

Developing Descriptors for Dioecious *Momordica* Species for Germplasm Characterization and Evaluation

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Momordica L. is a genus of tropical wild and underutilized vegetables of medicinal importance. The descriptions of morphological and agronomic traits would unravel their potential for successful utilization. A set of highly discriminating descriptors and descriptor states for the dioecious *Momordica* species of India comprising *M. dioica*, *M. sahyadrica*, *M. subangulata* ssp. *renigera* and *M. cochinchinensis* is proposed. The descriptors are proposed based on a study of morphological variability in over 667 herbarium specimens and 164 live collections of India.

Key Words: Characterization, Descriptors, Evaluation, Genetic diversity, *Momordica* L., Spine gourd, Sweet gourd, Teasle gourd

Introduction

The importance of germplasm as a basic tool for crop improvement is well recognized. Wild relatives and progenitors of cultivated plants together with semi-domesticates represent a strategic group of germplasm collections. As the genetic base of modern varieties is narrow and variability fast eroding, introgression of genes from wild species can substantially influence the breeding progress. Thus, the knowledge of their taxonomic range, morphological similarities, crossing ability and reaction to various biotic and abiotic stress are not only important from a botanical view point, but also to accelerate and increase their potential for utilization (Dolezalova *et al.*, 2003). Identifying a limited set of accessions likely to be of most interest to specific users from a large collection necessitates the use of a full-fledged descriptor as a tool to provide a generalized search strategy. It helps to differentiate between accessions and to describe the variability in characters of interest. Preliminary characterization and evaluation are pre-requisites for successful utilization of plant genetic resources.

The future strategies for horticulture and genetic resources management should focus on not only the already commercialized crop species but also on many relatively neglected minor vegetables that have received very little attention hitherto. In fact, these high quality minor crops are a better route to food security than many of today's tailor made varieties, which are low in vitamins and minerals (Padulosi *et al.*, 2001). It is rather ironic that

malnutrition and under nutrition are more prevalent in the diversity-rich zones where plenty of wild edible fruits and leafy green vegetables with rich nutritive potential are available (Pradheep *et al.*, 2003). These vegetables and fruits still have large genetic diversity, which should be collected, characterized, conserved and utilized. These crops can play an important role in the diversification of agriculture and production of eco friendly-organically grown vegetables. By working on the genetic resources of these potential taxa, wild foods can be made more popular and can also develop new crop domesticates (Rathore *et al.*, 2005).

Momordica L.: Taxonomy and Diversity

Momordica L. is a genus of tropical wild and under-utilized vegetables native to Asia and Africa. Fruits are rich in vitamins and minerals and are ascribed with many medicinal properties by indigenous communities. The genus *Momordica*, even though has high potential as nutraceutical vegetable, it remains under-utilized (with the exception of bitter gourd) as no concerted research and development efforts have been made to promote them as cultivated crops. Of about 40 *Momordica* species, there are approximately less than five species represented in world germplasm collections (Bettencourt and Konopka, 1990). The purpose of this article is to present a proposal of detailed descriptors for the dioecious, perennial *Momordica* species comprising sweet, spine and teasle gourd of South-East Asia.

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Descriptors for Wild Dioecious

Momordica Species

As a first step to study of genetic resources of these under-utilized vegetables, a database of herbarium and germplasm holdings was prepared. The observed variability in national collections (herbarium specimens and germplasm collections comprising of *M. dioica* Roxb., *M. sahyadrica* Joseph & Antony and *M. subangulata* Blume ssp. *renigera* WJJ de Wilde and *M. cochinchinensis* [Lour.] Spreng) together with published descriptions of these taxa in various flora were used as a source for preparation of descriptor and descriptor states for wild *Momordica*. The taxonomic validity of the entities is as per the recent

taxonomic revisions (Joseph, 2005; Joseph and Antony, 2006; 2007). The proposed descriptors and descriptor states are presented according to guidelines and definitions provided by IPGRI (2003, 2005 and 2007) and National Institute of Agrobiological Resources, Ibaraki, Japan (Nagamine and Takeda, 1999). The botanical terminology regarding plant morphology and elaboration of figures is based on Jackson (1965), Robinson and Walters (1997) and Nayar and More (1998).

