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Productivity of irrigated crop sequences in western Maharashtra

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ABSTRACT

A field experiment was conducted during rainy and winter seasons of 1989–90 to 1991–92 to study productivity of irrigated crop sequences. Sorghum [*Sorghum bicolor* (L.) Moench] grain-yield equivalent and net monetary return were significantly more from groundnut (*Arachis hypogaea* L.) than from sorghum, and groundnut–wheat (*Triticum aestivum* L. emend. Fiori & Paol.) sequence was more remunerative than sorghum–wheat sequence. The grain-yield equivalent and pooled stover yield of sorghum under sorghum (100% F)–wheat (100% F) and sorghum (100% F)–wheat (100% F)–green-manuring sequences were significantly more than that under sorghum (75% F)–gram (*Cicer arietinum* L.) (100% F) and sorghum (50% F)–wheat (50% F)–green-manuring sequences. The wheat-grain-yield equivalent of gram and pooled net monetary return were the lowest. The highest pooled grain yield of wheat and maximum benefit : cost ratio were recorded from the sorghum (100% F)–wheat (100% F)–green-manuring sequence, indicating importance of green-manuring in crop sequence. The pooled net monetary return from groundnut (100% F)–wheat (75 or 100% F) and sorghum (100% F)–wheat (100% F)–green-manuring with sunnhemp (*Crotalaria juncea* L.) sequences was found significantly more than other sequences, indicating beneficial effect of green-manuring even at recommended level of fertilizer application to sorghum and wheat. The pooled net monetary return from groundnut (100% F)–wheat (75% F) sequence was equivalent to that of sorghum (100% F)–wheat (100% F)–green-manuring sequence, indicating possibility of reducing 25% fertilizer dose to wheat.

Sorghum [*Sorghum bicolor* (L.) Moench]–wheat (*Triticum aestivum* L. emend. Fiori & Paol.) or gram (*Cicer arietinum* L.) and groundnut (*Arachis hypogaea* L.)–wheat are the most prominent crop sequences followed under irrigated conditions in western Maharashtra. The value of growing legumes in sustaining and improving the soil fertility has been known since long. The wheat productivity increases due to preceding legumes (Morey and Bagde, 1982; Jadhav and Koregave, 1988).

However, a 2-crop sequence exhausts more nutrients from the soil and as such it becomes necessary to develop a sequence with efficient fertilizer management. In order to encourage the rational use of fertilizers, it is essential that the cultivators are made aware of profitability of fertilizer application particularly under sequence cropping. Although sufficient information on various cultural aspects is available for single crop, the information on fertilizer constraints under sequence cropping is lacking. Hence an experiment was conducted on this aspect.

MATERIALS AND METHODS

The present investigation was conducted during the rainy season (*kharif*) and winter

season (*rabi*) of 1989–90 to 1991–92 at the Regional Fruit Research Station, Ganeshkhind, Pune. The experiment was laid out in randomized block design with 3 replications. Four crop sequences as indicated in Table 1 were studied. The quantity of fertilizer as per treatments applied to each crop under sequence along with crop varieties under study are also given in Table 1. *Kharif* crops were dibbled at the end of June in first 2 years and in first weak of July in last year. *Rabi* crops were sown in the last week of November in all the 3 years. Five irrigations were applied to wheat and 2 to gram at critical growth stages besides presowing irrigation. The experiment was conducted at the same site without changing the randomization of treatments, to assess the residual effect. The size of gross and net plot was 6.0 m x 4.5 m and 5.1 m x 3.6 m respectively.

The prices prevailing in the market during the experimental period were considered for calculating cost of cultivation and gross monetary return. The net monetary return were obtained by subtracting the cost of cultivation from the gross monetary return.

The rainfall of 552.3 mm in 42 rainy days in 1989, 738.9 mm in 49 rainy days in 1990 and 880.3 mm in 41 rainy days in 1991 was received during the *kharif* cropping period. This rainfall was adequate and well-distributed during *kharif* cropping period, resulting in satisfactory growth, development and yields of *kharif* crops.

RESULTS AND DISCUSSION

Kharif *cropping*

The mean sorghum-grain-yield equivalent of groundnut and net monetary returns were significantly more than sorghum at different fertility levels (Tables 2, 3) owing to higher market prices of groundnut pods.

