Characterization of horse gram cultivars using plant morphological characters

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ABSTRACT
The present study was conducted at Seed Research and Technology Center, Rajendranagar, Hyderabad during rabi, 2008-09 using 23 accessions of horse gram. In general, all the accessions were erect and twining with green coloured veins and greenish yellow flowers, green immature pods with straw coloured pedicels. However, variation was noticed among the cultivars with respect to other morphological characters. A key based on the observed stem, leaf, pod and seed characters was constructed which serves as an aid for the identification of different cultivars of horse gram and also serves as a guide for preparation of DUS manual for horse gram.

Key words: Horsegram, Leaf, Stem, Pod characters, Seed characters.

INTRODUCTION
Horse gram (Macrotyloma uniflorum, Fabaceae) which is a test crop under drought situation and it is the unexploited legume suitable under tropical and subtropical dry land agriculture. Being highly self pollinated crop, number of accessions available are very less and its variability on morpho - physiological studies carried is very meager. Assessment of genetic variation is an essential component in genotypes characterization and conservation. Continued usage of morphological data to describe cultivars indicates that these retain popularity in descriptors till date (Pauksens, 1975). Morphological descriptors provide unique identification of cultivated varieties they not only reflect the genetic constitution of the cultivar but also the environmental interaction within which it is expressed. There is a need to study the variability present in each character in different varieties available, so that quality seed can be supplied and further genetic improvement for a particular character (s) can be done. Proper cultivar identification has a significant importance at national and international level. If the true to type of seed is not available the entire seed production chain may fail (Naseem et al., 2011). Thus it is of paramount importance to characterize varieties for their correct identification (Cooke, 2003). Varietal descriptors often relate to field characters and not to seed characters. Hence for an effective seed quality control programme it is very essential to describe, differentiate and characterize these accessions.

MATERIALS AND METHODS
The study on characterization comprising 23 horse gram accessions was taken up at Seed Research and Technology Center, Rajendranagar, Hyderabad during Rabi, 2008-09. Three were developed varieties and the remaining twenty were germplasm lines and these 23 accessions were studied in R.B. D with two replications. Each treatment was sown in 2 rows of 4 m length with a spacing of 30 x 10 cm. All the recommended package of practices were followed to raise a healthy crop. Data was recorded on morphological (plant, stem, leaf and pod) characters, yield and yield contributing characters and seed quality parameters. Horse gram being an unexploited legume, the crop descriptor is not available for characterization. Hence an attempt has been made to characterize the cultivars both under field and laboratory conditions on the basis of plant, stem, leaf and seed characters regarding the spectrum of variability present in each trait so that it could serve as a basis for the preparation of DUS manual. This will help for the preparation of DUS guidelines which is essential for their registration in PPVFRA, maintenance breeding and seed production. In the present investigation, an attempt has been made to characterize different cultivars of horse gram based on morphological characters of stem, leaf, pod and seed.

