Seed Res. 50 (1): 28-34, June, 2022

DUS Characterization of Okra (*Abelmoschus Esculentus* (L.) Moench) Genotypes through Qualitative Characters

MJ JADAV*, CA BABARIYA AND DS DESHMUKH

Department of Seed Science and Technology, College of Agriculture
Junagadh Agricultural University, Junagadh, Gujarat– 362001, India
*mamtajadav19@gmail.com

(Received December 2021; Revised February 2022; Accepted March 2022)

ABSTRACT: The investigation was undertaken at the Sagdividi Farm, Department of Seed Science and Technology, College of Agriculture, Junagadh Agricultural University, Junagadh, during *kharif* 2021 to DUS characterize 23 okra genotypes released for general cultivation in Gujarat at state level as well as at the National level in central India based on the qualitative characters. Observations for twenty three okra genotypes were recorded for 14 morphological and 2 seed characters. Okra genotypes were divided into two groups based on the colour of the stem: green (19 genotypes) and red (4 genotypes), while based on the intensity of the stem's green colour, okra genotypes were grouped as light (20 genotypes) and medium (3 genotypes). All okra genotypes were divided into two groups based on the colour of the flower petals: cream (8 genotypes) and yellow (15 genotypes), while genotypes were divided into two groups based on the flower's purple base petal colour: both side (18 genotypes) and inside (5 genotypes), while based on the fruit colour, okra genotypes were grouped as green (9 genotypes) and light green (11 genotypes). Based on the fruit surface between ridges, the 23 genotypes of okra were categorized as flat (20 genotypes) and convex (3 genotypes). The okra genotypes were categorized as absent (12 genotypes) and weak (11 genotypes) based on the constriction of the basal region of fruits. The okra genotypes were divided into three groups based on fruit pubescence: weak (16 genotypes), medium (2 genotypes) and strong (5 genotypes), while okra genotypes were divided into three groups based on the shape of fruit apex: acute (15 genotypes), narrow acute (3 genotypes) and blunt (5 genotypes). All the 23 okra genotypes were having green colour between veins. The okra genotypes were divided into two groups: dark (18 genotypes) and medium (5 genotypes) based on the intensity of colour between veins. The okra genotypes were divided into light green (20 genotypes) and purple (3 genotypes) groups based on the colour of the leaf veins. Based on the depth of lobing, the genotypes were grouped as shallow (10 genotypes) and medium (13 genotypes), while based on the serration of leaf blade margin, the genotypes were grouped as weak (2 genotypes), medium (20 genotypes) and strong (1 genotype). Based on the seed colour, the genotypes were grouped as brown (6 genotypes) and green (17 genotypes), while based on the seed hairiness, the genotypes were grouped as present (19 genotypes) and absent (4 genotypes).

Key words: DUS test, Okra, Characterization, Qualitative characters

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench), also known as ladies finger, is an economically important annual vegetable crop grown in tropical and subtropical parts of the world. In India, it is grown for tender fruits, which are used as vegetable. This vegetable is called "Bhindi" in India. Okra is member of "Malvaceae" family with 2n=8x=72 or 144 chromosome and is polypoidy in nature and genus is "*Abelmoschus*". Okra is native of South Africa and Asia.

Characterization of crops is an essential step in a crop improvement programme [4]. Morphological descriptors are used for characterization of plant genotypes on the basis of external appearance. Registration and protection can be granted to a variety only if it confirms to the criteria of Distinctness, Uniformity and Stability. Distinct means, a variety should be clearly distinguishable by one or more essential characteristics from any other existing variety. A variety is deemed uniform, if it is sufficiently uniform in its relevant characteristics, subject to variation that may be expected from the particular features of its population. The variety is said to be stable, if its relevant characteristics remain unchanged after repeated propagation.

