

TAMIL NADU AGRICULTURAL UNIVERSITY

**Training manual
On
Latest Crop Varieties and its Morphological Features**

Organized jointlyBy

**Directorate of Centre for Plant Breeding & Genetics
&
Tamil Nadu Agriculture and Farmers Welfare Department
SAMETI, Kudimiyamalai**

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1. Improved rice varieties and its distinguished features

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Rice being the staple food crop of Tamil Nadu is cultivated in an area of 20.36 lakh hectares (Department of Agriculture, 2021) of which,73% of rice area in Tamil Nadu is occupied by TNAU varieties and 27% from other varieties. A total of 34rice varieties are in seed chain. The salient and distinguishable morphological featuresof popular and new varietiesreleased in rice from TNAU are elaborated as follows:

Early duration varieties for irrigated conditions

A good spectrum of varieties with preferred grain types are available for cultivation during *Sornavari/Kar/Kuruvai* and *Navarai/Summer* seasons in Tamil Nadu

CO 55

It is the first short duration superfine rice variety released from TNAU through participatory and accelerated evaluation approach as replacement for RNR 15048 to cater the quality demand of the high end market in rice. It is a derivative of ADT 43 and GEB 24, both of which are known for their fineness as well as cooking quality attributes. Interesting fact is that the release of CO 55 in 2021-22 (January 2022), a descendant of GEB 24 coincided with the centenary year of GEB 24 which is a noteworthy variety that had contributed for the development of several land mark varieties at national and International level. The variety has white short slender or super fine rice with desirable quality traits like high HRR (65.0%), cooking traits like desirable Linear Elongation Ratio (1.64), low Breadth-wise Elongation Ratio (1.37) intermediate amylose content and soft gel consistency. It produces an average grain yield of 6057kg/ha in 110-115 days which is 7.00 and 15.31 higher than ADT 53 and RNR 15048 respectively and will be a good alternate to CO 51 in terms of quality. CO 55 has semi dwarf plant stature with semi erect flag leaf and well exerted panicles. 1000 grain weight of paddy is 14.24g. It is moderately resistant to RTD. The distinguishable morphological traits of CO 55 are semi erect long flag leaf and super fine grains.

ADT 57

Released during January 2022, ADT 57 has medium slender grains with 1000 grain weight of 15.4g and quality characters are comparable to ADT 43. Derived from ADT(R) 45 and ACK 03002, it has a sturdy plant type with long and erect pale green flag leaves and just exerted panicles which are its key morphological traits. Its mean grain yield of 6502kg/ha is 12.0% higher than CO 51. The variety has high HRR of 60.6%, intermediate amylose content, soft gel consistency and LER of 1.6. It is resistant to blast and moderately resistant to stem borer and BPH.

CO 54

The variety CO 54 is a cross derivative of CB 04110/ CB 05501 with a duration of 115-118 days released in 2021. Its performance in terms of mean grain yield (6354 kg/ha) is 10.83 and 10.35 per cent higher over CO 51 and ADT 53. It has an erect habit with profuse tillering, dense panicles and medium slender grains with a 1000 grain weight of 15.44g. The flag leaf is erect at flowering and maturity. It is moderately resistant to BPH and blast, sheath rot and brown spot. It matures one week later than all other early maturing rice varieties.

ADT 55

Derived from ADT 43/ IRBB 60, the new variety ADT 55 released during 2020 is a three gene pyramided variety (*xa5*, *xa13* and *Xa21*) derived using marker assisted selection for bacterial blight resistance. It showed resistance to 11 pathogenic races of BB. Its average grain yield and potential yield is 5929kg/ha and 9206kg/ha respectively. It is an erect, semi dwarf, non-lodging with medium slender rice

ADT 53

It is a cross derivative of ADT 43 / JGL 384 released during 2018. The medium slender rice is rich in Zinc (26.06 ppm) and Iron (14.70 ppm) content. The average grain yield of this variety is 6334 kg/ha, while the potential yield recorded is 9875 kg/ha. The variety is moderately resistant to pests viz., BPH, leaf folder and diseases viz., blast, sheath rot and brown spot. 1000 grains weigh 14.5g and a golden wash will be present in the grains. Occasionally, terminal spikelets of the panicle show whitish outgrowth at its tip. Short erect boot leaf at flowering and angular at maturity.

CO 51

CO 51 is a high tillering semi-dwarf rice variety with open plant type, derived from cross, ADT 43 / RR 272-1745. It possesses intermediate panicle with completely filled grains and released in 2013 as a replacement for ADT 43. It has a mean grain yield of 6623 kg/ha. It produces medium slender white rice and 1000 grains of paddy weigh 16.0g. It is moderately

resistant to blast, BLB, RTD, BPH and GLH under artificial condition. It is notified in 13 states of our country.

TPS 5

The rice variety TPS 5 possessing medium bold rice is a derivative of the cross ASD16 / ADT37, both with bold grains. It matures in 120 days and has recorded a mean grain yield of 6300 kg/ha with 14.7 per cent increment over ASD16 during variety release. 1000 grain weight is 22.7g and suitable for Idli making. It has one week to 10 days extended duration than ASD 16 and ADT 37. It is moderately resistant to stem borer, leaf folder and hoppers. It is suitable for cultivation during *kar/late pishanam* seasons in Tamil Nadu. The flag leaf is long and semi-erect

Other well known long standing short duration varieties are two-in-one rice ADT 43 with good cooking quality and high yield, ADT (R) 45 with high yield, medium slender rice early maturing than ADT 43 and suitable for less water situations. The bold grain varieties are ADT 37 and ASD 16.

Varieties	Features
ADT 43	Open plant type, high tillering like IR 50, intermediate panicle
ADT(R) 45	Short angular flag leaf, tip curved grains, exposed panicles
ADT 37	Dark green flag leaf, compact dense panicles
ASD 16	Broad semi-erect to horizontal flag leaf, medium bold grains

Varieties suitable for single season wetlands

There is a specific season in August (Samba) where rice varieties are either direct seeded or transplanted in eight districts of Tamil Nadu and the crop is harvested during January coinciding with the harvest festival, after which crop rotation is practiced in rice fallows. The variety grown during this season is succumbed to heavy rains and low light intensity during the late vegetative phase. CR 1009 or Ponmani (short bold grains) or Savithri introduced from CRRI, Cuttack into Tamil Nadu by TRRI, Aduthurai is the ruling mega variety for the past four decades. Few varieties like ADT 44 with bold grains and ADT 50 with medium slender grains could not become popular.

The variety CR 1009 *Sub1* with the gene for submergence tolerance developed at IRRI was introduced by Paddy Breeding Station, Coimbatore and released during 2015 for these areas. It is almost similar to CR 1009 with on par yield of 5759 kg/ha in 155 days. It is supposed to impart tolerance for 14 days to submergence in vegetative phase. The plants are

5-10cm taller and the grain size is relatively larger compared to CR 1009. It is moderately resistant to brown spot, blast, brown plant hopper (BPH) and white backed plant hopper (WBPH).

Derived from BPT 5204 / I.W.Ponni and maturing in 155 to 160 days, ADT 51 is a new variety released during 2017 suitable for Thanjavur, Thiruvarur, Nagapattinam, Cuddalore, Pudukkottai, Trichy, Karur, Ariyalur and Perambalur Districts of Tamil Nadu. It is a high yielding variety with an average grain yield of 6533kg/ha and can perform better than CR 1009 and ADT 50 with a yield advantage of 9.8 and 12.7%. The potential yield of this variety is 10030kg/ha. The plant habit is medium tall, comparatively non-lodging, well exerted panicles with 150-200 grains per panicle. The rice is medium grade, white. The grains have high milling yield (70.3%) and head rice recovery (60.5%) and 1000 grains weigh 23.9g. Distinguishable morphological features of this variety are angular boot leaf and pale green leaves. It shows resistance for blast and moderate resistance to pests like leaf folder, stem borer, BPH and diseases like sheath blight and sheath rot.

Varieties suitable for *thaladi*/late samba in Delta and samba in non-Delta districts

ADT 54

Released in 2020, ADT 54 is a two- in one variety combining both high yield and quality on par with I.W.Ponni in the medium duration group. It is outperforming the earlier high yielding varieties in this group like ADT (R) 46 with long slender grains, CO (R) 50 with medium grains which are not very desirable for table purpose. The variety ADT 54 is a cross derivative of I.W. Ponni / Banskathi with a duration of 132 days. It is medium tall variety with semi-erect flag leaf, well exerted long panicles bearing approximately 350 filled grains/ panicle which contributes to its high yield. The crop will be attractive during flowering. The average yield of this variety is 6307 kg/ha which is 9.8 % and 11.2 % higher over BPT 5204 and ADT 49. The rice is medium slender with 1000 grain weight of 16.5g, good LER (1.6) and head rice recovery (63.1%). The physical and cooking qualities are on par with Improved White Ponni. It is moderately resistant to stem borer and blast.

CO 52

It is a derivative of the cross, BPT 5204 / CO (R) 50. Blast resistance in this variety was established through the presence of *pi54* gene. Mean grain yield of CO 52 is 6191 kg/ha with 11.3 and 8.1 per cent increase over BPT 5204 and CO (R) 49 respectively. It matures in 130-135 days. It possesses medium slender white rice, with a 1000 grain weight of 14.10g. It is a good replacement for the rice variety BPT 5204 due to its high linear elongation ratio (1.73) of cooked rice. The grains shatter during harvest. The variety is medium tall and the

canopy displays very long flag leaves hiding the panicles. The just curved tip of grains and long flag leaves are the characteristic features of this variety.

VGD 1

VGD 1 is a cross derivative of ADT43 and landrace *Jeeragasamba* with a crop duration of 125-130 days. It is an improvement of traditional *Jeeragasamba* well known for its small grains and special quality rice in our state. The drawbacks of tallness and lodging nature has been overcome in this new variety retaining the grain size and shape of *Jeeragasamba*. The variety is photo-insensitive, and plant type is semi-dwarf. The yield improvement of VGD 1 (5859 kg/ha) over *Jeeragasamba* is tremendous (32.6%). The grains are small, typical like *Jeeragasamba* with least 1000 grain weight of 8.9g. The rice upon cooking displays good LER (2.1 times) and has intermediate amylose (21.9%). Its head rice recovery is 62.1%. The cooked rice is non-sticky and soft and suitable for making briyani and khuska. Slightly aromatic due to the presence of 1,6,10,14-Hexa decatetraen-3-ol. It is moderately resistant to leaf folder, blast and brown spot.

TKM 13

TKM 13 is the cross derivative of WGL 32100 / Swarna, maturing in 128 days released during 2015 and suitable for late *thaladi* like ADT 39. It has translucent medium slender fine rice with lesser 1000 grain weight (13.5 g). The average grain yield of this variety is 5938 kg/ha which is 10.1 per cent increase over BPT 5204. It is moderately resistant to multiple pests and diseases *viz.*, leaf folder, stem borer, green leaf hopper, blast, rice tungro disease, brown spot and sheath rot. This variety has high milling yield (75.5%) and head rice recovery (71.7%) and is on par with the check variety BPT 5204. It matures 7-10 days earlier than BPT 5204.

CO (R) 50

CO (R) 50 derived using CO 43 / ADT 38 is a high yielding rice variety released both by CVRC (2009) as well as SVRC (2010) with a duration of 140 days. It is a new plant type (Ideotype) variety with medium tall stature, profuse tillering habit, sturdy culm, erect leaves and long panicles. It has medium grains with a 1000 grain weight of 20.5g. Key distinguishable morphological traits of CO (R) 50 are sturdy stem, long erect leaves, coarse grains and awns occasionally present in the spikelet (preferably in the spikelet present at the tip) of the secondary rachis.

The other popular varieties in seed chain in this group are ADT 39 with brown wash, medium slender grains, semi-dwarf plant type and Improved White Ponni with medium tall lodging habit and pale green horizontal leaves.

Early duration varieties for limited water conditions

TKM 15 released in 2022 and **CO 53** released in 2020 are suitable varieties for semi-dry/upland conditions. Generally, the varieties released so far possess either long bold or long slender grains. But the new varieties cater to our market demands in their grain type which is a break through. Both the varieties involve drought tolerant parents in their pedigree and mature between 115 and 120 days.

