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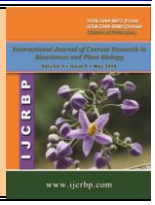

Original Research Article

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Comparative Gross Morphology of Some Species of *Sesamum* L.

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Abstract

Studies were carried out to compare the gross morphology – vegetative and floral of four species of the genus *Sesamum* L. occurring in Nigeria, West Tropical Africa with a view to provide information on their taxonomy, systematics, agronomic and identification traits at the early stage of their growth in the field as this has been problematic. Observations were made on fresh and herbarium specimens and records of relevant quantitative and qualitative traits taken. Appropriate statistical tools were applied to analyse quantitative traits. The results indicated variations strong enough to separate the taxa even at specific level. Similarities also exist that suggest they are still remaining together in a genus. Lower/early leaves separate them at species level. *S. indicum*–cordate, *S. angustifolium*–lanceolate, *S. radiatum*–ovate and *S. alatum*-oblong and identification at early stage of growth without flowers is possible. This information is available for the first time. The beak shape of capsules separates the taxa at specific levels. *S. angustifolium*–narrow oblong, *S. indicum*–broad oblong, *S. Radiatum*—square; whereas *S. alatum* has tapered apex. The seeds also aid in identifying *Sesamum* species: *S. angustifolium*–radially rough, *S. indicum*–smooth, *S. radiatum*–reticulately rough whereas *S. alatum* partially rough and winged. Dimensions of internode length, seed sizes and number of seeds per capsule, capsule length, beak length, and leaf dimensions separate the taxa at species level. Similarities which also suggest togetherness in same genus were identified and several documented for the first time.

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Keywords

Gross morphology
Plant systematics
Sesamum species

Introduction

Sesamum L. is a neglected genus (IPGRI, 2004) of the subfamily Asterideae, Family- Pedaliaceae, Order-Scrophulariales (Khidir , 1978). There is controversy on number of species in the genus (19-20 species) (Bedigian, 1984; Aguoru et al., 2014) with controversial taxonomy (Busari et al., 2005). All species in genus are believed to be of African origin (Nayar, 1995) but spread through western Asia to India where secondary centres of diversity exist (Khidir, 1978; Bedigian, 1984; Busari et al., 2005; Bedigian, 1988; 2003a; 2003b; 2004; Bedigian, 1985; Bedigian et al., 1985; Bedigian et al., 1986). *Sesamum* was taken to new world along slave routes and established both in Brazil and southern Carolina USA (Khidir, 1978; Bedigian, 2006; Bedigian et al., 1986). The genus is represented in Nigeria by 4 species (Hutchinson and Dalziel 1958; Aguoru et al., 2014). Medicinally and nutritionally the leaves, seeds and seed coats of the species are very rich in essential oils; amino acids; calcium etc (Brar and Ahuja, 1979; Kamal-Eldin, 1993; Johnson et al., 1979). Nigeria is ranked the 6th worlds' largest producer, 75,000MT annually of *S. indicum* a species in the genus coming from small family farm holders (FAO, 2004). Early identification of species in the field is difficult (Aguoru et al., 2014).

Aguoru et al. (2014) also worked on the phyto-geography of the various species in Nigeria establishing their locations. All taxonomic/systematic controversies are resolved using several lines of evidence, gross morphology being the most important (Radford, 1986; Aguoru and Okoli, 2012). This work was therefore set to use all the morphological evidences, vegetative and floral to separate the species of *Sesamum* L. found in Nigeria and also to make the identification of species easy at the early stage of growth which hitherto was not possible.

Materials and methods

This was done after Radford (1986), IPGRI and NBPGR (2004) and Aguoru and Okoli (2008). Observations on vegetative and floral characteristics of the *Sesamum* L. species were made on mature plants growing in the field or on identified and preserved materials deposited in the various herbaria consulted (FHI, UPH, UAM, BUK, UI, IFE). Living plants growing in the wild, farms, roadside, abandoned farm lands near residential buildings, in garden at Bayero University Biological Sciences Kano and various other places visited were examined. Photographs and drawings of relevant morphological features were taken or made. The floral diagram and formulae of the taxa were constructed. Measurements of the various morphological features were made. Various statistical tools relevant were used for the analysis of quantitative characters. A statistical kit SPSS was used. SHARP advanced D.A.L calculator was also used. Table 1 displays list of materials examined with locations of collection, collectors/herbarium number and date of collection for each species of *Sesamum*.

Table 1. Sources of *Sesamum* L. species examined.

