**Morphological Characterization of Niger Germplasm**

**Abstract**

The aim of the present study is to characterize 71 germplasm of niger (*Guizotia abyssinica* (L.f.) Cass.). The experiment was conducted in Randomized Complete Block Design with three replications at Project Coordinating Unit (Sesame and Niger) Research Farm, JNKVV, Jabalpur (M.P.) during kharif 2015. On the basis of niger descriptors, niger germplasm were characterized for thirteen morphological traits**.** A significant amount of variation was observed for most of the traits studied. The results revealed that maximum variation was recorded in flower petal color, number of petal per capitulum, leaf colour, leaf size, leaf shape, leaf angle of branching, plant branching pattern and seed coat colour. On the basis of frequency distribution, a majority of niger germplasm were found to possess yellow flower petal colour, medium number of petal per capitulum, purple stem pigmentation, sparse stem hairiness, green leaf colour, medium leaf size, medium leaf shape, serrate leaf serration of margin, horizontal leaf angle of branching, Slightly lobed margin of corolla, over all plant branching pattern, ovoid elongated seed shape and brown seed coat colour. Above study revealed the distinct characteristics of niger germplasm and indicated that morphological variations exist in these lines due to variation in genetic makeup and could be better utilized by breeders in the selection based on their specific requirement for breeding programme. This is highly useful study for varietal identification and conservation.

**Key words:** Morphological variation, Germplasms, Niger

**INTRODUCTION:**

Niger (*Guizotia abyssinica* (L.f.) Cass.) being an oilseed crop is mainly cultivated in Indian subcontinent and East African Countries (Getinet and Sharma, 1996) [5]. Niger is the only cultivated species of the genus *Guizotia* with a diploid plant chromosome number of 2n=2x=30 (Bisen *et al.,* 2016). Niger though a native to Tropical Africa, is wide spread and extensively cultivated in India since long and constitutes about 50% of Ethiopian and 3% Indian oilseed production. In India, it is primarily grown on the degraded soils in hilly and tribal pockets under input starved conditions over an area of about 3 lakh ha with larger area in Chhattisgarh, MP, Maharashtra and Odisha. It can be grown successfully without chemicals. In MP, it is grown in 0.43 lakh ha area with production of 0.16 lakh tonnes and productivity of 372 kg /ha (Anonymous, 2014) [1]. Niger seeds contain about 40% edible oil with fatty acid composition of 75-80% linoleic acid, 7-8% palmitic and steric acids, and 5-8% oleic acid (Dutta *et al.,* 1994) [4]*.* However, keeping quality of Niger is poor due to high content of unsaturated fatty acids. The oil is used for culinary purposes, manufacturing paints, soft soaps and for lighting and lubrication. Moreover, consuming Niger seed oil is beneficial from public health point of view because it contains minor quantities of substances such as tocopherols, phospholipids and sterols that provide protection against cardiovascular disorders and cancer (Ramadan and Morsel, 2002) [9]. Niger is a completely out crossing species with self-incompatibility mechanism. Characterization should eventually lead to a system of recording and storing useful data that can be readily retrieved and made available to others and help in planning breeding programmes (Debas *et al.,* 1994). ~~Among the several limiting factors for successful niger production.~~ Germplasm forms the raw material for any crop improvement programme. There is wide genetic diversity available in niger and characterizing these resources is a prerequisite for the genetic improvement of its cultivars. The characterization and evaluation are the important pre requisites for effective utilization of germplasm and also to identify sources of useful genes (Upadhayay *et al.,* 2010). In order to introduce a new plant variety to the markets commercially, it is necessary to register newly bred variety, which relies upon the results of DUS (distinctness, uniformity and stability) tests for a new genotype to be registered as a commercial variety, it needs to be distinct from all other released varieties, uniform and stable for morphological and other evaluated traits (Lombard *et al.,* 2000 and Tommasini *et al.,* 2003). Therefore, DUS test has been established to be the foundation of plant variety protection and also to identify a new variety from reference collection (Kwon *et al.,* 2005). There are several issues to be resolved with yield and yield attributing traits like seed yield and oil content. The current system of DUS testing has come across several significant shortcomings. The varieties to be assessed are increasing in number where their variability reduces, and the reference collections are expanding because of their internationalization, both of which result in the dramatic increase in expenses associated with these methods. Moreover, the existing methods are time consuming, which have altogether led to more necessity for developing a substitutionary, less costly system. Thus, the studies on the use of molecular markers in DUS testing proving the expected capability of molecular markers have encouraged International Union for the Protection of New Varieties of Plants (UPOV) to contemplate the introduction of molecular markers to the DUS testing system. Nevertheless, before this decision could be made, there are several issues to be resolved. Ideotype breeding aimed at modifying the plant architecture is also time-tested strategy to increase the yield potential. Therefore, the present study was undertaken to characterize the niger germplasm.