TKM 15 is a cross derivative of **TKM (R) 12 / IET 21620**. The grains are medium slender with 1000 grain weight of 15.0g, good milling (68 %) properties and head rice recovery (62.9 %). The plant type is semi-dwarf, with erect flag leaf at flowering and semi-erect at maturity, good tillering and non-lodging. It shows higher physiological efficiency under water stress due to the accumulation of higher proline content (2.15 mg/g), chlorophyll stability index (80.23 %) and total chlorophyll content (1.51 mg/g). On an average, it can yield 3995 kg/ha and 4217 kg/ha of grains under dry and semidry conditions respectively. Also, it shows moderate resistance to many diseases like blast, sheath rot, sheath blight, brown spot and RTD. The variety is suitable for Ramnad, Sivagangai, Thiruvallur, Chengleput, Kancheepuram, Pudukottai, Virudhunagar and Thoothukudi districts.

CO 53 possesses short bold white rice with a 1000 grain weight of 24.0g and suitable for idly making. It is medium tall in stature just like its parents **PMK(R)3** and land race *Norungan*. Its drought tolerant nature is due to better physiological efficiency and partial closure of stomata during water deficit conditions. It is specifically recommended for Ramanathapuram and Sivagangai districts but can also be grown as direct seeded semi dry or rainfed rice in water limited environments. Under dry conditions, its average grain yield is 3718 kg/ha and the yield advantage over **TKM (R) 12** and **Anna (R) 4** is 12.2 and 14.1% respectively. Under semi-dry conditions (3866 kg/ha), its yield advantage is 18.4 and 8.67% over the same checks. On quality aspects, the variety has 69.6% milling yield and 59.6% head rice yield. It is moderately resistant to multiple diseases viz., leaf blast, neck blast, sheath rot, brown spot and RTD and the insect WBPH. The key morphological feature of this rice variety is the presence of dirty brown furrows in the spikelets during flowering to milky stage, which gets faded away and becomes straw coloured at maturity. The flag leaf angle is semi-erect and the culm has exposed nodes.

Varieties for salt stress conditions

High yielding varieties suitable for cultivation in first season and second season (mid-early and medium duration) have been released for salt stress areas.

TRY 5

TRY 5, an early duration (105-112 days) saline tolerant rice variety is a mutant of TRY 2 and released during 2022. Its average grain yield under salinity/sodicity is 5113 kg/ha (12.64 % , 17.03 % , 16.7 % and 21.35% increase over TRY 2, ASD 16, ADT 45 and ADT 53 respectively). The grains are long slender with high milling (68 %) and head rice recovery (57 %). It is moderately resistant to blast, brown spot, BPH, WBPH and GLH.

TRY 4

The variety TRY 4 is the cross derivative of ADT 39 and CO 45 with duration of 125-130 days. Its average grain yield of 5730 kg/ha is 22.0 per cent increase over TKM 13, 16.5 per cent over ADT 39 and 7.0 per cent over TRY 3 under sodic/saline conditions. It produces medium slender white rice with high milling percentage (68.1%), good head rice recovery (57.2 %) and intermediate amylose content with good organoleptic characters. TRY 4 is the first saline tolerant rice variety from TNAU with medium slender grain type. Brown wash in the grains like that of ADT39 is the distinguishable trait of this variety. This variety has multiple resistance to major pests, leaf folder, stem borer and gall midge and to major diseases blast and brown spot. Suitable for cultivation in sodicity/saline patches of 11 districts namely Trichy, Ramanthapuram, Nagapattinam, Tiruvaur, Cuddalore, Tiruvallore, Thoothukudi, Tirunelveli, Krishnagiri, Dharmapuri and Salem of Tamilnadu during *thaladi*/late *thaladi* seasons.

TRY (R) 3

The parents are ADT 43 and *Jeeragasamba*. It is a medium tall rice variety with high tillering ability and matures in 130 -135 days. The grains are medium bold in shape and is highly suitable for 'Idli' making. Moderately tolerant to sodicity. It has high milling (71.3%), head rice recovery (66%) and high out turn of rice flakes (82.2 per cent). This variety is resistant to major pests *viz.*, leaf folder, stem borer and BPH and diseases *viz.*, blast, brown spot, sheath rot and sheath blight. It is suitable for *Samba*, Late *samba* and *Thaladi* seasons in Tamil Nadu.

2. Recent varieties of sorghum and their morphological features

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The world has been witnessing the vagaries of climate change in the form of rising sea levels, increased CO₂ and temperature levels, changing weather, ruinous droughts and floods. On the other side the global population is on the rise exponentially and there is a pressing need for increase the food production. Deployment of climate smart crops and breeding efforts into enhancing their resilience is the pragmatic solution. Nutri cereals are nutritionally rich group of millets comprising of sorghum, pearl millet, finger, foxtail, proso, barnyard, little and kodo millet. They are rich in protein, carbohydrates, vitamins, minerals and has low glycemic index. Quality seeds are the prime factor which plays a vital role in the production and productivity enhancement. It is imperative to know the special features and the distinguishing morphological features of the varieties / parents of the hybrids for quality seed production

1) Sorghum - CO 30

It is a high yielding dual purpose variety with improved stover quality. It matures in 100-105 days. The plant remains green at maturity and non-lodging. The average grain yield under irrigated conditions is 3360 kg/ha and 2800 kg/ha under rainfed situations. Under rainfed situation, it recorded a dry fodder yield of 6990 kg/ha and 9290 kg/ha under irrigated conditions. Grains are highly acceptable, white in colour, borne on medium cylindrical semi-compact ear heads. This variety is resistant to downy mildew and moderately resistant to shoot fly and stem borer and grain mould disease.

Distinguishing morphological characters- Sorghum CO 30		
Leaf sheath Pigment colour	:	Tan
Leaf length	:	Long
Leaf Midrib colour	:	White
Peduncle exertion	:	5.0 to 10.0 cm
Panicle shape	:	Symmetric
Panicle density	:	Semi compact
Glume colour	:	Straw
Glume size	:	1/4 grain covered
Seed colour	:	White
Seed size	:	Medium
Awn	:	Awnless
1000 grain weight (g)	:	28.3 g

2) Sorghum - CO 32

The dual purpose variety is a cross derivatives of APK 1 / M 35-1 and matures in 105 - 110 days. The grains are yellow white, borne on medium semi-compact ear heads. It gives mean yield of 3051 kg/ha (irrigated), 2231 kg/ha (rainfed) which is 10% higher than check CO 30. It has high protein (11.31-14.66%) and fibre content (5.8%) along with better cooking quality traits (Cooking grade 9). The stover quality is also best with 6.15 % protein and *in-vitro* dry matter digestibility of 54-58%. It possesses moderate resistance to shoot fly and stem borer pest and grain mould and downy mildew diseases. It is recommended for general cultivation in Tamil Nadu for both rainfed and irrigated condition.

Distinguishing morphological characters- Sorghum CO 32		
Leaf sheath Pigment colour	:	Yellow green
Leaf length	:	Long
Leaf Midrib colour	:	White
Peduncle exertion	:	5.0 to 10.0 cm
Panicle shape	:	Symmetric
Panicle density	:	Semi compact
Glume colour	:	Greyed orange to Greyed yellow
Glume size/length	:	Medium (75% of grain covered)
Seed colour after threshing	:	Yellow white
Grain Shape in dorsal view	:	Elliptic
Awn	:	Awnless
1000 grain weight (g)	:	16-25 g

3) Sorghum - K 12

It is a dual purpose sorghum variety, maturing in 95 days. It is a drought tolerant variety and recorded a mean yield of 3123 kg/ha of pearly white grains and 11.9 t/ha of dry fodder yield. The potential yield of 5300 Kg/ha was recorded in Senkottai of Tirunelveli District. This is a photo insensitive variety and moderately resistant to shootfly, stem borer and resistant to downy mildew. This variety is suitable for cultivation in rainfed vertisol tracts of Southern districts of Tamil Nadu and also suitable for summer irrigated tract of Tenkasi region.

1.	Year of Release	2015
2.	Pedigree	SPV 772 x S 35-29
3.	Plant height	225 -240 cm
4.	Mid rib colour	white
5.	Peduncle	Well exposed
6.	Ear head	Elongate, Semi compact

7.	Glume colour	Straw
8.	Glume size	Partially covered (40% of Grain)
9.	Seed colour	Creamy white
10.	Seed size	Spherical
11.	Anthercolour at dry	Orange
12.	Days to flowering	60-65 days
13.	Days to maturity	95 days
14.	Grain yield (kg/ha)	3123 kg/ha
15.	Straw yield (t/ha)	11.9 t/ha
16.	1000 grain weight	28.8 g

4) Forage sorghum – CSV 33MF

A multicut forage sorghum CSV 33MF was released by CVRC during 2017 at national level. It was derived from EMS mutant of CO (FS) 29. The variety has tall nature, thin stem, leafy and capable for multiple cuttings. First cut is at 65th day and subsequent cuts are at 45 days interval. It recorded green fodder yield of 1039.30 q/ha in three cuttings and 16.23 % higher than SSG 59-3 (National check). Similarly, it recorded dry fodder yield of 280.93 q/ha which is 13.10 % higher than SSG 59-3. It possess higher green fodder yield per day (7.36 q/ha) and dry fodder yield per day (2.0 q/ha). In addition to that CSV 33MF seed is non shattering type, recorded yield of 969 kg/ha and 1000 seed weight is 5.9 g. Besides, it is also having high tillering, regenerability score, IVDMD (52.29 %), TSS (6.65%), and low HCN content (66.73 ppm). It has, multiple disease resistance viz., resistant to leaf blight, anthracnose, rust and moderately resistant to downy mildew. It is also resistant to stem borer, midge and moderately resistant to mite and shoot fly. This variety was identified for *kharif* season in Haryana, Punjab, Uttarakhand, Uttar Pradesh, Gujarat, Rajasthan, Tamil Nadu, Karnataka and Maharashtra.

Distinguishing morphological characters- Forage Sorghum CSV 33MF	
Seedling: Anthocyanin colouration of coleoptile	Grayed Purple
Leaf sheath: Anthocyanin colouration	Grayed Purple
Leaf: Mid rib colour (5 th fully developed leaf)	Yellow green
Plant: Time of panicle emergence	Medium (66-75 days)
Plant: Natural height of plant up to base of flag leaf	Medium
Flag leaf: Yellow coloration of midrib	Absent
Flower with pedicel: Length of flower	Very long

Anther: Length	Short
Anther: Colour of dry anther	Grayed orange
Glume: Colour	Grayed purple
Plant: Total height	Long
Stem: Diameter (at lower one third height plant)	Small
Leaf: Length of blade (the third leaf from top including flag leaf)	Very long
Leaf: Width of blade (the third leaf from top including flag leaf)	Narrow
Panicle: Length without peduncle	Very long
Panicle: Length of branches (middle third of panicle)	Very long
Panicle: Density at maturity (ear head compactness)	Very loose
Panicle: Shape	Pyramidal
Neck of panicle: Visible length above sheath	Long
Glume: Length	Very long
Grain: Threshability	Difficult to thresh
Caryopsis: Colour after threshing	Greyed orange
Grain: Weight of 1000 grains	Very low (5.6 g)
Grain: Shape (in dorsal view)	Elliptic
Grain: Shape in profile view	Elliptic
Grain: Size of mark of germ	Small
Grain: Texture of endosperm(in longitudinal section)	Half vitreous
Grain: Colour of vitreous albumen	Grayed orange
Grain: Lusture	Non-lustrous

3. Recent varieties of Cumbu and their morphological features

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1) Cumbu- CO 10

The composite variety CO 10 was evolved by mixing and random mating of five elite, agronomically desirable inbred lines viz., PT6029, PT6033, PT6034, PT6039 and PT6047. The composite variety recorded a mean grain yield of 3526 kg/ha under irrigated and 2923 kg/ha under rainfed conditions with a duration of 85-90 days. It produces 4-6 productive tillers with mostly spindle shaped earheads. The grains are bold and grayish brown. It possess resistant to downy mildew. The protein content is high (12.07%).

