

Studies on the Relative Efficiency of Bajra (*Pennisetum typhoides*) and Guar (*Cyamopsis tetragonoloba*) Varieties Under Dryland Condition

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ABSTRACT

Investigations on the relative efficiency of *bajra* and *guar* varieties in utilizing rainfall and stored soil moisture were carried out on loamy sand soil of the middle Gujarat at Gujarat Agricultural University, Anand Campus during *Kharif* 1976 to 1978. The results suggested that 'J-1399' variety of *bajra* followed by 'BJ-104' gave higher yield and moisture use efficiency than the rest of the varieties tried. Among *guar* varieties, *guar* 'Malosan' followed by 'Kutch-8' resulted in higher seed yield and moisture-use efficiency than the rest. Considering the relative efficiency of *bajra* and *guar* varieties together, cultivation of *bajra* appeared to be an appropriate choice of crops, providing higher moisture use efficiency and monetary returns.

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INTRODUCTION

On drylands of North Gujarat Agro-climatic Zone, the soils of low fertility and water holding capacity, on one hand, and low and erratic rainfall on the other hand, seem to be responsible for low and unstable crop yields. For stabilizing crop production, the choice of crops and their varieties that are efficient utilizers of limited rainfall and stored soil moisture should be a basic approach. With a view to finding out the comparative efficiency of promising varieties of *bajra* and *guar* in utilizing rainfall and stored moisture, an investigation was undertaken for three consecutive *kharif* crop seasons from 1976 to 1978.

MATERIAL AND METHODS

Soil of the Research Farm of Anand campus of the Gujarat Agricultural University, where the present investigation

was carried out, is loamy sand in texture (more than 80 per cent sand), with pH ranging from 7.0 to 7.3. The soil depth, bulk density and total moisture storage capacity of the experimental site were of the order of more than 30 m, 1.49 g/cc and 233.9 mm, respectively. The field capacity and permanent wilting point were 15.7 per cent and 5.4 per cent respectively. The soil was poor in organic matter (0.5%) medium to high in phosphorus (46 to 80 kg/ha) and medium in potassium (160 to 179.2 kg/ha). Experimental details regarding crops and varieties used, layout design followed, plot size adopted and fertilizer dose applied are given in Table 1. The rainfall data is presented in Table 2.

RESULTS AND DISCUSSION

Yield and yield attributes :

Bajra varieties : 'J-1270' in 1976, 'J-1399' and 'CJ-104' in 1977 gave

TABLE 1

Experimental details.

Year	Crops and varieties		Layout design	Plot size (Gross)	Basal dose N kg/ha	Sowing date	Harvest date
	Bajra	Guar					
1976	NHB-3	Malosan	Compact Family Block Design Durgapur safed with 4 Replications	5.4 m x 5.4 m Bajra and Guar	Bajra 80	12-6-76	18-9-76 (Bajra)
	NHB-5	Bikaner			Guar 20	10-7-76	20-11-76 (Guar)
	J-87						
	J-1270	Kutch-8					
1977	J-1399	Malosan	Compact Family Block Design with 4 Replications	4.5 m x 4.5 m Bajra and Guar	Bajra 80	14-6-77	8-9-77 to 13-9-77 (Bajra)
	CJ-104	FS-277			Guar 20	16-6-77	14-11-77 (Guar)
	BJ-104	Kutch-8					
	NHB-5	Bikaner					
1978	J-1399	Malosan	Randomised Block Design with six Replications	5.4 m x 4.5 m for Bajra 4.5 m x 4.5 m for Guar	Bajra 80	22-6-78	1-9-78 to 11-9-78 (Bajra)
	CJ-104	Kutch-8			Guar 20	23-6-78	11-11-78 to 27-11-78 (Guar)
	BJ-104	FS-277					
	BK-560	BL-19-1-55					

significantly higher yields than the 'NHB-5'. There was no significant difference between 'J-1399' and 'CJ-104' in the year 1977 (Table 3). During 1978, the differences in grain yield among the different varieties were not significant.

TABLE 2

Rainfall data.

