Int.J.Curr.Microbiol.App.Sci (2017) Special Issue-4: 7-15

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-4 (September-2017) pp. 7-15**
Journal homepage: http://www.ijcmas.com

Original Research Article

An Economic Analysis of Improved Rabi Sorghum Cultivars in Rainfed Situation of Maharashtra, India

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A B S T R A C T

An attempt was made to study the economic performance of improved four sorghum cultivars namely, *Phule Vasudha*, *Phule Chitra*, *Phule Revati* and *Phule Anuradha* in Maharashtra. These cultivars were analysed vis-à-vis local variety to measure the improvement in the performance. Primary data was collected from three districts of Maharashtra namely, Solapur, Ahmednagar and Pune for the year 2013-14. About 50 % of the sample farmers adopted *Phule Vasudha* variety due to its adaptability in dryland conditions. The study revealed that despite increase in the cost of cultivation for the improved cultivars by 29 %, there was significant gain in terms of increased grain yield (65%), stover yield (58%), grain value (27%), stover value (99%), and net returns (72%). District wise assessment of these cultivars revealed that there were significant gains in terms of above parameters despite rise in the cost of cultivation. In all the districts operational costs were almost 40 % more than the local check which was the main reason behind large difference in cost of cultivation. Net returns from the cultivation of improved cultivars were mora than local variety in all three districts. Lack of irrigation facilities, human shortage and low mechanisation were main constraints in the study area.

Keywords

Sorghum, improved cultivars, Competitiveness, Cost of cultivation, Maharashtra

Introduction

Sorghum (*Sorghum bicolor* (L.) Moench) is country's fifth largest crop after wheat, rice and maize and pearl millet that is being cultivated by marginal and small farmers in semi-arid regions of the country. Sorghum is one of the five most important cereal crops in the world (Doggett, 1988). It is one of the main staple food crops for the world's poor and food-insecure people (Basavaraja, *et al.*, 2005). Sorghum has adaptive features that favour its growth in areas where other staple cereals such as wheat, maize and rice would not be suitable (Haussmann *et al.*, 2000; Rami *et al.*, 1998). It is grown during both in rainy (*kharif*) and post-rainy (*rabi*) seasons for multiple uses such as a food, feed, stover and fuel crop. Summer sorghum is also cultivated in parts of Maharashtra. Of late sorghum is grown in rice fallows in Guntur district of coastal AP. Sorghum grown in the rainy season is mainly utilized as feed and other industrial uses as the grain is often caught in incessant rains due to which the quality is affected by grain moulds. However, post-rainy sorghum is primarily used as food owing to its good grain quality and also serves as a main source of stover, especially during dry seasons. There has

been drastic reduction in sorghum area especially in the rainy season, but the area under post-rainy sorghum has remained relatively stable and is grown predominantly in six districts of Maharashtra (Solapur, Ahmednagar, Pune, Beed, Osmanabad and Aurangabad) and three districts of Karnataka (Bijapur, Gulbarga and Raichur), apart from parts of Andhra Pradesh and Tamil Nadu (Reddy *et al.,* 2012). The efforts made by the ICAR- Indian Institute of Millets Research (earlier known as NRCS and DSR) with the help of the All India Coordinated Sorghum Improvement Project (AICSIP) and State Agricultural Universities (SAU's) under NARS, has led to development of sorghum technologies for enhancing production and productivity to meet requirement of food, stover and feed. Despite its multiple uses, the area under sorghum in India has declined from 18.59 m. ha in TE 1969-70 to 6.61 m ha in TE 2012-13. However, its productivity has increased from 530 kg/ha to 920 kg/ha owing to significant improvements made in research and development. There is wide gap between national productivity and yield potential of the improved sorghum technologies developed from the research institutes. On this backdrop the present study was taken to analyse the performance of the four improved cultivars of sorghum in Maharashtra state of India.

Materials and Methods

As per the stated objective, the study required primary data which was collected from the farmers in the target regions. In Maharashtra, Pune, Ahmednagar and Solapur districts were selected for the study of performance of improved *rabi* sorghum cultivation in the current climatic situation under the All India Coordinated Sorghum Improvement Project (AICSIP). Specifically, the performance of Phule varieties which were developed by the MPKV, Rahuri were analysed for the study.