Sl. No.	Taxa	Collector/Accessory or Herbarium Number	Date collected	Locality
1	*S. angustifolium* (Oliv) Engl.	Ugbogu, Odewo and Lawrence / FHI 106386	22-6-2001	Sapoba forest, Benin – Edo State
		J.A. Emwiogbon / FHI 66581	2-6-73	Ngwo – Udi near Enugu, Enugu State
		J.A. Emwiogbon and J.C. Okafor / FHI 69334	26-1-74	Near Oguta lake present Oguta L.G.A, Imo State
		A.P.O. Jones / FHI 6571	20-05-42	Udi – near Enugu
		A.P.D Jones / FHI 467	12-2-43	Kabba – present Kogi state
		C.Geerling / FHI 43435	21-11-70	Yankari game reserve Bauchi state
		P. Wit, Z.O.Gbile, B.O. Daramola / FHI: 47383	24-4-72	Baga lake Chad
		B.O.Daramola / FHI: 78552	21-9-75	Akpabuyo Cross Rivers State
		J.A. Emwiogbon / FHI: 66611	12-7-73	Ngwo-udi near Enugu
		Ologumfemi and Fagbemi/FHI: 70723	6-3-73	Sosan village, Ondo
		Lady HoskynsAberahall / FHI: 27578	March 1950	Nike-Enugu
		R.G. Lowe /FHI: 50241	7-2-60	Ekulu River, Enugu
		G.F.A Onochie and Awua/FHI: 35810	21-5-56	Near River Uyaba, Enugu
		Edwin Ujor / FHI: 23907	16-7-48	Damaturu, Yobe State
		Fagbemi / FHI: 90065	6-2-79	Manibula Plateau
		Olorenfemi and Oguntayo/FHI: 84597	1977	Owo-Ondo
		Okeke, Ekwuno and Macaulay / FHI: 72608	06-08-74	Oguta lake, Imo State
		James, Adejimi / FHI: 78818	27-05-76	Lagun village, Iwo
		Boston C. / FHI: 53929	October 1962	Kabba present Kogi State
		J.A. Emwiogbon / FHI: 58864	23-11-66	Botanic Garden,Enugu
		Ekuno et al. / FHI: 92167	22-01-80	Eme River Enugu
		B.O. Daramola and A. Binuyo / FHI: 61931	01-03-68	Bida - Niger State
		D.P. Stanfield /FHI: 40029	14-10-57	Idogun – Owo
		Aguoru 0001	08-12-2006	Near Mechanic village North Bank Makurdi
		Aguoru 0002	09-12-2006	Ancha village near Daudu, Guma Local Govt., Benue State
		Aguoru 0003	08-12-2006	Opposite New Trailer Park. Federal Low Cost housing estate Lafia road, North Bank, Makurdi. Growing together with *S. indicum* in a farm
		Aguoru 0004	10-09-2006	Beside Ugwuanyi residence. Fed. low cost housing estate North Bank, Makurdi. Cultivated farm land.
		Aguoru 0005	11-09-06	Behind Amaje-Chris filling station North Bank, Makurdi. Cultivated farm land.

Sl. No.	Taxa	Collector/Accessory or Herbarium Number	Date collected	Locality
		Aguoru 0006	08-12-06	Behind Tiley Gyado Sec. Makurdi. Abandoned farm land.
		Aguoru 0007	08-08-06	Near Gulf course Lafia. Roadside.
		Aguoru 0008	18-12-06	Ankpa Quarters Road cemetery
		Aguoru 0009	29-12-06	Apir Mechanic village Makurdi
		Aguoru 0010	11-10-2007	Roadside along Ayangba road AnkpaKogi State
		Aguoru 0011	12-10-2007	Kogi state University premises Ayangba, Kogi State.
		Aguoru 0012	12-10-2007	Ugboju near Oturkpo. Roadside.
		Aguoru 0013	10-07-07	Near Upa's compound Udei village Guma LGA Benue State.
		Aguoru 0048	20-07-08	Gbajimba Rd near University of Agriculture. Experimental Farm
		Aguoru 0049	31-08-08	Federal low cost housing estate Lafia road, Makurdi.
2	*S. indicum* L.	H.D. Onyeachusim and M.G. Latilo / FHI: 54065	21-2-1964	Osomba village, Oban
		A.P.D. Jones /FHI: 6623	09-06-1942	Awka
		J.O. Ariwoado / FHI: 89201	08-07-1978	Utugwangi, Obudu
		Batten – Poole / FHI: 13242	24-07-1948	Bauchi
		Olorunfemi et al. / FHI: 93371	02-09-1980	Aiyede, Ekiti
		M.O. Ayaji / FHI: 26955	29-06-1950	Oni – Gambari
		S.O. Magaji /FHI: 27261	25-01-1968	Okene – Oguda Rd.
		Odewo and Binuyo /FHI: 96216	11-08-1981	Mokwa
		Eimunjeze et al. / FHI: 66504	20-05-1973	Keffi
		J.O. Chapman / FHI: 46246	28-06-1972	Mambilla, Plateau
		Daramola B.O. and M. Okoro / FHI: 99037	02-11-1982	Abuja
		B.O. Daramola /FHI: 84513	23-08-1977	Gembu – Janro – Umaru Camp.
		B.O. Daramola /FHI: 105098	30-07-1993	Bauchi
		Odewo et al. / FHI: 88121	25-10-1978	Badagry
		Eimunjeze and Oguntayo / FHI: 70206	16-05-1974	Iguoriakhi Benin Edo
		Magbogbeola et al. / FHI: 94926	23-07-1981	Majidu – Ikorodu
		H.D. Onyeachusim / FHI: 53737	15-08-1962	Ebute – Ikorodu
		Oyayomi and Osanynlusi / FHI: 82990	13-06-1977	Ohunbe Forest Reserve, Ogun
		Ekwuno et al. / FHI: 90947	18-09-1979	Isienu, Nsukka
		Ekwuno et al. / FHI: 88882	20-08-1978	Awi Forest Reserve, Calabar
		Oguntayo and Adejinmi / FHI: 83286	13-06-1977	Ohunbe Forest Reserve, Ogun
		T.K. Odewo / FHI: 87947	28-08-1977	Gembu, Mambilla Plateau
		T.K. Odewo / FHI: 87861	28-08-1977	Njawai, Gembu, Mambilla Plateau
		Zac O. Gbile / FHI: 80930	17-06-1977	Ejigbo – Oyo
		Magbagbeola et al. / FHI: 94659	23-04-1981	Orile-Ibara, Abeokuta
		Magbagheola et al. / FHI: 94927	22-06-1981	Badagry – Lagos
		Magbagheola et al. / FHI: 94745	26-06-1980	Ijebu, Ajebandele Forest Reserve
		Jones / FHI: 7178	30-12-1943	Oyo Ibadan
		J.C. Okafor and Omiyale / FHI: 62248	08-07-1966	Abakaliki
		C.F.A. Onochie /FHI: 40229	23-06-1958	Gulu Village Badeggi – Lapai Road
		M.C. Ejiofor / FHI: 19849	21-06-1960	U.I. Premises Ibadan
		Odewo and Adedeji / FHI: 96917	14-12-1981	Gombe – Yola Road
		Daramola and Ihe/ FHI: 86372	15-05-1978	Ipe- Ikun Road; Ikare
		Ariwoado /FHI: 89201	08-07-1978	Utugwang, Obudu
		Aguoru 0015	26-12-06	Railway Bypass opposite NYSC State Secretariat, Makurdi
		Aguoru 0016	26-12-06	Near General Hospital NASME N/Bank, Makurdi
		Aguoru 0017	29-12-6	Beside ECWA Secondary school North Bank, Makurdi
		Aguoru 0018	29-12-06	Opposite O.O. Obu North Bank, Makurdi
		Aguoru 0019	29-12-06	Ancha Village near Daudu Benue State
		Aguoru 0020	03-02-07	Former Agan Toll Gate Makurdi
		Aguoru 0021	03-02-07	Beside 'C' Division Police Makurdi
		Aguoru 0022	07-07-07	Besides BENKOS Hotel Uniagric Road, Makurdi
		Aguoru 0023	07-07-07	Beside TerGuma'scpd Makurdi