The proposed list of descriptors and descriptor states for the wild dioecious *Momordica* species is given in Tables 1 and 2. The set provides tool for species determination within the genus *Momordica* and

Table 1. Descriptors for characterization

Descriptor number	Descriptor name	Descriptor state (with code)
1. Vegetative characters		
1.1. Tuber		
(Specify age of tuber - only seedling tuber to be observed)		
1.1.1	Tuber (tap root) shape	1 conical 2 napiform 3 round bulged 4 fusiform 5 other (specify)
1.1.2	Protrusion of lenticels on tuber surface	1 weak 2 medium 3 strong
1.1.3	Tuber branching	1 absent 2 present
1.1.4	Occurrence of adventitious tuber	1 absent 2 present
1.1.5	Life span of tuber	1 ~5 years 2 < 5 years 3 > 5 years
1.1.6	Surface colour of tuber	1 light brown 2 dark brown 3 other (specify)
1.1.7	Inside colour of tuber	1 pale yellow 2 white 3 other (specify)
1.2. Seedling		
(Except 1.2.1, all other traits may be recorded in tuber sprouts/ratoon crop also)		
1.2.1	Germination	1 epigeal 2 hypogeal
1.2.2	Seedling vigour (visual score at 3-5 leaf stage)	1 low 2 medium 3 high
1.2.3	Primary leaf size	1 minute 2 small 3 medium 4 large
1.2.4	Primary leaf shape	specify
1.2.5	Primary leaf margin	1 smooth 2 wavy 3 dentate 4 lobed
1.3. Plant		
1.3.1	Growth habit	1 less viny 2 moderately viny 3 highly viny

contd.

Table 1 contd.

Descriptor number	Descriptor name	Descriptor state (with code)
1.3.2	Vine tip pubescence	1 glabrous 2 scarcely pubescent 3 pubescent
1.3.3	Stem nodal region - shape	1 quadrangular 2 round
1.3.4	Leaf shape (to be recorded at flowering stage)	
1.3.5	Leaf margin	1 entire 2 serrate 3 dentate 4 wavy 5 other (specify)
1.3.6	Leaf pubescence	1 glabrous 2 sparse 3 medium 4 dense 5 wooly 6 other (specify)
1.3.7	Lamina - gland dottedness (at 10X magnification) on lower surface	1 sparse 2 dense 3 medium
1.3.8	Leaf colour (fresh leaf)	1 light green 2 green 3 dark green
1.3.9	Leaf venation	1 fine network (aeroles) 2 spaced network 3 intermediate
1.3.10	Leaf lobing (1 st flowering node)	1 entire 2 lobed 3 mixed occurrence in same plant 4 other (specify)
1.3.11	Extent of lobing	1 shallowly lobed 2 broadly angled margins 3 deeply lobed and sub lobed
1.3.12	Lobe tip	1 acute 2 acuminate 3 ovate 4 obovate 5 other (specify)
1.3.13	Leaf odour	1 mild 2 not foetid 3 foetid (intense)
1.3.14	Leaf thickness	1 thin 2 medium 3 thick
1.3.15	Extent of leaf margin dentation	1 close 2 spaced 3 remote
1.3.16	Petiole-Lamina juncture shape	1 subangulate 2 round 3 cordate 4 other (specify)
1.3.17	Petiole-umbilical glands (viewed with naked eye)	1 absent 2 present
1.3.18	Tendril robustness	1 robust 2 fragile 3 medium
1.3.19	Tendril length (when uncoiled)	1 short (5-10 cm) 2 medium (11-20 cm) 3 very long (21-30 cm)

contd.

Table 1 contd.