MATERIALS AND METHODS

The experiment was conducted at sagdividi farm, Department of Seed Science and Technology, College of Agriculture, Junagadh Agricultural University, Junagadh during *Kharif* 2021 to the genotypes characterization in 23 okra genotypes *viz*., JOL-2K-19, HRB-55, JOL-14-

10, AOL-03-1, JOL-16-06, GAO-5, NOL-17-9, JOL-18-12, JOL-18-07, AOL-18-08, Pusa Sawani, GAO-5, JOL-18-11, Arka Abhay, EC 169513, JOL-18-9, EC-30563, JOL-18-1, KS-404, IC-2911-B, HRB-108-2, JOL-18-6, JOL-13-05, GO-6 and JOL-18-7 released for general cultivation based on the qualitative characters. The qualitative characters *viz*., stem colour, intensity of green colour stem, purple colour at base of flower petal, flower petal colour, fruit colour, fruit surface between ridges, constriction of basal part of fruits, fruit pubescence, shape of fruit apex, depth of lobbing, colour between veins, serration of leaf blade margin, intensity of colour between veins, vein colour, seed colour and seed hairiness were measured as per the guidelines of DUS testing [8].

RESULTS

Total 31 characteristic studied in which 16 qualitative and 15 quantitative characters. Based on the variation in qualitative characters, the genotypes were grouped into different categories (Table 1, 2 and 3). Based on the leaf colour between veins, all the 23 okra genotypes were having green colour between veins. Based on the intensity of colour between veins, genotypes were classified into dark (18 genotypes) and medium (5 genotypes) colour between veins. On the basis of stem colour, genotypes were grouped as green (19 genotypes) and red (4 genotypes), while based on the intensity of the stem's green colour, okra genotypes were grouped as light (20 genotypes) and medium (3 genotypes). All okra genotypes were divided into two groups based on the colour of the flower petals: cream (8 genotypes) and yellow (15 genotypes). The genotypes were divided into two groups based on the flower's purple base petal colour: both side (18 genotypes) and inside (5 genotypes), while based on the fruit colour, okra genotypes were grouped as green (9 genotypes) and light green (11 genotypes), while based on the fruit surface between ridges, the 23 genotypes of okra were categorized as flat (20 genotypes) and convex (3 genotypes). The okra genotypes were categorized as absent (12 genotypes) and weak (11 genotypes) based on the constriction of the basal region of fruits. The okra genotypes were divided into three groups based on fruit pubescence: weak (16 genotypes), medium (2 genotypes) and strong (5 genotypes). The okra genotypes were divided into three groups based on the shape of fruit apex: acute (15 genotypes), narrow

Table 1. Identification of grouping of okra genotypes based on Stem colour, intensity of green colour of stem, flower petal colour, petal base colour of flower (purple) and fruit colour

Genotypes	Stem colour	Intensity of green colour of stem	Flower petal colour	Petal base colour of flower (purple)	Fruit colour
JOL-16-06	Green	Light	Yellow	Inside	Green
JOL-14-10	Green	Light	Yellow	Both	Light green
HRB-55	Green	Light	Yellow	Inside	Light green
GAO-5	Green	Light	Yellow	Both	Light green
NOL-17-9	Green	Light	Yellow	Both	Light green
AOL-03-1	Green	Medium	Yellow	Both	Green
AOL-18-08	Green	Light	Yellow	Both	Green
Pusa Sawani	Green	Light	Yellow	Both	Light green
JOL-18-1	Green	Medium	Yellow	Both	Light green
JOL-18-07	Green	Light	Cream	Both	Green
JOL-2K-19	Red	Light	Yellow	Both	Green
Arka Abhay	Green	Light	Cream	Both	Light green
JOL-18-12	Green	Light	Yellow	Both	Green
JOL-18-6	Green	Light	Yellow	Both	Green
JOL-18-9	Red	Light	Yellow	Both	Light green
KS-404	Green	Light	Yellow	Inside	Light green
GO-6	Green	Medium	Cream	Both	Light green
EC- 169513	Red	Light	Yellow	Both	Green
JOL-18-11	Red	Light	Cream	Both	Light green
JOL-13-05	Green	Light	Cream	Inside	Light green
IC-2911-B	Green	Light	Cream	Both	Light green
HRB-108-2	Green	Light	Cream	Inside	Light green
EC-30563	Green	Light	Cream	Both	Green