In the rain-fed areas of Solapur, Ahmednagar and Pune districts in Maharashtra, the data was collected from the 50 each beneficiary farmers of the state agriculture universities (SAUs) especially Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri and the state agriculture ministry of these districts. The data was collected for the current period i.e. 2013-14 *rabi* sorghum cultivation for both local and improved *rabi* sorghum cultivars namely, *Phule Vasudha*, *Phule Chitra*, *Phule Revati* and *Phule Anuradha*.

The analyses were done in compliance with the cost concepts laid down by the Directorate of Economics and Statistics (DES), Ministry of Agriculture, Govt of India as given below.

The cost of cultivation and the activity-wise cost incurred per hectare were calculated for both improved and local varieties separately so that comparative statement could be made vis-à-vis advantage or disadvantage and benefits or loss of improved cultivars over local variety could be evaluated.

Operational cost is the direct or actual expenditure which the farmers made from land preparation till its harvesting and threshing. However, as per the DES pattern, Cost C2 is considered for calculating Gross and Net returns as well as Output Input Analysis. Cost of cultivation consists of paid cost (out of pocket expenses) and the imputed costs. The items covered under these costs are:

Paid-out costs

Hired labour (human, animal and machinery).

Maintenance expenses on owned animals and machinery.

Expenses on material inputs such as seed (home grown and purchased), fertilizer, Manure (owned &purchased), Pesticides and Irrigation

Depreciation on implements and farm buildings (such as cattle sheds, machine sheds, storage sheds).

Land revenue.

Rent paid for leased-in land.

Imputed Costs

Value of family labour / managerial input of the farmer, rent of owned land interest on owned fixed capital for which the farmer does not incur any cash expenses.

Costs are generated following certain cost concepts. These cost concepts and the items of costs are included under each concept are given below:

Cost A1

Value of hired human labour
Value of hired bullock labour.
Value of owned bullock labour.
Value of owned machinery labour.
Hired machinery charges.
Value of seed (both farm produced and purchased).
Value of insecticides and pesticides.
Value of manure (owned and purchased).
Value of fertilizer.
Depreciation on implements and farm buildings.
Irrigation charges.
Land revenue, cesses and other taxes.
Interest on working capital.
Miscellaneous expenses (artisans, etc.)

Cost A2: Cost A1+ rent paid for leased-in-land.

Cost B1: Cost A2+ interest on value of owned fixed capital assets (excluding land)

Cost B2: B1+ rental value of owned land (net of land revenue) and rent paid for leased-in land

Cost C1: Cost B1 + imputed value of family labour.

Cost C2: Cost B2+ imputed value of family labour

Results and Discussion

Adoption of improved cultivars by the sample farmers

From the three districts, 50 farmers each were selected through random sampling. Various rabi sorghum cultivars were adopted by the farmers based on the sorghum rabi cultivar technology suitable to their lands (which are mainly shallow soils).

The distribution of rabi sorghum farmers in three selected districts viz, Solapur, Pune and Ahmednagar growing different improved cultivars is given table 1. In Solapur, most farmers cultivated *Phule Vasudha* due to its adaptable and suitable nature as the district receives meagre rainfall. Therefore, forty four (44) out of fifty (50) sample farmers cultivated *Phule Vasudha*, 4 of them cultivated *Phule Chitra*, and 2 of them cultivated *Phule Revati* without irrigation. None of the sample farmer in Solapur cultivated *Phule Anuradha*. In Pune, 22 farmers cultivated *Phule Vasudha*, followed by *Phule Chitra* by 15 farmers and *Phule Anuradha* by 10 farmers, whereas, only 3 of them cultivated *Phule Revati*. In contrast to the other two

districts, most of the sample farmers in Ahmednagar cultivated *Phule Revati* as generally it requires good irrigation for proper growth and yield. However, depending upon the suitability of the soil, 23 of them cultivated *Phule Revati*, 14 of them *Phule Vasudha*, 9 of them *Phule Anuradha* and 4 of them *Phule Chitra*.

Competitiveness of the improved cultivars over local variety

The performance of the improved cultivars of sorghum was compared against the local variety to assess added and reduced costs and benefits in the study areas. The cost of cultivation of the improved varieties and the local check has been depicted in table 2. The results revealed that the average cost of cultivation of the four selected improved cultivars was 29 % more than the local variety mainly due to large differences in the fertilisers cost (278 per more than the local variety). The human labour cost and animal labour cost were also significantly higher for the improved cultivars (38 % and 25 % respectively). The cost of cultivation of *Phule Chitra* and *Phule Anuradha* was comparatively higher than the other two improved cultivars.