RESULTS AND DISCUSSION
The frequency distribution of qualitative attributes of released cultivars along with few examples varieties is...
<table>
<thead>
<tr>
<th>Plant descriptor</th>
<th>Range in expression</th>
<th>Number of varieties</th>
<th>Example varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Leaf size</strong></td>
<td>Small</td>
<td>4</td>
<td>HG 75, HG 54, HG 59, HG 18</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>8</td>
<td>HG 63, HG 14, HG 32, HG 17, HG 38, HG 41, HG 15, AK 38.</td>
</tr>
<tr>
<td></td>
<td>Big</td>
<td>11</td>
<td>HG 24, HG 58, HG 72, HG 11, HG 35, HG 49, HG 50, HG 52, HG 46, Palem 1, Palem 2</td>
</tr>
<tr>
<td><strong>Leaf pubescence</strong></td>
<td>Slightly hairy</td>
<td>15</td>
<td>HG 54, HG 59, HG 63, HG 18, HG 24, HG 58, HG 72, HG 11, HG 41, HG 49, HG 50, HG 52, Palem 1, Palem 2, AK 38.</td>
</tr>
<tr>
<td><strong>Leaf colour</strong></td>
<td>Light Green</td>
<td>1</td>
<td>HG 59</td>
</tr>
<tr>
<td></td>
<td>Dark green</td>
<td>10</td>
<td>HG 14, HG 18, HG 17, HG 58, HG 11, HG 35, HG 38, HG 41, HG 15, Palem 2</td>
</tr>
<tr>
<td><strong>Colour of the leaf petiole</strong></td>
<td>Green</td>
<td>3</td>
<td>HG 15, HG 52, AK 38.</td>
</tr>
<tr>
<td></td>
<td>Greenish with purple tinge</td>
<td>5</td>
<td>HG 75, HG 54, HG 59, HG 17, HG 11.</td>
</tr>
<tr>
<td></td>
<td>Greenish with dark purple tinge</td>
<td>1</td>
<td>HG 35.</td>
</tr>
<tr>
<td></td>
<td>Purple</td>
<td>1</td>
<td>HG 38.</td>
</tr>
<tr>
<td></td>
<td>Ovate to linear</td>
<td>1</td>
<td>HG 46.</td>
</tr>
<tr>
<td><strong>Stem colour (up to 5 cm)</strong></td>
<td>Green</td>
<td>21</td>
<td>HG 75, HG 59, HG 63, HG 14, HG 18, HG 32, HG 24, HG 17, HG 58, HG 72, HG 11, HG 35, HG 41, HG 49, HG 50, HG 52, HG 46, Palem 1, Palem 2, AK 38.</td>
</tr>
<tr>
<td></td>
<td>Purple</td>
<td>2</td>
<td>HG 54, HG 38.</td>
</tr>
<tr>
<td><strong>Stem pubescence</strong></td>
<td>Sparse</td>
<td>13</td>
<td>HG 18, HG 24, HG 58, HG 72, HG 11, HG 38, HG 15, HG 49, HG 52, Palem 1, Palem 2, AK 38.</td>
</tr>
<tr>
<td><strong>Twine colour</strong></td>
<td>Green</td>
<td>1</td>
<td>HG 24.</td>
</tr>
<tr>
<td></td>
<td>Green with light purple tinge</td>
<td>1</td>
<td>HG 52.</td>
</tr>
<tr>
<td></td>
<td>Purple</td>
<td>3</td>
<td>HG 75, HG 14, HG 38.</td>
</tr>
</tbody>
</table>
depicted in Table 1. In general all the accessions were erect and twining with green coloured veins and greenish yellow flowers, green immature pods with straw coloured pedicels. However, variation was noticed among the cultivars with respect to other morphological characters.

Data presented in Table 1 revealed that all the 23 accessions of horse gram were primarily classified on the growth habit and were found erect. These were further subdivided into 2 groups on the basis of leaf shape i.e., ovate and ovate to linear. Majority of the genotypes (22) possessed ovate leaves while only one genotype (HG 46) possessed ovate to linear leaves. All the accessions with ovate leaves were further subdivided into 3 groups on the basis of leaf size i.e., small, medium and big types. Of the 22 accessions, 4 genotypes were found to possess small leaves, 8 genotypes were having medium leaves and the rest 10 possessed big leaves (Fig. 1).

The genotypes with different leaf sizes could be further distinguished on the basis of leaf pubescence, color of the leaf and leaf petiole. Lapinski (1971) reported that cultivar identification among buckwheat varieties was distinctly possible on the basis of plant morphological characters viz., foliage colour, foliage shape and plant height. Similar study was made by Hirose et al. (1991) who used leaf shape and stem colour for identification and classification of buckwheat cultivars efficiently.