Table 2. Identification of grouping of okra genotypes based on fruit surface between ridges, constriction of basal part of fruits fruit pubescence, shape of fruit apex and leaf vein colour

Genotypes	Fruit surface between ridges	Constriction of basal part of fruits	Fruit pubescence	Shape of fruit apex	Leaf vein colour
JOL-16-06	Flat	Absent	Weak	Acute	Light green
JOL-14-10	Convex	Weak	Weak	Blunt	Light green
HRB-55	Flat	Weak	Weak	Acute	Light green
GAO-5	Flat	Absent	Medium	Acute	Light green
NOL-17-9	Flat	Absent	Weak	Acute	Light green
AOL-03-1	Flat	Absent	Strong	Narrow acute	Purple
AOL-18-08	Flat	Absent	Weak	Acute	Light green
Pusa Sawani	Flat	Weak	Weak	Acute	Light green
JOL-18-1	Convex	Weak	Weak	Acute	Light green
JOL-18-07	Flat	Absent	Strong	Acute	Purple
JOL-2K-19	Flat	Absent	Weak	Acute	Light green
Arka Abhay	Flat	Weak	Weak	Acute	Purple
JOL-18-12	Flat	Absent	Strong	Acute	Light green
JOL-18-6	Flat	Weak	Weak	Narrow acute	Light green
JOL-18-9	Flat	Weak	Weak	Acute	Light green
KS-404	Convex	Weak	Weak	Blunt	Light green
GO-6	Flat	Absent	Medium	Narrow acute	Light green
EC- 169513	Flat	Weak	Weak	Blunt	Light green
JOL-18-11	Flat	Weak	Strong	Blunt	Light green
JOL-13-05	Flat	Weak	Strong	Blunt	Light green
IC-2911-B	Flat	Absent	Weak	Acute	Light green
HRB-108-2	Flat	Absent	Weak	Acute	Light green
EC-30563	Flat	Absent	Weak	Acute	Light green

Table 3. Identification of grouping of okra genotypes based on depth of lobing, serration of leaf margin, colour between veins, intensity of colour between veins, seed colour and seed hairiness

Genotypes	Depth of lobing	Serration of leaf blade margin	Colour between veins	Intensity of colour between veins	Seed colour	Seed hairiness
JOL-16-06	Medium	Medium	Green	Dark	Brown	Yes
JOL-14-10	Shallow	Medium	Green	Dark	Green	Yes
HRB-55	Medium	Medium	Green	Dark	Green	No
GAO-5	Medium	Medium	Green	Dark	Green	Yes
NOL-17-9	Shallow	Medium	Green	Dark	Green	No
AOL-03-1	Medium	Medium	Green	Dark	Green	No
AOL-18-08	Medium	Medium	Green	Dark	Green	Yes
Pusa Sawani	Medium	Medium	Green	Dark	Green	Yes
JOL-18-1	Medium	Medium	Green	Dark	Brown	Yes
JOL-18-07	Shallow	Medium	Green	Dark	Green	Yes
JOL-2K-19	Shallow	Medium	Green	Dark	Green	Yes
Arka Abhay	Medium	Medium	Green	Medium	Green	Yes
JOL-18-12	Shallow	Medium	Green	Dark	Brown	Yes
JOL-18-6	Shallow	Medium	Green	Medium	Green	Yes
JOL-18-9	Medium	Medium	Green	Dark	Brown	Yes
KS-404	Shallow	Medium	Green	Dark	Green	Yes
GO-6	Medium	Strong	Green	Dark	Brown	Yes
EC- 169513	Shallow	Weak	Green	Medium	Green	Yes
JOL-18-11	Shallow	Medium	Green	Medium	Green	Yes
JOL-13-05	Medium	Medium	Green	Dark	Green	No
IC-2911-B	Medium	Medium	Green	Dark	Brown	Yes
HRB-108-2	Shallow	Medium	Green	Medium	Green	Yes
EC-30563	Medium	Weak	Green	Dark	Green	Yes