The district wise yield performance of the improved cultivars vis-à-vis the local check was presented in table 3. It was revealed that the mean grain yield advantage of the four improved cultivars was 66.13 % over the local variety, and the mean stover yield was 55.20 % more for the improved cultivars.

Amongst the selected districts the highest grain yield was recorded in Pune (86.24%) followed by Ahmednagar (83.98%) and Solapur (40.29%). In case of stover yield the highest yield advantage was in Ahmednagar district (71.79%). Highest grain was recorded for *Phule Revati* (34.17 Qtl./Ha.) in Ahmednagar district. It could be seen from the above results that there was significant yield advantage (both grain and stover yield) for the improved cultivars over the local variety despite higher cost of cultivation.

The above results are summarised in table 4 to give a clear comparison of the performance of the selected improved cultivars over the local variety. It could be seen from table 4 that cost of cultivation of the improved cultivars was 29 % more than the local variety mainly driven by the added operational costs. On the other hand the grain and stover yields were 65 % and 58 % more than local check respectively. The value of the grains from the improved cultivars was 27 % more than the local check, whereas the value of stover from improved variety was 99 % more i.e., almost double. The Gross returns of improved exceeds Rs. 60,000 per hectare whereas local one stood at Rs 40000 per hectare. Net returns from the improved cultivars over the cost C2 was 72 more than local check. The output-input ratios of improved and local varieties were 1.77 and 1.57 respectively. Similar results about the performance of sorghum were reported by Rao *et al.,* 2004; Wortmann *et al.,* 2010.

District-wise competitiveness of improved rabi sorghum cultivars over local variety

Solapur

The average cost of cultivation, Cost C2 of the improved sorghum was about Rs 28000 per hectare whereas that of Local hovered at Rs 23000 per hectare with a difference of 23 % higher than the former as shown in table 5. The operational cost was 37 % higher in case of the improved cultivars over the local check. However the same trend was followed in terms of added gross profit from the improved cultivars. The gross returns and the net returns were 32 % and 42 % more than the local check respectively.

There was only 12 % difference in grain value though the yield of improved sorghum exceeded 40 % mainly due to higher price and demand for local sorghum owing to its better taste. However, due to higher length of improved plants, the improved stalk value was double than the local.

Ahmednagar

The average cost of cultivation (Cost C2) of the improved sorghum stood at Rs 37000 per hectare whereas that of local variety was at Rs 30000 per hectare with a difference of 28 % as shown in table 6. The operational cost was higher by 40 % for the improved cultivars over local check. The grain yield and the stock yield were higher by 81 % and 86 % respectively. Value of the grains from improved cultivars was 37 % more but the value of the improved stover was twice as compared to the local variety. The net returns from the improved cultivars were more than double as compared to the local check.

Pune

Operational costs of the improved sorghum cultivars in Pune district was 46 % more than that of the local check. Higher operational costs were main drivers of the higher cost of cultivation (31%) of the improved cultivars. The grain and stover yield were higher for the improved varieties over local check by 86 % and 38 % respectively. But the difference in the value of the grains from improved cultivars was not much as compared to the difference in the grain yield. This was due to higher prices and preferences for the local grains owing to its better taste. The net returns from the improved varieties were 91 % over and above local check. Input-output ratios were 1.77 and 1.53 for improved and local variety respectively.

Constraints

Lack of irrigation

Since there was no irrigation source and the wells at farmer's field could hardly serve for their animal, most of the farmers were depending on rain for sorghum cultivation. The farmers grew sorghum despite exceeding low yield and less remuneration since it is the only crop that could survive in such a harsh climatic conditions where rainfall is uncertain at any point of time.