Morphological characters of Composite CO 10	
Characters	CO 10
Growth habit	Erect
Plant height (cm)	160-180
No. of productive tillers	4 - 6
Leaf sheath pubescence	Absent
Days to 50% flowering	47 - 50
Anthercolour	Yellow
Node pubescence	Absent, occasionally present
Node pigmentation	Green
Internode pigmentation	Green
Spike exertion	Usually complete, rarely partial
Spike length(cm)	28 - 34
Spikelet glume pigmentation	Absent
Presence of bristles	Absent
Spike shape	Spindle , occasionally cylindrical
Spike tip sterility	Absent, rarely present
Spike density	Compact, rarely semi compact
Seed colour	Grey brown (Greyish yellow)
Seed shape	Elliptical
1000 seed weight (g)	12 -13

4. Recent varieties of Maize and their morphological features

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1) Maize hybrid- CO 6

It is a single cross hybrid which matures in 110 days. Under irrigated condition, this hybrid recorded a mean grain yield of 7359 kg/ha with 28.23, 10.56 and 8.17 per cent increased grain yield over the existing hybrid Co (H) M 5 (5739 kg/ha), 900 M (G) (6656 kg/ha) and NK 6240 (6803 kg/ha) respectively. Under rainfed conditions, it recorded a mean grain yield of 4906 Kg/ha with 16.56, 19.04 and 21.62 per cent increased grain yield over check viz., CoH (M) 5 (4209 kg/ha), 900 M (G) (4121 kg/ha) and NK 6240 (4034 kg/ha) respectively. The hybrid has exhibited multiple disease resistance against the diseases viz., sorghum downy mildew, *maydis* leaf blight, post flowering stock rot, banded leaf and sheath

blight. It is also moderately resistant to stem borer under field condition. It possesses special attributes such as high starch (76.30%), high protein (11.25%) and high beta-carotene (0.48 mg/100g) with moderate level of fat (4.65%) and crude fibre (1.25%). The grains are bold, orange yellow in colour and semi dent type. The cobs are fully covered with husk and recorded high shelling (81%) with high test weight (400 g/1000 seeds).The hybrid is suited for cultivation both under irrigated (June-July & November - December) and rainfed (September-October) conditions.

Chief botanic & morphological- agronomic description of parents UMI 1200 and UMI 1230 and hybrid CO 6 as per DUS guidelines

Morphological characters		UMI 1200 (Female)	UMI 1230 (Male)	Hybrid CMH08-282
Stem	:	Green	Green	Green
Stem: Anthocyanin colouration of brace root	:	Present	Present	Present
Plant : Length up to flag leaf		Long	Long	Long
Leaf: Anthocyanin colouration of sheath	:	Present	Present	Present
Leaf: Attitude of blade	:	Straight	Curved	Curved
Leaf: Width of blade	:	Narrow	Broad	Medium
Leaf Sheath pubescence	:	Sparse	Sparse	Sparse
Days to 50% pollen shed (days)	:	59 - 62	57- 59	58 - 62
Days to 50% silking (days)	:	60 - 63	59 -62	60 - 62
Tassel: Time of anthesis	:	Medium	Late	Medium
Tassel: Anthocyanin colouration at base of glume	:	Present	Present	Present
Tassel: Anthocyanin colouration of glumes excluding base	:	Present	Present	Present
Tassel: Anthocyanin colouration of anthers	:	Present	Present	Present
Tassel: Density of spikelets	:	Dense	Lax	Lax
Tassel: Angle between main axis and lateral branches	:	Small	Large	Large
Tassel: Attitude of lateral branches	:	Straight	Curved	Curved
Tassel: Number of primary and lateral branches	:	Few	Many	Many
Ear: Anthocyanin colouration of silks	:	Present	Slightly present	Present
Ear placement	:	Long	Long	Long
Ear: length of peduncle	:	Short	Short	Short
Ear: Length without husk	:	Medium	Medium	Long
Ear: Diameter without husk	:	Medium	Medium	Large
Ear: Shape	:	Cylindrical	Cylindrical	Cylindrical

Ear: Number of rows of grains	:	Medium	Medium	many
Ear: Type of grains	:	Dent	Flint	Semi dent
Ear: Colour of top of grains	:	Orange	Yellow	Orange yellow
Ear: Colouration of glumes of cobs	:	Light purple	White	Light purple
Kernel: Shape	:	Round	Round	Round to indented
Kernel: 1000 kernel weight	:	250 - 290 g	190 - 220 g	390 - 400 g
Husk coverage	:	Cobs fully covered with husk sheaths		

2) Maize hybrid – COH(M) 8

The hybrid CO 8 is a single cross (UMI 1201 x UMI 1230), high yielding maize hybrid and matures in 95-100 days. Under irrigated condition, this hybrid recorded a mean grain yield of 7500 - 8000 kg/ha. Under rainfed condition, it has recorded a mean grain yield of 5000 - 5500 kg/ha. The hybrid has exhibited multiple disease resistance. It is also moderately resistant to stem borer under field condition. It possesses special attributes such as high starch (76.3%) and high protein (11.12%) content. The grains are bold, orange yellow in color and semi dent type. The hybrid is suited for cultivation both under irrigated (June-July & Nov –Dec); rainfed (Sept– Oct) conditions.

Chief botanic & morphological- agronomic description of parents UMI 1201 and UMI 1230 and hybrid COH(M) 8 as per DUS guidelines

Morphological characters		UMI 1201 (Female)	UMI 1230 (Male)	Hybrid CMH08-292
Stem	:	Green	Green	Green
Stem: Anthocyanin colouration of brace root	:	Present	Present	Present
Plant : Length up to flag leaf		Long	Long	Long
Leaf: Anthocyanin colouration of sheath	:	Present	Present	Present
Leaf: Attitude of blade	:	Straight	Curved	Curved
Leaf: Width of blade	:	Narrow	Broad	Medium
Leaf Sheath pubescence	:	Sparse	Sparse	Sparse
Days to 50% pollen shed (days)	:	56 - 58	57- 59	50 – 55
Days to 50% silking (days)	:	58 - 60	59 -61	53 – 57
Tassel: Time of anthesis	:	Medium	Late	Medium
Tassel: Anthocyanin colouration at base of glume	:	Present	Present	Present
Tassel: Anthocyanin colouration of glumes excluding base	:	Present	Present	Present
Tassel: Anthocyanin colouration of anthers	:	Present	Present	Present

Tassel: Density of spikelets	:	Dense	Lax	Lax
Tassel: Angle between main axis and lateral branches	:	Small	Large	Large
Tassel: Attitude of lateral branches	:	Straight	Curved	Curved
Ear: Anthocyanin colouration of silks	:	Present	Slightly present	Present
Ear: length of peduncle	:	Short	Short	Short
Ear: Shape	:	Cylindrical	Cylindrical	Cylindrical
Ear: Number of rows of grains	:	Medium	Medium	Many
Ear: Type of grains	:	Dent	Flint	Semi dent
Ear: Colour of top of grains	:	Orange	Yellow	Orange yellow
Ear: Colouration of glumes of cobs	:	Light purple	White	Light purple
Kernel: Shape	:	Indented	Round	Round to indented
Kernel: 1000 kernel weight	:	250 - 290 g	190 - 220 g	380 - 400 g
Husk coverage	:	Cobs fully covered with husk sheaths		

5. Improved varieties of nutria cereals

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Athiyandal

1) Ragi- ATL 1

The variety ragi ATL 1 is a cross derivative between TNAU 900 x CO(Ra) 14. It is an early duration culture and matures in 105 – 110 days. The average grain yield of this variety is 3128 kg/ha under irrigated and 2879 kg/ha under rainfed conditions. This variety has 8 - 9 incurved fingers per earhead and 5 – 6 productive tillers per plant. This variety possesses an easy threshability, synchronized maturity and non-lodging growth habit. It is rich in protein (11.9 %) and calcium (325mg/100g) with the high flouring capacity (92 %) and low residual weight (8 %). This variety is moderately resistance to leaf, neck and finger blasts. It is recommended for cultivation during *kharif* season as rainfed crop in Erode, Salem, Dharmapuri and Krishnagiri districts and as irrigated crop during summer in Thiruvannamalai and Vellore districts of Tamil Nadu.

Sl. No.	Characteristics	Ragi ATL 1
1.	Plant: Growth habit	Erect
2.	Plant pigmentation at leaf juncture	Present
3.	Leaf sheath Pubescence	Absent
4.	Days to 50% flowering	Early (< 55)
5.	Glume: Colour	Dark Green

6.	Stem: Culm Branching	Absent
7.	Flag Leaf Blade Length (cm)	Short (< 15.0)
8.	Flag Leaf Blade Width (cm)	Wide
9.	Peduncle:Length (cm)	Short (10.0 – 20.0)
10.	Ear : shape	Compact
11.	Finger : Branching	Absent
12.	Finger : Multiple whorl	Absent
13.	Ear head length (cm)	Short (4.0 – 6.0)
14.	Finger : Length (cm)	Short (<5)
15.	Finger : Width (cm)	Wide
16.	Finger : Number on main ear	High
17.	No. of Productive tillers/plant	Medium
18.	Plant: height at maturity(cm)	Medium
19.	Seed: Shattering	Absent
20.	Seed : Covering by Glumes	Intermediate
21.	Seed: Colour	Dark brown
22.	Seed : Shape	Round
23.	Seed : Surface	Smooth
24.	Pericarp : Persistence after threshing	Non Persistent
25.	1000 – grain weight (g)	High

2) Kudiraivali- MDU 1

It is a pure line selection of Arupukkottai local. It is a high yielding variety with high tillering capacity, high milling per cent and yellowish grey colour grain with good nutritional quality. It matures in 95-100 days and is suitable for *Kharif*, *Rabi* and summer seasons of Tamil Nadu. The variety recorded a mean grain yield of 2284 kg / ha over three years of station trials with 30% improved yield over CO(Kv)2. In MLT, 2012-13, the mean grain yield and fodder yield was 2677 kg/ha and 2984 kg/ha, respectively which was 15.8% and 23 per cent higher than the check CO(Kv)2. The variety is resistant to shoot fly, stem borer and smut.

- Non pigmented stem
- White color stigma
- Brownish grey seeds
- Compact and pyramidal shaped earhead

Sl. No.	Characteristics	MDU 1
1	Plant Growth habit	Erect
2	Basal tillers Number	High
3	Days to 50% flowering	Late
4	Plant Pigmentation at internodes and leaf sheath	Absent
5	Flag Leaf Blade Length (cm)	Medium
6	Flag Leaf Blade Width (cm)	Wide
7	Peduncle Length (cm)	Short
8	Inflorescence Shape	Pyramidical
9	Inflorescence Colour	Green
10	Panicle Compactness	Compact
11	Spikelet Arrangement on the rachis	Surrounded
12	Lower racemes : Shape	Straight
13	Lower racemes : Thickness	Slender
14	Lower racemes : Branching	Absent
15	Culm Branching	Present
16	Lower raceme length (cm)	Medium
17	Panicle Length (cm)	Long
18	Plant Height (cm)	Very Tall
19	Seed Shattering	Absent
20	Lodging	Absent
21	Grain Colour	Light Grey
22	Grain Shape	Oval
23	1000 grain weight (g) at 12% moisture content	High

3). Tenai-ATL 1

It is a cross derivatives of PS 4 x ISe 198 and matures in 80 - 85 days. It recorded average yield of 2117 kg/ha grain and 2785 kg/ha fodder which is 9.80% and 14.8% higher than CO(Te)7. It has bold grain with high bulk density, non shattering and high milling out turn (68.1%). This variety has nutritionally rich grain and straw. The plant has sturdy culm, uniform maturity with non-lodging trait which is ideal for mechanized harvesting. This variety possesses high tillering ability, drought tolerant, fertilizer responsive and no serious pest and disease occurrence.

Sl. No.	Characteristics	Tenai ATL 1
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1	Plant: Growth habit	Erect
2	Leaf: Colours	Green
3	Plant: Pigmentation at auricle	Absent
4	Leaf: Attitude	Droopy
5	Leaf Sheath Pubescence	Absent
6	Leaf Sheath: Intensity of Pubescence	Low
7	Leaf Blade: Pubescence	Present
8	Flag Leaf Blade Length (cm)	Medium
9	Flag Leaf Blade Width (cm)	Medium
10	Days to 50% flowering	Medium
11	Inflorescence Shape	Oblong
12	Inflorescence: Bristles	Present
13	Inflorescence: vLength of bristles	Short
14	Peduncle: Length (cm)	Medium
15	Inflorescence: Apical sterility	Absent
16	Inflorescence: Compactness	Compact
17	Inflorescence: Lobes	Present
18	Plant Height at maturity (cm)	Medium
19	Number of Productive tillers per plant	Moderate
20	Earhead: Length(cm)	Medium
21	Seed : Colour	Brown
22	Grain Shape	Elliptical
23	1000 grain weight (g)	High

4) Varagu- ATL 1

This variety is a pure line selection from DPS 63. It has recorded 2506 and 4394 kg/ha of grain and straw yield respectively under rainfed condition with duration of 105-110 days. It has strong and sturdy culm with regular, long and open panicles. The plant stature is medium tall and tufty. It is drought tolerant. The plant has 10-15productive tillers and non-shattering grains. This variety possesses easy threshability, synchronized maturity and non-lodging growth habit. The grains are bold and attractive light brown in colour. The grains are nutritious with preferred grain qualities for cooking and value addition. The nutrient rich straw is palatable and highly suitable for cattle feeding. In general, there is no serious pest and disease problem in Varagu. However, this culture is tolerant to shoot fly incidence and occurrence of grain smut and sheath blight diseases under field and controlled conditions.

