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MORMPHOMETRIC ANALYSIS OF MORPHOFORMS FROM *DOLCIHOS BIFLORUS* L.: A SEARCH

Sreelekshmi, S.G.[1] and K. Murugan[2*].
[1]SCMS Institute of Bioscience and Biotechnology Research and Development, Kochi.
[2]Department of Botany, University College, Thiruvananthapuram.
*E.mail: harimurukan@gmail.com

ABSTRACT

Three distinct morphoforms of horse gram (*Dolichos biflorus* Linn.) are recognized from the colour of the seed. The common morphoform is one with the buff seed coat (brownish colour). Others are cream and black seed coat types. The black seeded type is generally shorter in duration and low in vigour. In this context an attempt was made regarding the preliminary analysis of the morphoforms of *D. biflorus*. Morphometric characteristics were analyzed both in the seedlings and mature plants which includes length of the seedling, primary root, number of lateral roots, R/S ratio and vigour index. The mean data thus obtained are tabulated. There was no marked variation in seedling between the morphoforms. The variation between these was not significant statistically. Mean morphometric data of mature plants were statistically significant at 99.9% probability level. Foliar characteristics such as length of leaf varied from 9.1 to 9.7 cm, which were not statistically significant. However, the mean length of rachis shows significant variation at $P < 0.05$. Although there were slight variations in leaflets characteristics, they were not statistically significant between morphoforms. The duration of flowering ranged from 67 to 69 days. The black seed morphoform flowered a little earlier. However, there was no significant variation related to flowering period between the morphoforms.

Keywords: Horse gram (*Dolichos biflorus,* morphoforms, morphometric characters.

1. INTRODUCTION

The contribution of wild plants as foods has always been recognized as part of the local knowledge, which forms a greater part of the complex cultural system. Research has shown that many wild plants are rich in specific constituents, other than primary metabolites, referred as phytochemicals, which may have health promoting effects. The major plant-derived chemical groups, now recognized as having potential health promoting effects, at least under some circumstances, are the flavonoids, alkaloids, carotenoids, pre and pro-biotics, phytosterols, tannins, fatty acids, terpenoids, saponins and soluble and insoluble dietary fibres. These phytochemicals have the potential to be incorporated into foods or food supplements as nutraceuticals.

The term nutraceuticals can be summarized as "any non-toxic food extract supplement that has scientifically proven health benefits for both disease treatment and prevention". It has been generally stated that the health promoting effects of nutraceuticals and other functional foods are likely due to biochemical and cellular interactions, which together promote the overall health of an individual. In the global market place, nutraceuticals and functional foods have become a multi-billion dollar industry. *D. biflorus* commonly called Horse Gram or Kulatha is a branched sub erect or trailing annual leguminous herb. The medicinal uses of this plant date back to the Vedic period. It is most commonly used in Ayurveda and other traditional systems of medicines. This is a pulse crop of great potential values and is commonly designated as the 'poor man's pulse.' It is more prevalent in certain pockets of Kerala. However, the yield per unit area is low and also in the face of enhancing competition from other pulses, this crop has been replaced by other pulse crops, like green gram, black gram etc. Not much has been done in the improvement of production and productivity of this valuable crop. Moreover, morphoform categorization was not even tried in this pulse crop, though there was distinct differentiation in seed colour such as black, cream and brown. Thus, the present investigation has been undertaken to evaluate morphometric characterization of different morphoforms in terms of seed germination, growth and development.

2. MATERIALS AND METHODS

2.1. Plant materials

Kulatha or Horse gram (*Dolichos biflorus* Linn.) is a slender, sub erect low growing common twining creeper, native of most parts of India, and is found up to altitudes of 1000 m. They are succulent, pubescent, annual bushy herb. The plant is profusely

branched at the base, the branches intervening among themselves or with the plants of the companion crop (Kochar, 1992). The seeds of *Dolichos biflorus* for the present study were collected from Kerala Agricultural University, Trissur, Kerala. On the basis of seed colour, they were grouped into three morphoforms, viz., black, brown, and cream. The dry, uniform seeds of each morphoforms were sown separately in earthern pots, filled with farm-yard-manure and soil (Fig-1). The plants were raised for the production of pure seeds. The present investigations were carried out using these seeds, thus raised from pure breeding plants.

Fig. 1. *Dolichos biflorus* L. plant

2.2. Morpho-histometric analysis

2.2.1. Morphometric analysis of seedling and mature plants

Morphometric analysis of *Dolichos biflorus* L., was conducted during seed gemination (seedling characteristics) and then on mature plants. The analyses during germination were done from the date of sowing to the fifth day of germination. In the present study, the characteristics of seedling analysed were length of the seedling, radical, number of lateral roots, root/shoot (R/S) ratio, and the vigour index.

The length of seedling and the radicle was measured in centimeter. The R/S-ratio was calculated by dividing the radicle length to the length of seedling. The vigour index was computed using the formula.

