# Morphological Variation and Phenetic Relationship of Hyacinth Bean (*Lablab purpureus* (L.) Sweet) in Lombok, West Nusa Tenggara

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Hyacinth bean (*Lablab purpureus* (L.) Sweet) is a member of Fabaceae which has high economic potential but is still treated as an underutilized crop. Research on hyacinth bean in Indonesia so far is only focused on bio-chemical content and protein isolate. However, the study on morphological characters of hyacinth bean has never been conducted. The aimed of this research was to study morphological variation and the phenetic relationship of hyacinth bean germplasm (*Lablab purpureus* (L.) Sweet) in Lombok, West Nusa Tenggara. The research was conducted in 4 regencies (East Lombok, Central Lombok, West Lombok and North Lombok) and samples (stem, leaf, flower, fruit, and seed) were collected using exploration method.The result showed that based on the morphological characters, the 26 collected samples showed that there were morphological differences on stem color, pod morphology (color, edge, texture), and seed morphology (color, shape, and spot existence). Furthermore, phenetic relationship of 26 OTU's (Operational Taxonomy Unit) based on 78 morphological characters showed that the hyacinth bean was divided into 2 large groups. The groups was differentiated by pod color. Group I had white or green pod with light or dark green edge while group II had white pod with purple edge. Member of group II was a dominant germplasm of hyacinth bean.

*Keywords: hyacinth bean, morphological variation, phenetic relationship, Lombok*

## Introduction

Hyacinth bean (*Lablab purpureus* (L.) Sweet) is a member of Fabaceae originated from Afrika and widely distributed in tropics and subtropics (Konduri *et al.*, 2000). Over past 50 years, hyacinth bean has become an important legume crops particularly in Australia and America (Maass *et al.*, 2005). In Indonesia hyacinth bean were found in East Java and West Nusa Tenggara (Setyorini, 2008). Hyacinth bean has a high economic potential but is still treated as an underutilized crop. Their seeds can be used as an alternative resources in making tahu and tempeh, ketchup, composite flour, delicacy (emping), and protein isolate (Subagyo & Morita, 2008; Anonim, 2009). Smartt (1985) in Pengelly & Maass (2001) stated that this legume should be a priority in developing legumes potential in tropical agriculture.

Developing a crops potential needed basic information about their phenotype (morphology) and genetic diversity. Radford (1986) said that morphological characters traditionally were useful evidence in whole taxonomic levels particularly in species and genus. The appearance of morphological characters were affected by genetic and environmental factor. Researches on plant diversity usually started from the existence of morphological variation indicated in certain plant population.

Hyacinth bean shows diversity on their morphological characters particularly in flower colour, seed characteristics, and pod characteristics (Yuan *et al.*, 2008). In Lombok, people called hyacinth bean as *komak* and named it based on their growth form and pod appearance. Generally hyacinth bean divided into 2 types namely wild type and cultivated type. Wild type were characterized by erect and bushy growth form, relatively small seed and existence of spots on the seed. Cultivated type were characterized by climbing growth form,

relatively large seed, and usually no spots on the seed (Maass, 2006; Hall & Naidu, 2008). Researches on morphological variation in hyacinth bean were done by Pengelly & Maass (2001), Maass (2006), and Gowda (2006). Pengelly & Maass (2001) found that seed weight, seed colour, and pod length were distinguished character between wild and cultivated type. Gowda (2006) and Maass (2006) found that seed characteristics especially seed weight was the most varied character of hyacinth bean.

## Material and Method

The research was conducted in 4 regencies (West Lombok, Central Lombok, East Lombok, and North Lombok) and samples (stem, leaf, flower, fruit, and seed) were collected using exploration method. Twenty six samples whose morphologically completed were collected during the exploration. Scoring and standarization were done on 78 morphological characters based on descriptor used by Pengelly & Maass (2001) and Gowda (2006). List of morphological characters that had been used in this research are in Table 1.

