

THE GRAIN SORGHUMS OF THE *DURRA* GROUP

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Introduction

AMONG the grain sorghums, the *Durras* form the most important group. Snowden¹ has recently made a systematic classification of the cultivated sorghums. He has grouped the cultivated forms into six sub-series in a descending order of affinity to the wild types. The sub-series *Durra* is the last of these six and the most removed from the wild ones. It consists of four species:—*Sorghum rigidum* Snowden, *Sorghum durra* Stapf, *Sorghum cernuum* Host, and *Sorghum subglabrescens* Schweinf. et Aschers. Of these, the first named is a rare group and is reported to exist only in the Blue Nile district of the Anglo-Egyptian Sudan. Moreover, it is less closely related to the other three species than they are among themselves. These three, viz., *S. durra*, *S. cernuum* and *S. subglabrescens* form not only a compact, well-defined group, but are also culturally the most important among the grain sorghums. This article gives a brief review of the *Durra* sub-series, with special reference to Indian and particularly to Madras varieties.

Origin, History and Nomenclature

The origin, history and nomenclature of the species included in this sub-series have been fully reviewed by Snowden.

Chief Characteristics

The three important species of this sub-series are characterised by the following features. The plants are medium stout to robust with a coat of waxy bloom on the internode and leaf-sheath. The panicle is usually compact, medium compact or medium loose (Fig. 1), and only very rarely loose. The rachis is stout and grooved, and the branches and branchlets are short, erect and hairy (Fig. 2). The peduncle is usually erect except in

S. cernuum where it is mostly goose-necked (Fig. 3). The sessile spikelets show a wide range in shape from ovate elliptic to rhomboid (Fig. 4). The glumes are thick and spongy or thin and herbaceous. They are more or less equal in length. When herbaceous, there is often a transverse wrinkle about the middle of the glume (Figs. 4 & 6). In the thickly coriaceous forms, there is no wrinkling and the tip is strongly nerved. The lemmas are hyaline and ciliate, and most often have a long awn. The mature grains exceed the glumes in length and are as a rule readily separable. The embryo mark is ovate to elliptic, flat or rarely concave. The lateral lines are prominent. The endosperm is white in colour, mealy inside and hard towards the periphery. Unlike most of the species of the earlier groups, e.g., *Drummondii*, *Guineensia* and *Caffra*, the pedicelled spikelets in this are persistent (Fig. 4) and have only short pedicels. They are lanceolate to elliptic, and antheriferous or neuter. The stalk is generally sweet.

Sorghum durra Stapf.

(a) *Characteristics*:

The plants of this species are generally stout-stemmed and broad-leaved. The height varies from 125 cm. in the Sudan and Sind varieties to 400 or even 450 cm. in some of the Indian (Madras) varieties. The duration ranges from 95–145 days. The stalks are usually pithy in the ripe stage, but are mostly sweet. The internode (fourth from the top) is .9–2.4 cm. thick. The number of leaves varies from 7–16 in the mature plant. The panicle is generally medium-loose to medium-compact, sometimes compact, and rarely loose, and 9.5–28 cm. long and 5–17 cm. broad. The peduncle is erect as a rule, and is only rarely recurved. The heads are well emerged from the boot in the majority of types with a clearance of 10–15 cm. The branches are rather rigid at the bases. The racemes are somewhat crowded, mostly, three to four noded and fully hairy. Sessile spikelets vary in shape from obovate-elliptic to rhomboid, and are 4.0–6.5 mm. long and 2.5–5.0 mm. broad. They may be red, black, buff or straw coloured, when dry. The glumes are 4–6.0 mm. long and 3–4.5 mm. broad, and may be fully hairy or glabrate. The nodal bands may be fully hairy or glabrous (Fig. 5). The glumes are thickly coriaceous except at the tip, where it is thinly coriaceous and unevenly hairy. The tip of the outer glume is broad, triangular and strongly nerved. There are 12–16 primary and 6–8 secondary nerves on the lower glume. The upper glume also has 7–9 primary and 5–7 secondary nerves, and is ciliate on the margins. The glumes are never wrinkled. The outer lemma is ovate to broadly elliptic, 4.0–5.5 mm. long, 3–4 mm. broad and 2–5 nerved, and the inner is ovate and shortly two-lobed, with an awn up to 12 mm. in length. The anthers are 3–4 mm. long and

1 mm. wide. Grains vary in shape from obovate to broadly ovate or subrotund, and are 4.0–6.5 mm. long and 3.0–6 mm. broad, and have a broad rounded and much exposed top. The majority of the types are yellow or white grained; red grained come next, while brown-grained types are somewhat rare. The pedicelled spikelets are lanceolate to linear oblong, 4–8 mm. long and .75–2 mm. broad.

This species is characterised by the presence of obovate-elliptic to rhomboid-sessile spikelet, thickly coriaceous glume with broad and strongly nerved herbaceous tip, awned or rarely mucronate inner lemma and biconvex grain with broad and round top and wedge-shaped base. It differs from *S. cernuum* in having more thickly coriaceous glume which is not wrinkled and which becomes more or less glabrous on the back at length. Moreover the grain in *S. cernuum* is broadly elliptic to orbicular in shape and much more flattened than in *S. durra*. *S. durra* can be distinguished from *S. subglabrescens* in having thickly coriaceous and rather spongy glume which is comparatively more hairy and not transversely wrinkled as in the latter.

