

# Best Practices for Sorghum Cultivation and importance of value-addition



**Rajendra R Chapke**  
**Vilas A Tonapi**



**ICAR-Indian Institute of Millets Research**  
Rajendranagar, Hyderabad 500 030  
[www.millets.res.in](http://www.millets.res.in)



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**Abstract**

This reference book of the model training is a compilation of lectures delivered by the experts on latest aspects of sorghum development including millets on improved production technologies, crop management, preparation and value-added products, sweet sorghum, nutritional benefits, technology transfer and future implications. These apart, practical aspects of new process/methods, production and marketing were also covered. All the articles represented views of the respective contributors and they assume responsibility for any odd/advanced statements and opinions.

**Compiled by**

Rajendra R Chapke

**Book alignment and design**

Mr. K Sanath Kumar

**Cover design and photo credits**

Mr. HS Gawali

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Phone: 091-40-24599301, Fax: 091-40-24599304  
Web site: [www.millets.res.in](http://www.millets.res.in)

## BEST PRACTICES FOR SORGHUM CULTIVATION AND IMPORTANCE OF VALUE-ADDITION

### *C o n t e n t s*

1. Genetic improvement in kharif sorghum and latest kharif cultivars .....	3
<i>C Aruna</i>	
2. Major sorghum pests and their management .....	10
<i>PG Padmaja</i>	
3. Improved genotypes and heterosis in rabi sorghum.....	29
<i>Sujay Rakshit</i>	
4. Extension approaches in India: Prospects and challenges .....	35
<i>S Senthil Vinayagam<sup>1</sup> &amp; Rajendra R Chapke<sup>2</sup></i>	
5. Sweet sorghum - An important biofuel crop and technologies for enhancing crop productivity .....	46
<i>AV Umakanth</i>	
6. Sorghum production technology .....	60
<i>S Ravi Kumar</i>	
7. Value-addition to sorghum: Potential of sorghum for industrial uses in India and entrepreneurship development.....	69
<i>B Dayakar Rao</i>	
8. Sweet sorghum - A versatile bioenergy crop its juice quality and diversified uses .....	80
<i>CV Ratnavathi</i>	
9. Sorghum diseases - Importance and management options* .....	85
<i>IK Das</i>	
10. Alternative uses of millets and scope of entrepreneurship .....	92
<i>RG Math</i>	
11. Post harvest management of grain sorghum.....	98
<i>G Shyam Prasad<sup>1</sup> &amp; K Srinivasa Babu<sup>2</sup></i>	
12. Sweet sorghum for bio-fuel production - Industrial experiences and economics .....	107
<i>AV Umakanth</i>	
13. Sorghum cultivation in rice-fallows: A new opportunity .....	115
<i>Rajendra R Chapke<sup>1</sup> and VA Tonapi<sup>2</sup></i>	

14. **Prospects for sorghum biofortification** .....123  
*K Hariprasanna*
15. **Sorghum genetic resources management (2000 – 2015)**.....139  
*M Elangovan*
16. **Sorghum: An important forage crop**.....152  
*B Venkatesh Bhat<sup>1</sup> & Avinash Singode<sup>2</sup>*
17. **Go green to reduce pollution and retard global warming which is the need of the hour**.....157  
*KP Rajan*
18. **Principles of quality seed production and maintenance in sorghum** .....162  
*N Kannababu<sup>1</sup> & Vilas A Tonapi<sup>2</sup>*
19. **Mechanization of sweet sorghum cultivation – An overview** .....175  
*Aum Sarma*
20. **Millets: Current status in India, nutritional values and health benefits**.....179  
*RJ Sreenivasa*
21. **Supply chain management of dryland agricultural commodities** .....187  
*K Kareemulla*
22. **Alternate uses of millets and scope for entrepreneurship** .....194  
*K Uma Maheswari*
23. **Farmers' Rights in the context of Plant Variety Protection** .....199  
*K Hariprasanna*
24. **Sorghum production technology transfer and its impact**.....226  
*Rajendra R Chapke*





## 24. Sorghum production technology transfer and its impact

**Rajendra R Chapke**

*Principal Scientist, Indian Institute of Millets Research, Hyderabad*

### ABSTRACT

Frontline demonstrations (FLDs) programme is one of the approaches for disseminating farm technologies generated by research system. The programme which started with the conduct of 220 ha demonstrations in both *kharif* and *rabi* season during 1996-97, now they enhanced to more than 5000 ha, seeing the success of the programme in terms of adoption of recently released hybrids and varieties by the farmers. The results revealed that with the exploitation of the currently available sorghum production technologies, farmers could realize additional yield more than 50 per cent over the prevailing farmer's practices under wide range of agro-ecological sorghum growing regions.