Sl. No.	Taxa	Collector/Accessory or Herbarium Number	Date collected	Locality
		Aguoru 0024	07-07-07	In front of celestial Church besides Tonimas filling station, Makurdi
		Aguoru 0025	12-10-07	Minna, near FUT. Niger State
		Aguoru 0026	12-10-07	Near Golf course, Lafia
		Aguoru 0027	01-11-07	Oturkpa near Branch Ogbadibo LGA, Benue State
		Aguoru 0028	06-06-08	Ayagba Rd Ankpa
		Aguoru 0029	10-07-08	Near College of Agric. Yandev, Gboko
		Aguoru 0030	15-08-08	Along Keffi Road Akwanga
		Aguoru 0050	31-08-08	Federal Low Cost Housing along Lafia road, Makurdi
		Aguoru 0051	31-08-08	Ene Aisha's compound near Day Spring Hotel, Old Lafia Rd., Makurdi
3	*S. radiatum* Schum.& Thonn.	Ekwuno and Fagbemi /FHI: 94077	01-01-1980	Wumiri forest Reserve Borno
		M.C. Ejiofor / FHI: 29334	08-04-1951	Victoria – Cameroon
		Ekwuno and Fagbemi / FHI: 93967	29-09-1990	Kauwa Forest Reserve, Borno
		P. and J. Wit / FHI: 64909	31-01-1972	Jos road, Kaduna
		J.O. Ariwaodo / FHI: 49295	10-12-1976	Ugep, Obubara Cross Rivers
		P. wit et al. / FHI: 46192	19-11-1971	Sapoba FR Benin
		J. Olorunfemi / FHI: 30534	20-04-1951	Kumba Cameroon
		Ariwaodo and Adesina / FHI: 97294	12-09-1981	Warri – Niger Delta
		J.C. Okafor and M.G.Latilo/FHI: 57799	23-01-1966	Itu, Uyo
		J.A. D Jackson / FHI: 59673	28-01-1963	Kaduna
		Odewo and Binuyo / FHI: 96220	07-08-1981	Mokwa
		Fagbemi / FHI: 89962	23-08-1977	Gembu
		Okeke, Ekwuno and Macaulay/ FHI: 71295	03-08-1974	Sapoba, Benin
		Ekwuno et al. / FHI: 96300	09-02-1981	Oguta
		Ariwaodo and Adesina / FHI: 97296	18-09-1981	Warri
		R.O. Meikle / FHI: 50659	17-03-1950	Jebba, Kwara State
		B.O. Daramola / FHI: 38048	26-06-1950	Ankpa, Kogi State
		J.C. Okafor / FHI: 35870	23-10-1956	Ukpor – Nnewi Anambara State
		J.B. Gillett / FHI: 14403	15-08-1962	Ebute – Ikorodu, Lagos
		G.F.A Onochie / FHI: 15549	28-04-1953	Ijebu
		J.D. Kennedy / FHI: 10746	10-10-1931	Locality not indicated
		D.P. Stanfield / FHI: 39990	12-10-1957	Owo
		A.P.D. Jones / FHI: 730	04-03-1942	Sapoba, Benin
		J.D. Kennedy / FHI: 10747	May 1928	Sapoba, Benin
		Magbagbeola et al. / FHI: 94686	23-05-1981	Ijebu – Igbo
		Latilo et al. / FHI: 71788	16-10-1974	Calabar, Township
		Aguoru 0031	04-10-05	Beside General Hospital North Bank, Makurdi
		Aguoru 0032	10-10-05	Upaa's House Behind V.I.O North Bank Makurdi.
		Aguoru 0033	21-12-05	Beside former Day Spring Hotel, Old Lafia Rd., Makurdi.
		Aguoru 0034	29-12-05	Beside Obosi's compound behind VIO testing ground N/Bank Makurdi.
		Aguoru 0035	02-02-06	Beside Seed Faith Church Near N/Bank Mechanic Village Makurdi
		Aguoru 0036	07-07-06	Beside former midway inn Hotel New Bridge Road, Makurdi.
		Aguoru 0037	07-07-06	Ancha village near DauduGuma LGA Benue State.
		Aguoru 0038	07-07-06	Beside Senator Waku's office, Makurdi.
		Aguoru 0039	08-07-06	Beside NYSC State Secretariat
		Aguoru 0040	10-08-06	Eke village, along Enugu-Mkd Rd. Near Oturkpo
		Aguoru 0041	10-09-06	Ayargu, along LafiaMkd Road Nassarawa
		Aguoru 0042	10-09-06	Near TOMINAS Filling station LafiaNassarawa
		Aguoru 0043	10-09-06	College of Education compound Akwanga
		Aguoru 0044	26-06-07	Permanent site University of Abuja Niger
		Aguoru 0045	09-06-08	Abuja – Kaduna Road Suleja Niger State
		Aguoru 0046	10-07-08	Near Catholic Church Ichuwa, Benue State
		Aguoru 0047	19-06-08	Samaru campus, ABU Zaria