(b) *Distribution.*—

This species is now the most important grain sorghum in Egypt, the Anglo-Egyptian Sudan, Eritrea, Arabia and India. In recent times it has also been introduced into the United States of America and in addition is also grown in parts of Middle and Western Asia, namely Iraq, Mesopotamia and Palestine. In India *Durra* varieties are cultivated in almost all the provinces where sorghum is grown, particularly in Madras, Sind and Baluchistan. It forms the chief rain-fed variety in the Coimbatore, Guntur, Cuddapah, Kurnool, Kistna, Godavari and Vizagapatam districts and occupies about 46 per cent. of the total area (4.6 million acres) under sorghum in the Madras Presidency, *S. subglabrescens* having 18 per cent. and *S. cernuum* 17 per cent. Thus the species of the *Durra* sub-series occupy more than four-fifth of the total sorghum area in the Madras Presidency.

(c) *Varieties:*—

Out of the 16 varieties into which Snowden classifies *Sorghum durra* only nine, viz., *mediocre*, *coimbatoricum*, *javanicum*, *fecundum*, *eois*, *elongatum*, *fuscum*, *rivulare* and *maximum* are found in India. The remaining seven varieties, viz., *aegyptiacum*, *Fiorii*, *rutilum*, *niloticum*, *melanoleucum*, *erythrocarpum* and *luteolum* are confined to Anglo-Egyptian Sudan, Egypt and Eritrea. Among the varieties cultivated in India, vars. *mediocre*, *coimbatoricum* and *javanicum* alone are grown in the Madras Presidency. A short description of these is given below.

(i) Var. *mediocre* (Burkill) Snowden.—This variety is confined to the districts of Northern Circars namely, Vizagapatam, Godavari and Kistna, the Ceded districts of Cuddapah, Kurnool, Bellary and Anantapur and the adjoining districts, viz., Guntur, Nellore and Chittoor. It is known in the different districts under different local names such as *Bommayi jonna*, *Budda jonna*, *Desa jonna*, *Gidda jonna*, *Harasana jola*, *Mallemari jonna*, *Napa jonna*, *Pacha jonna*, *Pairu jonna*, *Pedda jonna* and *Zinkapuri jonna*. The *Pacha jonna* of the Circars and the Ceded districts is typical of this variety.

Chief Characteristics.—Types mostly rain-fed; plants medium tall; height 125–285 cm.; duration 100–130 days; stalk 0·9–1·5 cm. thick, pithy; leaves 10–14 in number, 50–70 cm. long and 6·9 cm. broad; sheath and glumes mostly reddish purple; axil purple; midrib white; panicle medium loose to medium compact, 10–25 cm. long and 5–12 cm. broad; awn long; glumes glabrous and slightly or fully bleached; grains pearly yellow, invariably with a characteristic brown wash, 4·5–5·5 mm. long and 3–4·5 mm. broad; pedicelled spikelets 4–6 mm. long, and ·75–1·5 mm. broad and turns brownish yellow on drying. This is the chief sorghum grown in the Northern Circars. But being a paddy tract, rice forms the chief cereal for food there, and sorghum is mostly exported. In the Ceded districts and also in Guntur, Nellore and Chittoor this variety forms one of the chief food grains. The yield ranges from 300–800 lb. of grain and 900–1,500 lb. of straw per acre.

(ii) Var. *coimbatoricum* (Burkill) Snowden.—As the name indicates, this variety is confined to the district of Coimbatore. Recently it has spread to the neighbouring districts mainly through the endeavour of the Agricultural Department. This variety is commonly known by the name *Periamanjol cholam* and is rarely called *Sadaimanjol*. The name *Periamanjol* refers to the long duration, the great height and the yellow grain of this variety.

Chief Characteristics.—Plants are very tall (tallest among the Indian sorghums), stout and long in duration. Height 300–450 cm.; duration 130–40 days; stalk 1–2 cm. thick; leaves 12–16 in number, 60–70 cm. long and 8–10·5 cm. broad; leaf-sheath and glume reddish or blackish purple; node glabrous; axil purple; midrib white; panicle large, medium loose, 14–26 cm. long and 7–17 cm. broad; awn long; grain pearly yellow with a characteristic brown wash and somewhat duller in colour than in var. *mediocre*; 4·5–5·5 mm. long and 3·5–4·5 mm. broad and tightly held by the glumes. This variety is highly season-bound, the flowering period being

confined to the months of October and November. The yields vary from 600–1,200 lb. of grain and 2,000–6,000 lb. of straw per acre. As a food grain this is considered superior to the other varieties in the Coimbatore district.

(iii) Var. *javanicum* (Hack.) Snowden.—This variety has a wider distribution than the two described above being found in all the sorghum growing provinces of India as well as in Afghanistan, Anglo-Egyptian Sudan, Egypt and in Morocco. In the Madras Presidency it is grown chiefly in the districts of Bellary, Anantapur, Chittoor and North Arcot. It is known under different local names such as *Hira jola*, *Konai cholam*, *Nagari cholam*, *Nettai jola*, *Nir jola*, *Vellai cholam* and *Vibhuthivantha jonna*. The *Vellai cholam* of Chittoor and North Arcot is typical of this variety. This consists of types which are grown both under irrigated and rain-fed conditions.

Chief Characteristics.—Height 140–75 cm. in the irrigated and 165–225 cm. in the rain-fed ones; duration 110–15 days in the irrigated, and 120–35 in the rain-fed types; stalk 0.9–1.6 cm. thick and pithy; leaves 7–12 in number, 60–70 cm. long and 6.5–9 cm. broad; panicles compact, ovate to conical, 10–20 cm. long and 6.5–10 cm. broad; glumes mostly reddish purple, always fully hairy, 4.5–6 mm. long and 2.5–4 mm. broad; awn long; grain mostly white, 4–5.5 mm. long and 3–5 mm. broad. The yield varies from 400–1,000 lb. of grain and 2,000–3,500 lb. of straw per acre.