Vigour index = (Length of shoot + Root length) x 100

The morphometric data of the mature plants were recorded after 50 percent flowering. The characteristics studied were the total height of plant, the mean length of internode, the total number of nodes, the length of leaf, petiole (rachis), first lateral petiolule (LP), median petiolule (MP), second lateral petiolule (LP), first lateral leaflet (LL), mid leaflet (ML), second lateral leaflet (LL), breadth of first lateral leaflet (LB), mid leaflet (MB), second lateral leaflet (LB),duration of flowering, length of flower, pedicel, sepal, standard petal, wing petal, keel petal, anthers, carpel, pod, breadth of pod and the number of seeds/pod. To avoid statistical error, the data were computed from ten plants and the mean was calculated.

3. RESULTS AND DISCUSSION

3.1. Morpho-histometric analysis

Many morphological features, which have enormous scope for research, are in fact simply neglected. However, in the present study on *Dolichos biflorus,* both vegetative and floral features were studied, to draw additional features that may help in discrimination of the three morphoforms (Fig. 2).

Morphometric characteristics were analyzed both in the seedlings and in mature plants.

Fig. 2. Flowers of different morphoforms of *Dolichos biflorus*

Fig. 3 Seeds morphoforms of horse gram (a) Black, (b) Cream and (c) Brown

3.2. Morphometric analysis of seedling and mature plants

In the present study, five days old seedlings were evaluated to discriminate and assess the interrelationship between three morphoforms of horse gram. The characters analyzed include length of the seedling, length of primary root, number of lateral roots, R/S ratio and vigour index. The mean

data thus obtained were tabulated (Table-1). There was no marked variation in seedling morphology between the morphoforms. However, the length of seedling varied from 1.18 cm in cream seeded variety to 1.20 cm in black, and to 1.21 cm in brown (Fig.3). The variation between these morphoforms was not significant statistically, as the calculated F-value was much lesser than that of tabulated index (Table-1). R/S ratio was lowest in cream and highest in brown seed morphoform. However, the vigour index was highest in black and lowest inbrown. They showed signifi cant variation between morphoforms, because the calculated F-value was far exceeding the tabulated value at $P < 0.05$ (Table-1).

Table 1. Mean morphometric data of seedling

Morphoforms	Characters			R/S Ratio	Vigour Index
	Length of Seedling (cm)	Length of radicle (cm)	No. of lateral Roots		
1	1.20	3.11	2.60	2.50	43.8
2	1.18	2.77	3.00	2.44	444
3	1.21	3.34	2.60	2.88	422
Calculated F - value	0.4777	0.1916	0.7576	1.1363	5.4927
Level of Significance	NS	NS	NS	NS	*

1 = Black; 2 = Cream; and 3 = Brown Morphoforms; NS = Not significant' * = siginificant at $p < 0.05$.

Interrelationship between these characteristics was computed and tabulated. Length of seedling was positively correlated to length of radicle and R/S ratio and negatively correlated to the number of lateral roots and vigour index. Radicle length showed positive correlation with R/S ratio and negative relationship with the number of lateral roots and vigour index. However, the number of lateral roots was positively correlated to vigour index. Variations in seedling characteristics to some extent are environmentally controlled. But phenotypic plasticity of seedling is, no doubt, an important factor in enabling a species to become widely distributed, but should not provide a basis for taxonomic discrimination. Although genetics and environmental variability on seed germination in soyabean (Sen and Ghosh, 1959) and in horse gram (Ram *et al.,* 2000) were studied, the study at morphoform level seems to be a new report in horse gram (Prasanthi *et al.,* 1999). mature plant characteristics were also calculated and tabulated (Table-2, 3, 4, 5, 6).

The genotypic and phenotypic variance in plant height was reported earlier (Ramakrishnan *et al.,* 1978; Suraiya, 1980). The heritability of various vegetative characteristics was also studied earlier by (Birari *et al.,* 1987). Foliar characteristics like the length of leaf (trifoliate leaf) varied from 9.1 cm in both black and brown morphoforms to 9.7 cm in the cream, which were not statistically varied from each other. The length of rachis ranged from 6.3 to 6.5 cm in the brown and black/cream morphoforms respectively. However, the mean length of rachis showed signifi cant variation at $P < 0.05$ (Table-3).

Table 2. Morphometric data of mature plants

Characters			
Morphoforms	Height (cm)	No. of nodes	Length of internode (cm)
1	112	12	9.0
2	113	16	5.6
3	120	18	9.0
Calculated F- value	36.46	7.6502	47.745
Level of Significance	***	*	***

1 = Black ; 2 = Cream; and 3 = Brown, * = Significant at p = 0.05;*** = Siginificant at $p < 0.001$

Table 3. Interrelationship of various characters in mature plant.

Characters	Height	No. of Node	Legume Internode
Height	1		
No. Node	0.826033188	1	
Leg. Inten	0.397359707	-0.18898224	1

Table 4. Mean data on foliar characteristics in different morphoforms of *D. biflorus* .