Descriptor number	Descriptor name	Descriptor state (with code)
2. Inflorescence seed and fruit, 2.1. Male inflorescence and flower 2.1.1 Male inflorescence - nature of branching		1 solitary 2 pseudoraceme 3 loose fascicle 4 truly branched (above the bract)
2.1.2	Bract - position on peduncle	1 at base 2 midway 3 at tip
2.1.3	Male bract shape	1 scar like 2 small foliar 3 reniform 4 fan shaped (cleft) 5 hooded 6 frilled 7 any other (specify)
2.1.4	Male bract size	1 minute 2 small 3 medium 4 large
2.1.5	Male bract pubescence	1 absent 2 sparse 3 stiff short hairy-conspicuous
2.1.6	Male bract colour	1 light green 2 dark green 3 whitish green
2.1.7	Male bract tip	1 coloured black-purple 2 no colour distinction
2.1.8	Flower colour (petal colour at full bloom). Use RHS colour charts (1995)	1 lemon yellow 2 dull yellow 3 bright yellow 4 creamish yellow 5 whitish yellow 6 any other (specify)
2.1.9	Flower size	1 small 2 medium 3 large
2.1.10	Male flower receptacle size	1 small 2 medium 3 large
2.1.11	Floral scent	1 odourless 2 faint 3 detectable from 1m distance
2.1.12	Floral odour	1 musky 2 other (specify)
2.1.13	Nectar guides (on petals)	1 absent 2 present
2.1.14	Nature of nectar guides	1 purple blotch on 3 inner petals 2 on all 5 petals 3 light greenish yellow region on base of petals 4 other (specify)
2.1.15	Male flower calyx shape	1 linear acute 2 round oval 3 broad elliptic 4 ovate oblong 5 other (specify)

contd.

Table 1 contd.

Descriptor number	Descriptor name	Descriptor state (with code)
2.1.16	Calyx cup colouration	1 non pigmented 2 pigmented purple-blackish 3 light creamish yellow 4 greenish yellow 5 blackish
2.1.17	Corolla tip	1 acute 2 broad ovate 3 round 4 other (specify)
2.1.18	Aestivation	1 just touching each other 2 overlapping 3 spaced 4 other (specify)
2.1.19	Petal pubescence	1 glabrous 2 glandular hairy
2.1.20	Petal shape	1 ovate 2 linear acute 3 rhomboid 4 other (specify)
2.1.21	Petal spur (at base)= scale	1 absent 2 present, but inconspicuous 3 prominent
2.1.22	Petal venation	1 less prominent 2 medium 3 high (embossed)
2.1.23	Pollen dust colour	1 yellow 2 orange 3 brown
2.1.24	Pollen abundance	1 scanty 2 medium 3 abundant
2.1.25	Male flower anthesis	1 early morning 2 evening
2.1.25	Insect visitors observed (list out)	
2.2. Female inflorescence and flower		
2.2.1	Female flower bract size	1 minute (scar like) 2 medium large 3 large
2.2.2	Female flower bract position	1 just below gynoecium 2 midway on pedicel 3 near axis
2.2.3	Gynoecium	1 small 2 medium 3 large
2.2.4	Ovary surface	1 smooth 2 warty 3 tubercled 4 echinate (softly) 5 ridged 6 other (specify)
2.3. Fruit		
2.3.1	Fruit size	1 small 2 medium 3 large
2.3.2	Immature fruit colour	1 whitish green 2 light green 3 dark green
2.3.3	Fruit surface echination	1 absent=smooth 2 mild-sparcely echinate 3 densely echinate

contd.

Table 1 contd.