Of the three varieties of *S. durra* described above vars. *coimbatoricum* and *mediocre* have yellow grains, and var. *javanicum* is mostly white grained. Var. *coimbatoricum* differs from vars. *mediocre* and *javanicum* in having much taller and more robust plants with larger panicles and bolder grains which are rather tightly held by the glumes. Moreover in this variety both reddish purple and blackish purple coloured leaf-sheaths are met with, while in *mediocre* and *javanicum* blackish purple is very rare. In var. *javanicum* the panicles are more compact than in the other two.

Sorghum cernuum Host.

(a) *Characteristics* :

Plants shorter than those of *S. durra*; height 110–300 cm.; duration 95–140 days; stalk 0.9–2.2 cm. thick, mostly juicy and sweet; leaves 7–15 in number, 45–75 cm. long and 5–10.5 cm. broad; node green and fully hairy; axil of leaf-sheath purple; leaf-sheath and glume mostly reddish purple, blackish purple being rare; awn long; panicle compact to medium compact, 8–27 cm. long and 5.5–19 cm. broad; peduncle mostly recurved (Fig. 3); rachis fully hairy and branches short and sub-erect; sessile spikelets broadly ovate to obovate-oblong and fully hairy; callus beard copious; glumes fully hairy to villous, equal, thick and spongy below the middle and

thin and papery above with a transverse wrinkle, creamy white to straw or buff in colour, 4-6 mm. long and 3-4.5 mm. broad and tips breaking off at maturity; grain rotundate or orbiculate, flattish, 4-6 mm. long and 3.5-5 mm. broad, protruding beyond the glumes, mostly white, occasionally red and rarely yellow in colour; pedicelled spikelets generally large, fully hairy and mostly antheriferous, turning red in red grained and straw coloured in white grained types.

The distinguishing characteristics of this species are the silky hairs on the nodes and the glumes, completely bleached glumes which are somewhat thick and spongy at the base, thin and herbaceous at the tip, transversely wrinkled or depressed at the middle, and breaking off at the tips, and the orbicular and flattened grains. This differs from *S. durra* in having more hairy and transversely wrinkled glumes and more flattened grains; and from *S. sub-glabrescens* in having fully hairy and completely bleached spikelets which are invariably long awned.

(b) *Distribution:*

This species is less wide in its distribution than *S. durra*. It is found in India, parts of Afghanistan, Persia, Arabia, Asia Minor, Egypt and British Somaliland. At one time it was extensively cultivated in Egypt, although it is now largely replaced by *S. durra*. This species figures to a slight extent in the United States of America having been first introduced in 1874 under the name of white durra. In India it is limited chiefly to the uplands of the Deccan. Varieties of this species are grown in Rajputana, Sind, Bombay, Hyderabad, Central Provinces, Central Indian States, Mysore and Madras. A few types are found in Bihar and Orissa also. The plants of these varieties seem to do well only in areas with highly retentive clayey soils, low rainfall during the growing period, and an absolutely rainless, cool weather during the ripening stages. The ability of the plants of this species to resist drought is shown by the fact that it is distributed over the driest areas of this Presidency as well as of India in general. In the Madras Presidency *S. cernuum* occupies a predominant place only in the Ceded districts. It is of minor importance in the adjacent districts of Guntur and Chittoor. Though isolated areas occur here and there, where *S. cernuum* is grown under irrigation, it is mostly a rain-fed species.

(c) *Varieties:*

Snowden has divided this species into seven varieties, viz., *truchmenorum*, *yemense*, *agricolarum*, *globosum*, *orbiculatum*, *subcylindricum* and *cernuum*, all of which occur in India, and two are confined to India alone in

their distribution. Of the above seven varieties only three namely, *agricolarum*, *globosum* and *orbiculatum* are cultivated in the Madras Presidency to a large extent, and a short description of these is given below.

(i) Var. *agricolarum* (Burkill) Snowden.—Grown chiefly in the district of Bellary and portions of Kurnool this is known locally as *Yerrajonna* and *Yerrapusi jonna* which refer to the red colour of the grain. It is usually cultivated as a dry crop. Owing to the juicy stalk and the leafy nature of the plants this is considered as a good fodder variety and yields 10,000–15,000 lb. of green fodder per acre. In extraction tests this gave 43.3 per cent. of juice with a Brix value of 12.6. This juice contained 6.6 per cent. of sucrose and 3.0 per cent. of glucose.

Chief Characteristics.—Height 250–300 cm.; duration 120–140 days; stalk 0.9–1.4 cm. thick; leaves 12–15 in number, 50–70 cm. long and 6–8 cm. broad with the margins turning red on drying; peduncle recurved in most cases; panicle compact, 9–15 cm. long and 6–8 cm. broad; grain red, very bold, 5.5 mm. long and 4.5 mm. broad with a dimple in rare cases; pedicelled spikelets 4–5 mm. long and 1–2 mm. broad.

(ii) Var. *globosum* (Hack.) Snowden.—The different forms of this variety are found chiefly in the districts of Cuddapah, Kurnool, Bellary, Anantapur and Chittoor. They are known by the names *Chitta jonna* and *Nallapusi jonna* in Kurnool, *Tella jonna* in Bellary, Cuddapah and Chittoor, and *Tella Thota jonna* in the district of Anantapur. They are mostly rain-fed types.

Chief Characteristics.—Height 180–240 cm.; duration 100–130 days; stalk 1–1.4 cm. thick; leaves 10–14 in number, 50–75 cm. long and 6.5–9.5 cm. broad; panicle medium to very compact, 10–20 cm. long and 7–10 cm. broad; grain very bold, mostly pearly white, 4.5–5 mm. long, and 3.5–5 mm. broad; a few double grained due to the lower lemma being fertile; endosperm mealy white; pedicelled spikelets 4–6 mm. long, and 1–2 mm. broad. This is the most important of the varieties of *S. cernuum* cultivated in the Ceded districts. The yield is 300–600 lb. of grain and 1,000–2,000 lb. of straw per acre.