Sl. No.	Characteristics	Varagu ATL 1
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1	Plant: Growth habit	Erect
2	Basal tillers: Number	High
3	Leaf : Attitude	Erect
4	Days to 50% flowering	Medium
5	Leaf Sheath Pigmentation	Absent
6	Leaf juncture: Pigmentation	Absent
7	Inter node: Pigmentation	Absent
8	Leaf blade: Pigmentation	Absent
9	Flag Leaf Blade Length (cm)	Short
10	Flag Leaf Blade Width (cm)	Medium
11	Peduncle: Length (cm)	Medium
12	Panicle Appearance	Open
13	Panicle Exertion	Complete
14	Spikelet: Arrangement on rachis	Regular
15	Spikelet: Irregular rows number	-
16	Spike: Branching	Absent
17	Spike: Curvature	Straight
18	Spikelet: Density	Dense
19	Culm: Branching	Low
20	Panicle : Length (cm)	Long
21	Thumb raceme : Length (cm)	Long
22	Raceme: Length (cm)	Long
23	Raceme: Number (Above thumb)	Medium
24	Glume: Space between Nerves	Narrow
25	Plant: Height (cm)	Tall
26	Lodging	Absent
27	Seed: Shattering	Absent
28	Grain: Colour	Light Brown
29	Grain : Shape	Elliptical (2)
30	1000 – grain weight (g) at 12% moisture content	Medium

5). Samai - ATL 1

The samai ATL 1 is a cross derivative of CO (Samai) 4 / TNAU 141 with a duration of 85-90 days. It recorded an average yield of 1587 and 3109 kg/ha of grain and straw under rainfed condition. It has recorded 11.2% and 13.7% increased grain and 11.85 and 14.4% increased straw yield over the checks, CO (Samai) 4 and Paiyur 2 respectively. The panicles are long and semi-compact with non-shattering grains. The variety is Input responsive. The

sturdy culm and uniform maturity with non-lodging trait aid for mechanized harvesting. Highly drought tolerant with no serious pest and disease occurrence. It has got bold grains with high bulk density. High milling out turn (66.3%) and suitable for value addition with consumer preference.

- dark green stem
- Semi compact panicles
- Golden yellow grains

Sl. No.	Characteristics	Samai ATL 1
1	Plant Growth habit	Decumbent
2	Basal tillers Number	Low
3	Days to 50% flowering	Late
4	Plant Pigmentation at leaf sheath	Absent
5	Leaf Sheath Pubescence	Absent
6	Ligule Pubescence	Present
7	Leaf Blade Pubescence	Absent
8	Inflorescence Shape	Arched
9	Peduncle Length (cm)	Long
10	Flag Leaf Blade Length (cm)	Long
11	Flag Leaf Blade Width (cm)	Medium
12	Culm Branching	Absent
13	Panicle Length (cm)	Long
14	Panicle Compactness	Intermediate
15	Lodging	Absent
16	Plant Height (cm)	Tall
17	Seed Shattering	Absent
18	Grain Colour	Golden yellow
19	Grain Shape	Oval
20	1000 grain weight (g) at 12% moisture content	Medium (2.0-3.0)

5. High yielding varieties of pulses and their morphological features

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Blackgram

CO 7: CO 7 is a hybrid derivative of VBN(Bg) 5 x *V. mungovarsilvestris* (22/10) and matures in 60 - 65 days. This variety recorded the mean yield of 881 kg/ha which is 12.1 , 12.4 and 14.4 *per cent* increase over the check varieties *viz.*, CO 6 (786 kg/ha) , VBN 6 (784 kg/ha) and VBN 8 (770 kg/ha), respectively. It is determinate plant type with synchronized maturity and suitable for single/mechanical harvest. This variety is resistant to yellow mosaic disease and moderately resistant to leaf crinkle and stem necrosis diseases. It has bold seed with 100 seed weight ranging from 5.5 - 6.0 g. It contains 22.3 *per cent* protein with good batter and organoleptic traits. Petiole colour is green with purple splashes. Drum shaped dull black seeds. It is recommended for cultivation during Adipattam (June – July) and Puratasipattam (September - October) seasons of Tamil Nadu.

MDU 1: It is a cross derivative of ADB 2003 x VBG 66 with a duration of 70-75 days. The average yield is 791kg/ha. It is moderately resistant to YMV and pod borer. It is resistant to leaf crinkle virus. It has good batter quality with 7.5% arabinose and 12.1% Globulin. It is hairy plant with long hairy pods. The seeds are bold blackish brown with dull hilum. It is suitable for *rabi* season (September – October).

ADT 6: It is a cross derivative of VBN 1 x VBG-04-006 with a duration of 65-70 days. The average yield is 741kg/ha. It has moderate resistance to Yellow Mosaic virus, Leaf Crinkle virus and Powdery mildew disease. The average protein content is 21.6% and arabinose of 5.7%. The plant type is tall and semi erect. This is suitable for rice fallow condition.

VBN 8: It is a cross derivative of VBN 3 x VBN 04-008 for a duration 65-75 days. The average yield is 900 kg/ha. It has synchronous maturity and non shattering pods. It is resistant to YMV and leaf crinkle virus. It has protein content of 21.9% and arabinose of 7.5%. Light purple wash on the basal portion of plant as well as petiole and the colour of ventral suture of immature pod is dark green with dense hairs. Matured pod is black colour with pubescence. It has dull, black colour and oval shaped seeds. It is suitable for all seasons.

VBN 9: It was derived from Mash 114 x Vamban 3 with duration of 70-75 days. It has average yield of 1230kg/ha. It has synchronized maturity and moderate resistance to MYMV, leaf crinkle, leaf curl and powdery mildew diseases. It has a protein content of 22.68%. Semi erect determinate plant type and stem colour is purple with green splashes. Leaf vein and

petiole colour is purple. Matured pods are black with pubescence. Seeds are dull black with oval shape. It is suitable for rice fallow condition in South Zone.

VBN 10 : It was derived from Vamban 1 x UH 04-04 with a duration of 70-75 days. It has yield of 1130kg/ha. It has synchronized maturity and resistant to MYMV, leaf crinkle and leaf curl virus diseases. Pubescent stem having purple and green splashes. Terminal leaflet is cuneate. Leaf vein and petiole colour is green. Matured pods are black with pubescence. Seeds are dull black with oval shape. It is suitable for rabi season cultivation in South Zone.

VBN 11: It is a cross derivative of PU 31 x CO 6 with a duration of 70-75 days. The yield is 860kg/ha in rainfed and 940kg/ha in irrigated condition. Resistant to MYMV and moderately resistant to powdery mildew diseases. It has a protein content of 22.6%.The stem is green with purple colour having pubescence. The terminal leaflet is lanceolate. The colour of the leaf vein and petiole is green. Pod colour is green at premature stage. At maturity black pods with pubescence and has black, dull and oval seeds. It is suitable for all seasons.

Greengram

CO 7: It is derived from MGG336 x CO GG 902 with the duration of 60-65 days. Yield under rainfed condition is 978 kg/ha and 1300 kg/ha under irrigated condition. It has protein content of 25.2%.It is having the special features viz., shiny bold seeds, synchronized maturity and moderately resistant to stemfly. Medium bold green shiny seeds, compound, lanceolate, dark green leaves. It is suitable for *kharif* season in South Zone.

CO 8: It is a cross derivative of COGG 923 x VC 8040A having the duration of 55- 60 days. It average yield is 845 kg/ha and is determinate with synchronized maturity. Suitable for single / mechanical harvest.Moderately resistant to MYMV and stem necrosis diseases. Moderately resistant to sucking pests like aphids and stem fly. The seeds are dull green and small sized.

VBN 4: It is derived from PDM 139 x BB 2664 with a duration of 65-70 days. It is high yielding with yield of 1024kg/ha. It is multiblooming and non shattering with moderate resistance to MYMV and powdery mildew and resistant to urdbean leaf crinkle virus disease. It has a protein content of 23.35%. The plant type is semi erect, determinate and large ovate leaves. Pods are pubescent and present above the plant canopy. The seeds are dull green and drum shaped. It is suitable for all season.

VBN 5: It is derived from VBN (Gg) 2 x ML 1451 with a duration of 70-75 days. It is high yielding with yield of 878 kg/ha. It is multiple blooming nature and non shattering. It is resistant to Mungbean Yellow Mosaic Virus (MYMV) and Urdbean Leaf Crinkle Virus

(ULCV) diseases. It has a protein content of 22.85 %. It has large trilobed and dark green leaves. The pods are positioned above canopy. Shiny green seeds with drum shape. It is suitable for all seasons

Redgram

CO (Rg) 7: This variety is a selection from PB9825 and released during 2004 with an average yield of 1023 kg/ha and a duration of 120-130 days. It is photo insensitive, bold seeded and moderately resistant to SMD. It has a protein content of 23.8%. This variety is having indeterminate growth habit. Flower colour is yellow and immature pod have green with purple streaks and the mature pod is brown in colour. Seed colour is reddish brown and globose in shape. Recommended for cultivation in South zone of the country during *khariif*, *rabi*, winter irrigated and summer irrigated.

CO 8: This variety is the cross derivative of APK 1x LRG 41 with a duration of 175-180 days . The variety recorded an average grain yield of 1600 kg/ha under rainfed condition and 1800 kg/ha under irrigated condition with a yield increase of 19 percent over CO 6 and 22 percent over VBN 2. Drought tolerant CO 8 variety is resistant to Sterility Mosaic Disease, root rot and moderately resistant to pod borer. Erect branching and indeterminate growth habit. Colour of standard petal is yellow and medium pattern of streaks are present. Pod colour is green with brown streaks and surface stickiness is present on the pod. Seed is cream in colour and globular shape. The 100 seed weight is 10.2 to 11.4g. The redgram variety CO 8 released for general cultivation in Tamil Nadu during 2017 for Aadipattam.

CO 9: Pigeonpea variety CO 9 (CRG 2012-25) is a cross derivative of CO 6 x IC 525427. It is a medium duration (170-180 days) variety and has exhibited an average yield of 1700 kg/ha which is 19% superiority over the best national check WRP-1, 17.58% and 14.61% over zonal checks CO 6 and ICP 8863 respectively. This variety is moderately resistant to SMD and wilt diseases and moderately resistant to pod fly and *Maruca* pests. Erect branching and indeterminate growth habit. Colour of standard petal is yellow and medium pattern of streaks are present. Pod colour is green with brown streaks and surface stickiness is present on the pod. It is released for cultivation in south zone during 2018.

Cowpea

CO (Cp) 7 : This variety is a gamma mutant of CO 4 (20 Kr) and released during 2002. This variety has an average yield of 1149 kg/ha. It is resistant to pod borer. Seeds are square shaped brownish white and with 12-14 g/100 seed weight. It has green and glabrous pods and

square shaped and brownish white seeds. Leaves are ovate, trifoliate, entire, green and glabrous. It is recommended for cultivation in South zone of the country.

VBN 3: This variety is a pedigree selection from the cross TLS 38 x VCP 161 with a duration of 75-80 days. It has yield of 1000kg/ha in rainfed condition, It is a semi erect determinate type with synchronized maturity and light brown grains. It is resistant to pod borer, pod bug, rust, anthracnose and bean common mosaic virus. Creamy yellow glabrous pods at maturity and has light brown, dull and kidney shaped seeds. It is suitable for sowing in (Purattasipattam) September to October

Chickpea

CO 4: This variety derived from ICC 42 x ICC 12237 with the duration of 80-85 days. Yield under rainfed condition is 1150 kg/ha. Attractive desi bold grains (30-32 g/100 seeds), tolerant to root rot disease. Erect petiole and light green leaves. Seeds are creamy yellow with brown hilum. It has compound trifoliate leaves. Compressed axillary raceme with pink flowers is found. It is suitable for *rabi* season.