Descriptor number	Descriptor name	Descriptor state (with code)
2.3.4	Fruit surface bumps & ridges	1 no ridges 2 obscurely ridged (feeble) 3 clearly ridged 4 ridged at base only 5 ridged at base and top 6 other (specify)
2.3.5	Fruit C.S (mature fruit at equatorial point)	1 uniformly soft echinate 2 clear cut ridges and echination 3 ridges faint but echinate 4 other (specify)
2.3.6	Fruit shape	1 round oval 2 winged 3 doom shaped 4 ellipsoid oblong 5 top shaped 6 others (specify with drawing)
2.3.7	Fruit pericarp ripening	1 slow 2 sudden
2.3.8	Fruit (blossom end) rostration	1 faint 2 medium 3 appreciable length
2.3.9	Fruit blossom end surface murication	1 ridged and flat 2 ridged and echinate 3 uniformly echinate 4 uniformly smooth 5 other (specify)
2.3.10	Calyx persistence	1 caducous 2 semi persistent 3 persistent
2.3.11	Fruit bitterness	1 not bitter 2 slightly bitter 3 very bitter
2.4. Seed		
2.4.1	Seed aril colour (at ripening)	1 yellow 2 orange 3 scarlet 4 blood red
2.4.2	Seed shape	1 oval 2 round 3 globular 4 stellate 5 squarish 6 cog-wheel 7 rectangular 8 other (specify)
2.4.3	Seed sculpturing	1 absent 2 present
2.4.4	Extent of sculpturing	1 faint 2 medium 3 filigree type 4 pitted and ridged 5 other (specify)
2.4.5	Seed ornamentation	1 absent 2 present
2.4.6	Type of ornamentation	1 golden lines on black seed coat 2 other (specify)
2.4.7	Seed sides (margins)	1 smooth 2 wavy = bitten

Table 2. Descriptors for evaluation

Descriptor no.	Descriptor name	Descriptor state with code
3. Seedling		
3.1	Days to emergence (specify after ripening period)	
3.2	Germination percentage	
4. Plant		
4.1. Stem		
4.1.1	Vine length (measured at senescence) [m]	
4.2. Leaf		
4.2.1	First flowering node leaf size (L x B)	
4.2.2	Petiole length (avg. of 5 leaves at flowering node) [cm]	
4. 3. Inflorescence		
4.3.1. Male flower		
4.3.1.1	Days to first male flower opening (specify seed or tuber origin)	
4.3.1.2	Days to 50% male flowering	
4.3.1.3	Male flower prolificacy - No. of flowers/plant/day (avg. count of 5 days)	
4.3.1.4	Male bract size (L x B - avg. of 5 flowers)	
4.3.1.5	Male Peduncle length (axis to base of bract) [cm]	
4.3.1.6	Male pedicel length (bract to calyx base) [cm]	
4.3.1.7	Male flower diameter (average of 5 flowers) [cm]	
4.3.2. Female flower		
4.3.2.1	Days to first female flower opening	
4.3.2.2	Days to 50% female flowering	
4.3.2.3	Female flower prolificacy (avg. count of 5 days)	
4.3.2.4	Female bract size (L x B - avg. of 5 flowers)	
4.3.2.5	Female peduncle length (axis to bract base) [cm]	
4.3.2.6	Female pedicel length (bract to gynoecium) [cm]	
4.3.2.7	Female flower diameter (avg. of 5 flowers) [cm]	
4.4. Fruit		
4.4.1	Days to first fruit maturity (flowering to fruit-split)	
4.4.2	Fruit length (including rostration) [cm]	
4.4.3	Fruit circumference (around fruit) [cm]	
4.4.4	Fruit diameter [cm] (measured in C.S of fruit)	
4.4.5	Cavity size (measured at widest point in fruit CS) [cm]	
4.4.6	Flesh thickness (measured from C.S of ripe fruit) [cm]	
4.4.7	Single fruit weight (average of 5 fruits) [g]	
4.4.8	No. of fruits/plant/season	
4.4.9	Seediness (No. of seeds/fruit, avg. of 5 fruits)	
4.4.10	Fruit stalk length (avg. of 5 fruits) [cm]	
4.4.11	Fruiting period (No. of days from first to last female flower opening)	
4.5. Seed		
4.5.1	100-seed weight [g]	
4.5.2	Seed storability (viability under normal storage)	1 6 months 2 1 year 3 above one year
4.6. Biotic and abiotic stress susceptibility		
4.6.1	Biotic stress susceptibility (on a 0-9 scale)	0 no incidence 1 very low 3 low 5 intermediate 7 high 9 very high
4.6.1.1	Witches broom /little leaf disease	
4.6.1.2	Seedling damping off (<i>Pythium affanidermaticum</i>)	
4.6.1.3	Fruit black rot (<i>Dydimella</i> sp.)	
4.6.1.4	Powdery mildew (<i>Oidium</i> spp.)	
4.6.1.5	Anthracnose (<i>Colletotricum lagenerium</i>)	
4.6.1.6	Root knot nematode (<i>Meladogyne incognita</i>)	
4.6.1.7	Fruit fly (<i>Bactocera cucurbitae</i>)	
4.6.1.8	Lady bird beetle (<i>Epilacna septima</i>)	
4.6.1.9	Vine gall fly (<i>Lasioptera falcata</i>)	