(iii) Var. *orbiculatum* Snowden.—This variety has a much wider distribution than either of the two described above, but in Madras it is grown to a lesser extent and is mostly found in the districts of Bellary, Chittoor and Guntur. The types in this variety are known as *Belikalu jola* (white pearly grained) in Bellary, *Mudda* (ball-like) *jonna* in Chittoor and *Venna Mudda* (butter ball) *jonna* in Guntur. This is similar to var. *globosum* in height, duration, and other plant characters, the chief point of difference being the more flattened nature of the grain in this variety.

The three varieties of *S. cernuum* namely *agricolarum*, *globosum* and *orbiculatum*, generally met with in the Madras Presidency, have been described above. In these, var. *agricolarum* consists of red grained types only and in this the spikelets and the margins of the leaves are reddish in colour, when dry. In the varieties *globosum* and *orbiculatum* the majority of the types are white grained. Variety *orbiculatum* can be distinguished from var. *globosum* by the grain of the former being orbicular in shape and much more flattened than that of the latter.

Sorghum subglabrescens Schweinf. et Aschers.

(a) *Characteristics*:

Height 70–335 cm.; duration 85–135 days; stalks generally pithy, thinner than those of *S. durra* and *S. cernuum*, range in thickness being 0·8–1·5 cm.; leaves 7–14 in number, 40–70 cm. long and 4·5–8 cm. broad; panicle compact to very compact and sometimes loose, 8–25 cm. long and 5–12 cm. broad; peduncle generally erect and rarely goose-necked; branches and branchlets less hairy than in the other two species; sessile spikelets oblong to hexagonal in shape, 4–6·5 mm. long, and 2·5–4 mm. broad, often hairy when in flower, and ultimately glabrate; callus beard scanty; glumes 4–6·5 mm. long and 2·75–4 mm. broad, thick and papery except near the base, wrinkled or depressed about the middle and with 12–14 primary and 5–8 secondary nerves; awn long in the majority of types; grain white, yellow or red and rarely brown in colour, 3–5·5 mm. long and 3–4·5 mm. broad; with a rounded tip and an abruptly compressed, wedge-shaped base; yellow type invariably long awned; pedicelled spikelet small, and reddish in red and yellowish in yellow grained types.

The distinguishing characteristics of this species are the semi-membraneous, glabrate glumes which are usually transversely wrinkled about the middle (Fig. 4) and broad topped grains with abruptly tapering wedge-shaped bases. The plants are usually shorter and less robust than in *S. durra* and somewhat less robust than in *S. cernuum*. *S. subglabrescens* can be distinguished from *S. cernuum* by the glumes of the former being glabrous or less hairy and the grains biconvex and broad topped with abruptly tapering wedge-shaped bases. It differs from *S. durra* in having obovate-oblong to hexagonal spikelets, less hairy to almost glabrous, thinner and transversely wrinkled glumes, and abruptly tapering grain bases.

(b) *Distribution*:

This species is distributed in the Anglo-Egyptian Sudan, Eritrea, Abyssinia, Arabia and India. It has also been introduced recently into South Africa, Nyasaland and the United States of America.

(c) Varieties:

Of the 17 varieties into which this species is classified by Snowden, 10 are limited in their distribution to Africa, and of the remaining seven some are found both in India and Africa, and the rest in India only. Of these seven varieties, *pabulare*, *rubidum*, *compactum*, *irungiforme* and *oviforme* are concentrated in the Madras Presidency, while *paniculatella* and *rugulosum* are reported from Bombay and the Central Provinces. In Madras *S. subglabrescens* is more abundant in the south than in the north where *S. durra* and *S. cernuum* predominate. A short description of the varieties cultivated in the Madras Presidency is given below.

(i) Var. *pabulare* Snowden.—The word *pabulare* indicates fodder, and this variety is raised more as a fodder than a grain crop. Under the names of *Nilwa jowar* and *Utavli jowar* it is grown extensively in the Bombay Presidency and the Central Provinces. In Madras it is not so prominent, and is represented only in two districts—Ramnad and Tinnevely, where these are known as *Arisi cholam* or *Uppu cholam*. These *Arisi cholams* have a great affinity to the *Irungu cholam* (*S. dochna*) in having reed-like stalks, narrow leaves, large number of tillers, loose panicles and small grains which are almost completely enclosed by the glumes. In these two districts the *Irungu cholam* being the most common variety grown for fodder, and the white grained forms of *S. subglabrescens* for grain, it is quite possible that the variety *pabulare*, having the characteristics of both *S. subglabrescens* and *S. dochna* might have originated as a product of hybridisation between the white-grained forms of these two species. Similarly the *Nilwa jowars* of Bombay, Bihar and the Central Provinces show some of the characteristics of both *S. cernuum* and *S. subglabrescens* and seem to have been evolved through hybridisation between certain white-grained types of these two species.

Chief Characteristics.—Height 180–225 cm.; duration 95–105 days; stalk 0.8–1 cm. thick; leaves rather stiff, 8–13 in number, 50–65 cm. long and 4.5–5.5 cm. broad; leaf-sheath and glumes either reddish or blackish purple, node, junction and glume completely hairy; panicle loose conical, 18–25 cm. long and 8–12 cm. broad; awn 8–10 mm. long; grain chalky white and small; glumes extending nearly to the tip of the grain, slightly bleached and transversely wrinkled; pedicelled spikelets small and sterile. This variety is of minor importance in the Madras Presidency.