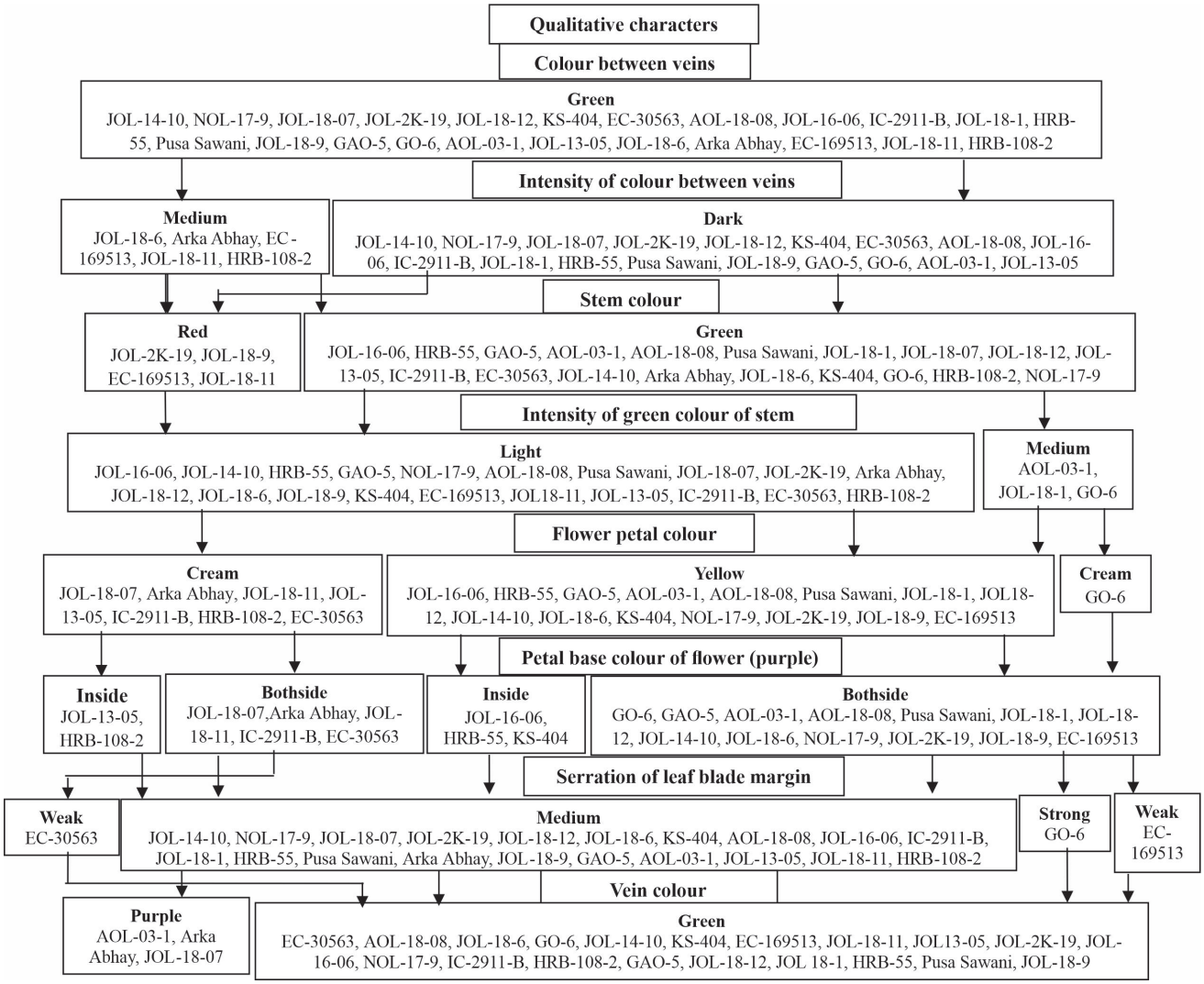

Figure 1. Okra genotypes identification keys on the basis of qualitative characters(a)

acute (3 genotypes) and blunt (5 genotypes). The okra genotypes were divided into light green (20 genotypes) and purple (3 genotypes) groups based on the colour of the leaf veins. Based on the depth of lobing, the genotypes were grouped as shallow (10 genotypes) and medium (13 genotypes), while based on the serration of leaf blade margin, the genotypes were grouped as weak (2 genotypes), medium (20 genotypes) and strong (1 genotype). Based on the seed colour, the genotypes were grouped as brown (6 genotypes) and green (17 genotypes), while based on the seed hairiness, the genotypes were grouped as present (19 genotypes) and absent (4 genotypes).