**MATERIALS AND METHODS:**

Seventy one germplasm of niger including check (IGPN-2004-1) were grown in a randomized complete block design replicated thrice at Project Coordinating Unit (Sesame and Niger) Research Farm, JNKVV, Jabalpur (M.P.) during *kharif* (2015-16). The distance between rows was maintained at 0.40 m and plant to plant 0.15 m. The soil of the experimental area is medium black with uniform topography and free from water logged conditions. The crop was raised under recommended package of practices along with prophylactic protection measures. The observations were recorded on flower petal color, number of petal per capitulum, stem pigmentation, stem hairiness, leaf colour, leaf size, leaf shape, leaf serration of margin, leaf angle of branching, margin of corolla, plant branching pattern, seed shape and seed coat colour.

Thirteen self assumed morphological descriptors have been considered essential for the description of seventy one germplasm of niger using guidelines for conducting test for distinctiveness, uniformity and stability in niger.

**Table 1:** **Experimental material**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S. No.** | **Germplasm** | **S. No.** | **Germplasm** | **S. No.** | **Germplasm** |
| 1 | 5-64 | 25 | IGP-76 | 49 | IGP-38 |
| 2 | 5-9 | 26 | NA-48 | 50 | RCR-64 |
| 3 | 5-1 | 27 | GA-23 | 51 | RCR-5-4 |
| 4 | 5-5 | 28 | DB-500 | 52 | IGP-50 |
| 5 | 5-4 | 29 | NO.36 | 53 | EC-158660 |
| 6 | 5-20 | 30 | IGP-37 | 54 | EC-158669 |
| 7 | 41-52 | 31 | M-3 | 55 | EC-158670 |
| 8 | 89-25 | 32 | IGP-234 | 56 | EC-158671 |
| 9 | 23-4 | 33 | PHULE-4 | 57 | EC-158672 |
| 10 | 89-20 | 34 | NO.1 | 58 | EC-158673 |
| 11 | 18-64 | 35 | COMP-II | 59 | NC-63586 |
| 12 | 5-70 | 36 | NO.14 | 60 | NC-62587 |
| 13 | 52-26 | 37 | COMB-2 | 61 | NC-63588 |
| 14 | 87-14 | 38 | CH-32 | 62 | NC-63591 |
| 15 | 41-50 | 39 | CH-4 | 63 | NC-63592 |
| 16 | 71-41 | 40 | KOMKEMP | 64 | NC-63595 |
| 17 | 87-32 | 41 | NR-76-14 | 65 | NC-63597 |
| 18 | 34-14 | 42 | MUTUNAY | 66 | N-20 |
| 19 | BHC-120 | 43 | BPB-1 | 67 | N-35 |
| 20 | GA-8 | 44 | GA-10 | 68 | CWA-1 |
| 21 | NO.5 | 45 | GOUDAGUDA | 69 | GA-5 |
| 22 | CH-53 | 46 | IGP-11 | 70 | NR-73-13 |
| 23 | CH-7 | 47 | GA-2 | 71 | IGPN-2004-1 (CHECK) |
| 24 | GHETA NO.1 | 48 | PHULE-2 |  |  |

