

Improved Production Technologies for kharif Sorghum



RR Chapke

JS Mishra

JV Patil



DIRECTORATE OF SORGHUM RESEARCH

(Indian Council of Agricultural Research)

Rajendranagar, Hyderabad 500 030, India



- ❖ Sorghum (*Sorghum bicolor* (L.) Moench) is an important cereal crop grown for food, feed and fodder in mostly dryland ecosystems of the country.
- ❖ In India, *kharif* sorghum is grown in an area of 28.92 lakhs hectare and *rabi* sorghum in 46.39 lakhs ha. Maharashtra (54%), Karnataka (18%), Rajasthan (8%), Madhya Pradesh (6%) and Andhra Pradesh (4%) are the major sorghum growing states.
- ❖ Though, the area under sorghum has declined from 18.61 m. ha in 1969-70 to 7.53 m. ha in 2008-09, its productivity has increased from 554 kg /ha to 1055 kg /ha during the same period due to adoption of improved production technologies developed by the research institutes.
- ❖ However, there is a wide gap between yields obtained by the farmers and yield potential of the improved sorghum technologies developed from the research institutes.

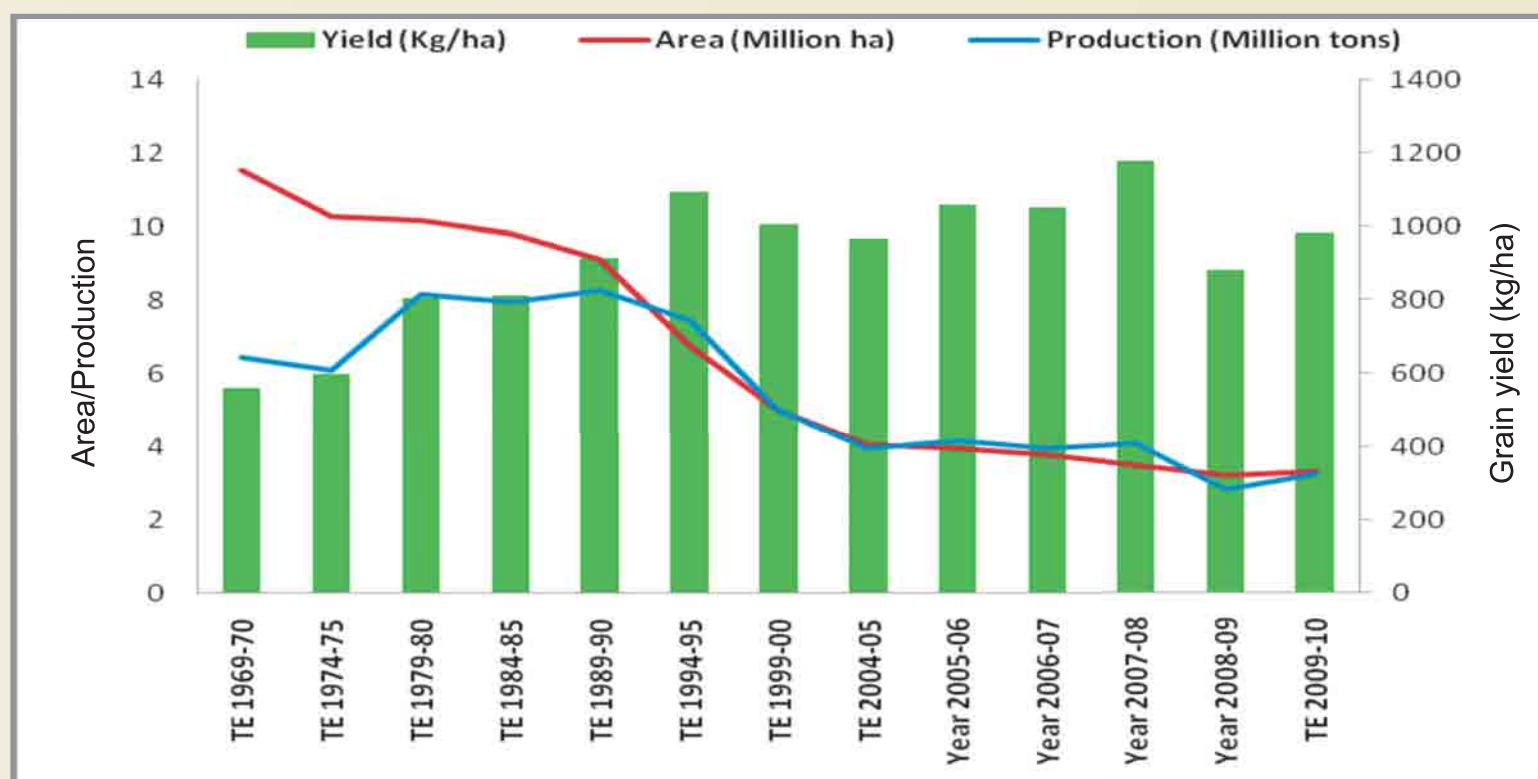


Fig 1: Trends of area, production and yield of kharif sorghum in India

Major constraints

- ❖ Non-availability of seeds of high yielding cultivars in the market at proper time, place and price.
- ❖ Biotic stresses such as shoot fly at early stage and grain mold at maturity.
- ❖ Severe birds' damage due to sporadic cultivation of this crop.
- ❖ Competition with cash crops like cotton, soybean, oilseeds, vegetables, etc.
- ❖ Inadequate policy support to promote sorghum grain through public distribution system (PDS) and mid-day meal scheme.
- ❖ Fast changing food habits of human being and unawareness of nutritional value of sorghum for health.



Scope

- ❖ To meet out the need of fodder, feed for animals and poultry in rainfed areas.
- ❖ Diversion of *kharif* grain over past three decades is increasing from food to industrial purposes such as biofuel, potable alcohol, starch, alternate food products, etc.