6. Improved varieties in groundnut and their morphological features

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Groundnut VRI 9 (SVRC 2022)

The Groundnut variety VRI 9 is a cross derivative between VG 0420 and VRIGn 6. It matures in 110-115 days and suitable for cultivation in *Kharif* and *Rabi* seasons. During *Kharif* season, VRI 9 has performed well by producing 2526 kg/ha of dry pod yield. The yield increase was 13.3 and 14.1 *per cent* over the best check varieties TMV 14 (2230 kg/ha) and VRI 8 (2213 kg/ha) respectively. In *Rabi* season, VRI 9 has registered an overall mean dry pod yield of 2921 kg/ha with 10.5 and 18.8 *per cent* increase over TMV 14 (2644 kg/ha) and VRI 8 (2459 kg/ha) respectively. This variety is suitable for rainfed (Chithiraipattam, Adipattam, Aippasipattam) and irrigated (Margazhipattam and Masipattam) cultivation. Groundnut VRI 9 has the special features of Absence of pod beak and Shallow pod constriction. Oil content is 48-50%.

MORPHOLOGICAL CHARACTERS of GROUNDNUT VRI 9

I. MORPHOLOGY			
1.	Life- form	:	Annual
2.	Growth habit	:	Erect
II. STEM			
1.	Branching pattern	:	Sequential
2.	Number of branches	:	
	a. Primary		5-9
	b. Secondary	:	3-5
3.	Height of main stem(cm)	:	40-45
4.	Plant width or spread(cm)	:	40-50
5.	Stem pigmentation	:	Absent
6.	Stem surface	:	Sparse hairs along the main stem
III. INFLORESCENCE AND FLOWER			
1.	Type of inflorescence	:	Compound (2-3 flowers per axil)
2.	Standard petal colour		Standard petal orange to yellow color
3.	Colour of standard petal markings	:	The standard crescent has dark red lines radiating from the base to the periphery of the standard petal
4.	Peg pigmentation	:	Present
IV. LEAF			
1.	Leaf color	:	Green
2.	Leaf length(mm)	:	33-42

3.	Leaflet width (mm)	:	14-22
4.	Leaflet shape	:	Elliptical
5.	Leaflet surface		Sparsely hairy
6.	Leaflet margin	:	Hairy
7.	Leaflet tip	:	Obtuse or some time acute
V. POD			
1.	No. of seeds / pod	:	1-2
2.	Pod beak	:	Absent
3.	Pod constriction	:	Shallow
4.	Pod reticulation	:	Prominent
5.	Pod length (mm)	:	24-28
6.	Pod width (mm)	:	12-14
VI. SEED			
1.	Seed color	:	One color
2.	Primary seed color	:	Rose
3.	Secondary seed color	:	Tan
4.	Seed length (mm)	:	13-16
5.	Seed width (mm)	:	8-10
6.	100 kernel weight (g.)	:	45-50
VII. MATURITY			
1.	Days to seedling emergence	:	5-6 days
2.	Days to 50% flowering	:	28-32 days
3.	Days to maturity	:	110-115 days

Groundnut VRI 10 (SVRC 2022)

Groundnut variety VRI 10 is a cross derivative between VRI 2 and NRCG CS 349. It matures in 90-95 days and suitable for cultivation in *Kharif* and *Rabi* seasons. During *Kharif* season, VRI 10 has performed well by producing 2535 kg/ha of dry pod yield. The yield increase was 10.8 and 26.0 *per cent* over the best check varieties TMV 14 (2289 kg/ha) and GG 7 (2010 kg/ha) respectively. In *Rabi* season, VRI 10 registered an overall mean dry pod yield of 2448 kg/ha with 16.2 and 22.0 *per cent* increase over TMV 14 (2107 kg/ha) and GG 7 (2007 kg/ha) respectively. This variety is suitable for rainfed (Chithiraipattam, Adipattam, Aippasipattam) and irrigated (Margazhipattam and Masipattam) cultivation. Groundnut VRI 10 has the special feature of Spanish bunch, early maturity, Medium pod constriction, Prominent pod beak, and Rose colour testa. Oil content is 46-48%.

MORPHOLOGICAL CHARACTERS of GROUNDNUT VRI 10

I. MORPHOLOGY			
1.	Life- form	:	Annual
2.	Growth habit	:	Erect
II. STEM			
1.	Branching pattern	:	Sequential
2	Number of branches	:	
	a. Primary		4-8
	b. Secondary	:	1-3
3	Height of main stem(cm)	:	45-55
4	Stem pigmentation	:	Absent
5	Stem surface	:	Sparse hairs along the main stem
III. INFLORESCENCE AND FLOWER			
1.	Type of inflorescence	:	Compound (2-3 flowers per axil)
2.	Standard petal colour		Standard petal orange to yellow color
3.	Colour of standard petal markings	:	The standard crescent has dark red lines radiating from the base to the periphery of the standard petal
4.	Peg pigmentation	:	Absent
IV. LEAF			
1.	Leaf color	:	Light Green
2.	Leaf length(mm)	:	41-55
3.	Leaflet width (mm)	:	20-28
4.	Leaflet shape	:	Elliptical
5.	Leaflet surface		Sparsely hairy
6.	Leaflet margin	:	Hairy
7.	Leaflet tip	:	Obtuse or some time acute
V. POD			
1.	No. of seeds / pod	:	1-2
2.	Pod beak	:	Prominent
3.	Pod constriction	:	Medium
4.	Pod reticulation	:	Prominent
5.	Pod length (mm)	:	25-30
6.	Pod width (mm)	:	10-15
VI. SEED			
1.	Seed color	:	One color
2.	Primary seed color	:	Rose
3.	Secondary seed color	:	Tan
4.	Seed length (mm)	:	12-16
5.	Seed width (mm)	:	5-8
6.	100 kernel weight (g.)	:	48-55
VII. MATURITY			

1.	Days to seedling emergence	:	5-6 days
2.	Days to 50% flowering	:	23-25 days
3.	Days to maturity	:	90-95 days

Groundnut BSR 2 (SVRC 2019)

Groundnut variety BSR 2 is a cross derivative between TMV 2 and TVG 0004. It matures in 105-110 days and suitable for cultivation in *Kharif* and *Rabi* seasons. BSR 2 registered 2360 kg/ha and 2222 kg/ha dry pod yield in irrigated and rainfed condition respectively. It is moderately resistant to LLS and Rust apart from pests like apids, thrips, jassids and defoliaterd. Medium size kernels possessing oil content of 45 % and shelling percentage of 70.2.

MORPHOLOGICAL CHARACTERS of GROUNDNUT BSR 2

1	Plant habit		
1.1	Life form	:	Annual
1.2	Growth habit	:	Erect (Spanish bunch)
2	Stem characters		
2.1	Branching pattern	:	Irregular with flowers on main stem
2.2	No. of branches	:	Primary : 4-6 Secondary : 6-9
2.3	Plant height (cm)	:	45-49
2.4	Stem pigmentation	:	Absent
2.5	Stem surface	:	Subglabrous
3.	Leaf characters		
3.1	Leaflet shape	:	Wide elliptic
3.2	Leaflet size	:	Medium
3.3	Leaf colour	:	Green
3.4	Leaf pubescence	:	Almost glabrous on both sides
3.5	Leaflet margin	:	Entire
3.6	Leaflet tip	:	Obtuse
4.	Pod characters		
4.1	Pod beak	:	Slight
4.2	Pod size	:	Medium
4.3	Kernel nature	:	Two seeded rarely one seeded
4.4	Constriction	:	Slight
4.5	Reticulation	:	Moderate
4.6	Shelling out-turn (%)	:	70.2
5.	Kernel characters		
5.1	Kernel size	:	Medium
5.2	Testacolour	:	Tan
5.3	100-kernel weight (g)	:	40 - 43 (Medium)

6.	Maturity		
6.1	Days to emergence	:	6-7 days
6.2	Days to 50% flowering	:	24-27 days
6.3	Days to maturity	:	105-110 days

Groundnut VRI 8 (SVRC 2016)

Groundnut variety VRI 8 is a cross derivative between ALR 3 and AK 303. It matures in 105-110 days and suitable for cultivation in *Kharif* and *Rabi* seasons. VRI 8 registered 2700 kg/ha and 2130 kg/ha dry pod yield in irrigated and rainfed condition respectively. It is moderately resistant to LLS and Rust with shelling percentage of 70. Medium bold kernels possessing oil content of 49 %.

MORPHOLOGICAL CHARACTERS of GROUNDNUT VRI 8

I. MORPHOLOGY			
1.	Life- form	:	Annual
2.	Growth habit	:	Decumbent-3
II. STEM			
1.	Branching pattern	:	Sequential
2	Number of branches	:	
	a. Primary		5-8
	b. Secondary	:	5-10
3	Height of main stem(cm)	:	55-60
4	Stem pigmentation	:	Absent
5	Stem surface	:	Sub-glabrous, hairs in one or two rows along the main stem
III. INFLORESCENCE AND FLOWER			
1.	Type of inflorescence	:	Compound (2-3 florets in axil)
2.	Standard petal colour		Standard petal orange-yellow colour.
3.	Colour of standard petal markings	:	mild orange streaks
4.	Peg pigmentation	:	Absent
IV. LEAF			
1.	Leaf color	:	Green
2.	Leaf length(mm)	:	70.2
3.	Leaflet width (mm)	:	28.5
4.	Leaflet shape	:	Lanceolate
5.	Leaflet surface		Almost glabrous on both surfaces
6.	Leaflet margin	:	Hairy
7.	Leaflet tip	:	Obtuse
V. POD			
1.	No. of seeds / pod	:	2-1-3
2.	Pod beak	:	Moderate

3.	Pod constriction	:	Moderate
4.	Pod reticulation	:	Prominent
5.	Pod length (mm)	:	29.6
6.	Pod width (mm)	:	14.9

VI. SEED			
1.	Seed color	:	One color
2.	Primary seed color	:	Rose
3.	Secondary seed color	:	Tan
4.	Seed length (mm)	:	15-17
5.	Seed width (mm)	:	7-8
6.	100 kernel weight (g.)	:	44.0 – 50.0
VII. MATURITY			
1.	Days to seedling emergence	:	6-7 days
2.	Days to 50% flowering	:	28-32 days
3.	Days to maturity	:	105-110 ys

7. Improved varieties in sesame and their morphological features

Dr.A.Mahalingam

Regional Research Station, Vridhachalam

VRI 3 (2017)

White seeded sesame variety VRI 3 is a cross derivative between SVPR 1 x TKG 87 and suitable for *Rabi / summer* seasoncultivation.It matures in 75-80 days. Average seed yield of VRI 3 is 975 kg/ha during Rabi season and 1055kg/ha during summer seasons. It is moderately resistant to *Macrophomina* root rot and phyllody diseases. Oil content is 51%. Sesame VRI 3 is having the distinguishable feature of Cream seed coat colour and White colour corolla with purple lip.

MORPHOLOGICAL CHARACTERS of Sesame VRI 3

1	Name of Cultivar	VRI 3
2	Species	<i>Sesamum indicum</i> L
3	Pedigree/ percentage	SVPR 1 x TKG 87
4	Year of Identification	2018
5	Notification –No./Date	-
6	Description of variety / Hybrid	
	1. Seed coat colour	Cream
	2. Stem colour	Green
	3. Stem pubescence	Sparse
	4. Stem shape	Square

	5. Leaf arrangement	Alternate
	6. Leaf colour	Green
	7. Leaf shape	Linear
	8. Leaf angle	Horizontal
	9. Petal colour	Light purple
	10. Petal hairiness	Sparse
	11. Flowers /axil	One
	12. Capsule shape	Narrow oblong
	13. Capsule hairiness	Sparse
	14. Capsule length	1.5 to 2.5 cm
	15. Branching habit	Top and profuse branching
	16. Days to flowering (50%)	32 – 35 days
	17. Plant height (cm)	90-120 cm
	18. Oil Content	50-51 %
7	Identification Distinguishing Morphological Characters	Cream seed coat colour and White colour corolla with purple lip
8	No. of Days to Maturity	75-80 days
9	Reaction to Major Pests & Diseases	Moderately resistant to <i>Macrophomina</i> disease with disease incidence of 16 <i>per cent</i> and moderately resistant to Shoot webber cum capsule borer pests.
10	Quality of produce	The sesame variety VRI 3 is having 50-51 <i>per cent</i> oil content.
11	Area of Adaptation	For cultivation in the irrigated tracts of summer and rabi seasons in Tamil Nadu
12	Production Conditions	Irrigated and rainfed condition
13	Seed yield (kg/ha) Potential/Average	995 kg/ha (Rabi) 1055 kg/ha (Summer)

VRI 4 (CVRC 2022)

Brown seeded sesame variety VRI 4 is a cross derivative between VRI Sv 2 x GT 10 and suitable for *Rabi / summer* seasoncultivationin all zones of India and matures in 85-90 days. Average seed yield of VRI 4 is 957 kg/ha which is 11.0 and 14.5 *per cent* increased seed yield over national check varieties TKG 22 (852 kg/ha) and GT 10 (818 kg/ha) respectively. Average Oil yield is 380 kg/ha which is 8.0 and 11.6 *per cent* increased oil yield over national check varieties TKG 22 (350 kg/ha) and GT 10 (336 kg/ha) respectively. It is moderately resistant to *Macrophomina* root rot and phyllody diseases. Based on the increased seed and oil yield and resistance to diseases and pests, VS 13-006 was released as VRI 4 for *rabi / summer* season cultivation in all zone of India during 2022 through CVRC.