**RESULTS AND DISCUSSIONS:**

Morphological traits of the niger germplasm were studied using self assumed descriptors. Result revealed that a significant amount of variation was recorded on almost all the characters recorded (Table-1). The petal colour of the flower is one of the important characters for characterization. Based on the variation in the flower petal colour, germplasm were categorized in three groups *viz.,* light yellow, yellow and dark yellow. Seven germplasm lines were having light yellow, fifty eight having yellow and six were having dark yellow flower petal colour. The genes determine the colour of the petal by developing or blocking of anthocyanin pigmentation. It is often preferred because it is considered to have a positive impact on the pollination of flowers

The genotypes varied among themselves for number of petal per capitulum. On the basis of number of petal per capitulum, germplasm were categorized into three groups *viz.,* few, medium and profuse. Fifty one germplasm lines were having medium number of petal per capitulum and twenty were having profuse number of petal per capitulum. Similar characterization pattern was adopted by Rani et al. (2010) by taking distinguished morphological traits in niger..

Based on stem pigmentation, germplasm were categorized in two groups *viz.,* green and purple. All the germplasm under study had purple stem pigmentation. None were found to be green.

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Based on stem pigmentation, germplasm were categorized in two groups *viz.,* green and purple. All the germplasm under study had purple stem pigmentation. None were found to be green.

Among the seventy one germplasm, **s**ixty two germplasm showed sparse stem hairness and nine germplasm had dense stem hairiness.

Based on leaf colour, germplasm were categorized in three groups *viz.* light green, green and dark green. Six germplasm had light green, fifty six had green and nine had dark green leaf colour. Similar results were reported by Rani et al. (2010). Leaf size varied significantly among the germplasm. Germplasm were categorized in three groups *viz.,* small, medium and large leaf size. Five germplasm had small leaf, fifty seven had medium leaf size and nine had large leaf size. Based on leaf shape, germplasm were categorized in three groups *viz.,* narrow, medium and broad shape. Four germplasm lines had narrow shape, sixty three medium and four were broad shaped. On the basis of leaf serration of margin, germplasm were categorized in three groups *viz.,* entire, serrate and others. Nine germplasm showed entire leaf serration of margin, whereas, sixty two lines showed serrate leaf serration of margin.

Based on leaf angle of branching, germplasm were categorized in three groups *viz.,* erect, horizontal and drooping. Five germplasm lines had erect branching, fifty eight showed horizontal branching and eight showed drooping type leaf angle of branching. On the basis of margin of corolla, germplasm were categorized in two groups *viz.,* slightly lobed and deeply lobed. Sixty nine germplasm showed slightly lobed margin of corolla, whereas, two lines showed deeply lobed margin of corolla. Based on plant branching pattern, germplasm were categorized into three groups *viz.,* basal, overall and apical. Eleven were having basal, fifty seven showed overall and three showed apical branching pattern.In previous studies, it was indicated that the inheritance of branching habit was determined by one single dominant gene, Sarita et al. (2013) [11]. However, the genetic basis of them has remained elusive.

Based on seed shape, germplasm were categorized in three groups *viz.,* elongated*,* ovoid elongated and ovoid wide. Overall germplasm lines had ovoid elongated seed shape. On the basis of seed coat colour, germplasm were categorized in three groups *viz.,* grey, brown and black. Ten germplasm lines had grey, four black and fifty seven had brown seed coat colour. All earlier researchers in sesame, outlined seed coat colour to be under digenic control with several confusing segregants beyond plausible explanation Baydar and Turgut (2000), Falusi (2007) [8, 9]. Recently, Zhang *et al.* [10], using a high-density linkage map analyzed the genetic segregation and quantitative trait loci (QTL) for sesame seed coat color and showed that two major genes with additive dominant- epistatic effects along with polygenes were responsible for controlling the seed coat color trait.

A majority of niger germplasm were found to possess yellow flower petal colour (81.69%), medium number of petal per capitulum (71.83%), purple stem pigmentation (100%), sparse stem hairiness (87.32%), green leaf colour (78.87%), medium leaf size (80.28%), medium leaf shape (88.73%), serrate leaf serration of margin (87.32%), horizontal leaf angle of branching (81.69%), Slightly lobed margin of corolla (97.18%), over all plant branching pattern (80.28%), ovoid elongated seed shape (100%), and brown seed coat colour (80.28%) (Table-1).