<table>
<thead>
<tr>
<th>Character</th>
<th>Value</th>
<th>Genotypes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matured pod colour</td>
<td>Straw</td>
<td>2 HG 11, HG 52</td>
</tr>
<tr>
<td></td>
<td>Straw with Light purple streaks</td>
<td>1 HG 15</td>
</tr>
<tr>
<td></td>
<td>Straw with purple streaks</td>
<td>13 HG 59, HG 63, HG 14, HG 18, HG 24, HG 17, HG 72, HG 35, HG 49, HG 50, HG 46, Palem 1, AK 38</td>
</tr>
<tr>
<td></td>
<td>Straw with dark purple streaks</td>
<td>7 HG 75, HG 54, HG 32, HG 58, HG 38, HG 41, Palem 2</td>
</tr>
<tr>
<td>Pod pubescence</td>
<td>Sparse</td>
<td>9 HG 14, HG 32, HG 17, HG 58, HG 11, HG 41, HG 50, HG 52, Palem 2</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>4 HG 54, HG 35, HG 49, Palem 1</td>
</tr>
<tr>
<td></td>
<td>Medium to Dense</td>
<td>1 HG 63</td>
</tr>
<tr>
<td></td>
<td>Dense</td>
<td>9 HG 75, HG 59, HG 18, HG 24, HG 72, HG 38, HG 15, HG 46, AK 38</td>
</tr>
<tr>
<td>Pod curvature</td>
<td>Curved (Slightly)</td>
<td>17 HG 59, HG 54, HG 32, HG 17, HG 58, HG 72, HG 11, HG 35, HG 41, HG 15, HG 49, HG 50, HG 52, HG 46, Palem 1, Palem 2</td>
</tr>
<tr>
<td></td>
<td>Curved (Moderate to sickle shaped)</td>
<td>1 HG 54</td>
</tr>
<tr>
<td></td>
<td>Curved (Sickle shaped)</td>
<td>3 HG 63, HG 24, HG 38</td>
</tr>
<tr>
<td>Seed colour</td>
<td>Straw</td>
<td>3 HG 24, HG 17, AK 38</td>
</tr>
<tr>
<td></td>
<td>Straw with greenish tinge</td>
<td>1 HG 59</td>
</tr>
<tr>
<td></td>
<td>Light straw</td>
<td>3 HG 14, HG 32, Palem 2</td>
</tr>
<tr>
<td></td>
<td>Straw with black tinge</td>
<td>5 HG 18, HG 72, HG 38, HG 41, HG 49</td>
</tr>
<tr>
<td></td>
<td>Straw with blackish green tinge</td>
<td>1 HG 11</td>
</tr>
<tr>
<td></td>
<td>Straw with orange tinge</td>
<td>1 HG 15</td>
</tr>
<tr>
<td></td>
<td>Black</td>
<td>9 HG 75, HG 54, HG 63, HG 58, HG 35, HG 50, HG 52, HG 46, Palem 1</td>
</tr>
</tbody>
</table>

The genotypes with different leaf sizes could be further distinguished on the basis of leaf pubescence, color of the leaf and leaf petiole. Lapinski (1971) reported that cultivar identification among buckwheat varieties was distinctly possible on the basis of plant morphological characters viz., foliage colour, foliage shape and plant height. Similar study was made by Hirose et al. (1991) who used leaf shape and stem colour for identification and classification of buckwheat cultivars efficiently.
Of the 4 genotypes with small leaves, 3 could be distinguished with slight hairy leaves while the genotype, HG 75 possessed moderately hairy leaves. The former 3 genotypes (HG 54, HG 59 and HG 18) could be further categorized on leaf color. HG 59 possessed light green leaves and purple tinged leaf petiole, HG 54 green leaves with purple tinged leaf petioles and HG 18 dark green leaves with light purple tinged petioles (Fig. 1). While the latter genotype, HG 75 was distinct from others with moderately hairy green leaves with purple tinged green leaf petioles.

Eight genotypes with medium sized leaves could be classified into 2 groups on the basis of leaf pubescence i.e., slightly hairy with 4 genotypes and moderately hairy with 4 genotypes. Of the former 4 genotypes, 3 possessed green leaves while the other HG 41 possessed dark green leaves with light purple tinged green leaf petioles. Of the 3 genotypes with green leaves, AK 38 possessed green leaf petiole. While the other two, HG 63 and HG 32 had light purple tinge on green leaf petioles. All the four genotypes which had moderate hairy leaves were dark green in color. However, on the basis of color of the leaf petiole, they were distinguished into 3 groups viz., greenish with light purple tinge (HG 14), greenish with purple tinge (HG 17), green (HG 15) and purple (HG 38).

Based on the leaf pubescence, accessions with big leaves were further classified into slightly hairy and moderately hairy groups. Eight genotypes fall in the former group while only 2 genotypes fall in the latter group (HG 35 and HG 50). These two groups were subdivided into 2 categories on the basis of leaf color. Five genotypes were slightly hairy with green leaves while 3 were slightly hairy with dark green leaves. Former group (slightly hairy with green leaves) is further distinguished on the basis of color of the leaf petiole into 2 groups. One group comprising of 4 genotypes with light purple tinged green leaf petioles while HG 52 was found to possess green leaves with green leaf petioles. The latter group (slightly hairy with dark green leaves) consists of 3 genotypes. Of these 3 genotypes, 2 were found to have dark green leaves with light purple tinged petioles (HG 58 and Palem 2). While, HG 11 was found to possess purple tinge on leaf petioles. Of the 2 genotypes which possessed moderately hairy leaves. HG 35 had dark green leaves with dark purple tinged leaf petioles while HG 50 had green leaves with light purple tinged leaf petioles.