The qualitative characters helped in identifying and grouping of the okra genotypes. On the basis of qualitative characteristics, okra genotypes identification keys are presented in the Figure 1 and 2. The genotypes *viz*., AOL-03-1 and JOL-18-1 were having similarity in green colour between veins, dark intensity of colour between veins, green stem colour, medium intensity of green colour of stem, yellow flower petal colour, bothside petal base colour of flower (purple), medium serration of leaf blade margin and green vein colour [5]. The genotypes *viz*., JOL-14-10, NOL-17-9, JOL-2K-19, JOL-18-12, AOL-18-08, Pusa Sawani and GAO-5 were having green colour between veins, dark intensity of colour between veins, green stem colour, light intensity of green colour of stem, yellow flower petal colour, bothside petal base colour of flower (purple), medium serration of leaf blade margin and green vein colour [5]. The genotypes *viz*., JOL-2K-

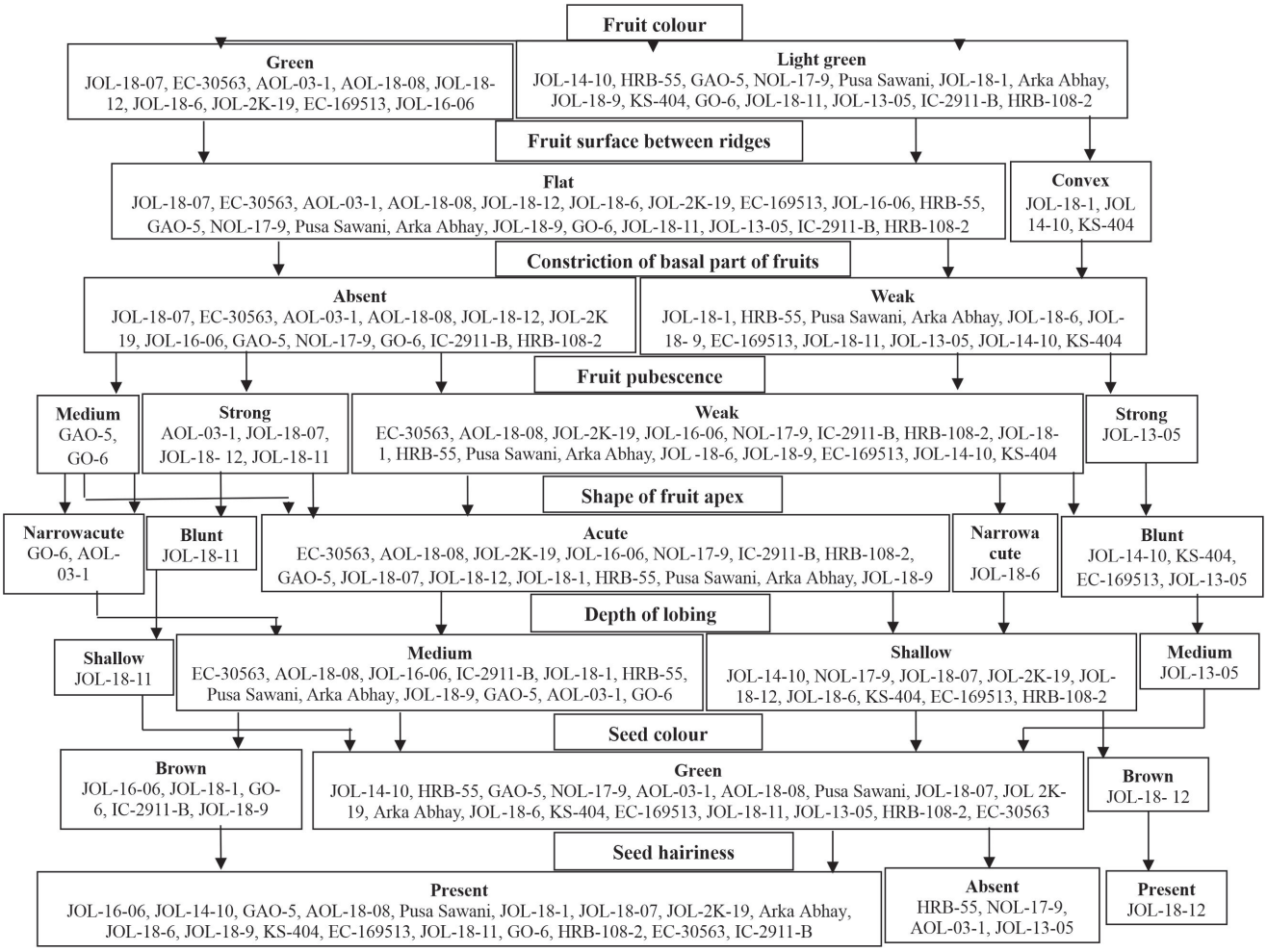

Figure 2. Okra genotypes identification keys on the basis of qualitative characters(b)

19 and JOL-18-9 were having green colour between veins, dark intensity of colour between veins, red stem colour, light intensity of green colour of stem, yellow flower petal colour, bothside petal base colour of flower (purple), medium serration of leaf blade margin and green vein colour [7]. The genotypes *viz*., JOL-13-05 and HRB-108-2 were having green colour between veins, green stem colour, light intensity of green colour of stem, cream flower petal colour, inside petal base colour of flower (purple), medium serration of leaf blade margin and green vein colour, but differing in intensity of colour between veins with medium (HRB-108-2) and dark (JOL-13-05) [5]. The genotypes *viz*., JOL-16-06, HRB-55 and KS-404 were having similarity in green colour between veins, dark intensity of colour between veins, green stem colour, light intensity of green colour of stem, yellow flower petal colour, inside petal base colour of