### Introduction

Sorghum (*Sorghum bicolor* L. Moench) is the fourth largest crop after wheat, rice and maize which is being cultivated by resource poor, small and marginal farmers in semi-arid regions of the country. The efforts made by the Directorate of Sorghum Research (DSR), All India Coordinated Sorghum Improvement Project (AICSIP) and State Agricultural Universities since its inception, has led to technologies for enhancing production and productivity to meet requirement of food, fodder, feed and fuel.

In spite of its multiple uses, the area under grain sorghum in India has declined from 18.61 m. ha in 1969-70 to 5.75 m. ha in 2013-14. However, because of significant improvements made in research and development, its productivity has increased from 522 kg /ha to 912 kg /ha during the same period. There is a wide gap between average national productivity and yield potential of the improved sorghum technologies developed from the research institutes. The project aimed to involve the scientists who developed the technologies in demonstration of their product to the farmers (user of the technologies) and to have first hand feedback on its performance and problems for its further refinement. This programme is being organized by the DSR since its inception which was financially sponsored by the Ministry of Agriculture (Table 3).

Thus, FLD is one of the important programmes to evaluate and demonstrate the production potential of recently released sorghum cultivars in the farmers' fields. Besides, building confidence of the farmers to adopt the latest technologies, it gave

valuable feedback to modify the research programme based on experience gained during the programme. Now-a-days, the farmers preference is for dual purpose cultivars to meet the requirement of both fodder and food. The farmers' choice is also varies at locations to locations. Keeping these in view, FLDs on sorghum were organized and is being organized at different locations with the help of AICSIP centres. The results of the *kharif* FLDs organized during 2009-10 are highlighted in this articles to projects its implementation and impact.

### **Guidelines for frontline demonstrations**

Including in the guidelines given by the Ministry of Agriculture, Department of Agriculture and Cooperation (DAC), the following guidelines are revised for implementing the FLD programme in different sorghum growing regions of the country.

**Selection of the farmers:** Farmers from the different categories including SC and ST, who are interested, cooperative and responsive, should be selected. The farmers should be within limit, as 20-25 numbers maximum from a single village or from a cluster with one technical field assistance.

**Site selection:** FLD sites should preferably be selected on road sides of the village in order to get exposure to the maximum numbers of farmers including non-beneficiaries.

**Field layout:** The field layout should be included farmer's practice. The component demonstration and total package demonstration need to be conducted separately. The field for FLD should be minimum of 0.4 ha.

**Field boards and labels:** The trials should be labeled with field boards and plates showing name of latest cultivars, date of sowing and fertilizers (NPK) dose, etc.

### **Technology for demonstration**

- a. **Package demonstrations:** Details of practices used should be listed out under demonstrations and made available to the farmers at the beginning. The farmers' practices are also need to be enlisted at the beginning of the programme.
- b. **Demonstrations on high yielding cultivars:** The demonstrations should include the cultivars developed within the last five years period. Their performance should be compared with local cultivars. All the management practices except the cultivars should be same.

**Literature distribution:** Handouts or leaflets on the demonstrated technologies in local language should be distributed to the farmers along with critical inputs as a subscription.

**Field book maintenance:** The field book having farmer's details, layout design, date-wise operations, component-wise cost incurred, labour requirement, yield attributes, yield data, etc., along with the farmers' practice (as a check) must be maintained.

**Data support:** Data need to be generated or collected on physico-chemical properties of soil, annual rainfall and district-wise area, production and yield (APY) in addition to the FLDs' data.

**Contact with line departments:** These demonstrations should be focused on adoption of critical technological gaps. The Strategic Research and Extension Plans (SREPs) prepared by ATMAs have identified such technological gaps for major crops of the district. While preparing plan for the FLDs, the SREP of the district may be consulted by the concerned scientist of implementing centres.

**Latest approach:** Farm Field Schools are being setup at Block / Village level by the ATMA official on the field of progressive farmers, who may be linked in organizing FLDs on sorghum.

**Technology dissemination:** Conduct extension activity like, farmers' day, field days and field visits and explain superiority of the demonstrated technologies over their own practices involving maximum number of farmers of the village and surrounding areas.

**FLD monitoring:** The monitoring team of experts should assess the trials on different parameters including utilization of funds, crop management, field layout, literature distribution, etc.