Lack of human labour

The fast rural-urban migration hindering the rural development has led to the scarcity and increasing cost of human labour for the dry-land agriculture, especially for sorghum which is a labour intensive crop. For instance, weeding requires 5 to 10 women labour, harvesting also requires 5 to 10 of man labours which are mostly done by pulling out the root instead of cutting it for next season land preparation

Table.1 Variety-wise distribution of farmers

Sl. No.	District	No. of Sample farmers	Variety wise distribution of the sample farmers			
			Phule Vasudha	***Phule Chitra***	***Phule Revati***	***Phule Anuradha***
1	**Solapur**	50	44	04	02	00
2	**Pune**	50	22	15	03	10
3	**Ahmednagar**	50	14	04	23	09
	Total	**150**	**80**	**23**	**28**	**19**

Table.2 Cost of improved and local variety sorghum cultivation in rain-fed areas

	Improved cultivar				Mean Improved cultivar	Local variety	Difference of Improved over Local (%)
	Phule Vasudha	Phule Chitra	Phule Revati	Phule Anuradha			
Operational cost	9366.73	24227.96	11668.74	27622.72	25253	17584	44
Human labour							
Hired	2660	7141.3	3500	7059.21	7187	4230	70
Family	2510	6603.26	3076.79	6921.05	6685	5798	15
Total	5170	13744.57	6576.79	13980.26	13872	10028	38
Bullock labour							
Hired	95.29	238.23	95.29	238.23	238	191	25
Owned	988.71	1888.59	676.14	1827.56	2144	1717	25
Total	1084	2126.81	771.43	2065.79	2382	1908	25
Machine labour	1091	3266.3	1615.18	3003.29	3102	2548	22
Seeds	260	650	260	650	650	650	0
Fertilizer & manure							
Fertilizer	1046.37	2195.08	1446.84	4796.05	3069	812	278
Manure	178.67	804.35	271.43	1394.74	672	720	-7
Total	1225.03	2999.43	1718.27	6190.79	3742	1531	144
Insecticides	0	0	0	0	0	0	
Pesticides	0	0	0	0	0	0	
Irrigation charges	0	0	0	0	0	0	
Int. On working capital	536.6933	1440.85	727.0784	1732.59	1505	918	64
Fixed costs	3557.98	8894.94	3557.98	8894.94	8895	8895	0
Rental value of owned land	1985.72	4964.29	1985.72	4964.29	4964	4964	0
Land revenues, cases & taxes	250	625	250	625	625	625	0
Dep. On implements & F. Bldg	206.37	515.93	206.37	515.93	516	516	0
Interest on fixed capital	1115.89	2789.72	1115.89	2789.72	2790	2790	0
Total cost (c2)	12924.7	33122.9	15226.72	36517.66	34148	26479	29
C2*	12924.7	33122.9	15226.72	36517.66	34148	26479	29
C3	14217.17	36435.18	16749.39	40169.42	37563	29127	29
C3 (RS./QUINTAL)	1816.504	24227.96	1642.672	2228.38	1815	1407	29

Table.3 The district-wise performance of improved sorghum cultivars

District		Variety wise yield of the improved cultivars (Qtl/hectare)				Mean	Local Check	Yield Advantage (%)
		Phule Vasudha	Phule Chitra	Phule Revati	Phule Anuradha			
Solapur	Grain Yield	18.84	17.5	18.13	NA	18.7	13.33	40.29
	Stover Yield	61.51	62.5	71.88	NA	62	42.42	46.16
Pune	Grain Yield	19.17	27.5	25	15.56	21.38	11.48	86.24
	Stover Yield	45.14	62.5	64.13	39.58	62.24	45.23	37.61
Ahmednagar	Grain Yield	21.19	19.83	34.17	20.25	22.17	12.05	83.98
	Stover Yield	56.39	75.58	62.5	55	49.75	28.96	71.79
Mean	Grain Yield	19.57	20.76	25.49	18.03	20.7	12.46	66.13
	Stover Yield	54.41	71.03	64.51	47.7	58	37.37	55.2

Table.4 Economics of improved Vs Local variety *rabi* sorghums Rs per hectare

Parameters	**Improved Sorghum**	**Local Sorghum**	**Difference of Improved over Local (%)**
Operational Cost	25253	17584	44
Cost of Cultivation, Cost C2	34148	26479	29
Grain Yield (Qtl.)	20.7	12.57	65
Stalk Yield (Qtl.)	60	38.04	58
Value of Grain (Rs.)	39972	31421	27
Value of Stalk (Rs.)	20347	10235	99
Gross Returns	60318	41656	45
Net Returns over Cost C2	26170	15177	72
Output-Input Ratio	1.77	1.57	12