flower (purple), medium serration of leaf blade margin and green vein colour [7]. The genotypes *viz*., Arka Abhay and JOL-18-07 were having green colour between veins, green stem colour, light intensity of green colour of stem, cream flower petal colour, bothside petal base colour of flower (purple), medium serration of leaf blade margin and purple vein colour, but differing in intensity of colour between veins with dark (JOL-18-07) and medium (Arka Abhay) [7]. GO-6 was having green colour between veins, green stem colour, medium intensity of green colour of stem, cream flower petal colour, bothside petal base colour of flower (purple), strong serration of leaf blade margin and green vein colour, dark intensity of colour between veins [6]. The genotypes *viz*., IC-2911-B and EC-30563 were having green colour between veins, green stem colour, light intensity of green colour of stem, cream flower petal colour, bothside petal base colour of flower (purple), green vein colour and dark intensity of colour between veins, but differing in serration of leaf blade margin with weak

(EC-30563) and medium (IC-2911-B) (10). The genotype JOL-18-6 was having green colour between veins, green stem colour, light intensity of green colour of stem, yellow flower petal colour, bothside petal base colour of flower (purple), green vein colour, medium intensity of colour between veins and medium serration of leaf blade margin [6]. EC-169513 was having green colour between veins, red stem colour, light intensity of green colour of stem, yellow flower petal colour, bothside petal base colour of flower (purple), green vein colour, medium intensity of colour between veins, weak serration of leaf blade margin [10]. The genotype JOL-18-11was having green colour between veins, red stem colour, light intensity of green colour of stem, cream flower petal colour, bothside petal base colour of flower (purple), green vein colour, medium intensity of colour between veins, medium serration of leaf blade margin [10].