Sl. No.	Taxa	Collector/Accessory or Herbarium Number	Date collected	Locality
		Aguoru 0052	31-08-08	Near Naka Road cemetery Makurdi
		Aguoru 0053	31-08-08	Near Industrial Layout Naka Road Benue State
		Aguoru 0054	01-09-08	Near Federal Low Cost Housing Naka Road Benue State
4	*S. alatum* Thonn.	P.Wit and B.O. Daramola / FHI: 80345	09-07-1973	Yola, Adamawa State
		M.G. Latilo / FHI: 62627	28-07-1969	Ilorin, Kwara State
		D.P. Stanfield / FHI: 56577	13-02-1965	
		Soladonye, Ekwuno and Ihe / FHI: 83968	29-10-1977	Maiduguri, Borno State
		B.O. Daramola / FHI: 61367	29-05-1968	Kano, Kano State
		J.K. Jackson / FHI: 15830	20-06-1966	Kano, Kano State
		Onyeachusim Odewo and Olorunfemi / FHI: 101452	17-09-84	Not indicated

Results and discussion

Gross morphological evidences have been exploited in the delimitation of taxa at various levels and times (Aguoru and Okoli, 2008; Bedigian, 2006; Aguoru, 2009). The gross morphological features of the *Sesamum* species displayed enormous variations that could be applied in strengthening their delimitation at the specific levels and provide agronomic information and early identification in the field. Table 1 displays the sources of the *Sesamum* species examined indicating location and dates of collection, collectors and accession numbers with the various herbaria visited. Table 2 lays out the gross morphological features; vegetative and floral of the *Sesamum* species occurring in Nigeria. These were obtained from both fresh and herbarium materials. Figs.1a and 1b show floral diagram and formulae of the species in this work respectively. Florally they are zygomorphic and hermaphroditic, ovary is superior. Figs. 2a – 2d show gross morphological features of *Sesamum* species studied.

Fig. 3 depicts the nature of the lower leaves of the *Sesamum* species. Fig. 4 shows variations in the nature of beaks of capsules of the various *Sesamum* species investigated which separates the species and affirms treatment as separate species whereas Fig. 5 shows the shape of seeds and surface architecture of seeds obtained from the various *Sesamum* species. All the species are annuals with *S. angustifolium* sometimes surviving to a second year with the aid of underground stumps. Their stems have 4 angles and 4 furrows and affirm inclusion in same genus. Leaves of S. *angustifolium* are cup shaped, S. *indicum* parted, S. *radiatum* trifoliate and S. *alatum* islanceolate, these agrees their separation and treatment as separate species. All have simple leaves in general. General dimensions of leaves, petiole, stem, internode as shown by their means on Table 2 separate the species. Presence and exstipulate nature of glands indicate taxonomic relatedness. Shape of lower leaves separate the species taxonomically, S. *indicum* is concave, S. *angustifolium* is subovate, S. *alatum* is lanceolate whereas *S. radiatum* is ovate.

Table 2. Summary of morphological, macro-morphometric and Micro-morphometric characters of the *Sesamum* species studied.