Table.5 Economics of improved *rabi* sorghum cultivation in Solapur per hectare

Particulars	**Improved Varieties**				**Local Sorghum**	**Difference of Improved over Local (%)**
	Phule Vasudha	***Phule Chitra***	***Phule Revati***	**Mean**		
Operational Cost	19003	18662	19519	18996	13852	37
Cost of Cultivation, Cost C2	27898	27557	28414	27891	22747	23
Grain Yield (Qtl.)	18.84	17.50	18.13	18.70	13.33	40
Stalk Yield (Qtl.)	61.51	62.50	71.88	62.00	42.42	46
Value of Grain (Rs.)	37670	35000	36250	37400	33313	12
Value of Stalk (Rs.)	18452	18750	21563	18600	9260	101
Gross Returns	56122	53750	57813	56000	42573	32
Net Returns over Cost C2	28224	26193	29399	28109	19826	42
Output-Input Ratio	2.01	1.95	2.03	2.01	1.87	7

Table.6 Economics of improved *rabi* sorghum cultivation in Ahmednagar per hectare

Particulars	*Phule Vasudha*	*Phule Chitra*	*Phule Revati*	*Phule Anuradha*	Mean	Local Sorghum	Difference of Improved over Local (%)
Operational Cost	26840	25198	28345	23881	28479	20357	40
Cost of Cultivation, Cost C2	35735	34093	37240	32776	37374	29252	28
Grain Yield (Qtl.)	19.17	27.50	25.00	15.56	22.17	12.28	81
Stalk Yield (Qtl.)	45.14	62.50	64.13	39.58	55.28	29.75	86
Value of Grain (Rs.)	36417	52250	47500	29556	42117	30694	37
Value of Stalk (Rs.)	20000	20000	20000	20000	20000	10000	100
Gross Returns	56417	72250	67500	49556	62117	40694	53
Net Returns over Cost C2	20682	38157	30260	16779	24743	11443	116
Output-Input Ratio	1.58	2.12	1.81	1.51	1.66	1.39	19

Table.7 Economics of improved *rabi* sorghum cultivation in Pune

(per hectare)

	Phule Vasudha	*Phule Chitra*	*Phule Revati*	*Phule Anuradha*	Mean	Local Sorghum	Difference of Improved over Local (%)
Operational Cost	24934	23452	26364	25822	26778	18363	46
Cost of Cultivation, Cost C2	33829	32347	35259	34717	35673	27258	31
Grain Yield (Qtl.)	21.19	19.83	34.17	20.25	21.38	11.48	86
Stalk Yield (Qtl.)	56.39	75.58	62.50	55.00	62.24	45.23	38
Value of Grain (Rs.)	40267	37683	64917	38475	40613	28693	42
Value of Stalk (Rs.)	20301	27210	22500	19800	22406	12886	74
Gross Returns	60568	64893	87417	58275	63018	41580	52
Net Returns over Cost C2	26739	32547	52158	23558	27345	14322	91
Output-Input Ratio	1.79	2.01	2.48	1.68	1.77	1.53	16

Low mechanization

The use of machinery such as tractors was not economically feasible as most of the farmers have small landholdings; secondly, farmers were accustomed with family bullock and human labour as it requires minimum capital despite taking excessive time and labour investment.

It could be concluded from the above discussions that there was significant yield gain in case of the improved rabi sorghum cultivars in all the three selected districts of Maharashtra. The performance of improved cultivars in Solapur over local variety was lower than Pune and Ahmednagar which may be due to less application of fertilizers and manures. Though improved cultivars have higher yield, most of the small land holding farmers preferred to cultivate local variety for their own consumption as local cultivars have better taste and better stover quality for the animal. With regard to marketing of the produce, the farmers solely depend on the demand generated by the brokers/middlemen. This curtailed their bargaining power for higher price for their

produce. Lack of regulated markets and lack of bargaining power are the two major setbacks for sorghum growers in order to increase its area of cultivation.

Most of the farmers take up sorghum cultivation not with the profit motive but as it is the only crop that can withstand in the worst climatic situation which often prevails in this region. In such cases, establishment of proper marketing channel and building of sustainable linkages of farmers with the market through the research institutes and government departments was necessary to ensure income generation from their produce.

It is observed that the farmers received better yield in improved cultivars. Besides, through the active participation of public and private stakeholders, the potential of sorghum in uplifting the economy of the farmers could have been explored.

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