Table 1. Treatment details with varieties of crops

Crop sequence			Fertilizer (kg/ha)					
Kharif	*Rabi*	Summer	*Kharif*			*Rabi*		
			N	P_2O_5	K_2O	N	P_2O_5	K_2O
Sorghum	Wheat	Fallow	100	50 (100 % F)	0	120	60 (100 % F)	60
Sorghum	Gram	Fallow	100	50 (100 % F)	0	25	50 (100 % F)	0
Sorghum	Gram	Fallow	75	37.5 (75% F)	0	25	50 (100 % F)	0
Groundnut	Wheat	Fallow	25	50 (100 % F)	0	120	60 (100 % F)	60
Groundnut	Wheat	Fallow	25	50 (100 % F)	0	90	45 (75% F)	45
Sorghum	Wheat	GM with sunnhemp	100	50 (100 % F)	0	120	60 (100 % F)	60
Sorghum	Wheat	GM with sunnhemp	75	37.5 (75% F)	0	90	45 (75% F)	45
Sorghum	Wheat	GM with sunnhemp	50	25 (50% F)	0	60	30 (50% F)	30

GM, Green-manuring

'CSH 5', 'HD 2189', 'Vishwas' and 'JL 24' were the varieties of sorghum, wheat, gram and groundnut respectively

Similar trend was observed during all the years. The benefit : cost ratios were also more with groundnut–wheat sequence. Thus groundnut–wheat sequence was more remunerative than sorghum–wheat sequence. Sorghum with 100% fertilizer (F) grown after wheat with 100% F and wheat 100% F, followed by green-manuring gave significantly more pooled sorghum grain and net monetary return than sorghum with

Table 2. Mean grain-yield equivalent (kg/ha) of sorghum and wheat as influenced by different crop sequences

Crop	*Kharif* cropping				Crop	*Winter* cropping			
	Y_1	Y_2	Y_3	Pooled		Y_1	Y_2	Y_3	Pooled
Sorghum (100% F)	6,663	6,843	4,903	6,143	Wheat (100% F)	4,493	4,875	5,301	4,891
Sorghum (100% F)	6,336	6,465	4,648	5,816	Gram (100% F)	3,594 (1,797)	3,667 (1,834)	2,941 (1,471)	3,398 (1,701)
Sorghum (75% F)	5,973	5,882	3,595	5,150	Gram (100% F)	3,431 (1,710)	3,504 (1,752)	2,759 (1,380)	3,229 (1,701)
Groundnut (100% F)	7,154 (2,015)	13,742 (2,810)	6,904 (2,496)	9,269 (2,440)	Wheat (100% F)	4,412	4,829	5,556	4,932
Groundnut (100% F)	6,826 (1,924)	12,907 (2,642)	6,423 (2,322)	8,719 (2,295)	Wheat (75% F)	4,025	4,593	5,574	4,733
Sorghum (100% F)	6,772	7,760	5,229	6,421	Wheat (100% F)	4,639	5,410	6,028	5,359
Sorghum (75% F)	6,481	6,645	4,684	5,936	Wheat (75% F)	3,513	4,593	4,920	4,341
Sorghum (50% F)	5,991	5,828	4,139	5,320	Wheat (50% F)	3,019	4,212	4,757	4,095
CD (P = 0.05)	NS	970	526	805		240	405	391	332

Y_1, 1989–90; Y_2, 1990–91; Y_3, 1991–92
Figures in parentheses indicate actual yield

Table 3. Pooled stover or haulm or straw yield, net monetary return and benefit : cost ratios as influenced by different crop sequences

Crop	*Kharif* cropping			Crop	*Rabi* cropping			*Kharif* + *rabi* cropping	
	Stover or haulm yield (kg/ha)	Net monetary return (Rs/ha)	Benefit: cost ratio		Straw yield (kg/ha)	Net monetary return (Rs/ha)	Benefit: cost ratio	Net return (Rs/ha)	Benefit: cost ratio
Sorghum (100% F)	12,213	15,729	2.78	Wheat (100% F)	7,462	16,018	3.25	31,747	2.99
Sorghum (100% F)	11,565	14,446	2.64	Gram (100% F)	2,762	9,884	2.97	24,330	2.76
Sorghum (75% F)	10,591	11,651	2.36	Gram (100% F)	2,669	9,182	2.82	20,833	2.53
Groundnut (100% F)	2,832	21,282	4.33	Wheat (100% F)	7,813	16,427	3.31	37,709	3.79
Groundnut (100% F)	2,740	19,616	4.07	Wheat (75% F)	7,450	15,928	3.36	35,544	3.70
Sorghum (100% F)	12,636	16,943	2.92	Wheat (100% F)	8,031	18,297	3.57	35,241	3.21
Sorghum (75% F)	11,552	14,924	2.76	Wheat (75% F)	7,062	14,098	3.09	29,137	2.90
Sorghum (50% F)	10,791	12,916	2.56	Wheat (50% F)	6,524	13,331	3.08	26,248	2.79
CD (P = 0.05)	1,263	2,872			1,180	2588		3,042	

75% F preceded by wheat with 75% F, followed by green-manured sunnhemp (Tables 2, 3). It dicate importance of recommended fertilizer doses for both the cereal crops and inclusion of green-manuring crop in sequence. Similar trend was observed for sorghum grain yield during 1990 and 1991 (Table 2). Sorghum grown after wheat with 75% F and green-manured sunnhemp (*Crotalaria juncea* L.) during summer produced equivalent pooled grain yield and net monetary return to that of sorghum with 100% F, followed by gram with 100% F due to enrichment of soil with plant nutrients, which indicates importance of green-manuring crop in sequence.