Meteorological weeks	Periods	Rainfall (mm)			No. of rainy days		
		1976	1977	1978	1976	1977	1978
June 4-10		388.6	—	—	5	—	—
June 11-17		—	57.4	3.8	—	4	1
June 18-24		4.0	96.3	15.5	1	2	3
June-July 25-1		—	362.7	—	—	6	—
July 2-8		—	154.8	14.2	—	7	3
July 9-15		62.0	168.4	115.9	6	5	5
July 16-22		191.0	29.6	4.1	5	3	—
July 23-29		116.6	141.5	38.6	3	7	2
July-Aug. 30-5		128.4	37.4	5.6	6	6	1
Aug. 6-12		18.0	59.4	8.8	2	4	1
Aug. 13-19		130.0	13.0	141.4	5	3	5
Aug. 20-26		—	—	100.1	—	—	4
Aug. Sept. 27-2		259.4	96.6	276.3	6	5	6
Sept. 3-9		54.3	43.3	3.3	3	6	1
Sept. 10-16		66.0	—	—	3	—	—
Sept. 17-23		4.0	21.6	—	1	4	—
Sept. 24-30		—	—	0.8	—	—	—
Oct. 1-7		—	—	—	—	—	—
Oct. 8-14		—	—	—	—	—	—
Oct. 15-21		—	—	—	—	—	—
Oct. 22-28		—	—	—	—	—	—
Oct-Nov. 29-4		—	—	—	—	—	—
Nov. 5-11		2.0	—	0.5	1	—	—
Nov. 12-18		—	—	30.5	—	—	—
Nov. 19-25		100.8	—	—	5	—	—
Nov-Dec. 26-2		—	8.6	45.8	—	1	3
Total		1687.1	1290.6	805.2	51	65	36

Bajra 'J-1399' gave higher yield because of higher thousand grain weight and longer ear heads than other varieties, viz. 'HNB-3', 'NHB-5', 'J-87', 'BJ-104' and 'CJ-104'. Studies carried out at a number of Dry Farming Research Centres viz., Akola, Agra, Bijapur, Bangalore, Hissar, Anantpur and Hyderabad during kharif-1971 (Anonymous, 1971) established the superiority of *bajra* 'HB-3' over other varieties. This difference may be due to the variations in weather and soil conditions.

However, the differences in fodder yield among different varieties were significant in all the seasons. 'J-1270' in 1976, 'J-1399' and 'BJ-104' in 1977 and 'J-1399' and 'BK-560' in 1978 gave significantly higher fodder yield over other varieties.

The protein per cent was higher (7.7 and 9.5%) in 'J-1399' in 1977 and 1978, while it was higher in 'J-87' (9.0%) during 1976.

(b) *Guar* varieties : The differences among *guar* varieties with regard to grain and husk yields were not significant in the year 1976, while grain yield in 1977 and husk yield in 1978 were significant. 'Malosan' and 'Kutch-8' varieties gave higher grain yield than the other varieties in all the three years (Table 4). It seems that higher number

TABLE 3

Yield, yield attributes, protein content and moisture use efficiency of different varieties of bajra 1976 to 1978.

Year	Varieties	Yield, q/ha				Yield attributes		Protein %	Consumptive use, mm	Moisture use efficiency ² kg/mm/ha
		Grain		Stover	No. of effective tillers plant	Length of ear head, cm	1000 grain weight, g			
1976	J-1270	27.48	93.15	1.4	25.0	6.25	6.3	679.0	4.1	
	NHB-3	13.62	46.46	1.3	18.5	6.22	8.0	679.0	2.0	
	NHB-5	18.06	59.74	1.1	19.7	5.28	6.4	667.0	2.7	
	J-87	15.46	65.87	1.5	23.9	6.54	9.0	690.0	2.3	
	SEm $\pm$	1.44	5.89	-	-	0.21	0.3	-	-	
	C.D. .05	4.59	18.84	-	-	0.67	1.0	-	-	
	J-1399	34.89	55.30	2.0	38.7	9.77	9.77	542.0	6.4	
1977	CJ-104	25.88	40.57	1.8	19.0	6.65	7.3	463.5	5.5	
	BJ-104	23.38	43.62	1.1	23.7	7.94	5.6	454.8	5.2	
	NHB-5	12.57	31.99	1.1	21.2	6.97	6.5	444.3	2.8	
	SEm $\pm$	2.96	4.60	-	-	0.45	0.3	-	-	
	C.D. .05	9.48	14.71	-	-	1.44	0.7	-	-	
	J-1399	23.08	70.60	1.0	29.2	6.40	9.5	557.6	4.1	
	CJ-104	22.03	35.11	1.7	21.1	5.73	9.8	498.6	4.6	
1978	BK-560	24.30	71.95	1.0	22.6	6.08	8.9	559.1	4.3	
	BJ-104	25.23	56.91	1.4	23.6	5.22	9.3	489.7	5.1	
	SEm $\pm$	0.83	2.13	-	-	0.26	0.2	-	-	
	C.D. .05	ns	6.41	-	-	0.78	0.7	-	-	

TABLE 4

Yield, yield attributes, protein content and moisture use efficiency of different varieties of guar 1976 to 1978.