### **1. Frontline demonstrations on *kharif* sorghum**

In total, 254 frontline demonstrations (FLDs) on sorghum were organized during the year under report in 29 districts across the 7 different sorghum growing states viz., Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh, Rajasthan, Gujrat and Tamil Nadu. Latest sorghum cultivars (SPSH 1148, CSV 20, CSV 23, CSH 23 and CSV 17) were commonly undertaken and compared with farmers' cultivar as local check to evaluate and demonstrate their performance in farmers' fields at different locations.

### Highlight of the results

The demonstrated improved sorghum cultivars irrespective of the agro-ecological regions yielded better by obtaining 12 to 67% higher grain yield and 1% to 64% more fodder yield than the local check. It was also proved more economical than the local checks. On an average, the demonstrated cultivars could earn net returns of Rs.17,955/- per ha, which was 56.21 per cent more than the local check (Rs.11,494/- per ha). It was also resulted in to 0.45 more B:C ratio from them. However, the rate of increase varied at different locations. The higher increase in grain yield 368% was obtained in *Mevad* region of the Rajsthan and lowest 12% was in *Vidharbha* region of the Maharashtra. Similar trend was observed in case of fodder yields, except in the *Mevad* region (yield increased 1%) because the local cultivars were also performed better (Table 2).

### Yield gaps

The results show that the grain yield of sorghum was lower under farmer's practice (1.52 t. ha<sup>-1</sup>) as compared to FLD's (2.20 t. ha<sup>-1</sup>) indicating a wider gap (45%). However, comparatively lower yield gap (21.53%) was found in case of stover yield (Table 4 and Fig. 1). The cultivars could bridge the yield gap in grain (45%) and stover (21.53%) through improved sorghum technologies, *kharif* sorghum farmers could able to produce the maximum grain and stover yields. Since, the demonstrated sorghum cultivars shows potential to increase the yields and profits over local one at almost all the locations, FLDs may be conducted systematically in small area under control with location-specific sorghum technologies to build up confidence of the farmers for its wide adoption.

**Table 1 Economics of *kharif* sorghum cultivation under FLDs**

S. No.	FLD Centre	Economic					
		Cost of cultivation (Rs.ha <sup>-1</sup> )		Net return (Rs.ha <sup>-1</sup> )		B:C ratio	
		FLD	FP	FLD	FP	FLD	Local check
1	Palem	10900	9125	25162	16830	3.29	2.83
2	Udaipur	8500	7700	16950	7160	2.74	1.85
3	Surat	15038	14310	20215	12812	1.34	0.90
4	Indore	8064	6787	17818	12695	3.21	2.91
5	Akola	14109	15501	20321	17298	1.44	1.11
6	Coimbatore	9211	7643	7264	2170	1.70	1.45
	Mean	10970	10178	17955	11494	2.29	1.84



**Table 2 State-wise yield gap between FLDs and farmer's practice (FP)**

S. No.	State	Grain yield (t. ha <sup>-1</sup> )			Stover yield (t. ha <sup>-1</sup> )		
		FLD	FP	Yield gap (%)	FLD	FP	Yield gap (%)
1	Andhra Pradesh	3.5	2.45	42	8.6	6.25	38
2	Rajsthan	1.64	0.35	368	7.82	7.73	01
3	Gujrat	2.16	1.63	33	6.19	5.02	23
4	Madhya Pradesh	2.33	1.86	25	7.10	5.26	35
5	Maharashtra	2.36	2.10	12	8.50	8.08	05
6	Tamil Nadu	1.22	0.73	67	7.20	4.40	64
	Mean	2.20	1.52	91.17	7.57	6.12	27.67