contd.

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Table 2 contd.

Descriptor no.	Descriptor name	Descriptor state with code
4.6.1.10	Pumpkin caterpillar (<i>Margaronia indica</i>)	
4.6.1.11	Leaf minor (<i>Liriomyza trifoli</i>)	
4.6.1.12	Leaf hopper (<i>Hishimonus phycitis</i>)	
4.6.1.13	Red Pumpkin beetle (<i>Aulocophora fevicolii</i>)	
4.6.2	Abiotic stress susceptibility (indicator- yield performance)	
4.6.2.1	Susceptibility to shade	1 low 2 medium 3 high
4.7	Biochemical evaluation of (a) Tender fruits (b) Green leaves/tips	
4.7.1	Moisture	
4.7.2	Carbohydrates	
4.7.3	Proteins	
4.7.4	Fat	
4.7.5	Calcium	
4.7.6	Phosphorus	
4.7.7	Iron	
4.7.8	Magnesium	
4.7.9	Vitamin A	
4.7.10	Antioxidants	
4.7.11	Flavanoids	
4.7.12	Dietary fibre	
5. Evaluation for value addition/quality traits		
5.1	Fruit tenderness index (from pollination to seediness calculated as days up to which a sharp knife easily passes through)	
5.2	Suitability for vegetable preparation (based on consumer preference after organoleptic tests)	1 excellent 2 good 3 average 4 poor
5.3	Suitability of ripe fruits as vegetable salads (based on organoleptic tests and visual appeal)	1 excellent 2 high 3 medium 4 low
5.4	Usefulness as pot herb and leafy vegetable	1 excellent 2 good 3 average 4 poor
5.5	Fruit shelf life under room temperature	1 high (1 week) 2 medium (3 days) 3 low (1day)
5.6	Fruit shelf life under refrigeration (vegetable stage)	1 high (2 weeks) 2 medium (1 week) 3 low (< 1 week)

for characterization of infra-specific morphological variability. Morphological variability encountered at seedling, vegetative, flowering and fruiting stages of the plant has been included for preliminary characterization. Descriptor for evaluation consists of traits of crop husbandry value and response to biotic and abiotic stresses. Exploitation of some characters for inter- and infra-specific categorization is based on the personal experience of the authors at both levels of variation. Passport data descriptors, handling site descriptor and environmental descriptors are not provided for sake of brevity, which may be followed, as it is common for all cucurbits. Present treatment of extent of

variability for some traits such as leaf shape, fruit shape etc. are not exhaustive as numerous types difficult to describe in technical terms, but easy to depict through illustrations have been found in the existing collection. Further collection and study of variability across the country may lead to spotting of more diverse types and accordingly the descriptor states may need elaboration and modification in future.