(ii) Var. *rubidum* (Burkill) Snowden.—This is one of the four important varieties of *S. subglabrescens* grown in the Madras Presidency. Its distribution extends from Nellore in the North to as far as Madura in the South, being cultivated in Nellore, Guntur, North Arcot, Ceded districts, Salem,

Coimbatore, Trichinopoly and Madura. Among these districts however, its greatest prominence is in Salem and Trichinopoly where large areas are grown under the name of *Sen cholam*. The name *rubidum* has arisen from the word *rubidus* meaning reddish, and the grain in this is generally red or light red. This consists of both irrigated and rain-fed types the latter being 50–100 cm. greater in height and 20–30 days longer in duration than the former. The most common names by which this variety is known are *Kunkuma jola*, *Makkattai cholam*, *Palapu jonna*, *Sakkaraguliga jonna*, *Sen cholam* and *Yerra jonna*. The *Sen cholam* is the most typical of this variety.

Chief Characteristics.—Height 125–245 cm.; duration 100–135 days; stalk 1–1.2 cm. thick; leaves 8–12 in number, 50–60 cm. long and 5–7.5 cm. broad; leaf-sheath and glumes reddish purple; node and junction glabrous; panicle medium compact in rain-fed and compact to very compact in irrigated types, 10–14 cm. long and 5–7 cm. broad; peduncle usually erect and rarely recurved; glumes slightly bleached and wrinkled; awn long in most of the rain-fed types, and absent in the irrigated ones; and grain bold, red, light red or pink in colour. The yield is 1,500–3,000 lb. of grain and 3,000–5,000 lb. of straw per acre under irrigated condition while the rain-fed crop gives 600–800 lb. of grain and 2,000–3,000 lb. of straw.

(iii) Var. *compactum* (Burkill) Snowden.—This variety is found only in India where it is confined to the Central Provinces and the Madras Presidency. In the latter province it is grown chiefly in the districts of Coimbatore, Trichinopoly and South Arcot, and to a small extent in Bellary and Anantapur. It is known as *Azhukku cholam*, *Chinna* or *Chitrai manjal cholam*, *Dosakaya jonna*, *Kullamanjal* or *Kullanari cholam*, *Manja makkattai* and *Sena jonnalu*. The *Chinna manjal* and *Manja makkattai* are typical of this variety. As in *rubidum*, *irungiforme* and *oviforme* the types in this variety also fall into two groups of duration, the shorter (95–110 days) grown under irrigation from March to June, and the longer (120–135 days) grown rain-fed from July to December. The irrigated ones are 160–220 cm. and the rain-fed ones 200–310 cm. tall. Other characteristics are:—stalk 1–1.4 cm. thick; leaves 10–13 in number, 50–70 cm. long and 7–8 cm. broad; leaf-sheath and glumes reddish purple; nodal band, junction and glumes glabrous; panicle medium compact to compact, ovate; awn long; glumes obovate, blunt tipped, and wrinkled with tips breaking off at maturity, and grains pearly yellow with or without a brown wash. In the *Chinna manjal cholam* the tissue at the nodal band develops a characteristic purple colour which presents a checkered or cracked appearance at the ripe stage, and this purple is linked with the sienna coloured dry anther and yellow grain without the brown wash. The yields vary from 1,500–2,500 lb. of grain and

3,000-5,000 lb. of straw per acre in the irrigated, and 500-800 lb. of grain and 2,000-4,000 lb. of straw in the rain-fed crops.

(iv & v) Var. *irungiforme* (Burkill) Snowden and Var. *oviforme* Snowden.— These two varieties are similar in all morphological characters and cultural features. The only difference is that the var. *oviforme* has a much denser and shorter panicle than the var. *irungiforme* in which the panicle shape varies from compact to medium compact. These two varieties are therefore discussed together. As already recorded, both the varieties are purely Indian in their distribution and the majority of types are found in Madras and a few reported from Bombay, Sind and the Central Provinces. Both the varieties are known by a number of local names, the most common of these being *Chinna vellai*, *Ennai vellai*, *Kattai vellai*, *Kokki vellai*, *Kullanari cholam*, *Tella jonna*, *Uppam* or *Uppu cholam* and *Vellai cholam*. The last named is perhaps the most typical of these. Variety *irungiforme* is more widely distributed in Trichinopoly district while var. *oviforme* predominates in Madura. In some cases both the varieties are known by the same local name as *Kullanari cholam*, *Uppam cholam* and *Vellai cholam*.

Chief Characteristics.—Height 150-230 cm. in the irrigated and 220-350 cm. in the rain-fed ones; duration 90-110 days in the irrigated and 125-35 days in the rain-fed ones; stalk 1-1.2 cm. thick; leaf-sheath and glume reddish purple or blackish purple, brown sheath being rare; leaves 10-14 in number, 50-60 cm. long and 5-7.5 cm. broad; node and junction glabrous in the majority of types; panicle compact to medium compact, 15-20 cm. long and 8-10 cm. broad in *irungiforme*, and more compact and 8-14 cm. long and 5-8 cm. broad in *oviforme*; glumes ovate to obovate, broad tipped, transversely wrinkled in the majority of types and 3.5-5 mm. long and 3-4 mm. broad; and grains white, mostly pearly. Both the varieties consist chiefly of irrigated types, the rain-fed ones being few and less important. The irrigated crop is raised from January to June and gives 1,500-3,000 lb. of grain and 4,000-6,000 lb. of straw per acre. The rain-fed is grown from July to February and produces an acre yield of 500-800 lb. of grain and 2,000-4,000 lb. of straw.

The five varieties of *S. subglabrescens*, namely, *pabulare*, *rubidum*, *compactum*, *irungiforme* and *oviforme*—cultivated in the Madras Presidency have been described above. Var. *pabulare* differs from the others in having reed-like stalks, profuse tillering, loose conical-shaped, long panicles and small grains which are almost completely enclosed by the glumes. Var. *rubidum* is distinguished from the rest by its red or light red grains. Among the remaining varieties *compactum* has pearly yellow grain invariably asso-

ciated with a long awn, and *irungiforme* and *oviforme* are white grained. Var. *irungiforme* differs from var. *oviforme* in having more elongated and less dense panicles.