The genotypes *viz*., JOL 14-10 and KS-404 were having light green fruit colour, convex fruit surface between ridges, weak constriction of basal part of fruits, weak fruit pubescence, blunt shape of fruit apex, shallow depth of lobing, green seed colour and present seed hairiness [3]. IC-2911-B and JOL-18-9 were having similarity in light green fruit colour, flat fruit surface between ridges, weak fruit pubescence, acute shape of fruit apex, medium depth of lobing, brown seed colour and present seed hairiness, but differing in constriction of basal part of fruits with absent (IC-2911-B) and weak (JOL-18-9) [3, 9]. The genotypes *viz*., JOL-18-07 and JOL-18- 12 were having similarity in light green fruit colour, absent constriction of basal part of fruits, flat fruit surface between ridges, strong fruit pubescence, acute shape of fruit apex, shallow depth of lobing and present seed hairiness with absent, but differing in seed colour with green (JOL-18-07) and brown (JOL-18- 12) [9]. The genotypes *viz*., HRB-55, Pusa Sawani and Arka Abhay were having similarity in light green fruit colour, flat fruit surface between ridges, weak constriction of basal part of fruits, weak fruit pubescence, acute shape of fruit apex, medium depth of lobing and green seed colour, but differing in seed hairiness with present (Pusa Sawani and Arka Abhay) and absent (HRB-55) [8, 9]. The genotypes *viz*., EC-30563, AOL-03-1, AOL-18-08 and JOL-2K 19 were having similarity in green fruit colour, flat fruit surface between ridges, absent constriction of basal part of fruits, weak fruit pubescence, acute shape of fruit apex, green seed colour and present seed hairiness, but differing in depth of lobing with shallow (JOL-2K 19) and medium (EC-30563, AOL-03-1 and AOL-18-08) [1]. The genotypes *viz*., HRB-108-2 and NOL-17-9 were having light green fruit colour, flat fruit surface between ridges, weak constriction of basal part of fruits, weak fruit pubescence, acute shape of fruit apex, green seed colour, present seed hairiness and shallow depth of lobing, but diferring in seed hairiness present (HRB-108-2) and absent (NOL-17-9) [3, 1]. The genotype AOL-03-1 was having green fruit colour, flat fruit surface between ridges, absent constriction of basal part of fruits, strong fruit pubescence, narrow acute shape of fruit apex, green seed colour, medium depth of lobing and absent seed hairiness [8, 1]. The genotype GAO-5 was having light green fruit colour, flat fruit surface between ridges, absent constriction of basal part of fruits, medium fruit pubescence, acute shape of fruit apex, green seed colour, medium depth of lobing and present seed hairiness [8]. JOL-18-11 was having light green fruit colour, flat fruit surface between ridges, weak constriction of basal part of fruits, strong fruit pubescence, blunt shape of fruit apex, green seed colour, shallow depth of lobing and present seed hairiness [11]. The genotype JOL-13-05 was having light green fruit colour, flat fruit surface between ridges, weak constriction of basal part of fruits, strong fruit pubescence, blunt shape of fruit apex, green seed colour, medium depth of lobing and present seed hairiness [2]. EC-169513 was having green fruit colour, flat fruit surface between ridges, weak constriction of basal part of fruits, weak fruit pubescence, blunt shape of fruit apex, green seed colour, shallow depth of lobing and present seed hairiness. The genotype JOL-16-06 was having green fruit colour, flat fruit surface between ridges, absent constriction of basal part of fruits, weak fruit pubescence, acute shape of fruit apex, brown seed colour, medium depth of lobing and present seed hairiness (2) [11]. The genotypes *viz*., JOL-18-6 and EC-169513 were having green fruit colour, flat fruit surface between ridges, weak constriction of basal part of fruits, weak fruit pubescence, green seed colour, shallow depth of lobing and present seed hairiness, but differing in shape of fruit apex with narrow acute (JOL-18-6) and blunt (EC-169513) [2, 11]. GO-6 was having light green fruit colour, flat fruit surface between ridges, absent constriction of basal part of fruits, medium fruit pubescence, narrow acute shape of fruit apex, brown seed colour, medium depth of lobing and present seed hairiness. The genotype JOL-18-1 was having light green fruit colour, convex fruit surface between ridges, weak constriction of basal part of fruits, weak fruit pubescence, acute shape of fruit apex, brown seed colour, medium depth of lobing and present seed hairiness.