Table 1. Qualitative and quantitative characters of hyacinth bean used for this research

| Characters | | | |
|---|---|---|---|
| | **Qualitative characters** | 40 | Appendage position on raceme |
| 1 | Habitus | 41 | Fruit type |
| 2 | Growth form | 42 | Pod constriction |
| 3 | Leaf type | 43 | Pod colour |
| 4 | Leaf vernation | 44 | Pod edge |
| 5 | Leaf venation | 45 | Pod serrate colour |
| 6 | Leaf colour | 46 | Pod edge colour |
| 7 | Leaf vein colour | 47 | Down edge pod colour |
| 8 | Leaf hairiness on down surface | 48 | Pod rod colour |
| 9 | Petiole colour | 49 | Pod attachment (young) |
| 10 | Pulvinus colour | 50 | Pod attachment (mature) |
| 11 | Leaf stalk shape | 51 | Pod widest part |
| 12 | Leaf stalk hairiness | 52 | Pod surface |
| 13 | Terminal leaflet shape | 53 | Seed colour (young) |
| 14 | Terminal leaflet margin | 54 | Seed colour (mature) |
| 15 | Leaf apice type | 55 | Seed colour (dry) |
| 16 | Terminal leaflet petiole colour | 56 | Spot existence on the seed |
| 17 | Terminal leaflet base | 57 | Spot,s dispersal |
| 18 | Left leaflet shape | 58 | Seed shape |
| 19 | Left leaf let margin | 59 | Hilum colour |
| 20 | Left leaflet apice | 60 | Inner seed colour |
| 21 | Left leaflet petiole colour | | **Quantitative characters** |
| 22 | Left leaflet base | 61 | Pulvinus length |
| 23 | Right leaflet shape | 62 | Leaflet lenght |
| 24 | Right leaf let margin | 63 | Terminal leaf ratio |
| 25 | Right leaf apice | 64 | Petiole length of terminal leaf |
| 26 | Right leaf base | 65 | Stipule number of terminal leaf |
| 27 | Stem colour | 66 | Left leaf ratio |
| 28 | Stem hairiness | 67 | Petiole length of left leaflet |
| 29 | Stem shape | 68 | Stipule number of left leaflet |
| 30 | Branch orientation | 69 | Right leaf ratio |
| 31 | Raceme type | 70 | Petiole length of right leaflet |
| 32 | Raceme stalk shape | 71 | Stipule number of right leaflet |
| 33 | Raceme stalk colour | 72 | Raceme length |
| 34 | Raceme position | 73 | Pod ratio |
| 35 | Flower bud colour | 74 | Number of seeds/pod |
| 36 | Petal colour | 75 | Seed ratio (fresh) |

## Result and Discussion

This research showed that from 26 samples collected based on morphological characters, the hyacinth bean varied on stem colour, leaf characteristics (venation colour and leaf shape), pod characteristics (pod colour, pod edge colour, and pod texture), seed characteristic ( seed shape, seed colour, and the existence of spots on the seed).

Table 3. List of samples and morphological characteristic of hyacinth bean (*Lablab purpureus* (L.) Sweet) in Lombok, West Nusa Tenggara