- ❖ A major source of nutritious and healthy food to the resource poor population in dryland agricultural areas.



High Yielding Cultivars

Hybrids

CSH 14

Year of release	: 1992
Duration	: 105 days
Grain yield	: 3.7-4.0 t/ha
Fodder yield	: 8.5-9.0 t/ha
Salient features	: Medium tall, early maturing, semi-loose panicle, bold seed, tolerant to grain mold and leaf spot disease, suitable for low rainfall areas and intercropping



CSH 16

Year of release	: 1997
Duration	: 110 days
Grain yield	: 4.0-4.5 t/ha
Fodder yield	: 9.5-10.0 t/ha
Salient features	: Medium tall, long, loose panicle, medium bold seed, tolerant to grain mold and resistant to leaf spot disease, easily digestible fodder for cattle



CSH 23

Year of release : 2005
Duration : 105 days
Grain yield : 4.0-4.2 t/ha
Fodder yield : 8.5-9.0 t/ha
Salient features : Medium bold and white seed, early maturing and avoids terminal drought



CSH 25

Year of release : 2007
Duration : 110-115 days
Grain yield : 4.0-4.5 t/ha
Fodder yield : 12-13 t/ha
Salient features : Medium tall, long semi-loose panicle, medium bold seed, resistant to grain mold and aphids, high grain yield with quality fodder



Varieties

CSV 15

Year of release : 1996
Duration : 110-112 days
Grain yield : 3.5-3.7 t/ha
Fodder yield : 11.5-12.5 t/ha
Salient features : Dual purpose, sweet stalk, bold round seed, green forage, resistant to all leaf spot diseases, tolerant to shootfly and stem borer.



CSV 17

Year of release	: 2002
Duration	: 97 days
Grain yield	: 2.2-2.7 t/ha
Fodder yield	: 6.5-7.0 t/ha
Salient feature	: Dwarf, early maturing with green leaves, medium bold seed, tolerant to pests and leaf spot diseases.



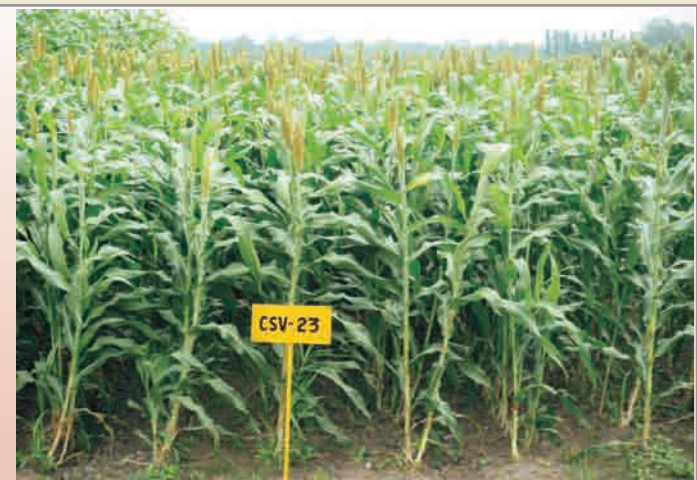
CSV 20

Year of release	: 2006
Duration	: 109 days
Grain yield	: 3.0-3.5 t/ha
Fodder yield	: 13-14 t/ha
Salient features	: Tall, dual purpose with medium sized round seed, semi loose and long panicle.