Year	Varieties	Yield q/ha		Yield attributes				Protein %		Moisture	
		Grain	Husk	No. of branches		100 grain weight, g	No. of pods/plant	No. of seeds/pod	in seeds mm	Consumptive use mm	Moisture use efficiency, kg/mm/ha
				Effective	Total						
1976	Malosan	10.81	5.92	*	8.0	34.74	40.8	*	28.2	619.0	1.7
	Bikaner	9.63	5.61	*	4.4	33.86	21.0	*	28.2	633.0	1.7
	Durgapur safed	9.30	7.55	*	5.7	32.73	27.0	*	27.8	620.0	1.5
	Kutch-8	11.06	6.09	*	6.6	33.27	30.8	*	28.0	621.0	1.7
	S Em $\pm$	0.66	0.98	-	-	0.97	6.9	*	0.07	-	-
	C.D. .05	ns	ns	-	-	ns	ns	-	ns	-	-
1977	Malosan	10.55	7.67	7.9	15.9	38.47	49.1	7.9	32.8	620.0	1.7
	Kutch-8	8.46	7.34	8.8	19.4	34.25	73.1	7.9	33.9	620.2	1.4
	FS-277	6.43	5.59	0.9	1.4	28.82	32.5	8.1	29.4	614.3	1.1
	Bikaner	7.90	6.98	9.0	14.7	30.31	52.5	7.3	29.7	630.7	1.2
	S Em $\pm$	0.87	0.77	-	-	0.78	9.4	-	1.1	-	-
	C. D. .05	2.79	ns	-	-	2.48	30.1	-	ns	-	-
1978	Malosan	10.23	7.16	2.6	5.1	37.30	15.2	7.4	33.4	633.4	1.6
	Kutch-8	10.75	7.23	3.5	6.1	35.90	19.1	7.8	34.0	631.3	1.7
	FS-277	9.18	5.50	1.7	2.2	31.10	19.9	7.2	32.9	629.5	1.5
	B.L. 19-1-55	9.73	6.36	3.1	6.3	30.70	18.2	7.6	34.5	639.2	1.5
	S Em $\pm$	0.40	0.26	-	-	0.22	3.2	-	0.6	-	-
	C.D. .05	ns	0.79	-	-	0.66	ns	-	ns	-	-

*No observation was recorded.

of pods per plant and test weight in *guar* variety 'Kutch-8'/'Malosan' were mainly responsible for higher grain yield obtained in these varieties. Similar studies carried out at different research stations of Gujarat, as reviewed by Shah and Yadavendra (1977), indicated the superiority of 'Kutch-8' over other varieties.

Consumptive Use and Moisture Use Efficiency:

Soil moisture determinations by gravimetric method at sowing, harvest and certain important development stages of crop growth were carried out. Total consumptive use of moisture was calculated as per method suggested by Dastane (1972). Data on the consumptive use and moisture use efficiency of *bajra* and *guar* varieties are presented in Table 3 and 4, respectively.

Bajra varieties: There were differences in the consumptive use values as well as in the moisture use efficiency among different *bajra* varieties during all the years. In 1976 and 1977, 'NHB-5' exhibited strikingly lower consumptive use values than 'J-87' in 1976 and 'J-1399' in 1977 while in 1978, 'BJ-104' showed lower than that of 'J-1399' because of differences in their maturity period. On the other hand, moisture use efficiency was higher in 'J-1270' in 1976, 'J-1399' in 1977 and 'BJ-104' in 1978. In an experiment conducted at CAZRI, a differential moisture use among *bajra* varieties was observed, although there were no distinct differences in moisture use values (Lahiri, 1975 and Daulay *et al.* 1978). It was further observed that consumptive use was mainly influenced by distribution of rainfall rather than by total precipitation (Lahiri,

1975). These results are in agreement with the above observations. During 1976 and 1977, although there were no marked difference in the consumptive use among various varieties tested, *bajra* 'J-1270' in 1976 and 'J-1399' in 1977 resulted in markedly higher moisture use efficiency of 4.1 to 6.4 kg/mm/ha as against 2.0 and 2.8 kg/mm/ha in 'NHB-3' and 'NHB-5', respectively.

Guar varieties: During kharif 1976, consumptive use in *guar* varieties 'Malosan', 'Kutch-8' and 'Durgapur Safed' was almost the same (618 to 621 mm), which was lower than 'Bikaner' (633 mm.). A higher moisture use efficiency of 1.7 kg/mm/ha was observed for 'Malosan', 'Bikaner' and 'Kutch-8' varieties as against 1.5 kg/mm/ha under 'Durgapur Safed'. There were no marked differences in the consumptive use among 'Malosan', 'Kutch-8' and 'FS-277', but 'Malosan' resulted in the maximum moisture use efficiency of 1.7 kg/mm/ha followed by 'Kutch-8' in the year 1977. However, 'Malosan' and 'Kutch-8' gave almost the same moisture use efficiency of 1.6 and 1.7 kg/mm/ha, respectively in the year 1978.