Border Types

The three important species in the sub-series *Durra* have now been discussed. There occur however certain types that appear to be intermediate between these species. They cannot be included under any one of these three—*S. durra*, *S. cernuum* or *S. subglabrescens*, and can only be classed as intermediate or border types. Thus there are border types between *S. durra* and *S. cernuum*; between *S. cernuum* and *S. subglabrescens*, and also between *S. durra* and *S. subglabrescens*. These border types are mostly found in regions where all the three species are simultaneously grown as in the Ceded districts. In the other districts where either one species alone is grown or different species are raised in different seasons, these border types are rare, probably due to lack of chances for intercrossing. The *Tella kugu jonna* of Anantapur and *Tella jonna* of Cuddapah are considered as border types between *S. durra* and *S. cernuum*, *Manadanti* and *Palumadi jonna* of Bellary and *Cherukku jonna* of Kurnool as border types between *S. cernuum* and *S. subglabrescens* and *Kakimari jonna* of Anantapur seems to be a border type between *S. durra* and *S. subglabrescens*.

A Brief Review of Plant Characters met with in the Durra Group

Height and Duration.—Most of the types in the *Durra* sub-series fall within the medium duration group, and have the unimodal disposition in their internodal lengths.² The relationship between height and duration was studied in a mutant in a *Pacha jonna* type (*S. durra* var. *mediocre*) and the short early was a simple dominant to the tall-late.³

Root colour.—In this sub-series there is a preponderance of the reddish purple type, the blackish purple being few and the brown rare.

Root system.—Most of the varieties of the *Durra* sub-series have very well developed root systems. This is more evident in the rain-fed than in the irrigated ones. Some, particularly when desheathed, have a tendency to develop aerial roots.⁴

Leaf-sheath.—In this group the leaf-sheath covers more than the lower half of the internode, and the direction of the æstivation is normal, being alternately clockwise and anti-clockwise.⁵ Aberrations from this normal condition have been met with in a *Pacha jonna* type called *Edakula jonna* in which two to seven successive leaf-sheaths were clockwise or anti-clockwise in æstivation.

Leaf-blade.—In the majority of the varieties in this group the leaf-blade is broad with smooth junctions and wavy margins.⁶ In *S. durra* and *S. cernuum* most of the types have hairy leaf tips.

Nodal band.—This is generally green and mostly hairy in this group, the glabrous types being in a majority in *S. subglabrescens* alone. Purple coloured band is rare.

Axil of leaf-sheath.—Most of the types in this sub-series have purple coloured axil. Green axils are very few and deep purple ones rare.

Leaf-junction.—In the majority of the varieties of this group the junction is generally green, hairy and smooth. It is worth noting that hairy nodes and junctions are more numerous in the rain-fed than in the irrigated types.

Midrib colour.—In the *Durra* sub-series generally the midrib is white in colour and the stalk pithy but sweet. In *S. cernuum* the majority have juicy stalks. Apart from juiciness or pithiness, the midrib in some types in all these species is yellow⁷ and in a rare mutant in *S. durra*, it is brownish purple.⁸ The colour in these cases is confined to the mechanical tissue. The yellow is dominant and the brownish purple recessive to the colourless condition.

Peduncle.—In this sub-series the peduncle may be erect or recurved, the latter being in a majority in *S. cernuum*. In *S. subglabrescens* a half recurved type is commonly met with in var. *rubidum*, *compactum*, *irungiforme* and *oviforme*. Warty protuberances are also met with in certain types and these are presumed to help in the liberation of the head from the boot.

Emergence of panicle.—The heads are fairly well emerged in *S. durra* and *S. subglabrescens*, but in *S. cernuum* the emergence is poor.

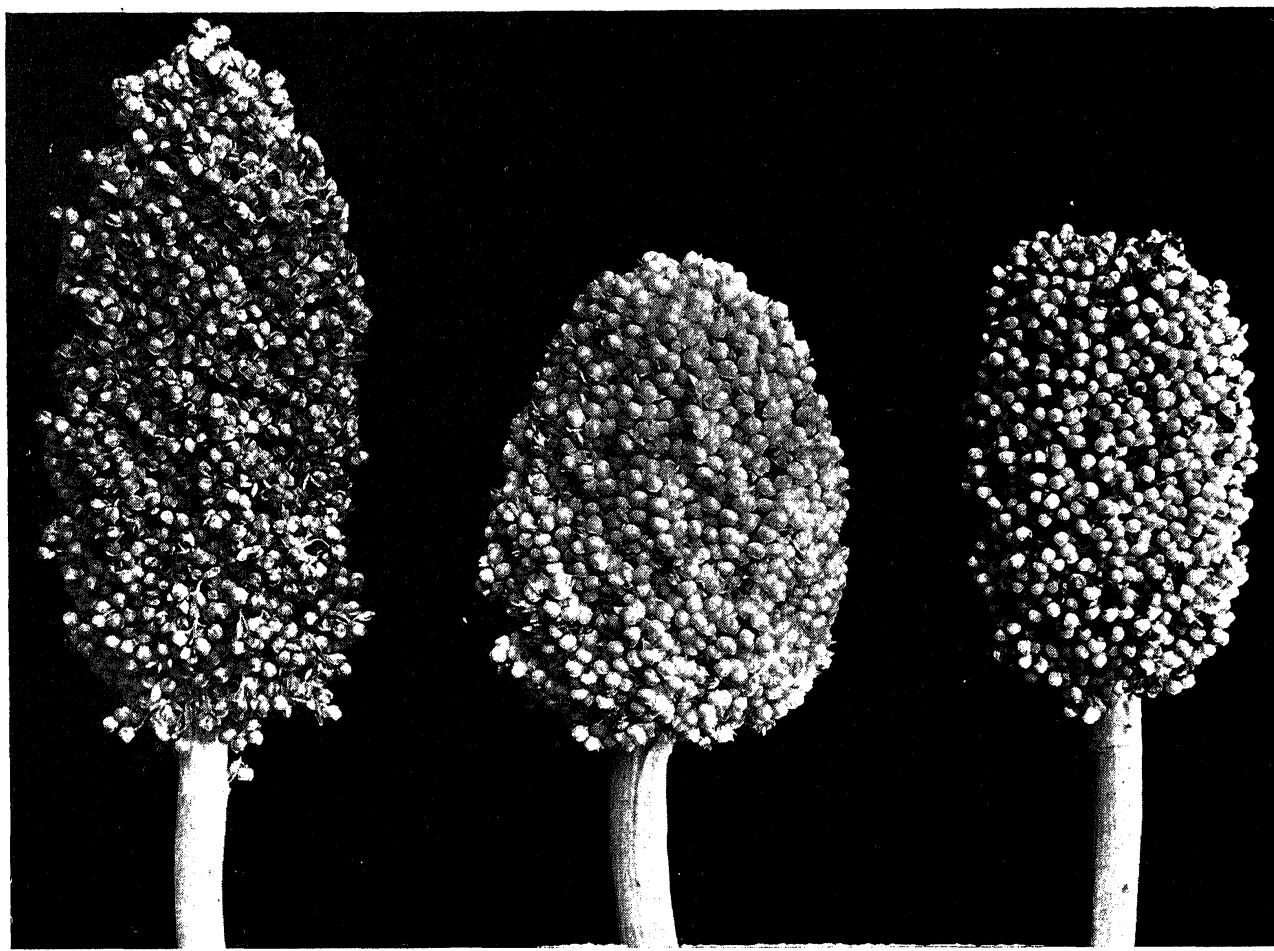
Panicle.—In the *Durra* sub-series the panicle shape falls mostly in the ovoid group⁹ with variations in the degree of compactness. Within the ovoid group the medium compact behaved as a simple dominant to the compact type.