CSV 23

Year of release	: 2007
Duration	: 110-115 days
Grain yield	: 2.5-3.0 t/ha
Fodder yield	: 15-16 t/ha
Salient features	: Tall (220 cm), dual purpose for normal rainfall sorghum growing regions, white colour grains and tolerant to shoot fly and stem borer



Improved Package of Practices

Land preparation

- Deep ploughing once in summer followed by 2-3 harrowings
- 8-10 tonnes of farm yard manure (FYM) per ha
- Soil application of Thirum @ 4.5 kg/ha

Sowing

- 3rd week of June to 1st week of July with on-set of monsoon

Seed rate

- 7-8 kg seeds per ha (3 kg/acre)

Spacing

- Row to row 45 cm and plant to plant distance 12 to 15 cm
- Maintain plant population as 1,80,000 plants per ha (72,000 plants per acre)

Seed treatment

- Treat the seed with 14 ml imidacloprid (Goucho) + 2 g carbendazim (Bavistin) for one kg seed, or thiomethaxam (Cruser) 3 g/kg seed

Fertilizer application

- **For light soils and low rainfall areas:** 60 kg Nitrogen, 30 kg P_2O_5 and 20 kg K_2O per ha. Apply 30 kg nitrogen, and total phosphorus and potash at sowing and remaining 30 kg nitrogen at 30-35 days after sowing (DAS).
- **For medium-deep soils and moderate to high rainfall areas:** 80 kg nitrogen, 40 kg P_2O_5 and 40 kg K_2O per ha. Apply half nitrogen + full P_2O_5 and K_2O at sowing and remaining nitrogen at 30 DAS.

Weed control and inter cultivation

- Keep the crop free from weeds for about initial 35 days
- Spray atrazine @ 0.5 kg a.i./ha immediately after sowing
- *Striga* can be controlled by hand pulling when population is less, otherwise spray 2,4-D sodium salt @ 1.0 kg a.i./ha
- Two times inter cultivation with blade hoe at 3 and 5 weeks of germination.



Field preparation



Inter cultivation

Insect-Pest Management

Shoot fly

Nature of damage

- ❖ Infestation occurs during seedling stage up to 1 month. Maggos cut the growing point and feeds on the decaying tissues.
- ❖ The infestation results in withering and drying of the central leaf, giving a typical “deadheart” symptom.

Control measures

- ❖ Early sowing within 7 to 10 days of the onset of monsoon.
- ❖ High seed rate @ 10 to 12 kg/ha
- ❖ Inter cropping of sorghum + redgram in 2:1 or 2:2 ratio.
- ❖ Seed treatment with imidacloprid @14 ml/kg seed or thiamethoxam 70 WS @ 3 g/kg seed or furadan/carbofuran 50SP@100 g/kg of seed may also be used.
- ❖ Soil application of carbofuran 3G granules @20kg/ha in furrows at the time of sowing



Adult



Damage

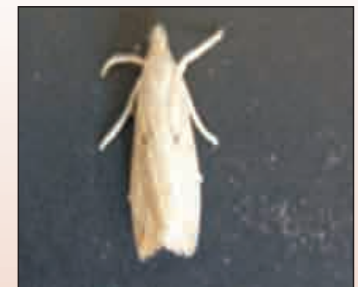
Stem borer

Nature of damage

- ❖ It attacks the crop from 2 weeks after germination until crop harvest.
- ❖ Irregular-shaped holes on the leaves, caused by the early instar larvae feeding in the whorl.
- ❖ Drying of central shoot giving “deadheart” look.
- ❖ Extensive stem tunneling.
- ❖ After panicle emergence, peduncle tunneling results in their breaking or result in complete or partial chaffy panicles.

Control measure

- ❖ Uprooting and burning of stubbles and chopping of stems of earlier crop to prevent its carryover.
- ❖ Need-based application of carbofuran 3G, carbaryl 3G, or furadan 3G @ 8-12 kg/ha at 20 and 35 days after emergence inside the leaf whorls.
- ❖ Intercropping of sorghum with cowpea.



Adult



Damage

Disease Management

Grain mold

Symptoms

- ◆ Grains show symptoms of fungal infection and develop fungal bloom of various colours (black, white or pink) depending on fungus.
- ◆ The infected grains are soft, powdery, low in nutritional quality, poor germination and acceptability for human consumption.

Control measures

- ◆ Harvesting of genotypes at physiological maturity and drying.
- ◆ Spray of Tilt 25% EC @ 0.2% starting from flowering and another spray after 10 days interval.



Downy mildew

Symptoms

- ◆ The most conspicuous symptom is the appearance of vivid green and white stripes on the leaves and white patches of oospores.
- ◆ Whole leaves may become chlorotic at advance stage and plants usually fail to exert panicles. Even if panicles are exerted, they are small, compact or club-shaped and have little or no seed set .