Sl. No.	Characters	*S. angustifolium*	*S. indicum*	*S. radiatum*	*S. alatum*
1	**Duration/habit**	Annual, All times, biennial surviving by underground stumps; herbaceous, erect. Height 1-6M	Annual, herbaceous erect. Height 1.5-4M	Annual, herbaceous erect. Height 1.5-7M	Annual, herbaceous erect. Height 3-6M
1b	**Habitat**	Weed of abandoned farm land	Cultivated in farms	Weed of abandon farm land. All times cultivated.	Weed of savannah. All times cultivated.
2	**Stem**	Angular - 4 angles, and 4 – furrows. Square	Angular, 4 angles and 4 furrow	Angular 4 angels and 4 furrows	Angular 4 angels and 4 furrows
3	**Leaf type**	Simple, sessile or sub-sessile. Cup shaped	Simple, Parted	Simple	Simple, lanceolate
4	**Leaf surface**	Pubescent	Pubescent	Pubescent	Pubescent
5	**Lower/early leaf character**	Lanceolate to sub-sessile	Parted into three, cup shaped, concave	Ovate. Reverse cup shaped, convex	Lanceolate with long petiole

Sl. No.	Characters	*S. angustifolium*	*S. indicum*	*S. radiatum*	*S. alatum*
6	**General dimension leaf**				
	i. Length				
	Range	7.96 – 8.86	9.15 – 11.30	5.45 – 6.09	7.46 – 8.39
	Mean	8.41±0.45	10.21±1.06	5.77±0.32	7.30±0.16
	ii. Width				
	Range	1.46 – 1.63	3.40 – 4.25	2.22 – 2.77	0.93 – 1.10
	Mean	1.55±0.09	3.83±0.43	2.50±0.28	1.02±0.09
7	**Leaf shape**	Lanceolate	Narrowly cordate	Ovate	Lanceolate
8	**Petiole**				
	Range	0.29-0.66	4.81-6.85	1.33-1.54	7.15-7.29
	Mean	0.48±0.19	5.83±1.02	1.43±0.10	7.22±0.07
9	**Internode**				
	Range	5.17-6.12	8.40-10.53	2.88-4.51	4.33-4.97
	Mean	5.65±0.48	9.47±1.07	3.70±0.82	4.65±0.32
10	**Presence of gland and gland colour**	Present, sessile, pinkish and axillary	Present, sessile, pinkish and axillary	Present, sessile, pinkish and axillary	Present, sessile, pinkish and axillary
11	**Phyllotaxy of Lower leaves**	Alternate short internode	Opposite	Alternate with short internode	Alternate
11a	**Phyllotaxy of Upper leaves**	Alternate with long internode	Alternate with short internode	Alternate with very short internode	Opposite with short internode
12	**Stipule**	Exstipulate	Exstipulate	Exstipulate	Exstipulate
13	**Inflorescence**	Solitary	Solitary	Solitary	*
14	**Flower**	Bisexual, hypogynous, zygomorphic and complete	Bisexual, complete, zygomorphic and hypogynous	Bisexual, zygomorphic, complete and hypogynous	*
15	**Aestivation**	Valvate	Valvate	Valvate	*
16	**Pedicel**				
	Range	0.27-0.30	0.37-0.44	0.62-0.67	*
	Mean	0.29±0.02	0.41±0.04	0.65±0.03	*
17	**Calyx (sepal)**				
	i. Length				
	Range	0.41-0.49	0.49-0.61	.035-0.43	*
	Mean	0.45±0.04	0.55±0.06	0.39±0.04	*
	ii. Breadth				
	Range	0.10-0.14	0.13-0.17	0.11-0.16	*
	Mean	0.12±0.02	0.15±0.02	0.14±0.03	*
18	**Corolla (petal)**				
	i. Length				
	Range	2.55-3.12	1.98-2.35	2.92-3.30	*
	Mean	2.84±0.29	2.17±0.19	3.11±0.19	*
	ii. Breadth				
	Range	2.55-3.12	1.98-2.35	2.92-3.30	*
	Mean	2.84±0.29	2.17±0.19	3.11±0.19	*
19	**Filament length**				
	Range	1.51-1.61	0.92-1.03	1.65-1.82	*
	Mean	1.56±0.05	0.97±0.05	1.73±0.08	*
20	**Stamen type**	Epipetalous	Epipetalous	Epipetalous	*
21	**Style length**				
	Range	1.62-1.70	1.10-1.20	1.43-1.52	*
	Mean	1.66±0.04	1.15±0.45	1.48±0.05	*
22	**Anther condition (where it faces)**	Introrse	Introrse	Introrse	*
23	**Anther fixation (how it is held)**	Basifixed	Basifixed	Basifixed	*
24	**Ovule type**	Many	Many in each locule	Many in each locule	*
24a	**Placentation**	Axile	Axile	Axile	*
25	**Fruit type**	Capsule	Capsule	Capsule	Capsule
25a	**Fruit length**				
	Range	1.42-1.68	2.24-2.38	2.18-2.48	5.30-6.09
	Mean	1.55±0.13	2.31±0.07	2.33±0.15	5.70±0.40