Awn.—The presence of awn is the most common feature in this group. Of the three species, *S. durra* and *S. cernuum*—mostly rain-fed—consist almost entirely of long awned types, while in *S. subglabrescens* both nil awned and long awned types occur, with the latter in slight excess especially in the rain-fed varieties. As already recorded, the yellow grain is almost invariably associated with a long awn. The awn is greenish in the flowering stages but the column takes on the tint of the glume on drying.

Glume.—In all the three species in this sub-series the glumes are thickly coriaceous at the base and thinly coriaceous to herbaceous at the tip. In *S. cernuum* and *S. subglabrescens* the herbaceous tip breaks and falls away at maturity. Both the glumes (as in *S. cernuum* and the majority of *S. subglabrescens*), or one only (as in the rest of *S. subglabrescens*), or neither (as in *S. durra*) may be transversely wrinkled (Fig. 6). Glume wrinkling commences in about 15 days after flowering, when the grains are in the dough stage, and completes in about 10 days, by which time the grain becomes fairly hard. Wrinkling tends to desiccate the upper half of the glume, with the result that any colour present there gets bleached out, and hence in most of the types of this group the glume is partially or completely bleached. Wrinkling has been recorded as dominant to its absence,¹⁰ but it is not stated whether one glume alone or both the glumes were wrinkled. In crosses between types with both the glumes wrinkled and no wrinkling in any glume the F₁ showed wrinkling on both the glumes, and the F₂ gave a 9:7 ratio of wrinkled to not-wrinkled. A heterozygous mutant with both the glumes wrinkled occurred in an irrigated *Sen cholam* (upper glume alone wrinkled) and it gave a monogenic segregation between both glumes and upper alone wrinkled. The relationship between the upper glume alone wrinkled and the complete absence of wrinkling, and other aspects are under study. The glumes in all these varieties are short nerved. In crosses with the long nerved types of *S. nervosum* the short nerved condition behaved as a simple dominant.⁵

Grain.—White, yellow and red are the most common grain colours met with in this group; brown is rare. *S. durra* and *S. subglabrescens* contain all the colour forms. In *S. cernuum*, on the other hand, white and red alone are usually met; yellow and brown are very rare. The grain shape in this sub-series varies from ovate to rotund or orbiculate with a wide range in the size of the grain. The largest grain so far met with in sorghum is found in var. *niloticum* and *rivulare* of *S. durra* and the most flat grain in the *Chapti juar* (*S. cernuum*) of the Central Provinces. A few types in this group have dimpled grains. This character was first noted in a type of *Sakkara-guliga jonna* of Bellary classified under *S. cernuum*. Later on dimpled types were found to occur in varieties of *S. subglabrescens* as well of this tract.

Pedicelled spikelets.—In this sub-series the pedicelled spikelets are elliptic to lanceolate or linear-oblong in shape, sparsely to moderately hairy, large, conspicuous and antheriferous, or small and neuter, and always persistent. The pedicel is short. In red and yellow grained varieties the margins of the pedicelled spikelets turn red and brownish yellow.