Above study revealed the distinct characteristics of niger germplasm and indicated that morphological variations exist in these germplasm lines due to variation in genetic makeup and could be better utilized by breeders in the selection based on their specific requirement for breeding programme as this is highly useful study for varietal identification and conservation.

**Table 1: Morphological characterization of germplasm for descriptor exhibition with frequency and percent score in Niger**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S. No.** | **Character** | **Classes** | **Number of entries/****frequency** | **Percentage of entry (%)** | **Germplasm** |
| 1 | Flower Petal Colour | Light yellow | 7 | 9.86 | M-3, 18-64, 89-25, EC-158671, EC-158660, NC-63586, GA-2 |
| Yellow | 58 | 81.69 | 5-64, 5-9, 5-1, 5-5, 5-4, 5-20, 41-52, 23-4, 89-20, 5-70, 52-26, 87-14, 41-50, 71-41, 87-32, BHC-120, GA-1, NO.5, CH-53, NA-48, GA23, DB-500, NO.36, IGP-37, IGP-234, PHULE-4, NO.1, COMP-II, NO.14, COMB-2, CH-32, CH-4, KOMKEMP, NR-76-14, MUTUNAY, BPB-1, GA-10, GOUDAGUDA, IGP-11, PHULE-2, IGP-38, RCR-64, RCR-5-4, IGP-50, EC-158670, EC-158673, NC-62587, NC-63588, NC-63591, NC-62592, NC-63595, NC-63597, N-20, N-35, CWA-1, GA-5, NR-73-13, IGPN-2004-1 |
| Dark yellow | 6 | 8.45 | CH-7, 34-14, GHETA No.1, IGP-76, EC- 158669, EC- 158672 |
| 2 | Number of petal per capitulam | Few | - | - | None |
| Medium | 51 | 71.83 | 5-64, 5-9, 5-1, 5-5, 5-4, 5-20, 23-4, 5-70, 52-26, 87-14, 87-32, BHC-120, GA-1, NO.5, NA-48, GA23, DB-500, NO.36, IGP-37, PHULE-4, COMP-II, NO.14, CH-32, CH-4, KOMKEMP, NR-76-14, GA-10, GOUDAGUDA, IGP-11, PHULE-2, IGP-38, RCR-64, RCR-5-4, IGP-50, EC-158673, NC-62592, NC-63595, N-20, N-35, NR-73-13, M-3, EC-158671, NC-63586, GA-2, CH-7, 34-14, GHETA No.1, IGP-76, EC- 158669, EC- 158672, IGPN-2004-1 |
| Profuse | 20 | 28.17 | 41-52, 89-25, 89-20, 18-64, 41-50, 71-41, CH-53, IGP-234, NO.1, COMB-2, MUTUNAY, BPB-1, EC-158660, EC-158670, NC-62587, NC-63588, NC-63591, NC-63597, CWA-1, GA-5 |
| 3 | Stem pigmentation | Purple | 71 | 100 | 5-64, 5-9, 5-1, 5-5, 5-4, 5-20, 23-4, 5-70, 52-26, 87-14, 87-32, BHC-120, GA-1, NO.5, NA-48, GA23, DB-500, NO.36, IGP-37, PHULE-4, COMP-II, NO.14, CH-32, CH-4, KOMKEMP, NR-76-14, GA-10, GOUDAGUDA, IGP-11, PHULE-2, IGP-38, RCR-64, RCR-5-4, IGP-50, EC-158673NC-62592, NC-63595, N-20, N-35, NR-73-13, M-3, EC-158671, NC-63586, GA-2, CH-7, 34-14, GHETA No.1, IGP-76, EC- 158669, EC- 158672, 41-52, 89-25, 89-20, 18-64, 41-50, 71-41, CH-53, IGP-234, NO.1, COMB-2, MUTUNAY, BPB-1, EC-158660, EC-158670, NC-62587, NC-63588, NC-63591, NC-63597, CWA-1, GA-5, IGPN-2004-1 |