Sl. No.	Characters	*S. angustifolium*	*S. indicum*	*S. radiatum*	*S. alatum*
25b	**Fruit breadth**				
	Range	0.30-0.33	0.46-2.32	0.47-0.50	0.73-0.79
	Mean	0.32±0.02	1.39±0.93	0.49±0.02	0.76±0.02
26	**Beak length**				
	Range	0.16-0.19	0.29-0.30	0.10-0.10	0.91-1.04
	Mean	0.18±0.02	0.30±0.01	0.10	0.98±0.07
27	**Beak shape**	Narrow oblong	Broad oblong	Square	Tapered apex
28	**Seed shape/ colour**	Oval with concave sides blackish in colour	Oval with convex sides, whitish in colour	Elongated, blackish in colour	Winged & brownish in colour.
29	**Seed architecture**	Radially rough	Smooth	Reticulately rough	Partially rough
30	**Seed length**				
	Range	0.11-0.16	0.30	0.24-0.28	0.22-0.27
	Mean	0.14±0.03	0.30	0.26±0.02	0.25±0.03
31	**Seed breath**				
	Range	0.11-0.15	0.14-0.19	0.11-0.15	0.11-0.16
	Mean	0.13±0.02	0.17±0.03	0.13±0.02	0.14±0.03
32	**Venation**	Reticulate	Reticulate	Reticulate	Reticulate
33	**Root system type**	Tap	Tap	Tap	*
34	**Number of seeds per capsule**				
	Range	86 -96	64 -76	54 – 68	*
	Mean	91±5.0	70.00±6.0	60.00±6.0	*

*** Indicates herbarium material was used and attribute could not be measured/ correctly observed.**

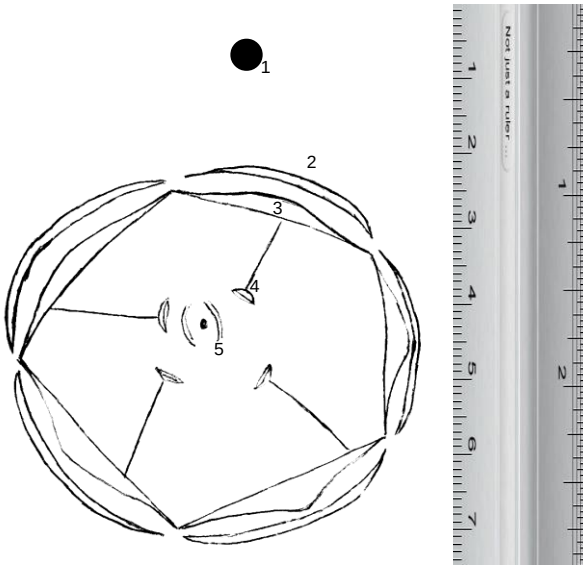

Fig. 1a: The floral diagram of the genus *Sesamum* (X3). 1- Main axis; 2-Calyx or Sepals; 3-Petals or Corolla; 4: Androecium; 5: Gynoecium.

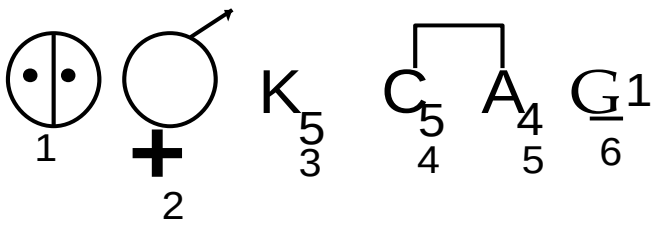

Fig. 1b: The floral formula of the genus *Sesamum.* 1-Symmetry (Zygomorphism); 2-Hermaphroditism; 3-Calyx (5); 4-Petals (5); 5-Androecium (4) attached to petals; 6: Gynoecium (1) with superior Ovary.