MORPHOLOGICAL CHARACTERS of Sesame VRI 4

1	General	
1.1	Name of the variety	: VS 13-006
1.2	Pedigree	: VRI Sv 2 x GT 10
1.3	Year of development	: 2013
1.4	Year of identification	: 2022
1.5	Origin (Name of the Institute)	: Regional Research Station, Tamil Nadu Agricultural University, Vriddhachalam– 606 001, Cuddalore District, Tamil Nadu
2	Habit	
2.1	Plant growth type	: Indeterminate
2.2	Plant growth habit	: Semi erect
3	Stem characters	
3.1	Stem hairiness	: Sparse
3.2	No. of primary branches	: 4-5
3.3	No. of secondary branches	: 2-3
4	Leaf characters	
4.1	Leaf hairiness	: Medium
4.2	Leaf shape	: Lanceolate
4.3	Lobe incision of basal leaf	: Absent
5	Flower characters	
5.1	Days to flower initiation	: 30-35
5.2	No. of nodes to 1 st flower	: 4
5.3	Days to 50% flowering	: 35-40
5.4	No. of flowers per axil	: One
5.5	Corolla length	: 28 – 30mm
5.6	Corolla hairiness	: Sparse
5.7	Exterior corolla colour	: White with deep pink shading
5.8	Interior corolla colour	: White with pink shading
6	Capsule characters	
6.1	No. of capsules per leaf axil	: 1
6.2	No. of capsules per plant	: 50-150
6.3	No. of locules per capsule	: Four
6.4	Capsule arrangement	: Monocapsular
6.5	Capsule hairiness	: Sparse
6.6	Capsule shape	: Narrow oblong
6.7	Mean capsule length	: 25 – 30mm
6.8	Mean capsule width	: 7-10mm
6.9	No. of seeds per capsule	: 65-72

6.10	Capsule dehiscence at maturity		Partially shattering
6.11	Days to maturity		85-90 days
7	Seed characters		
7.1	Seed coat colour		Brown
7.2	1000 seed weight		2.5-3.0g.
8	Disease reaction	:	The culture VS 13-006 is resistant to Phyllody and <i>Cercospora</i> leaf spot diseases

8. Improved varieties in sunflower and their morphological features

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Sunflower COH3 hybrid (SVRC 2018)

The sunflower hybrid COH3 is developed from a cross between a male sterile line COSF 6A and multi head restorer line IR6 and suitable for all sunflower growing tracts (especially Perambalur, Erode Namakkal, Karur, Trichy, Dindigul, Thoothukudi and Viruthunagar) of Tamil Nadu. Sunflower COH3 is a high yielding hybrid with the duration of around 90-95 days. It has performed well both under rainfed and irrigated situations. Hybrid is having the yield potential of 2410 kg/ha during *Kharif* season and 2150 kg/ha during *Rabi* which is 17.4 and 15.4 per cent over Sunbred 275 and CO2 Hybrid respectively. COH3 hybrid possessing high oil content around 42 % as compared to check hybrids viz., Sunbred 275 (38.5%) and CO 2 Hybrid (39.8 %) and high volume weight (47 g/100ml). Non-lodging hybrid COH3 having moderate resistance for diseases viz., necrosis, leaf spot and powdery mildew

Morphological characteristics of COH 3 and its parental lines

Nature of the cultivar	Hybrid
Year of release	2018
Notification number	No. S.O. 6318(E) 26.12.2018
Pedigree	COSF-6A x IR-6
Areas of adaptation/Recommended ecology	Tamil Nadu
Seed yield (kg/ha)	
a) Average	2280kg/ha (Irrigated)
b) Potential	2750 kg/ha (Irrigated)
Oil content (%)	42
Days to maturity	
<i>Kharif</i>	92-95 days
<i>Rabi</i>	90-95 days

Days to 50% flowering	
<i>Kharif</i>	55-58 days
<i>Rabi</i>	52-57 days
Plant height (cm)	Tall (160-170)
Head diameter (cm)	Medium (18-20)
Harvest index	0.35
Seed filling (%)	100
100 Seed weight (g)	Medium (5.2)
Volume weight (g/100 ml)	47g
Hull content (%)	26-28
Leaf characters	
Leaf size	Medium (25-27)
Leaf shape	Cordate
Leaf colour	Dark green
Leaf blistering	Absent
Leaf fineness of serration	Medium
Leaf angle of lateral veins	Right angle or nearly right angle
Leaf angle between lower part of petiole and stem	Erect
Leaf hairiness	Absent
Petiole pigmentation	Absent
Stem characters	
Stem hairiness at the top	Absent
Stem pigmentation	Absent
Number of leaves on main stem	20-22
Flower characters	
Ray flower number	Medium 35-40
Ray flower shape	Elongated
Ray flower colour	Yellow
Disc flower colour	Yellow
Pollen colour	Yellow
Number of bracts on the back of the head	Medium
Bract anthocyanin colouration	Absent
Head attitude at maturity	Half turned down
Head size	Medium 18-20 cm
Head shape of grain side	Convex
Plant branching	Basal
Seed characters	
Seed length	Medium (1-1.2 cm)
Seed shape	Elongated
Seed base colour	Black
Seed mottling	Absent
Seed stripes	Absent

Distinguishing characteristics of parents of released hybrid COH3

Character	Female (COSF 6A)	Male (IR 6)
Leaf colour	Dark Green	Light Green
Leaf blistering	Absent	Absent
Petiole pigmentation	Absent	Present
Number of leaves	20-22	18-20
Flowering time	53 days after sowing	60 days after sowing
Ray flower number	Medium 35-40	Few 20-25
Head diameter	Medium	Small
Plant branching	No branching	Over all
100-seed weight	Medium (4.4 g/100 seeds)	Low (3.6 g/100 seeds)
Seed stripes colour	Absent	Absent

9. Improved varieties/hybrids in castor and their morphological features

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Tapioca and Castor Research Station
Yethapur

1. Castor Variety YTP 1

Parentage : TMV 6 x Salem Local

Average yield : 1456 kg/ha

Distinguishing morphological characters

The new variety is red stemmed, triple bloom and spiny. The variety can be maintained as perennial with average yield of 3 kg / plant / annum. The variety is resistant to lodging with non shattering capsules. The variety is specifically known for high basal branching and proportion of female flowers more than 95 percent. The variety is fertilizer responsive and suitable for intercropping also. First harvest on 120th Day of sowing, Bold seed with 100 seed weight of 45 grams. The variety YTP 1 is resistant to wilt, semilooper, *spodoptera* and capsule borer.

Description of Castor Variety YTP 1

a. Plant height	:	193 cm
b. Distinguishing morphological characters	:	
Hypocotyl anthocyanin colouration :		Present
Stem colour :		Red
Bloom :		Triple
Type of inter node on the stem :		Elongated
Branching pattern :		Divergent

Plant Height : Tall
 Plant Type : Normal

Leaf Characters

Anthocyanin pigmentation of young
 Emerging leaves : Present
 Anthocyanin colouration of Lamina : Present
 Lamina Shape : Flat
 Lascination (on 4th leaf from top) : Shallow
 Hairiness : Absent
 Petiole surface : Smooth

Reproductive phase

Type of flower on primary spike : Monoecious

Spike Characters

Size : Long
 Shape : Conical
 Arrangement of capsules : Semi compact

Capsule Characters

Colour : Green
 Spininess : Spiny
 Size : Bold

Seed characters

Size : Bold
 Shape : Oval
 Colour : Chocolate brown
 Mottling : Small
 Caruncle : Medium

Quantitative Description

Days to 50 % flowering : 65 - 70
 Days to maturity (First picking) : 115-120
 Number of nodes to primary raceme
 Mean : 21
 Range : 18-23
 Plant height (cm)up to base of primary raceme : Tall
 Mean : 193 cm
 Range : 185 to 195
 100 seed weight (g) : 45 grams

Oil Content (%)

Mean : 49
 Range : 48-51

c. Maturity (range in number of days)	:	115-120 days (Primary spike)
d. Maturity group (, medium and late-	:	Early

Wherever such classification exists)		
e. Reaction to major disease under field and controlled conditions (reaction to physiological strains / races/bio-types to be indicated wherever possible)	:	Wilt Resistant
f. Reactions to major pests (under field and controlled conditions including store pests)	:	Resistant to Semilooper , <i>Spodoptera</i> , Thrips and Capsule borer
g. Agronomic features (<i>e.g</i>) resistance to lodging, shattering; fertilizer responsiveness; suitability for early or late sown conditions, seed rate <i>etc.</i>	:	High basal branching; proportion of female flowers (95%); Resistant to lodging; Non-shattering; suitable for rainfed and areas of limited irrigation. Compact plant type suitable for intercropping system. Suitable for perennial system also.
h. Quality of produce of grain, forage/fibre including nutritive value, where ever relevant	:	49 % Oil content

2. Castor Hybrid YRCH 1

- Parentage DPC 9 x TMV 5
- Average yield 1861 kg/ha under rainfed ecosystem and oil content 49 per cent.
- Early duration of 150-160 days (15 days earlier than TMVCH 1 and 30 days earlier than GCH 4).
- Semi dwarf highly branching and high yielding.
- Proportion of female flower on the spike is more than 95 per cent.
- Resistant to lodging.
- Non shattering type.
- Fertilizer responsive.
- Suitable for rainfed and areas of limited irrigation potential because of its short duration.
- Less time lag between any two order of spike, hence more number of spike is produced in short period.
- Compact plant type suitable for intercropping system also.
- Because of its earliness, it escapes botrytis in early sown conditions during kharif in Tamil Nadu. It recorded the score of 5 in the 0-9 scale with only 11 to 25 % of capsule affected under normal epiphytotic conditions.

- Low leaf hopper (Hopper burn 11 – 25 per cent) and whitefly (1 in 0-5 scale) incidence.
- Moderately tolerant to capsule borer with an incidence of less than 20 per cent during peak infestation level.

Description of hybrid

a. Plant height	:	100 to150cm, Mean 125 cm
b. Distinguishing morphological characters (as in Crop Production Guide)		
Hypocotyl anthocyanin colouration	:	Present
Stem colour	:	Light red
Bloom	:	Triple
Type of inter node on the stem	:	Elongated
Branching pattern	:	Divergent
Plant Height	:	Medium Tall
Plant Type	:	Normal
Leaf Characters		
Anthocyanin pigmentation of young Emerging leaves	:	Present (Light)
Anthocyanin colouration of Lamina	:	Absent
Lamina Shape	:	Flat
Lascination (on 4 th leaf from top)	:	Shallow
Hairiness	:	Absent
Petiole surface	:	Smooth
Type of flower on primary spike	:	Mostly pistillate(Rarely staminate)
Spike Characters		
Size	:	Long
Shape	:	Conical
Arrangement of capsules	:	Compact
Capsule Characters		
Colour	:	Green
Spininess	:	Spiny
Size	:	Medium Bold
Seed characters		
Size	:	Medium bold
Shape	:	Oval
Colour	:	Mottled Chocolate
Mottling	:	Small
Caruncle	:	Medium
Quantitative Description		
Days to 50 % flowering	:	35 - 45
Days to maturity (First picking)	:	90 -100
Number of nodes to primary raceme	:	14.00
	Mean	12-16
	Range	
Plant height (cm) up to base of primary raceme	:	Medium tall
	Mean	125