Characters											
Morphoforms	Length of leaf (cm)	Length of rachis (cm)	Length of petiole (cm)			Length of leaflet (cm)			Breadth of leaflet (cm)		
			LP 1	MP	LP 2	LL 1	ML	LL 2	LB 1	MB	LB 2
1	9.1	6.5	0.3	0.3	0.3	2.4	2,6	1.5	1.5	1.3	0.9
2	9.7	6.5	0.2	0.3	0.25	2.6	2,4	1.5	1.5	1.5	1.2
3	9.1	6.3	0.3	0.3	0.3	2.7	2,5	2.6	1.7	1.7	1.3
Calculated F-Value	0.833	8.66	0.3478	0.01	0.1235	0.2314	0,3	2.5	0.1429	1.8507	1.8072
Level of Significance	NS	*	NS	NS	NS	NS	NS	NS	NS	NS	NS

1 = Black; 2 = Cream and 3 = Brown; NS = Not significant, * = Significant at $p < 0.05$.

Table 5. Mean data on floral characteristics and duration of flowering in different morphoforms of *D. biflorus.*

Morphoforms	Duration (days)	Flower length (cm)	Length of pedicel (cm)	Length of sepal (cm)	Length of petal			Length of anther (cm)	Length of carpel (cm)
					Standard (cm)	Wing (cm)	Keel (cm)		
1	67	2.70	0.371	0.30	1.30	1.30	0.90	0.20	1.20
2	68	2.73	0.40	0.25	1.20	1.10	1.20	0.20	1.20
3	69	2.76	0.40	0.20	1.25	1.20	1.00	0.20	1.10
Calculated F-value	1.5004	0.7058	0.1886	0.5892	1.5613	2.9701	0.2698	0.0683	0.0529
Level of Significance	NS	NS	NS	NS	NS	NS	NS	NS	NS

1 = Black ; 2 = Cream; and 3 = Brown morphoforms ; NS = Not significant.

Besides the length of rachis, the length of petiole was also analysed individually from each trifoliate leaf and were designated as LP1, VP and LP2, in clock-wise direction. The length of LP1 varied from 2 to 3 mm, showed the lowest reading in the cream seed morphoform. The mean length of median petiole was 3 mm, irrespective of morphoform demarcation. Similarly, the length of LP2 was also more or less the same in all the morphoforms studied. Moreover, the variation in the length of petiole between morphoforms was not statistically significant (Table-3). The length and breadth of leaflet also showed no significant variance between

morphoforms analysed. However, the mean length of second lateral leaflet (LL2) was the lowest in the black and cream seed morphoforms. The breadth of LL was much lower than the rest of the leaflets and was least in the black morphoform, averaging 9 mm. Although there were slight variations in leaflets characteristics, they were not statistically signifi cant between morphoforms (Table-3).

Interrelationships between different foliar characteristics were computed by ANOVA and the results were tabulated .The mean length of the trifoliate leaf was correlated to the length of rachis, mean length of lateral leaflet (LL) and also to breadth of second lateral leaflet (LB). All other foliar characteristics showed negative correlation to leaf length. The mean length of rachis showed negative correlations to other features. However, the length of petioles exhibited strong interrelationship with other features and also to the length of median leaflet. But the mean length of median leaflet was negatively correlated to most of the characters analysed. The breadth of leaflets, however, showed strong interrelationship with one another. The black seed morphoform flowered a little earlier. The duration of flowering ranged from 67 to 69 days (Table - 4). However, there was no significant variation related to flowering period between the morphoforms. The length of pedicel was uniform in all the morphoforms studied (4 mm). The mean length of sepals in horse gram was 2-3 mm. However, they did not reveal any significant variance. The length of petals was also uniform in terms of percentage length of standard, wing and keel petals. The variations noticed in the present study were not statistically significant (Table-4).Similarly the length of anthers and the length of carpels were also more or less uniform and showed no significant variation.

The interrelationship between floral characteristics was analysed by ANOVA. Duration of flowering was found to be related strongly to length of flower, length of pedicel and length of keel petal, and it was negatively correlated to other floral parts. The interrelationship between duration of flowering and other agronomic characteristics was reported earlier by several investigators (Ghorpade, 1985; Birari *et al.,* 1987). An investigation on morphometric characteristics of fruit in three morphoforms of *Dolichos biflorus* with distinct seed colour was analysed. The length of pod ranged from 5-6 cm, the breadth 0.59 cm to 0.62 cm and the number of seeds/pod was 5 (Table-5 and 6). Between the morphoforms, these features showed no significant variation. Interrelationships between various characteristics of pods revealed that the breadth of the pod was positively related to the number of seeds/pod. However, the length of fruit was negatively correlated with the breadth of the fruit. In horse gram, Aggarwal and Kang (1976) observed significant positive correlation of pod length with grain number, grain weight. Suraiya (1980) reported that pod length exhibited genotypic correlations with seed yield in 15 morphoforms of horse gram. The present observation is in conformity with earlier investigations.

Table 6. Mean data on characters of pod in horse gram

Morphoforms	Length of pod (cm)	Breadth of pod (cm)	No. of seeds/pod
1	6.0	0.61	5
2	5.0	0.62	5
3	5.5	0.59	4
Calculated F-value	0.54407	0.50	0.5767
Level of Significance	NS	NS	NS

1= Black; 2=Cream; and 3 = Brown; NS= Not Significant.

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