Control measures

- ◆ Deep ploughing before planting to reduce oospores.
- ◆ Seed dressing with metalaxyl/ ridomil25@ 1g a.i./kg.seed followed by spray with ridomyl-MZ @ 3g/liter water.



Sorghum-based Cropping Systems

Intercropping

- Intercropping sorghum with legumes not only produces higher yields per unit area and time, but also provides nutritional security, economic benefits and improves soil health.
- Sorghum+ pigeonpea (2:1) and sorghum+ soybean (3:6) are the two most common sorghum - based intercropping systems in the country.
- Sorghum + fodder cowpea (2:2) provides nutritive green fodder, helps to improve soil fertility and checks weed growth.
- Medium duration sorghum genotype like CSH 16, CSH 18, CSH 23, CSV 15 and CSV 20 are most suitable for intercropping.



Sorghum+ pigeonpea (2:1)



Sorghum+soybean intercropping (3:6)

Sequence cropping

- Sorghum (*kharif*)-chickpea, safflower and mustard (*rabi*) are the most suitable cropping sequences under limited irrigation conditions.
- These cropping sequences are more profitable in areas receiving annual rainfall above 700 mm and in medium to deep soils having high water retention capacity.
- In irrigated situations, sorghum-wheat sequence is also followed in some parts of northern and Central India.

Impact of the Technologies

- The area under sorghum is reduced drastically from 17.37 m ha in 1970-71 to 7.67 m ha in 2009-10. However, due to concerted efforts made by the scientists, extension workers, developmental agencies and farmers, average productivity has now reached to >1000 kg/ha during 2009-10.
- Latest sorghum cultivars (CSH 23, CSV 20, CSV 23, CSV 17 and CSV 15) demonstrated under frontline demonstrations (FLDs) gave up to 67% higher grain yield and up to 64% higher stover yield than the local cultivars during *kharif* 2009 (Fig. 2). On an average, the demonstrated cultivars gave 56% more net profit (Rs.17,955/-per ha), than the local cultivars (Rs. 11,494/- per ha).

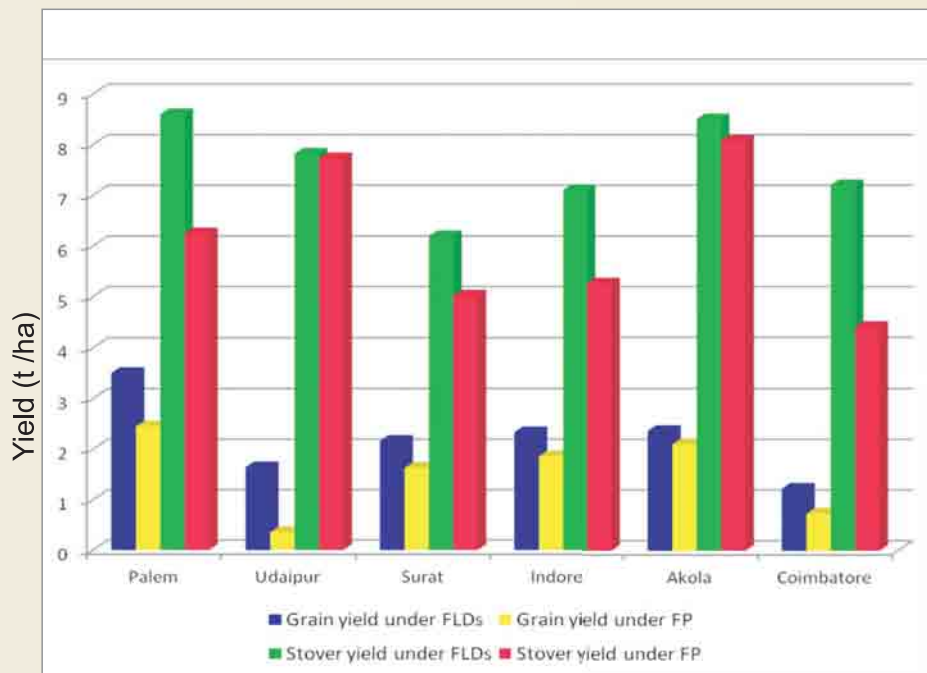


Fig. 2. Performance of latest sorghum cultivars over local (FP) under *kharif* FLDs



Interaction with farmers on *kharif* FLD field at Jorjika Kheda village in Udaipur, Rajasthan

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Published by

Dr. JV Patil

Director

Directorate of Sorghum Research,
Hyderabad 500 030, India

Phone: 091-40-24018651

Fax: 091-40-24016378

Web site: www.sorghum.res.in