| No | Collection name | Local name | Morphological Characteristics | Location |
|---|---|---|---|---|
| 1 | LOBAR 1 | *Komak IR* | Terminal leaf round,purple stem, purple flower, short raceme, white pod with purple edge, black seed | Kediri Village, Subdistrict Kediri, West Lombok |
| 2 | LOBAR 2 | *Komak Beaq Bokon* | Temninal leaf *deltoid*, purple stem, purple flower, long raceme, white pod with purple edge, dark brown seed | Narmada village, Subdistrict Narmada, West Lombok |
| 3 | LOBAR 3 | *Komak Putiq* | Terminal leaf *deltoid*, light green stem, white flower, long raceme, white pod with light green edge, dark brown seed | Medana village, Subdistrict Tanjung , West Lombok |
| 4 | LOTENG 1 | *Komak Ejo* | Terminal leaf *deltoid*, dark green stem, white flower, long raceme, light green pod with green edge, brown seed | Pujut village, Subdistrict Pujut, Central Lombok |
| 5 | LOTENG 2 | *Komak Putiq* | Terminal leaf *deltoid*, light green stem, white flower, long raceme, white pod with light green edge, dark brown-black seed | Segala Anyar village, Subdistrict Pujut, Kabupaten Central Lombok |
| 6 | LOTENG 3 | *Komak Bangket* | Terminal leaf *deltoid*, dark green stem, white flower, long raceme, green pod with dark green edge, cream seed with spots near hilum | Segala Anyar Village, Subdistrict Pujut, Central Lombok |
| 7 | LOTENG 4 | *Komak Ejo* | Terminal leaf *deltoid*, dark green stem, white flower, short raceme, green pod with dark green edge, dark brown seed | Kawo Village, Subdistrict Pujut, Central Lombok |
| 8 | LOTENG 5 | *Komak Putiq* | Terminal leaf *deltoid*, light green stem, white flower, long raceme, white pod with light green edge, brown seed | Barejulat Village, Subdistrict Jonggat, Central Lombok |
| 9 | LOTENG 6 | *Komak Ejo* | Terminal leaf *deltoid*, dark green stem, purple to reddish flower, long raceme, green pod with dark green edge, black seed | Barejulat Village, Subdistrict Jonggat, Central Lombok |
| 10 | LOTENG 7 | *Komak Ejo* | Terminal leaf *deltoid*, green stem, white flower, short raceme, light green pod with green edge, dark brown seed | Barejulat Village, Subdistrict Jonggat, Central Lombok |
| 11 | LOTENG 8 | *Komak Beaq Bokon* | Terminal leaf *deltoid*, purple stem, purple flower, long raceme, white pod with purple edge, black seed | Barejulat Village, Subdistrict Jonggat, Central Lombok |
| 12 | LOTENG 9 | *Komak Beaq Bokon Belo* | Terminal leaf rhomboid, purple stem, purple flower, short raceme, white pod with purple edge, black seed | Jago Village, Subdistrict Praya Tengah, Central Lombok |
| 13 | LOTENG 10 | *Komak Lanter* | Terminal leaf rhomboid, green stem,white flower, short raceme, light green pod with dark green edge, black seed | Pengenjek Village, Subdistrict Pringgarata, Central Lombok |
| 14 | LOTENG 11 | *Komak Putiq* | Terminal leaf *deltoid*, light green stem, white flower, long raceme, white pod with light green edge, brown seed | Aik Bukak Village, Subdistrict Batukliang Utara, Central Lombok |
| 15 | LOTENG 12 | *Komak Beaq Bokon* | Terminal leaf round, purple stem, purple flower, long raceme, white pod with purple edge, black seed | Aik Bukak Village, Subdistrict Batukliang Utara, Central Lombok |

