas publishing house Pvt. Ltd., Chandhi Nagar, Banglore, India.

Tabaei-Aghdaei, S.R., A. Babaei, M. Khosh-Khui, K. Jaimand, M.B. Rezaee, M.H. Assareh and M.R. Naghavi. 2007. Morphological and oil content variations amongst Damask rose (*Rosa damascena* Mill.) landraces from different regions of Iran. Scientia Horticulturae, 113: 44-48.

Wissemann, V. 2000. Epicuticular wax morphology and the taxonomy of *Rosa* (section Caninae, subsection Rubiginosae). Plant System. Evol., 221: 107-112.

Wissemann, V. 2003. Conventional taxonomy (wild roses). *In*: Roberts, A., Debener, T. & Gudin, S. (eds.), *Encyclopedia of Rose science*. Elsevier, Oxford. 111–117.

Yan, Z..F., O. Dolstra, T. Hendriks, T.W. Prins, P. Stam and P.B. Visser. 2005. Vigour evaluation for genetics and breeding in rose. Euphytica, 145: 339-347.