The mean haulm yield of groundnut was significantly lower than stover yield of sorghum (Table 3) owing to lower biological potential of groundnut. The stover yield of sorghum fertilized with 75 and 50% F sequenced with gram (100% F) and wheat (50% F)–green manuring respectively was also significantly lower than sorghum with 100% F sequenced either with gram (100% F) or with wheat (75 or 100% F) followed by green-manuring.

Rabi *cropping*

The wheat-grain-yield equivalent of gram was significantly lower than wheat grown at different fertility levels during latter 2 years and in pooled data (Table 2) owing to lower biological potential of gram. Similar trend was observed for pooled straw yield (Table 3). The wheat grain yield was significantly higher when fertilized with 100% F than wheat fertilized with reduced doses of fertilizers during 1989–90 (Table 2). However, the highest wheat grain yield with maximum benefit : cost ratio was recorded under the sequence of sorghum (100% F)–wheat (100% F)–green-manuring during 1990–91 and 1991–92 and in pooled data (Table 2), indicating importance of green-manuring crop in a sequence. The addition of large quantity of organic matter due to burying of green-manured sunnhemp added nitrogen in soil to benefit succeeding cereal crops in sequence and increased their yields. These results are similar to those reported by Patil (1985), Puranik *et al.* (1990) and Jadhav *et al.* (1992). The grain yield of wheat was significantly lower under the sequence of sorghum (50% F)–wheat (50% F)–green-manuring than sorghum (100% F)–wheat (100% F), groundnut (100% F)–wheat (100% F) during latter 2 years and in pooled data and groundnut (100% F)–wheat (75% F) during the last year (1991–92).

The wheat grain yield recorded under groundnut (100% F)–wheat (75% F) sequence was equivalent to that recorded under sorghum (100% F)–wheat (100% F) during latter 2 years and in pooled data (Table 2) resulting in saving of 25% fertilizer dose to wheat. This could be assigned to N added by the preceding groundnut through root nodules, roots, leaves etc. to benefit succeeding wheat in sequence. These results corroborate the findings of Morey and Bagde (1982) and Jadhav and Koregave (1988).

The pooled net monetary return was the lowest from gram (Table 3) due to lower biological potential of the crop indicating that wheat was more economical than gram under irrigated conditions. The poolded net monetary return from wheat was significantly more under the sequence of sorghum (100% F)–wheat (100% F)–green-manuring than wheat fertilized with reduced doses of 50 or 75% F under the same sequence (Table 3). This indicated that there was no scope for reduction of fertilizer dose

to wheat below the recommended level. The pooled net monetary return from wheat under groundnut (100% F)–wheat (75% F) sequence was equivalent to that obtained from sorghum (100% F)–wheat (100% F) indicating that there was a scope for reduction of fertilizer dose to wheat to the extent of 25% of recommended level when it was preceded by groundnut.

Kharif + rabi *cropping*

The pooled net monetary return was the lowest from the sequence of sorghum (75% F)–gram (100% F) due to reduction in fertilizer dose to sorghum and lower biological potential of gram (Table 3). The pooled net monetary return from groundnut (100% F)–wheat (75 or 100% F) and sorghum (100% F)–wheat (100% F)–green-manuring sequences was significantly higher than other sequences (Table 3), indicating beneficial effect of green-manuring even at recommended level of fertilizer application to sorghum and wheat. The benefit : cost ratios were also more under these sequences. This was assigned to the inclusion of legume (groundnut) in former sequences and green-manuring crop (sunnhemp) in latter sequence. The pooled net monetary return from the sequence of groundnut (100% F)–wheat (75% F) was significantly more than that obtained from sorghum (100 F)–wheat (100% F) and was equivalent to that of sorghum (100% F)–wheat (100% F)–green-manuring sequences indicating that there was a scope to reduce the fertilizer dose to wheat to the extent of 25% when it was preceded by groundnut. This was assigned to N added in soil by preceding groundnut through root nodules, roots, leaves etc. to benefit succeeding wheat in sequence. These results are in conformity with the findings of Morey and Bagde (1982), Sonar and Zende (1984), Patil (1985), Jadhav and Koregave (1988) and Tomar and Tiwari (1990).

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