	Range	100 to 150	
100 seed weight (g)		26.6 (24.7 to 28.5)	
Oil Content (%)	Mean Range	49 48-51	
c. Maturity (range in number of days) Seeding/ Transplanting to flowering, Seed to seed		First Harvest-90 to 100 days Second Harvest -120to 130 days Final Harvest – 150 to 160 days	
d. Maturity group (early, medium and late- wherever such classification exists)		Early (150-180 days duration)	
Agronomic features (e.g) resistance to lodging, shattering; fertilizer responsiveness; suitability for early or late sown conditions, seed rate etc		Resistant to lodging, Non Shattering type .Highly fertilizer responsive with semi dwarf plant ideotype. Suitable for rainfed and areas of limited irrigation potential. The plant type is compact and relatively short in stature and augurs well for intercropping system also in addition to pure cropping system. Another more important special attribute is that the time lag between any two different order of spike is less when compared to GCH 4 .Hence it produces more number of spikes per unit time and finally the total duration is also less with the duration of 150-160 days.	
h. Quality of produce of grain, forage/fibre including nutritive value, where relevant		Oil content - 49 %	
i. Reaction to stresses		---	
9. Description of parents of the hybrid		Female	Male
a. plant height(cm)	Mean Range	85 105to125	140 135 to 150
b. Distinguishing morphological characters			
Hypocotyl anthocyanin colouration		Present	Present
Stem colour		Green	Red
Bloom		Zero	Triple
Type of inter node on the stem		Elongated	Elongated
Branching pattern		Divergent	Divergent
Location of Branches		Basal	Basal
Plant Height		Medium Tall	Medium Tall
Plant Type		Normal	Normal
Leaf Characters			
Anthocyanin pigmentation of young Emerging leaves		Present	Present (Light)
Anthocyanin colouration of Lamina		Absent	Present

Lamina Shape		Flat	Flat
Lascination (on 4 th leaf from top)		Shallow	Shallow
Hairiness		Absent	Absent
Petiole surface		Smooth	Smooth
Reproductive phase			
Type of flower on primary spike		Pistillate	Monoecious
Spike Characters			
Size		Long	Medium
Shape		Conical	Conical
Arrangement of capsules		Compact	Semcompact
Capsule Characters			
Colour		Dark Green	Green with purple tinge
Spininess		Spiny	Spiny
Size		Medium Bold	Medium Bold
Seed characters			
Size		Medium bold	Small
Shape		Square	Oval
Colour with dark septa.		Light Brown	Grey speckled
Mottling		Small	High
Caruncle		Big	Big
Quantitative Description			
Days to 50 % flowering		40-45	45-50
Days to maturity (First picking)		105-125	105-110
Number of nodes to primary raceme			
	Mean	12	14
	Range	10-16	12-16
Plant height (cm) up to base of primary raceme		Medium tall	Medium tall
	Mean	85	140
	Range	60 to 110	135-150
100 seed weight (g)		25.7	20
Oil Content (%)		50.2	48
e. Is there any problem of synchronization? If yes, methods to overcome it as the parental duration is similar		No Problem of synchronization	
f. Reaction to major pests under field and controlled conditions (reaction too physiological strains/races bio-types to be indicated wherever possible)		-	Tolerant to GLH and white fly
g. Reactions to major pests (under field and controlled conditions including store-pests)		-	-
h. Agronomic features (e.g) resistance to lodging and shattering; fertilizer responsiveness; seed rate etc		Resistant to lodging, Non Shattering	Non Shattering

i. Reaction to stresses	--	Drought Tolerant
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3. Castor Hybrid YRCH 2

Parentage : M 619 -1 x SKI 215

Average yield : 2089 kg/ha

Distinguishing morphological characters

The new hybrid is red stemmed , triple bloom and semispiny. The hybrid is resistant to lodging with non shattering capsules. The hybrid is specifically known for high basal branching and proportion of female flowers more than 95 percent. The hybrid is fertilizer responsive and suitable for intercropping also.

Reaction to Pests and Diseases

The hybrid YRCH 1116 is resistant to wilt. Tolerant to semilooper, spodoptera, leafhopper and capsule borer.

Description of hybrid

a. Plant height	:	139 cm
b. Distinguishing morphological characters (as in Crop Production Guide)		
Hypocotyl anthocyanin colouration	:	Present
Stem colour	:	Red
Bloom	:	Triple
Type of inter node on the stem	:	Elongated
Branching pattern	:	Divergent
Plant Height	:	Medium Tall
Plant Type	:	Normal
Leaf Characters		
Anthocyanin pigmentation of young Emerging leaves	:	Present
Anthocyanin colouration of Lamina	:	Present
Lamina Shape	:	Flat
Lascination (on 4 th leaf from top)	:	Shallow
Hairiness	:	Absent
Petiole surface	:	Smooth
Reproductive phase		
Type of flower on primary spike	:	Monoecious
Spike Characters		
Size	:	Long
Shape	:	Conical
Arrangement of capsules	:	Semi compact
Capsule Characters		
Colour	:	Green

Spininess	Semi Spiny	
Size	Medium Bold	
Seed characters		
Size	Medium bold	
Shape	Oval	
Colour	Chocolate brown	
Mottling	Small	
Caruncle	Medium	
Quantitative Description		
Days to 50 % flowering	56 - 60	
Days to maturity (First picking)	110-115	
Number of nodes to primary raceme	Mean Range	18 16-20
Plant height (cm) up to base of primary raceme	Mean Range	Medium tall 139 cm 120 to 150
100 seed weight (g)	29.0 (28 to 30.5 g)	
Oil Content (%)	Mean Range	49 48-51
a. Maturity (range in number of days) Seeding/ Transplanting to flowering, Seed to seed	180 days	
b. Maturity group (early, medium and late- wherever such classification exists)	Early	
c. Reaction to major disease under field and controlled conditions (reaction to physiological strains / races/bio- types to be indicated wherever possible)	Wilt Resistant	
d. Reactions to major pests (under field and controlled conditions including store pests)	Tolerant to semilooper, spodoptera, leaf hopper and capsule borer	
e. Agronomic features (<i>e.g</i>) resistance to lodging, shattering; fertilizer responsiveness; suitability for early or late sown conditions, seed rate <i>etc.</i>	Semi-dwarf and high basal branching; proportion of female flowers (95%); Resistant to lodging; Non-shattering; suitable for rainfed and areas of limited irrigation. Compact plant type suitable for intercropping system.	
f. Quality of produce of grain, forage/fibre including nutritive value, where ever relevant	49 % Oil content	
g. Reaction to abiotic stresses	-	
9. Description of parents of the hybrid	Female	Male
a. plant height(cm)	66 cm	107 cm
	Mean Range	
b. Distinguishing morphological characters		
Hypocotyl anthocyanin colouration	Absent	Present

Stem colour		Green	Red
Bloom		Triple	Double
Type of inter node on the stem		Condensed	Elongated
Branching pattern		Convergent	Divergent
Plant Height		Short	Medium Tall
Plant Type		Dwarf	Normal
Leaf Characters			
Anthocyanin pigmentation of young Emerging leaves		Absent	Present
Anthocyanin colouration of Lamina		Absent	Present
Lamina Shape		Flat	Flat
Lascination (on 4 th leaf from top)		Shallow	Shallow
Hairiness		Absent	Absent
Petiole surface		Smooth	Smooth
Reproductive phase			
Type of flower on primary spike		Pistillate	Monoecious
Spike Characters			
Size		Long	Medium
Shape		Conical	Conical
Arrangement of capsules		Compact	Semi compact
Capsule Characters			
Colour		Dark Green	Green with purple veins
Spininess		Spiny	Non Spiny
Size		Medium Bold	Medium Bold
Seed characters			
Size		Medium bold	Medium bold
Shape		Oval	Oval
Colour with dark septa.		Light Brown	Light brown
Mottling		Medium	High
Caruncle		Big	Big
Quantitative Description			
Days to 50 % flowering		60-65	55-60
Days to maturity (First picking)		105-110	100-105
Number of nodes to primary raceme	Mean Range	20 17-22	19 16-21
Plant height (cm) up to base of primary raceme	Mean Range	Medium tall 66 60 to 73	Medium tall 107 100-114
100 seed weight (g)		20.6	25.4
Oil Content (%)		48	49

a.Days to 50% flowering	62	57
b.Maturity (range in number of days from seed to seed)	105-110	100-105
c.Is there any problem of synchronization? If yes, methods to overcome it	No Problem of synchronization as the parental duration is similar	
d.Reaction to major pests under field and controlled conditions (reaction to physiological strains/races bio-types to be indicated wherever possible)	Wilt resistant Wilt resistant	
e.Reactions to major pests (under field and controlled conditions including store-pests)	Tolerant to leaf eating	Tolerant to capsule borer caterpillars
f.Agronomic features (e.g) resistance to lodging and shattering; fertilizer responsiveness; seed rate etc.	Non shattering Fertilizer responsive	Non shattering Fertilizer responsive

10. High yielding cotton varieties and their characters

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Coimbatore

1. MCU 5 : *Gossypiumhirsutum*

Year of release: 1968

Cotton variety MCU 5 is a cross derivative of [(Sealand 542 x MCU 1)x MCU 2] // (MCU 1 x Gatooma) developed at Cotton Breeding Station, Coimbatore. Its duration is 165-170 days. It recorded an average seed cotton yield of 1910 kg/ha. Its recorded mean fibre length of 29.0 mm and fibre strength of 22.0 g/tex, capable of spinning 70 s' count. It recorded ginning out turn of 34.0 and suitable for cultivation in the Winter Irrigated Conditions.

Morphological features

- ❖ Leaf : Dark green with five lobed leaves.
- ❖ Flower : Cream
- ❖ Pollen : Yellow
- ❖ Petal Spot : Absent
- ❖ Bolls Character : Medium sized boll, ovoid, smooth and 3 loculed

2. MCU 7 : *Gossypiumhirsutum*

Year of release : 1972

Cotton MCU 7 variety is developed by X ray irradiation of x L1143EE. It matures in 135 days duration. It has recorded as average seed cotton yield of 1330 kg/ha. Its fibre length is 25.0 mm and fibre strength is 22.0 g/tex. It recorded ginning out turn of 33.2 per cent and suitable for for Rice fallow conditions

Morphological features

- Flower : Cream
- Pollen : Cream
- Petal Spot : Absent

3. CO 14 : *Gossypiumhirsutum*

Year of release : 2016

Extra long staple Cotton variety CO 14 is developed by pedigree method with the cross combination of (MCU 5 x TCH 92-7) x MCU 5-1. Its duration is 150 days and suitable for winter irrigated tracts of Tamil Nadu viz., Coimbatore, Erode, Salem, Dharmapuri,

Namakkal, Dindigul and Theni. It recorded an average seed cotton yield of 1768 Kg/ha. It recorded 34.8% of ginning out turn and 6.0 g of boll weight. Regarding fibre qualities, it is having more than 35.00 mm of 2.5% span length and 22.7 g/tex of bundle strength. The higher yielding capacity, attractive large boll size and extra long staple fibre of TCH 1716 is a boon in the production of extra long staple cotton in India. It recorded moderately resistance to jassids and *Alternaria* leaf spot.

Morphological features

- Leaf (shape) : Palmate
- Flower (Petal colour): Cream
- Flower (Pollen colour): Cream
- Petal Spot : Absent
- Boll (Shape): Round to oval

4. CO 17 : *Gossypiumhirsutum*

Year of release : 2020

Cotton variety CO 17 is a short duration compact plant type with synchronized boll maturity suitable for high density planting system (HDPS). It developed at Department of Cotton, TNAU, Coimbatore from the parental hybridization involving Khandwa 2 and LH 2220. It matures in 125-135 days and it possesses zero monopodia with short sympodial length and is highly suited for high density planting system. It recorded an average seed cotton yield of 2361 kg/ha which is 18.9% increase over the check variety Suraj (National check entry identified for HDPS). Suitable for rice fallow, winter rainfed and summer irrigated tracts of Tamil Nadu

Morphological features

- Plant is erect, compact type with short sympodia
- Leaves are broad, palmate lobed and green in colour
- Cream petal with cream pollen
- Petal Spot : Absent
- Bolls are medium in size, ovate with 4-5 locules

Cotton Research Station, Srivilliputtur

1. SVPR 2 : *Gossypiumhirsutum*

Year of release: 1996

SVPR 2 is a hybrid derivative of TSDT 22 and JR 36. Its duration is 160 days. Its seed cotton yield is 1658 kg/ha and recorded 36.4 % of ginning outturn with mean fibre length of 24.8 mm and fibre strength of 26.3 g/tex. Moderately resistant to Jassids and *Alternaria* leaf spot. Tolerant to Drought and high night temperature prevailing during Summer. Medium Staple popular Cotton variety in southern Tamil Nadu. Suitable for Summer irrigated and rice fallow tracts of Tamil Nadu

Morphological features

- Petal colour: Cream
- Petal spot: Absent
- Pollen colour: Cream
- Boll shape : Oblong/ ovate with pointed tip

2. SVPR 4 : *Gossypium hirsutum*

Year of release: 2009

SVPR 4 is a cross derivative of MCU 5 and S 4727. It matures in 150 days. It recorded average seed cotton yield of 1658 kg/ha. It possesses high ginning outturn of 36.4 %. It recorded a mean fibre length of 27.5 mm and fibre strength of 28.4 g/tex. This variety is moderately resistant to leaf hopper. Highly tolerant to drought and high night temperature prevailing during Summer. Suitable for Summer Irrigated tracts of Tamil Nadu (Madurai, Dindugul, Theni, Virudhunagar, Tirunelveli, Ramanathapuram, Villupuram and Cuddalore Districts).