**Table 3 Details of frontline demonstrations conducted since 2006**

Year	Varieties/hybrids demonstrated	Area covered (ha)	Demos	States/locations
2013-14	CSV 22R, CSV 18R, Phule Vasuda, Phule Suchitra, Phule Revati, Phule Anuradha, PKV Kranti, Parbhani Moti, CSV 26R and CSV 29R	152	341	Maharashtra, Karnataka and Andhra Pradesh
2012-13	CSV 22R, CSV 18R, Phule Vasuda, Phule Suchitra, Phule Revati, PKV Kranti, Parbhani Moti and CSV 26R	156	280	Maharashtra, Karnataka and Andhra Pradesh
2011-12	CSH 16 (in rice-fallows)	50	126	Guntur district of Andhra Pradesh
2010-11	CSH 23, CSV 23, CSV 20, CSV 17, SPH 1148, CSH 25, SU 1080, CoS 30, CSV 22, Phule Yashodha, Phule Vasudha and CSV 18	250	431 (125K+306R)	Maharashtra, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Rajsthan, Gujarat
2009-10	CSH 23, CSV 23, CSV 20, CSV 17, SPH 1148, CSH25, PJ1430, SU 1080, JJ 1022, Co (s)28, PKV-kranti, CSV 22R and CSV18R	283	471 (254K+217R)	Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Rajsthan, Gujarat, Uttar Pradesh
2008-09	CSH 23, CSV 23, SPV 1616, CSV 17, SPV 1753, PJ 1430, SU 1080, JJ 1041, and JJ 1022	47.20	90	Karnataka, Madhya Pradesh, Rajsthan
2007-08	CSV13, CSV17, CSV19SS, SPV1616, SPV1430, NSV13, ICSV745, SSV84, GJ40, JJ1041, PVK400, PVK801, PVK809	312	479	Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Rajsthan, Gujarat, Uttarakhand, Jharkhand, J&K, Uttaranchal
2006-07	SPV1616, CSV17 and state released cultivars	271	498	Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Rajsthan, Gujarat, Uttar Pradesh, Jharkhand, Uttaranchal

(Source: Report on frontline demonstrations on sorghum, National Research Centre for Sorghum, Hyderabad)

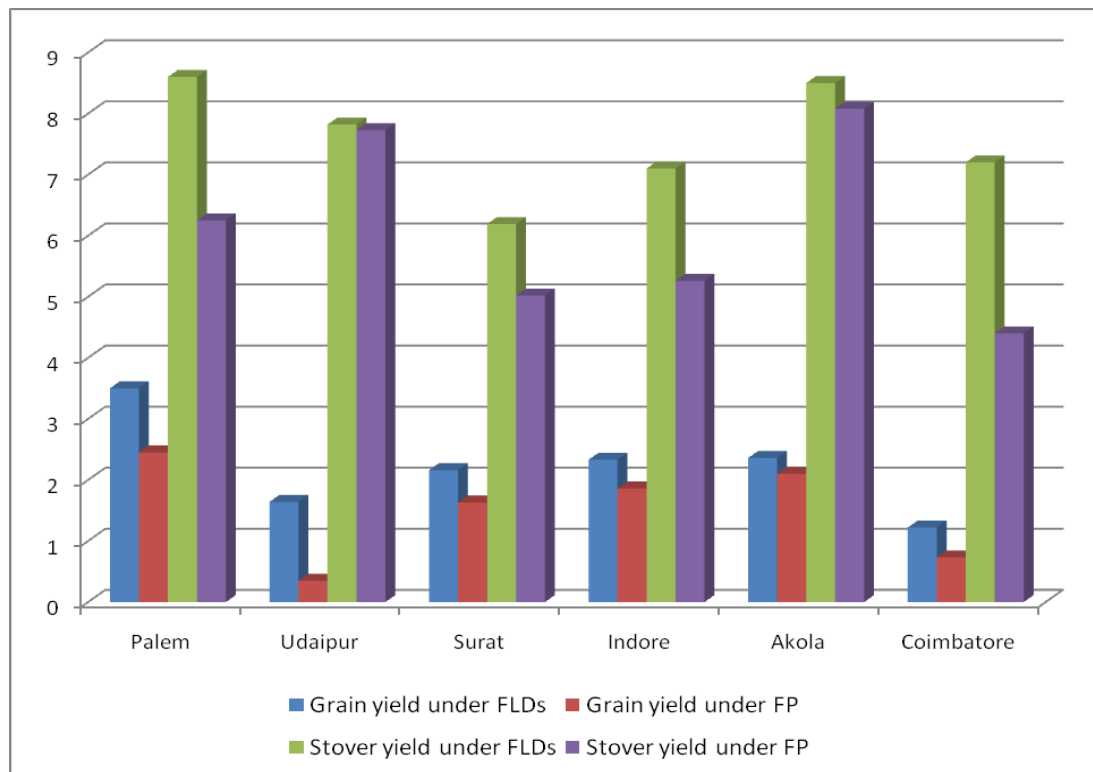


Fig. 1 Performance of kharif FLD cultivars over local check (t/ha)