| No | Collection name | Local name | Morphological Characteristics | Location |
|---|---|---|---|---|
| 16 | LOTENG 13 | *Komak Beaq Bokon Belo* | Terminal leaf *deltoid*, purple stem, purple flower, short raceme, white pod with purple edge, black seed | Aik Bukak Village, Subdistrict Batukliang Utara, Central Lombok |
| 17 | LOTENG 14 | *Komak Beaq Bokon Belo* | Terminal leaf *deltoid*, purple stem, purple flower, short raceme, white pod with purple edge, black seed | Karang Sidemen Village, Subdistrict Batukliang Utara, Central Lombok |
| 18 | LOTENG 15 | *Komak Beaq Bokon* | Terminal leaf *deltoid*, purple stem, purple flower, long raceme, white pod with purple edge, brown seed | Karang Sidemen Village, Subdistrict Batukliang Utara, Central Lombok |
| 19 | LOTIM 1 | *Komak Putiq* | Terminal leaf rhomboid, light green stem, white flower, long raceme, white pod with light green edge, dark brown seed | Montong Bunut Village, Subdistrict Tanjung Luar, East Lombok |
| 20 | LOTIM 2 | *Komak IR* | Terminal leaf *deltoid*, purple stem, purple flower, tlong raceme, white pod with purple edge, black seed | Montong Bunut Village, Subdistrict Tanjung Luar, East Lombok |
| 21 | LOTIM 3 | *Komak Leles* | Terminal leaf rhomboid, dark purple stem, purple flower, long raceme, white pod with purple edge, dark brown seed | Prian Village, Subdistrict Montong Gamang, East Lombok |
| 22 | LOTIM 4 | *Komak Putiq* | Terminal leaf *deltoid*, light green stem, white flower, long raceme, white pod with light green edge, dark brown seed | Prian Village, Subdistrict Montong Gamang, East Lombok |
| 23 | LOTIM 5 | *Komak Putiq* | Terminal leaf *deltoid*, light green stem, white flower, short raceme, white pod with light green edge, brown seed | Bat Man, Subdistrict Selaparang Village, East Lombok |
| 24 | LOTIM 6 | *Komak Leles* | Terminal leaf *deltoid*, dark purple stem, purple flower, short raceme, white pod with purple edge, black seed | Bat Man Village, Subdistrict Selaparang, East Lombok |
| 25 | LOTAR 1 | *Komak Beaq Bokon* | Terminal leaf *deltoid*, dark purple stem, purple flower, short raceme, white pod with purple edge, dark brown seed | Senaru Village, Subdistrict Bayan, North Lombok |
| 26 | LOTAR 2 | *Komak Beaq Bokon* | Terminal leaf *deltoid*, dark purple stem, purple flower, long raceme, white pod with purple edge, black seed | Senaru Village, Subdistrict Bayan, North Lombok |

Pod and seed characteristics were the most varied character among hyacinth bean population in Lombok. Based on pod characteristics, hyacinth bean in Lombok were divided into 3 large groups : (1) member of hyacinth bean which had white pod with purple edge, it was the most common hyacinth bean found in Lombok; (2) member of hyacinth bean which had white pod with light green edge; and (3) member of hyacinth bean which had green pod with dark green edge, this kind of bean were rare and hard to found.

Morphological variation in hyacinth bean showed many characters were polymorphic in both their vegetative and generative organs. Of 78 characters, 65 were polymorphic consist of 18 quantitative characters and 47 were qualitative characters. Phenetic-numerical analysis of hyacinth bean showed morphologically they were clustering based on certain characters and showed no reflect on geographic.