Morphological features

- Petal colour: Cream
- Petal spot: Absent
- Pollen colour: Yellow
- Boll shape : Oblong/ ovate
- Boll weight: 3.6 g (small)

3. SVPR 5 *Gossypium hirsutum*

Year of release: 2014

SVPR 5 is a cross derivative of NDH 1658 x Surabhi. It matures in 150 days. It recorded average seed cotton yield of 1845 kg/ha. It recorded a mean fibre length of 29.0 mm and fibre strength of 27.8 g/tex. It recorded 36.4 % of ginning outturn. This variety is moderately resistant to leaf hopper. Highly tolerant to drought and high night temperature

prevailing during Summer. Suitable for irrigated areas (Kharifseason) of South Zone and Summer Irrigated Cotton tracts of Southern Tamil Nadu.

Morphological features

- Petal colour: Light yellow
- Petal spot: Absent
- Pollen colour: Cream
- Boll shape : Round / Oblong
- Boll weight: 3.9 g (small)

4. SVPR 6 *Gossypiumhirsutum*

Year of release: 2017

SVPR 5 is a cross derivative of SVPR 2 and BJA 592. It matures in 155 days. It recorded average seed cotton yield of 2312 kg/ha. It recorded a mean fibre length of 29.1 mm and fibre strength of 27.3 g/tex. It recorded 33.4 % of ginning outturn. Moderately resistant to leaf hopper, White fly, Bacterial leaf blight and Alternaria leaf spot. Tolerant to drought and high night temperature prevailing during Summer. Suitable for Irrigated areas (Kharifseason) of South Zone and Summer Irrigated Cotton tracts of Southern Tamil Nadu.

Morphological features

- Petal colour: Cream
- Petal spot: Absent
- Pollen colour: Light Yellow
- Boll shape : Round Oblong
- Boll weight: 4.3 g (medium)

Agricultural Research Station, Kovilpatti

1. K12 (Karunganni) *Gossypiumarboreum*

Year of release: 2017

K 12 cotton variety (Karunganni), a medium staple variety is a cross derivative of K11 x K9. It matures in 135-140 days. It recorded average seed cotton yield of 1193 kg/ha. It recorded a mean fibre length of 27.7 mm and fibre strength of 22.1 g/tex. Resistant to Leafhopper and other sucking pests. Suitable for Winter Rainfed Vertisol tracts of southern districts of Tamil Nadu.

Morphological features

- Petal colour: yellow
- Petal spot: Present
- Pollen colour: Yellow
- Boll shape : Ovate

11. Improved Varieties of Forage Crops released from TNAU for livestock production

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Agriculture and animal husbandry in India are interwoven with the intricate fabric of the society in cultural, religious and economical ways as mixed farming and livestock rearing forms an integral part of rural living. Livestock sector plays a vital role in the economic development of the country particularly for the welfare of rural population of India by providing nutritive food, rich in animal protein to the general public and in supplementing family incomes and generating gainful employment in the rural sector, particularly among the landless, small, marginal farmers and women.

Tamil Nadu has vast resources of 227.23 lakh livestock population (19th Live stock census) which play a vital role in improving the socio economic conditions of the rural people. The small, marginal farmers and landless labourers mainly depend on livestock and poultry as it provides sustainable livelihood opportunities of rural poor.

Appreciable quantum of research work done on Forage crops in TNAU, Coimbatore has resulted in the release of 29 high yielding forage crop varieties/hybrids for general cultivation in Tamil Nadu and subsequently spread over a dozen states in India. Among the forage varieties released, the green fodder varieties viz., perennial fodder sorghum CO (FS) 29, perennial fodder sorghum CO 31 and lucerne CO 2 which is propagated through seed heralded a new era in fodder research and development. Adaptation of high yielding fodder varieties coupled with high nutritive value is one of the major concern to meet out the fodder requirement of increasing livestock population and to ensure the stable milk production and productivity as well. The special features of newly released high yielding green fodder varieties under cultivation and in seed production chain is as follows.

1. Fodder Sorghum

Sorghum (*Sorghum bicolor* (L.) Moench) is a tropical annual crop used for both grain and fodder. It is the foremost important fodder crop in India followed by berseem and lucerne.

Fodder sorghum is usually based on Sudan grass and grain sorghum. They retain the multi-cut qualities of Sudan grass but have a much higher yield potential. So far three sorghum varieties namely CO 27, CO (FS) 29 and CO 31 have been released from TNAU for

the fodder purpose. The salient features of fodder sorghum varieties which are under cultivation are given below.

i. Perennial fodder sorghum CO (FS) 29

Perennial fodder sorghum CO (FS) 29 was released during the year 2001. It is a cross derivative of *Sorghum bicolor* (L.) Moench (TNS 30) and *Sorghumsudanense*. The perenniality or regeneration efficiency was derived from *Sorghumsudanense*.

Special features

- Perennial crop
- Profuse tillering (10-15)/soft stem and more number of leaves (80-105/clump)
- High digestibility (IVDMD 50.3 %)
- Crude protein (8.41 %) and less fibre (24 %)
- First harvest on 65-75 days after planting and subsequent harvest at 50-55 days interval (6-7 harvests/year)
- Green fodder yield is 160-170 t/ha/year

ii. Perennial Fodder sorghum CO 31

Perennial fodder sorghum variety CO 31 is a gamma ray induced mutant of CO (FS) 29 treated at 400 Gy which was released during 2014. This variety is found to have the seed retention capacity after maturity besides high fodder yield and quality, which is a major problem in CO (FS) 29 leading to poor seed production as a result of shattering behavior.

Special features

- High tillering with broad leaves
- Enhanced seed yield due to intact seeds
- High crude protein (9.86 %) and dry matter yield (49.73 t/ha/yr)
- Low HCN (172 ppm) and crude fibre (19.8 %)
- Superior ratooning ability renders 6-7 harvests per year
- Highly palatable, preferred by milch cattle, goat and sheep

Morphological characters of perennial fodder sorghum CO(FS) 29 and CO 31

S. No.	Characters	CO (FS) 29	CO 31
1.	Leaf colour	Green	Green
2.	Leaf stem ratio	0.24	0.26
3.	Leaf midrib colour	White	White
4.	Days to 50% flowering	65 - 70 days	65 - 70 days
5.	Inflorescence compactness	Loose erect	Loose erect

6.	Seed colour	Black	Dark purple
7.	Shattering	Very high	Very low
8.	Endosperm colour	Light brown	Light brown
9.	Awns	Present	Present
10.	1000 seed weight (g)	5	5.2

III. Legume fodders

1. Lucerne

Lucerne (*Medicago sativa*) also called as Alfalfa, is a perennial flowering plant in the pea family *Fabaceae* cultivated as an important forage crop in many countries around the world. Lucerne seems to have originated in South-central Asia and considered as ‘Queen of Forage crops’ which has been heralded as having the highest feeding value of all commonly grown fodder crops, producing more protein per unit area. The popular lucerne variety CO 1 was released during 1980 from TNAU followed by CO 2 and CO 3 during the year 2013 and 2017 respectively. The salient features of lucerne varieties which are under cultivation are furnished below.

ii. Lucerne CO 3

Lucerne CO 3 has been identified for cultivation in south zone of India during 2017. It is polycross derivative involving CO 1 as one of the parent.

Special features

- High protein content: 22.4%
- Highly palatable
- More seed yield

iii. Lucerne CO 4

Lucerne variety CO 4 is a polycross derivative of CO 1 derived out of polycross breeding programme. This variety was released for southern zone of India for cultivation during the year 2019.

Special features

- Green fodder yield: 60.8t/ha/yr
- Protein Content: 18.6 %
- First harvest at 65-70 days and subsequent harvest at 25-28 days

Morphological characters of lucerne CO 3

S. No.	Characters	CO 3
1.	Leaf colour	Dark green
2.	Leaf stem ratio	0.50
3.	Shape of stipules	Medium, acuminate
4.	Stem girth (cm)	1.2 - 1.4
5.	Days to 50% flowering	65 - 70 days
6.	Flower colour	Purple
7.	Length of flower cluster (cm)	2.5 - 3.0
8.	No. of spirals per pod	3 - 5
9.	No. of seeds per pod	4 - 6
10.	Seed colour	Golden yellow
11.	1000 seed weight (g)	3.6

2. Fodder cowpea

Cowpea (*Vigna unguiculata*) originated in Africa is a dual crop used for food grains and fodder worldwide. It is considered as an important leguminous fodder crop owing to its high nutritional value and short duration. The feeding value of fodder cowpea is high and quite comparable with lucerne. In India, it is grown in some parts of Rajasthan, Gujarat, Maharashtra, Karnataka and Tamil Nadu. It has a great potential for sustainable agriculture in marginal lands and semi arid regions of the country. The fodder cowpea variety CO 5 was released during 1986 followed by CO (FC) 8 during 2004 and CO 9 and TNFC 0926 during 2016 were released from TNAU. The salient features of fodder cowpea varieties which are under cultivation are given below.

i. Fodder cowpea CO 9

In order to improve the green fodder yield potential of CO (FC) 8, hybridization programme was initiated during 2008 and a promising variety CO 9 was evolved by intervarietal cross between CO 5 and BundelLobia 2.

Special features

- Higher green fodder and dry matter yield (22.82 and 3.85 t/ha)
- More number of branches with broader leaves
- Higher protein content (21.56 %)
- Reduced fibre portions confer increased digestibility, palatability and intake rate

- Moderately resistant to yellow mosaic virus and resistant to major pests
- Shorter in duration (50-55 days); Suited for intercropping with sorghum and maize

Morphological characters of fodder cowpea culture CO 9 and TNFC 0926

S. No.	Characters	CO 9	TNFC0926
1.	Habit	Semi spreading, erect in early stages of growth, later on trailing/ creeping, indeterminate type with luxurious growth.	Semi spreading/erect in early stages of growth, later on trailing/ creeping, indeterminate type with luxurious growth
2.	Leaves	Dark green; Trifoliate, entire, lush green foliage	Characterized by dark green and broader leaves.
3.	Flower colour	Violet	Violet
4.	Pod colour	Green	Green
5.	Seeds shape	Rhomboid	Rhomboid
6.	Seed colour	Light brown (uniform)	Buff to Gray buff
7.	1000 seed weight	170 g	160 g
8.	Days to 50% flowering	50 – 55 days	50-55 days
9.	Days to maturity	90 – 95 days	90-95 days

ii. Fodder cowpea TNFC 0926

Fodder cowpea variety TNFC 0926 has been identified for cultivation in north eastern zone of India during 2016. It was developed by intraspecific cross between the cowpea variety CO 5 and KBC 2.

Special features

- Semi spreading/erect in early stages of growth, later on trailing/ creeping, indeterminate type with luxurious growth
- Seed colour: Buff to Gray buff
- Seed shape and size: Rhomboid

3. Hedge Lucerne/ *Desmanthus*

Desmanthus is a productive, drought-tolerant, herbaceous, perennial legume green fodder crop. It is very palatable to livestock, has a high digestibility and protein content,

doesnot cause bloat. Two varieties namely CO 1 and CO 2 was released during the year 1976 and 2019 respectively.

i. Desmanthus CO 2

*Desmanthus*CO 2 is a Gamma ray mutant of Velimasal (*Desmanthus* CO 1) and it was released for cultivation during the year 2019 for all India level.

- Protein content : 15.58%
- Green fodder yield: 441.8 q/ha/yr
- Seed yield: 175 – 200 kg
- First harvest 70 - 75 days and subsequent harvests at 40 - 45 days

Morphological characters of *Desmanthus* CO 2

1.	Name of the variety	<i>Desmanthus</i> CO 2
	Common name	Hedge Lucerne/ <i>Desmanthus</i>
	Botanical name	<i>Desmanthusvirgatus</i> L.
2.	Plant type	In-determinant
3.	Foliage	Characterized by light green leaves Shape: Bipinnate leaf
4.	Pigmentation on plant parts	Pink pigmentation in leaf axel
5.	Flower colour	White
6.	Days to 50% flowering	70-75 days
7.	Days to maturity	120-130 days
8.	Pod colour	Early stage; Green Maturity stage; Brown
9.	1000-seed weight	4.1 gram
10.	Seed colour	Dark brown