| Green | - | - | None |
| 4 | Stem hairiness | Sparse | 62 | 87.32 | 5-64, 5-9, 5-1, 5-5, 5-4, 5-20, 23-4, 5-70, 52-26, 87-14, 87-32, BHC-120, GA-1, NO.5, NA-48, DB-500, NO.36, IGP-37, COMP-II, NO.14, CH-32, CH-4, KOMKEMP, GOUDAGUDA, IGP-11, PHULE-2, IGP-38, RCR-64, RCR-5-4, EC-158673, NC-62592, NC-63595, N-20, N-35, NR-73-13, EC-158671, NC-63586, GA-2, CH-7, 34-14, GHETA No.1, IGP-76, EC- 158669, 41-52, 89-25, 89-20, 18-64, 71-41, CH-53, IGP-234, NO.1, COMB-2, MUTUNAY, BPB-1, EC-158660, EC-158670, NC-62587, NC-63588, NC-63591, NC-63597, CWA-1, IGPN-2004-1 |
|  | Dense | 9 | 12.68 | 41-50, GA23, M-3, PHULE-4, NR-76-14, GA-10, IGP-50, EC- 158672, GA-5 |
| 5 | Leaf colour | Light green | 6 | 8.45 | 5-64, 41-50, CH-7, NA-48, NO.1, N-20 |
| Green | 56 | 78.87 | 5-9, 5-1, 5-5, 5-4, 5-20, 23-4, 5-70, 52-26, 87-14, 87-32, BHC-120, GA23, DB-500, NO.36, IGP-37, PHULE-4, COMP-II, NO.14, CH-32, CH-4, , GA-10, IGP-11, PHULE-2, IGP-38, RCR-64, RCR-5-4, EC-158673, NC-62592, NC-63595, N-35, NR-73-13, M-3, EC-158671, NC-63586, GA-2, 34-14, GHETA No.1, IGP-76, EC- 158669, EC- 158672, 41-52, 89-25, 89-20, 18-64, 71-41, CH-53, IGP-234, BPB-1, EC-158660, EC-158670, NC-62587, NC-63591, NC-63597, CWA-1, GA-5, IGPN-2004-1 |
| Dark green | 9 | 12.68 | GA-1, NO.5, COMB-2, KOMKEMP, NR-76-14, MUTUNAY, GOUDAGUDA, IGP-50, NC-63588 |
| 6 | Leaf shape | Narrow | 4 | 5.63 | 23-4, GHETA No.1, NA-48, CWA-1 |
| Medium | 63 | 88.73 | 5-64, 5-9, 5-1, 5-5, 5-4, 5-20, 5-70, 87-14, 87-32, BHC-120, GA-1, NO.5, GA23, DB-500, NO.36, IGP-37, PHULE-4, COMP-II, NO.14, CH-32, CH-4, KOMKEMP, NR-76-14, GA-10, PHULE-2, IGP-38, RCR-64, RCR-5-4, IGP-50, EC-158673, NC-62592, NC-63595, N-20, N-35, NR-73-13, M-3, NC-63586, GA-2, CH-7, 34-14, IGP-76, EC- 158669, EC- 158672, 41-52, 89-25, 89-20, 18-64, 41-50, 71-41, CH-53, IGP-234, NO.1, COMB-2, MUTUNAY, BPB-1, EC-158660, EC-158670, NC-62587, NC-63588, NC-63591, NC-63597, GA-5, IGPN-2004-1. |
| Broad | 4 | 5.63 | 52-26, GOUDAGUDA, IGP-11, EC-158671 |
| 7 | Leaf size | Small | 5 | 7.04 | 5-5, 52-26, GA-1, NR-76-14, EC-158673 |