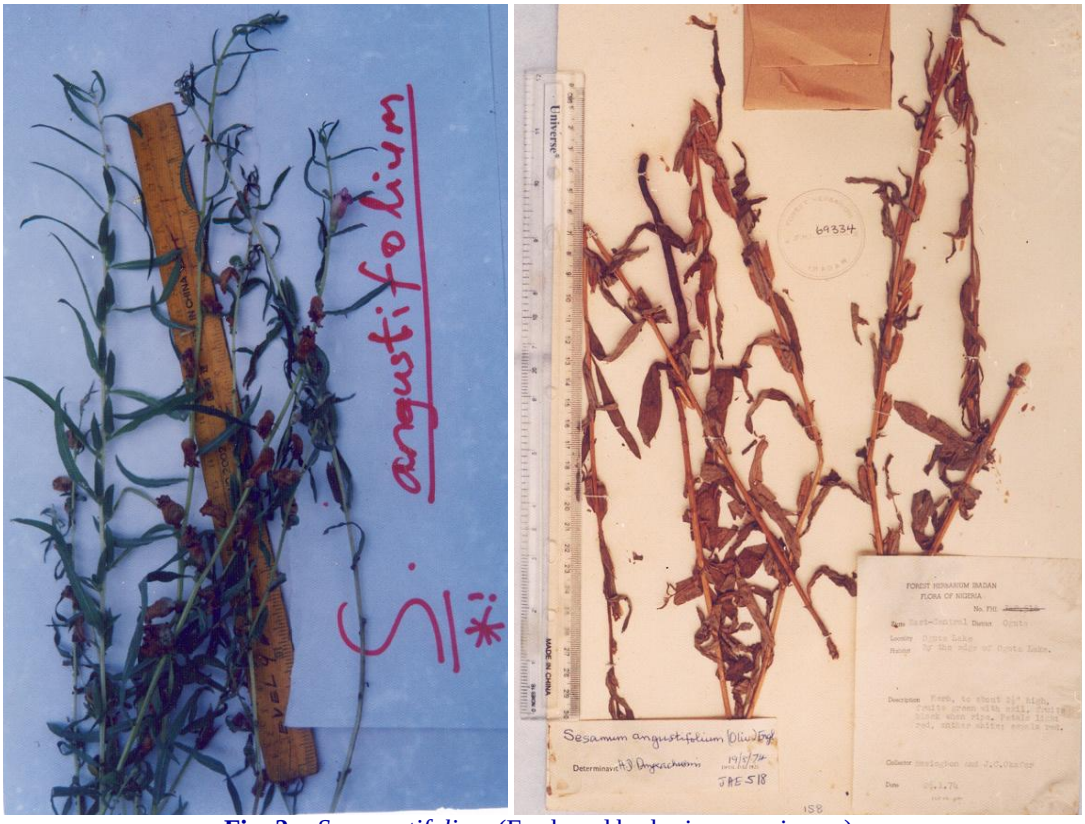

Fig. 2a: *S. angustifolium* (Fresh and herbarium specimens).

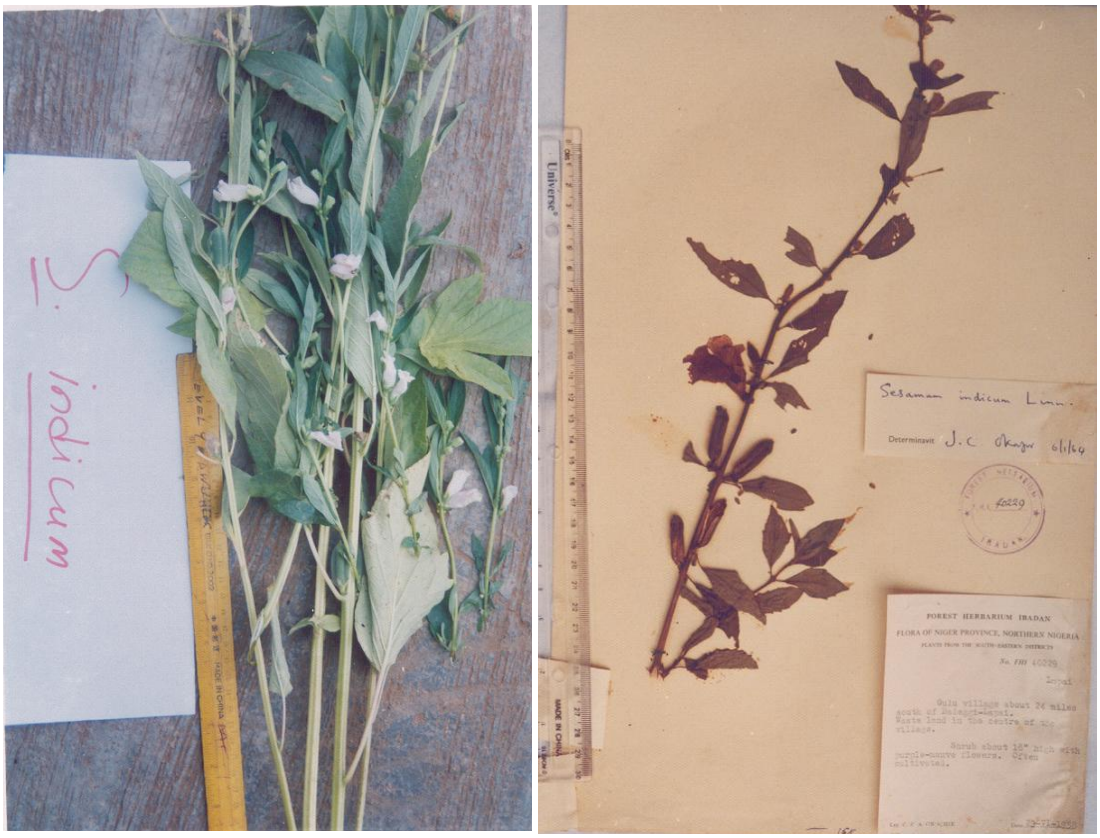

Fig. 2b: *S. indicum* (Fresh and herbarium specimens).

Fig. 2c: *S. radiatum* (Fresh and herbarium specimens).

Fig 2d: *S. alatum* (Herbarium specimen).