## 2. Frontline demonstrations on *rabi* sorghum

*Rabi* sorghum is valued mainly for direct human food consumption and fodder for livestock. In last two decades, the *rabi* sorghum area has increased (3.23 m ha during 1991-96 and 3.59 m ha during 2013-14) with increase in yield (from 539 kg/ha to 840 kg/ha during the same period). Maharashtra is major sorghum growing state followed by Karnataka and Andhra Pradesh in the country. *Rabi* sorghum is mostly grown in dryland conditions on residual soil moisture of rainy season. The productivity of *rabi* sorghum is dependent on quantity of rains during pre-season monsoon and water holding capacity of soil, use of moisture conservation practices, use of high yielding cultivars on basis of soil types and available production technologies. Whereas, in few pockets of Western Maharashtra and Karnataka, the crop is grown on irrigated conditions with two to four irrigations with higher productivity up to 3.5 to 4.0 t/ha. The productivity of *rabi* sorghum is less (840 kg/ha during 2013-14) than that of rainy season (*kharif*) sorghum (1033 kg/ha). The important reasons for that are; (i) non-adoption of improved sorghum cultivars on soils type basis and (ii) the crop is grown on residual soil moisture. Keeping these in view, FLDs on sorghum were organized with latest high yielding *rabi* sorghum varieties at different locations.

### Highlight of results

During 2013-14, in Telangana, CSV 22R gave 39% more grains yield (1.82 t/ha). Sorghum variety viz., CSV 18R yielded higher (2.33 t /ha) grains in *Marathwada* region of Maharashtra. Performance of CSV 29R was found better in terms of grains yield (1.45 t /ha) at Bijapur centre. Demonstrated variety; Phule Revati gave higher grain yield (1.87 t /ha) than the local varieties viz., *maldandi* and *dagadi* (0.52 t /ha) in Solapur area. Phule Vasudha was also performed better (1.86 t /ha) in Western Maharashtra region. The improved sorghum cultivars increased the grain and fodder yields over local check in all the locations. The yield advantages were ranged from 29% to 194% in grain and 28% to 150% in fodder. Among the locations, the highest yield in both grain (1.97 t /ha) and fodder (5.57 t /ha) was observed in *Marathwada* region of Maharashtra (Table 5 & Fig. 2).

### State-wise yield gaps

It is cleared from Table 5 and Fig. 2 that the grain yields of sorghum was lower under farmer's practice (1.06 t. ha<sup>-1</sup>) as compared to FLD's (1.64 t. ha<sup>-1</sup>) indicating wider gap (63%), across the states. However, lower yield gap (50%) was found in case of stover yields under farmer's practice (2.69 t. ha<sup>-1</sup>) as compared to FLD's (3.93 t. ha<sup>-1</sup>).

**Table 4 Economics of FLDs on sorghum**

S. No.	FLD Centre	Grain yield (t.ha <sup>-1</sup> )		Stover yield (t.ha <sup>-1</sup> )		Cost of cultivation (Rs.ha <sup>-1</sup> )	Net return (Rs.ha <sup>-1</sup> )		B:C ratio	
		FLD	LC	FLD	LC		FLD	LC	FLD	LC
1	Parbhani	1.97	0.67	5.57	2.85	14831	44576	14768	3.00	2.00
2	Solapur	1.26	0.52	2.72	1.09	14208	20903	7508	2.39	2.10
3	Rahuri	1.73	1.04	4.40	2.51	29491	17032	6591	1.58	1.31
4	Bijapur	1.45	1.12	2.78	2.19	7867	22136	16013	2.81	2.13
5	Tandur	1.83	1.32	4.78	3.73	14102	40250	31176	2.86	2.38
	Mean	1.65	1.27	3.72	2.47	16100	28979	15211	2.53	1.98

**Table 5 State-wise yield gap between FLDs and farmer's practice (FP)**

S. No.	Location	Grain yield (t.ha <sup>-1</sup> )			Stover yield (t.ha <sup>-1</sup> )		
		FLD	LC	Yield gap (%)	FLD	LC	Yield gap (%)
1	Maharashtra	1.65	0.74	122	4.23	2.15	96
2	Karnataka	1.45	1.12	29	2.78	2.19	27
3	Telangana	1.83	1.32	39	4.78	3.73	28
	Mean	1.64	1.06	63	3.93	2.69	50