(a) *S. durra*

(b) *S. cernuum*

(c) *S. subglabrescens*

FIG. 1. Sorghum Panicles

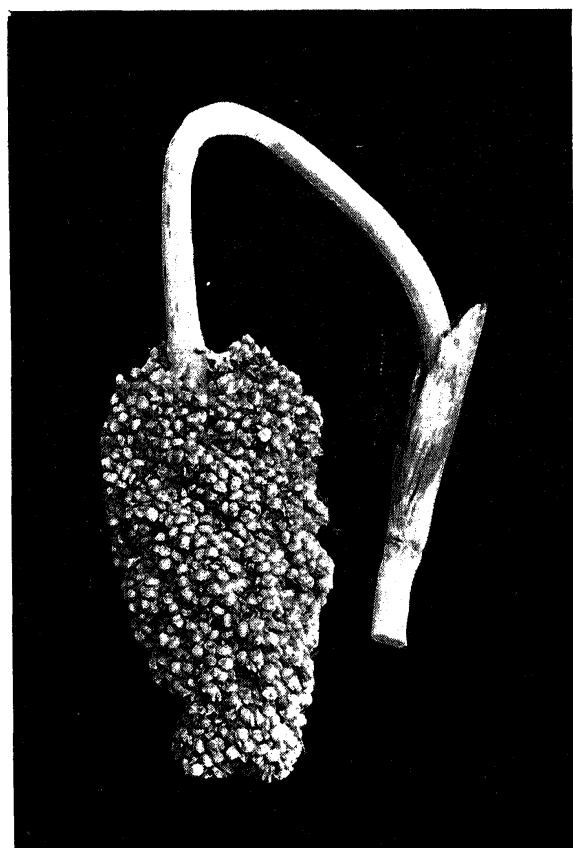


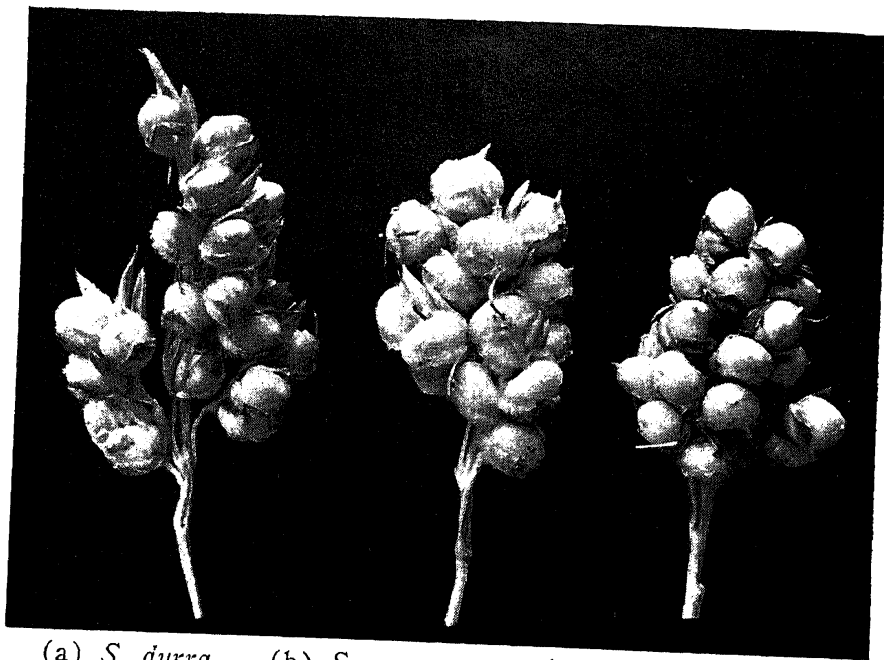
FIG. 3. A Panicle showing
recurved (goose-necked)
peduncle



(a) Hairy

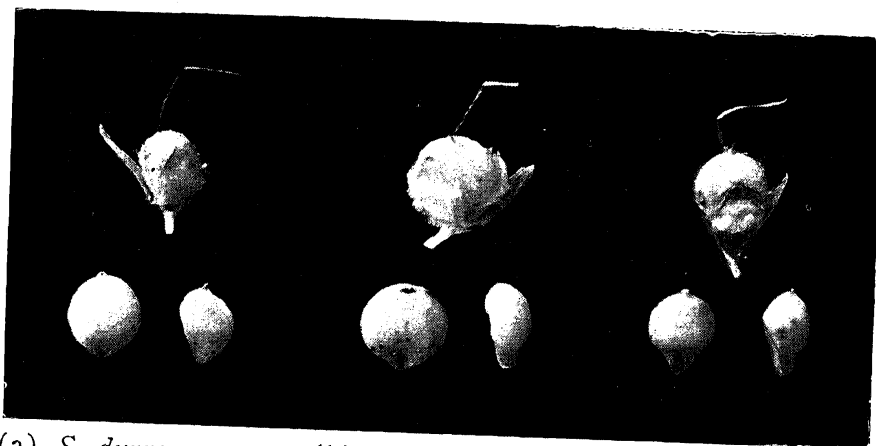
(b) Glabrous

FIG. 5. Nodal bands



(a) *S. durra* (b) *S. cernuum* (c) *S. subglabrescens*

FIG. 2. Panicle Branches



(a) *S. durra* (b) *S. cernuum* (c) *S. subglabrescens*

FIG. 4. Spikelets and Grains (Front and Side views)



(a) Both glumes wrinkled (b) Upper glume alone wrinkled (c) Both glumes not wrinkled

FIG. 6. Glume Wrinkling

Chlorophyll colour grades.—Most of the varieties of the *Durra* group have green leaves. But certain types of *S. subglabrescens* particularly the rain-fed *Sen cholam* have light green leaves. Dark green is the prevalent colour in the African group *Caffra*. In crosses between the three grades of green, dark green has proved a monogenic dominant to green, and green a monogenic dominant to light green. A 9:6:1 ratio of dark green, green and light green has been obtained connoting supplementary factors.

Summary

A brief review of the three important species of the *Durra* group, viz., *S. durra*, *S. cernuum* and *S. subglabrescens*, with special reference to the Indian and particularly to Madras varieties, is given. *S. rigidum*, also included in this group but which does not fit in with this, is omitted. Detailed descriptions and distinguishing characteristics of the varieties of these three species cultivated in the Madras Presidency are provided. A short review of the important characters met with in this group has been added at the end with special reference to panicle shape and glume wrinkling. Figs. 1-6 illustrate the different types of panicles, panicle branches, spikelets, grain shapes, glume wrinkling and node hairiness in the different species.

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