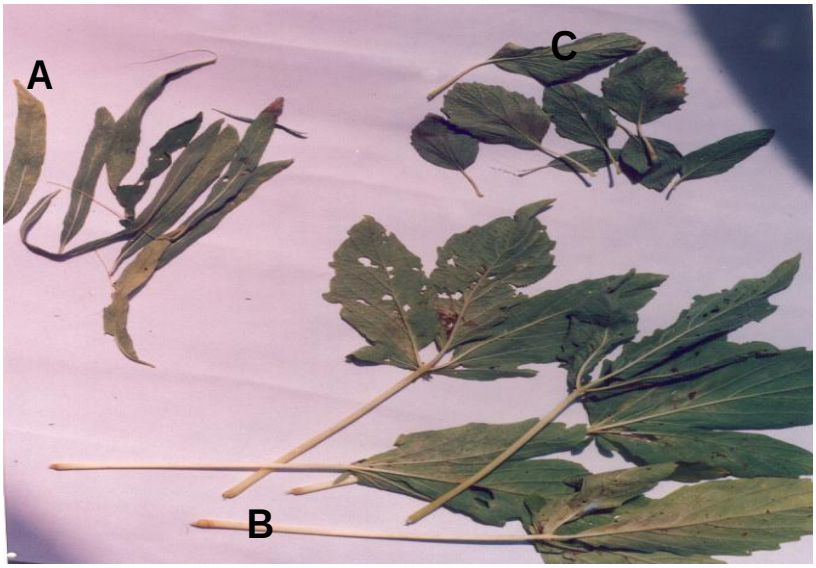

Fig. 3: A. *Sesamum angustifolium*–lanceolate; B. *Sesamum indicum*–trifoliate and ovate; C. *Sesamum radiatum* – cordate.

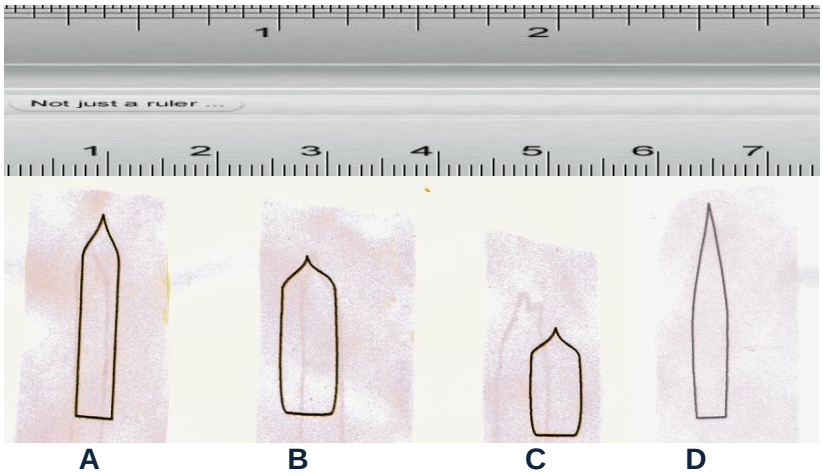

Fig. 4: The shape of beaks on capsule of each species (X3). A = *S. angustifolium* – narrow oblong; B = *S. indicum* – broad oblong; C = *S. radiatum* – square; D = *S. alatum* – tapered at apex (adapted from IPGRI and NBPGR, 2004 with modifications).

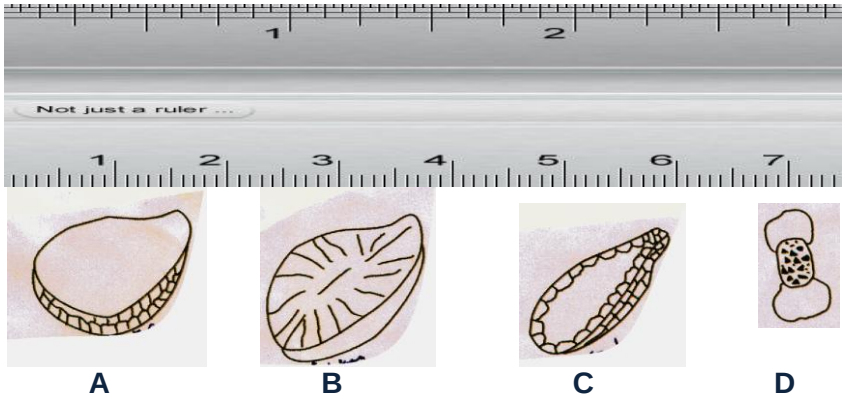

Fig. 5: The seed shapes of the *Sesamum* species studied (X4). A = *S. angustifolium* = oval with concave sides; B = *S. indicum* = oval with convex sides; C = *S. radiatum* = elongated; D = *S.alatum* = winged (adapted from IPGRI and NBPGR, 2004 with major modifications).

An indented taxonomic (diagnostic) key based on the morphological attributes of the species investigated in this study is presented below.

1 Lower leaf phyllotaxy alternate
  2 Upper leaf phyllotaxy also alternate with long internode, capsule beak narrow oblong, seeds shaped Oval with concave sides ……*S. angustifolium*
2[1] upper leaves phyllotaxy also alternate with short internode, capsule beak squared, seeds elongated in shape ……*S. radiatum*
  3 Upper leaf phyllotaxy not alternate
  3[1] upper leaf phyllotaxy opposite, capsule beak tapered towards the end, seeds winged……..…*S. alatum*
1[1] Lower leaf phyllotaxy opposite with trifolisation, upper leaves alternate, capsule beak oblong, seed shape oval with convex sides ……..*S. indicum*

Conflict of interest statement

Authors declare that they have no conflict of interest.

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