| Medium | 57 | 80.28 | 5-64, 5-9, 5-1, 5-4, 5-20, 5-70, 87-14, 87-32, BHC-120, NO.5, NA-48, GA23, DB-500, NO.36, COMP-II, NO.14, CH-32, CH-4, KOMKEMP, IGP-11, PHULE-2, IGP-38, RCR-64, RCR-5-4, IGP-50, NC-62592, NC-63595, N-20, NR-73-13, M-3, EC-158671, NC-63586, GA-2, CH-7, 34-14, GHETA No.1, IGP-76, EC- 158669, EC- 158672, 41-52, 89-25, 89-20, 18-64, 41-50, 71-41, CH-53, IGP-234, NO.1, COMB-2, MUTUNAY, EC-158660, NC-62587, NC-63588, NC-63597, CWA-1, GA-5, IGPN-2004-1 |
| Large | 9 | 12.68 | 23-4, IGP-37, PHULE-4, BPB-1, GA-10, GOUDAGUDA, EC-158670, NC-63591, N-35 |
| 8 | Leaf serration of margin | entire | 9 | 12.68 | 89-20, IGP-38, NC-63591, 5-5, 5-20, DB-500, NO.1, NO.14, RCR-5-4 |
| serrate | 62 | 87.32 | 5-64, 5-9, 5-1, 5-4, 23-4, 5-70, 52-26, 87-14, 87-32, BHC-120, GA-1, NO.5, NA-48, GA23, NO.36, IGP-37, PHULE-4, COMP-II, CH-32, CH-4, KOMKEMP, NR-76-14, GA-10, GOUDAGUDA, IGP-11, PHULE-2, RCR-64, IGP-50, EC-158673, NC-62592, NC-63595, N-20, N-35, NR-73-13, M-3, EC-158671, NC-63586, GA-2, CH-7, 34-14, GHETA No.1, IGP-76, EC- 158669, EC- 158672, 41-52, 89-25, 18-64, 41-50, 71-41, CH-53, IGP-234, COMB-2, MUTUNAY, BPB-1, EC-158660, EC-158670, NC-62587, NC-63588, NC-63597, CWA-1, GA-5, IGPN-2004-1 |
| others | - | - | None |
| 9 | Leaf angle of branching | Erect | 5 | 7.04 | 23-4, GA-23, EC-158671, NC-63595, GA-5 |
| Horizontal | 58 | 81.69 | 5-64, 5-9, 5-1, 5-5, 5-4, 5-20, 5-70, 52-26, 87-32, BHC-120, GA-1, NO.5, NA-48, DB-500, NO.36, IGP-37, COMP-II, NO.14, CH-32, KOMKEMP, NR-76-14, GA-10, GOUDAGUDA, PHULE-2, IGP-38, RCR-64, RCR-5-4, IGP-50, EC-158673, NC-62592, N-20, N-35, NR-73-13, NC-63586, GA-2, CH-7, 34-14, GHETA No.1, IGP-76, EC- 158669, EC- 158672, 41-52, 89-25, 89-20, 18-64, 41-50, 71-41, CH-53, IGP-234, COMB-2, EC-158660, EC-158670, NC-62587, NC-63588, NC-63591, NC-63597, CWA-1, IGPN-2004-1 |
| Drooping | 8 | 11.27 | 87-14, PHULE-4, M-3, NO.1, CH-4, MUTUNAY, BPB-1, IGP-11 |
| 10 | Margin of corolla | Slightly lobed | 69 | 97.18 | 5-64, 5-9, 5-1, 5-5, 5-4, 5-20, 23-4, 5-70, 52-26, 87-14, 87-32, BHC-120, GA-1, NO.5, NA-48, GA23, DB-500, NO.36, IGP-37, COMP-II, NO.14, CH-32, CH-4, KOMKEMP, NR-76-14, GA-10, GOUDAGUDA, IGP-11, PHULE-2, IGP-38, RCR-64, RCR-5-4, IGP-50, EC-158673, NC-62592, NC-63595, N-20, N-35, NR-73-13, M-3, EC-158671, NC-63586, GA-2, CH-7, 34-14, GHETA No.1, IGP-76, EC- 158669, EC- 158672, 41-52, 89-25, 89-20, 18-64, 41-50, 71-41, IGP-234, NO.1, COMB-2, MUTUNAY, BPB-1, EC-158660, EC-158670, NC-62587, NC-63588, NC-63591, NC-63597, CWA-1, GA-5, IGPN-2004-1 |