Similar characterization and grouping of okra genotypes based on the qualitative characters were made by Bas and Koludar (2001), Saifullah and Rabbani (2009), Nwangburuka *et al.* (2011), Oppong-Sekyere *et al.* (2011), Amiteye *et al.* (2019), Temam *et al.* (2021), Samim *et al.* (2018), Ouedraogo *et al.* (2016), Reddy *et al.* (2016), Singh *et al.* (2015) and Pandravada *et al.* (2015).

We have shown that qualitative morphological characters were quite efficient in varietal identification and in estimating DUS in okra. Stem: Colour, Leaf blade: Depth of lobbing and Fruit: Colour characters were used for grouping purpose. It will then be appropriate to test the adapted system; the results may be useful not only for varietal registration, but also in the wider context of varietal classification and clustering. DUS descriptors for 16 only qualitative traits exhibited variability for 23 okra genotypes, all traits while variability was present in genotypes, revealing the existence of substantial genetic variability with the potential to assign different morphological profiles for varietal identification and characterization and serve as morphological markers to locate unique parental material for particular features in okra genotypes and can be used for registration with PPV and FRA and seed purity testing.

REFERENCES

1. AMITEYE S, AMITAABA T AND AMOATEY HM (2019). Morphological characterization of accessions of okra (*Abelmoschus* spp (L.)). *International Journal of Pure and Applied Bioscience,* **7**(1): 1-13.
2. BAS T AND KOLUDAR J (2001). Characterization on okra (*Abelmoschus esculentus* (L.)) germ-plasm in Turkey. *Acta Horticulturae,* **560**: 133-36.
3. BISHT IS (1997). Classification of genetic diversity in *Abelmoschus tuberculatus* germplasm collection using morphometric data. *Annals of Applied Biology,* **130**(2): 325- 35.
4. DE VICENTE MC, GUZMAN FA, ENGELS J AND RAMANATHA RV (2005). Genetic characterization and its use in decision making for the conservation of crop germplasm. The role of biotechnology, Vill Gualino, Turin, Italy, **(5- 7)**: 1-8.
5. JAWAHARLAL K (1994). Studies on varietal characterization in inbreds, hybrids and varieties of cotton through physical, physiological and bio-chemical methods. M. Sc Thesis. Tamil Nadu Agricultural University, Coimbatore.
6. OUEDRAOGO MH, BOUGMA LA, SAWADOGO N, KIEBRE Z, OUEDRAOGO N, TRAORE ER, NANEMA RK, KANDO PB AND SAWADOGO M (2016). Assessment of agromorphological performances and genetic parameters of okra varieties resulting from participative selection. *International Journal of Advanced Research,* **3**(1): 1554-64.
7. PANDRAVADA SR, REDDY MT, SIVARAJ N, JAIRAM R, SUNIL N, CHAKRABARTY SK AND BISHT IS (2015). Preliminary characterization and evaluation of on farm conserved okra germplasm from tribal pockets of Telangana. *Annals of Plant and Soil Research,* **17**(4): 342-45.
8. PPV AND FR ACT. (2001). Protection of Plant Varieties and Farmers' Rights (No. 53 of 2001. Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi, 476.
9. REDDY MT, PANDRAVADA SR, NATARAJAN S AND NEELAM. (2016). Characterization of Indian landraces germplasm and morphological traits desirable for designing a customer-driven variety in okra (*Abelmoschus esculentus* (L.) Moench). *Journal of Global Agriculture and Ecology* **6**(1): 7-34.
10. SAMIM S, SOOD S., SINGH A, VERMA A AND KAUR A. (2018). Morphological characterization of okra (*Abelmoschus esculentus* (L.) Moench). *International Journal of Current Microbiology and Applied Sciences* **7**(10): 2011-19.
11. SINGH B, CHAUBEY T, UPADHYAY DK, JHA A, PANDEY SD AND SANWAL SK. (2015). Varietal characterization of okra (*Abelmoschus esculentus*) based on morphological descriptions. *Indian Journal of Agricultural Sciences,* **85**(9): 1192-1200.
12. TEMAM N, WASSU M AND AKLILU S. (2021). Variability assessment of okra (*Abelmoschus esculentus* (L.) Moench) genotypes based on their qualitative traits. *International Journal of Agronomy* https://doi.org/10.1155/2021/6678561.