There is no published descriptor for bitter gourd, teasle gourd, sweet gourd or spine gourd or any *Momordica* species by IPGRI. The lone reference to a descriptor to *Momordica* was seen in NATP Minimal Descriptor for

Vegetable Crops (Anon., 2001) where bitter gourd, sweet gourd and spine gourd are treated together. They, being evolutionarily divergent groups (bitter gourd on the one hand, sweet gourd and spine gourd on the other hand), should be treated separately as they vary for more than 75% characters by virtue of their breeding behaviour and growth forms (Joseph, 2005).

A descriptor based on experience of dealing with four species of less cultivated or wild gathered dioecious, perennial species of *Momordica* from India and South-East Asia is presented here. A critical review of the user community is invited to improve and revise this descriptor for the benefit of vegetable researchers, dealing with crop improvement of sweet, spine and teasle gourd.

References

- Anonymous (2001) *NATP Minimal Descriptors for Vegetable Crops*. National Bureau of Plant Genetic Resources, New Delhi, pp 61–66.
- Bettencourt E and J Konopka (1990) *Directory of Crop Germplasm Collections*. 4. Vegetables, International Bureau of Plant Genetic Resources, Rome, 147 p.
- Dolezalova I, E Kristkova, A Lebeda, V Vinter, D Astley and IW Boukema (2003) Basic morphological descriptors for genetic resources of wild *Lactuca* spp. *Plant Genet. Resour. Newsl.* **134**: 1–9.
- IPGRI (2003) *Descriptors for Melon (Cucumis melo L.)*. International Plant Genetic Resources Institute, Rome, Italy (<http://www.ipgri.cgiar.org/publications/pubselect.asp>).
- IPGRI (2005) *Minimum Descriptor Lists for Cucurbita, Cucumber, Melon and Watermelon*. International Plant Genetic Resources Institute, Rome, Italy.
- IPGRI (Bioversity International) (2007) *Guidelines for the Development of Crop Descriptor Lists*. Bioversity Technical Bulletin Series. Bioversity International, Rome, Italy (<http://www.bioversityinternational.org>).
- Jackson BD (1965) *A Glossary of Botanical Terms with their Definition and Accent* (4th edition), Hafner Publishing Co., London.
- Joseph John K (2005) *Studies on Ecogeography and Genetic Diversity of the Genus Momordica L. in India*. Ph.D. Thesis, Mahatma Gandhi University, Kottayam, Kerala, India, 315 p.
- Joseph John K, VT Antony and YC Roy (2006) On the occurrence, distribution and taxonomy of *Momordica subangulata* Blume ssp. *renigera* (G. Don) de Wilde in India. *Genet. Resour. Crop Evol.* **54(6)**: 1327–1332.
- Joseph John K and VT Antony (2007) *Momordica sahyadrica* sp.nov. (Cucurbitaceae), an endemic species of Western Ghats of India. *Nord. J. Bot.* **24(5)**: 539–542.
- Nagamine T and H Takeda (1999) *The Descriptors for Characterization and Evaluation in Plant Genetic Resources* (Vol. 2), National Institute of Agrobiological Resources, Ibaraki, Japan.
- Nayar N.M and TA More (1998) *Cucurbits*, Science Publishers, Enfield, NH, USA.
- Padulosi S, T Hodgkin, JT Williams and N Haq (2001) *Underutilized Crops: Trends, Challenges and Opportunities in the 21st century*, International Plant Genetic Resources Institute, 222 p.
- Pradheep K, SM Gomez and A Kalamani (2003) Possibilities of broadening plant wealth of horticulture from existing flora of Tamil Nadu, India: an overview. *Asian J. Plant Sci.* **2(9)**: 719–730.
- Rathore DS, U Srivastava and BS Dhillon (2005) *Management of Plant Genetic Resources of Horticultural Crops: Issues and Strategies* In: BS Dhillon, RK Tyagi, S Saxena, GJ Ramdhawa (eds) *Plant Genetic Resources: Horticultural Crops*, Narosa Publishing House Pvt. Limited, New Delhi, India, pp 1–18.
- Robinson RW and DS Decker-Walters (1997) *Cucurbits*. CAB International, London.