| Deeply lobed | 2 | 2.82 | PHULE-4, CH-53 |
| 11 | Plant branching pattern | Basal | 11 | 15.49 | 5-9, 23-4, 89-20, 87-14, 41-50, COMP-II, KOMKEMP, EC-158671, NC-63591, NC-63597, N-20 |
| Overall | 57 | 80.28 | 5-64, 5-1, 5-5, 5-4, 5-20, 5-70, 52-26, 87-32, BHC-120, GA-1, NO.5, NA-48, GA23, DB-500, NO.36, NO.14, CH-32, CH-4, NR-76-14, GA-10, GOUDAGUDA, IGP-11, PHULE-2, IGP-38, RCR-64, RCR-5-4, EC-158673, NC-62592, NC-63595, N-35, NR-73-13, M-3, NC-63586, GA-2, CH-7, 34-14, GHETA No.1, IGP-76, EC- 158669, EC- 158672, 41-52, 89-25, 18-64, 71-41, CH-53, IGP-234, NO.1, COMB-2, MUTUNAY, BPB-1, EC-158660, EC-158670, NC-62587, NC-63588, CWA-1, GA-5, IGPN-2004-1 |
| Apical | 3 | 4.23 | PHULE-4, IGP-37, IGP-50 |
| 12 | Seed shape | Elongated | - | - | None |
| Ovoid elongated | 71 | 100 | 5-64, 5-9, 5-1, 5-5, 5-4, 5-20, 23-4, 5-70, 52-26, 87-14, 87-32, BHC-120, GA-1, NO.5, NA-48, GA23, DB-500, NO.36, IGP-37, PHULE-4, COMP-II, NO.14, CH-32, CH-4, KOMKEMP, NR-76-14, GA-10, GOUDAGUDA, IGP-11, PHULE-2, IGP-38, RCR-64, RCR-5-4, IGP-50, EC-158673, NC-62592, NC-63595, N-20, N-35, NR-73-13, M-3, EC-158671, NC-63586, GA-2, CH-7, 34-14, GHETA No.1, IGP-76, EC- 158669, EC- 158672, 41-52, 89-25, 89-20, 18-64, 41-50, 71-41, CH-53, IGP-234, NO.1, COMB-2, MUTUNAY, BPB-1, EC-158660, EC-158670, NC-62587, NC-63588, NC-63591, NC-63597, CWA-1, GA-5, IGPN-2004-1 |
| Ovoid wide | - | - | None |
| 13 | Seed coat colour | Grey | 10 | 14.08 | 5-1, 18-64, 87-32, CH-7, IGP-234, NR-76-14, IGP-11, IGP-50, NC-62587, N-35 |
| Brown | 57 | 80.28 | 5-64, 5-9, 5-5, 5-4, 5-20, 23-4, 5-70, 52-26, 87-14, BHC-120, GA-1, NO.5, GA23, DB-500, NO.36, IGP-37, PHULE-4, COMP-II, NO.14, CH-4, KOMKEMP, GA-10, GOUDAGUDA, PHULE-2, IGP-38, RCR-64, RCR-5-4, EC-158673, NC-62592, NC-63595, N-20, NR-73-13, M-3, EC-158671, NC-63586, GA-2, GHETA No.1, IGP-76, EC- 158669, EC- 158672, 41-52, 89-25, 89-20, 41-50, 71-41, CH-53, NO.1, COMB-2, MUTUNAY, BPB-1, EC-158660, NC-63588, NC-63591, NC-63597, CWA-1, GA-5, IGPN-2004-1 |
| Black | 4 | 5.63 | 34-14, NA-48, CH-32, EC-158670 |

**Fig.1 Frequency distribution of different morphological traits in Niger germplasm**

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The research work is a M.Sc (Ag) thesis work and both the author and co-author have contributed equally to the analytical methods used for the research concept and the experiment design.

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