**Stem morphological characters:** Stem color (up to 5 cm) was a very distinct characteristic and 21 accessions had green stem while only 2 (HG 54 and HG 38) were purple colored. However, HG 54 had moderate pubescence on stems with greenish purple twines. While, HG 38 had sparse hairs on the stem with purple twines (Fig. 2).

Twenty one accessions with green stem were grouped into 3 classes on the basis of stem pubescence. Twelve (12) accessions with sparse hairs were further distinguished into 3 groups: 10 accessions with greenish
purple twine color while one each had green twines (HG 24) and green twines with light purple tinge (HG 52). Of the 8 accessions with moderate pubescence, 2 (HG 75, HG 14) had purple twines while 6 had greenish purple twines (HG 59, HG 32, HG 35, HG 41, HG 50, HG 46). Only one accession was distinct with dense hairs and greenish purple twine color (HG 63) (Fig. 2).

**Pod morphological characters:** The color of the immature pod of all the accessions was green with straw colored pedicels and the pods of all the accessions were intermediate in position. All the accessions had straw colored matured pods with different shades of purple color. Of the 7 straw colored accessions with dark purple streaks, 2 (HG 75, HG 38) had dense hairs on the pods, 4 (HG 32, HG 58, HG 41 and Palem 2) with sparse hairs. While HG 54 had moderate hairs. On the other hand, 13 straw colored accessions with purple streaks were further sub grouped into 4 classes viz., 6 accessions with dense hairs on the pods, 3 each with sparse and moderate hairs, while HG 63 had moderate to dense hairs (Fig. 3).

On the other hand, HG 11 and HG 52 possessed straw colored, slightly curved pods with sparse hairs. While, HG 15 had straw colored dense haired, slightly curved pods with light purple streaks.

The shape of the pod for all the accessions was sickle shape but the degree of curvature of the pod was varied in different accessions. Accordingly, they were classified into the following 5 groups (Fig. 3):

- Moderately curved: AK 38.
- Moderately curved with greenish purple tinge: HG 63.
- Sickle shaped: HG 38, HG 24, and HG 63.
- Sickle shaped with purple twines: HG 32.
- Sickle shaped with greenish purple twines: HG 35.

**Seed morphological characters:** Seed characters such as seed size and seed shape serve as a criterion for characterizing the horse gram accessions. Of the 23 accessions, 2 (HG 75, HG 46) were small seeded, 14 possessed medium sized seeds and 7 with big seeds. These 3 main groups (black) were further subdivided into different sub groups on the basis of seed color. While 14 medium seed sized genotypes were grouped into 5 classes viz., 5 accessions were black colored, 3 each were straw colored with black tinge (HG 18, HG 41, HG 49) and light straw colored (HG 14, HG 32, Palem 2), 2 (HG 17 and AK 38) were straw colored and one (HG 59) with green tinge on straw coloured pods. Accessions with big seed size were broadly grouped into 2 colors i.e. black (HG 63 and HG 50) and straw colored. The latter color on the basis of presence of different tinge colours were distinguished into 4 classes namely straw colored with orange tinge (HG 15), straw colored (HG 24), straw colored with black tinge (HG 72 and AK 38) and straw colored with blackish green tinge (HG 11) (Fig. 4). In soybean, varietal characterization was made by Gaurav (1998) and significant variation among cultivars was observed for seed morphological traits.
A key (Figs. 1 to 4) based on the observed stem, leaf, pod and seed characters was constructed which serves as an aid for the identification of different cultivars of horse gram. Further this key also serves as a guide for preparation of DUS manual for horse gram. With a single morphological character it was difficult to characterize individual genotype but when a number of morphological characters were applied a better classification was obtained. Similar findings like morphological characters alone were able to classify all the buckwheat varieties as individual genotype and had more relevance for characterization of cultivars (Naseem et al., 2011). Morphological characters should be used in conjunction with more reliable methods of characterization such as biochemical or molecular markers for varietal characterization in horsegram.

Among the 20 characters studied the following characters viz., growth type all are erect, leaf shape is ovate only, vein colour, flower colour, twining habit, immature pod colour, pedicle colour, pod position was similar in all the 23 genotypes. However for other characters spectrum of variability was observed. Thus we can distinguish the varieties very critically on the DUS characteristics which will be a stable character for the documentation of traits.

REFERENCES