Relative moisture use efficiency of bajra and guar varieties:

In order to compare the moisture use efficiency of *bajra* and *guar* varieties over different seasons, grain and straw yields were converted into money values at the prevailing market rates in different years. Economic analysis of the data is presented in Table 5. It revealed that the cultivation of *bajra* resulted in higher monetary returns and moisture use efficiency than *guar*, irrespective of the

TABLE 5

Yield and monetary returns of varieties of bajra and guar.

Crops	Varieties	Grain yield, q/ha			Stover/husk yield, q/ha			Monetary (net) return, Rs./ha		
		1976	1977	1978	1976	1977	1978	1976	1977	1978
Bajra	NHB-5	18.06	12.57	-	59.74	31.99	-	661.00	767.00	-
	J-1399	-	34.86	23.08	-	55.30	70.60	-	4034.00	898.00
	CJ-104	-	25.88	22.03	-	40.57	35.11	-	2646.00	735.00
	BJ-104	-	23.88	25.23	-	43.62	56.91	-	2366.00	1063.00
Guar	Malosan	10.81	10.55	10.23	5.92	7.67	7.16	330.00	515.00	92.00
	Kutch-8	11.06	8.46	10.75	6.09	7.34	7.23	357.00	210.00	665.00
	Bikaner	9.63	7.90	-	5.61	6.98	-	210.00	117.00	-
	FS-277	-	6.34	9.18	-	5.59	5.50	-	103.00	445.00
		mean								
		724.00						2441.50		
		1690.50						1714.50		
		479.00						407.66		
		163.50						171.00		
Moisture use efficiency, Rs/mm/ha										
Crops	Varieties	Consumptive use, mm			Mean			Mean		
		1976	1977	1978	1976	1977	1978	1976	1977	1978
Bajra	NHB-5	667.0	444.3	-	555.7	-	-	0.99	1.77	-
	J-1399	-	542.0	557.6	549.8	-	-	-	7.44	1.52
	C J-104	-	463.5	498.9	518.2	-	-	-	5.70	1.47
	B J-104	-	454.8	489.7	472.3	-	-	-	5.20	2.17
Guar	Malosan	619.0	620.0	633.4	637.1	-	-	0.53	0.83	0.93
	Kutch-8	621.0	620.2	631.3	624.2	-	-	0.57	0.32	1.05
	Bikaner	633.0	630.7	-	631.9	-	-	0.33	0.19	-
	FS-277	-	614.3	629.9	621.9	-	-	-	0.17	0.71
Note: The monetary (net) return was worked out at the following rate (Rs/q)										
		1976	1977	1978				1976	1977	1978
Bajra grain		95	130	100	Guar grain			102	150	140
Bajra stover		7	15	10				-	-	-

seasons. The rainfall received during 1976 and 1977 was higher, while in 1978 it was normal. Similar observations for *bajra* were recorded in the years of high rainfall among *bajra* and *moong* varieties (Daulay *et al.* 1978). Among different varieties of *bajra*, 'J-1399' resulted in higher monetary return of Rs. 4034/ha, and moisture use efficiency of Rs. 7.44/mm/ha in 1977 than rest of the varieties. In the case of *guar* varieties 'Malosan' gave higher monetary returns (Rs. 479/ha) and higher moisture use efficiency (Rs. 0.75/mm/ha), followed by 'Kutch-8' variety (Rs. 0.65/mm/ha).

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REFERENCES

- Anonymous, 1971. Review of 1971-72. *kharif* yield data of the AICRP for Dryland Agriculture, Coordinating cell, Hyderabad: 3-4. (Unpublished)
- Daulay, H. S., R. P. Singh and K. C. Singh, 1978. Studies on the relative efficiency of *bajra* and *mung* varieties in utilizing rainfall and stored soil moisture on dryland of Western Rajasthan. *Ann. Arid Zone*. **17**: 19-29.
- Dastane, N. G. 1972. A practical manual for Water Use Research on Agriculture, Navbharat Prakashan, Poona, 120 pp.
- Lahiri, A. N. 1975. Water use by desertic vegetation and its hydrological implications. *Ann. Arid Zone*. **14**: 135-148.
- Shah, R. M. and J. P. Yadavendra, 1977. *Guar* varietal evaluation in Gujarat. *Proc. of the first ICAR Guar Research Workshop*, Jodhpur, 69-72.