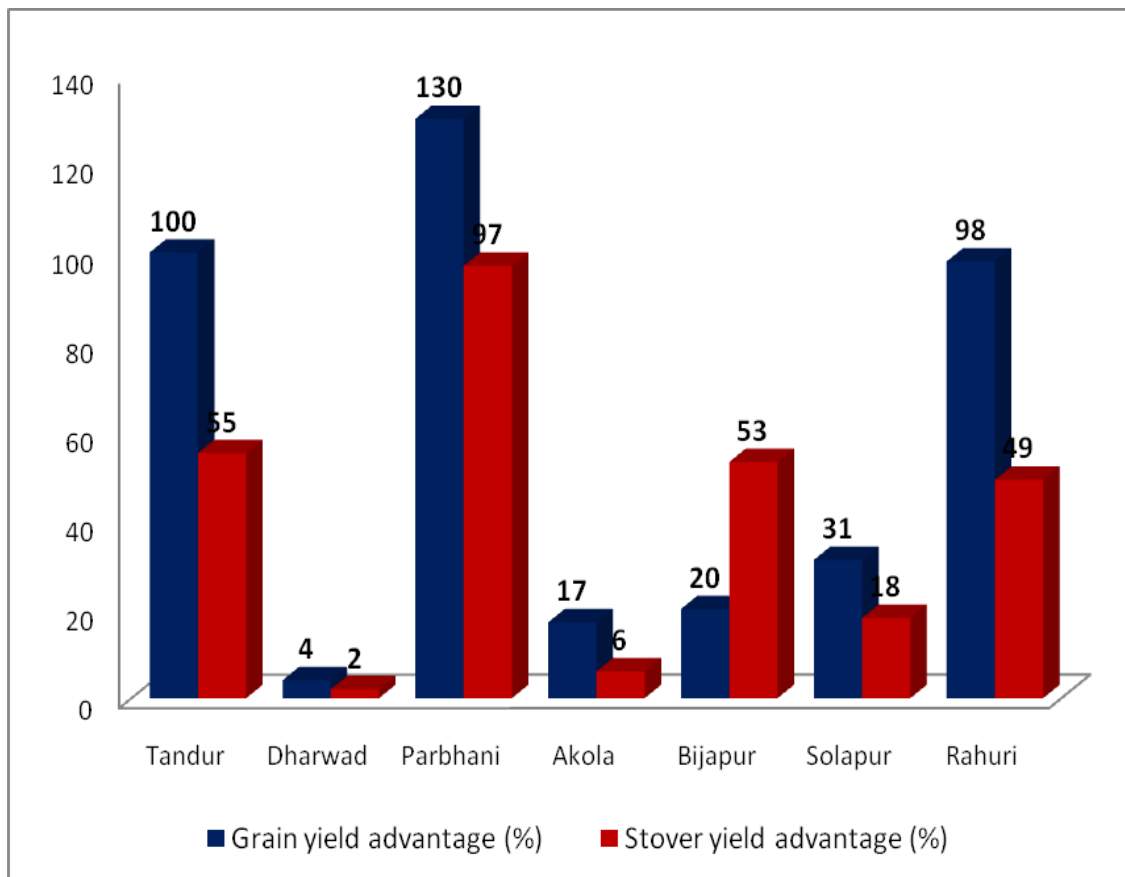


Fig. 2 Yield advantage of rabi FLD varieties over local check (%)

### Transfer of technology through Extension programmes

The sorghum production technologies developed by the research institutes are disseminated through various Extension agencies of Central and State Agricultural Universities and also through Frontline demonstrations, on-farm trials and by conduct of Farmer's Days.

During last five years, more than 35,000 farmers and different stakeholders were exposed to the latest sorghum technologies through various extension programmes organized by this institute such as short duration trainings, hands-on trainings, krishi melas, field day, field visits, video shows, frontline demonstrations, method demonstrations, etc. The following extension programmes were also conducted to transfer of the production technologies effectively.

### Training

In order to popularize the sorghum production technologies, regular training of the field extension functionaries of the state department of agriculture and line departments, non-governmental organizations and others involved in the transfer of technologies of sorghum is organized at DSR, Hyderabad. Several national level workshops-cum-seminars and training programme are being organized.

### **Linkages**

The linkages not only with State department of agriculture of different states but also with the line departments involved in sorghum popularization of sorghum viz., Department of Animal husbandry, Department of dairy etc., the State Agricultural Universities, other central institutions like NDDB, MANAGE, NIRD, sister ICAR institutions and various non-governmental organizations involved in the transfer of sorghum production technologies have been established to popularize sorghum production technology.

### **Live demonstrations**

Regular demonstrations are being laid at the institute farm with the popular, released and pre released cultivars of sorghum for the exposing the improved cultivars to the farmers, extension officials, and visitors to the institute. Apart from these demonstrations, demonstrations are also laid down in the select farmer's fields to demonstrate the production potential of the released improved cultivars.