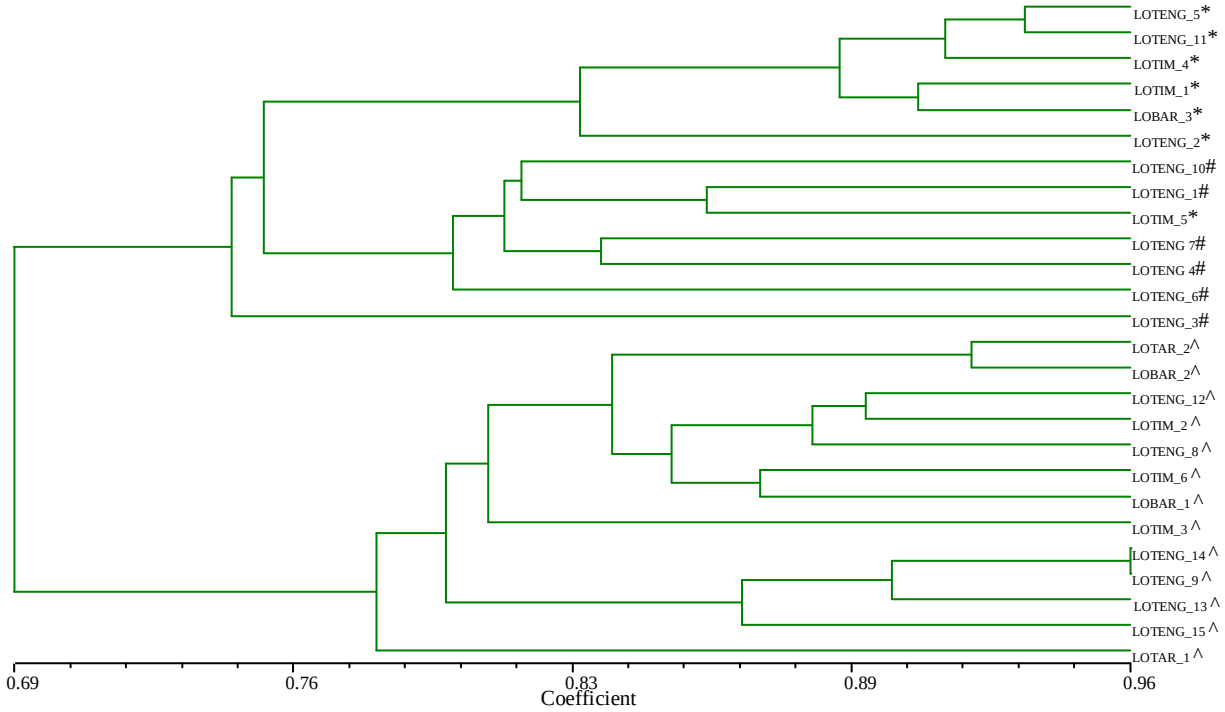


Figure 1. Dendrogram showed phenetic relationships based on morphological characters on hyacinth bean (*Lablab purpureus* (L.) Sweet) in Lombok, West Nusa Tenggara

Note :

* : white pod with light green edge

^ : white pod with purple edge

\# : green pod with dark green edge

Dendrogram (Figure 1) showed phenetically hyacinth bean in Lombok were divided into 2 large clusters with similarity index ranging between 69-96%, LOTENG 9 and LOTENG 14 were the closest OTU with similarity index 96%. Stem colour, flower colour, pod edge colour, and seed colour were distinguished character of both clusters. Cluster I were characterized by green series on stem colour (light green or dark green), vein colour, and pod edge colour (light green or dark green); white flowers; and brown seed on almost their member. Cluster I were divided into 3 subclusters with stem colour, pod colour, and raceme length were distinguished each subclusters. Clusters II were characterized by purple series on their stem colour, vein colour, pod edge colour, and flowers colour; seed colour varied from black (70%) to dark brown (30%). Cluster II were divided into 3 subclusters with raceme length were characterized each subclusters.

Those clustering pattern and distinguished characters were differ with clustering pattern of hyacinth bean found in Africa, India, and Australia. Pengelly & Maass (2001) found that hyacinth bean in India, Africa, and Australia were clustered based on wild and cultivated type and not reflected geographic origin. Members of the clusters were determined by seed characteristics (seed weight and colour) and pod size. Meanwhile, members of subclusters were determined by raceme length, time to flower, no.of nodes/raceme, plant height, leaf and pod length. The same results were also obtained by Maass (2006) and Gowda (2006) stated that seed weight were the most varied character.

Morphological diversity of hyacinth bean in Lombok had similarity index ranging from 69-96%. This value was lower than Pengelly & Maass (2001) which showed similarity index of hyacinth bean in India, Africa, and Australia ranging from 89-99%. It might be because the differences in number, characters type, and samples collected method that had been used in their research. Pengelly & Maass (2001) were collected samples for core collection candidate so not all hyacinth bean germplasms which showed morphological variation in both their vegetative and generative organs were chosen as a sample. Meanwhile, samples collected on analysis of morphological variation of hyacinth bean in Lombok were conducted by exploration method where each morphological variation that found in each location were collected to characterized.

Although it does not reflect geographic pattern but certain hyacinth bean which had white pod with purple edge tend to had wide geographic distribution and considered as a dominant. The other hyacinth bean which had green pod tend to had narrower distribution area. This hyacinth bean with narrow distribution area needed to consereved immediately to prevent them from extinction because of habitat lost and lack of people concerned to conserved (Maass *et al*., 2005; Hall & Naidu,2008).

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