Agriculture Update | February & May 2010 | Vol. 5 | Issue 1 & 2| 64-68 | RESEARCH ARTICLE

Economics of paddy based cropping system under south Gujarat condition

H.M. VIRDIA AND H.D. MEHTA

See end of the article for authors' affiliations

Correspondence to :
H.M. VIRDIA
Regional Rice Research Station, Vyara, Tapi, SURAT(GUJARAT) INDIA

ABSTRACT

A field experiment was conducted at Regional Rice Research Station, Navsari Agricultural University, Vyara dist.Tapi (Surat, Gujarat) during the year 2003-04 to 2005-06 on heavy black soil to find out most economic rice based cropping system under transplanting(T.P.) or drilled condition. Transplanting condition reported higher yield of paddy as well as subsequent *Rabi*/summer crops. Paddy equivalent yield and monitory return were significantly higher with T.P. conditions than drilled condition. Among cropping sequences, paddy-groundnut(s) system recorded significantly higher paddy equivalent grain and straw yield, gross and net realization as well as benefit cost ratio followed by paddy-castor system, while paddy-sorghum and paddy-wheat system reported much lower value.

Key words :
Cropping system, Paddy

Accepted :
October, 2009

INTRODUCTION

Intensification of cropping is the need of the day to increase monetory output from the available land. The per capita availability of land is consequently decreasing while food and fodder demand is increasing. Sustainable crop production including appropriate cropping sequences is one of the practices to increase output per annum from limited natural resources. Rice is the major and most common *Kharif* crop of the high rainfall area and mainly grown rainfed either by transplanting or direct seeding by drilling. Rice transplanting on puddled soil is complicated and highly labour intensive. The timely availability of labour for transplanting is a big problem in most area. Moreover, under puddled condition, though the yield of paddy is high it has its own limitations and ill effects on soil health and subsequent sequential field crops on same field. Puddling results in poor soil physical condition for establishment and raising the succeeding crops (Tripathi *et al*.,2003). Due to rising costs of labour and excessive water use in puddled transplanting rice in the irrigated eco-system, direct seeding of rice is gaining popularity in south–east Asia (Balasubramanian and Hill, 2002). Direct seeded rice needs only 34% of the total labour requirement and saves 29% of the total cost of transplanted crops (Ho and Romli, 2000).

To sustain the rice based agriculture, efficient cropping system can contribute to a great extent. An effective crop rotation not only helps to increase the crop productivity, economics and soil fertility, but also improve the water use efficiency by reducing weeds, providing conducive microclimate for plant growth and development as well as physical properties of the soil (Faroda *et al*., 2007).

Paddy based cropping system includes various *Rabi*/summer crops, *viz.*, wheat, pulses, sorghum, groundnut, castor etc. however, under limited water availability up to *Rabi* crops it is not possible to go for more remunerative rice-groundnut system which is being popular among farmers but some time they fail to get good crops due to limitation of irrigation water after March or April. To find alternative and more remunerative crop either in transplanting or drilled condition, this experiment was conducted.

METHODOLOGY

A field experiment was conducted during 2003-04, 2004-05 and 2005-06 at Regional Rice Research Station, Vyara dist.Tapi (Surat). The experimental soil was deep black, having normal pH, low in organic carbon and available N and high in available P_2O_5 and K_2O (Table 1).

The experiment was laid out in split plot design with 4 replications. The main plot treatment involved 2 sowing/transplanting (crop establishment) methods of paddy(G.R.-3), *viz*., transplanting and drilling. After the rice harvested each main plot was divided into 4 sub plots for *Rabi*/summer crops [castor

Table 1 : Initial soil status

	Transplanting field			Drilled field		
	2003-04	2004-05	2005-06	2003-04	2004-05	2005-06
pH (1:2.5)	7.3	7.6	7.7	7.3	7.8	7.6
Ec (1:2.5)	0.19	0.21	0.18	0.18	0.20	0.18
OC %	0.48	0.50	0.52	0.42	0.44	0.52
Avail N (kg/ha)	207	209	255	202	214	270
Avail P_2O_5 (kg/ha)	40	41	64	42	42	43
Avail K_2O (kg/ha)	199	247	261	202	180	114

Table 2 : Detail of package of practices followed in crop sequence

	Paddy		Castor	Groundnut	Wheat	Sorghum
	T.P.	Drill				
Season	*Kharif*	*Kharif*	*Rabi*	Summer	*Rabi*	Summer
Variety	GR-3	GR-3	GCH-4	GG-2	GW-366	GJ-38
Spacing (cm)	20 x 15	30	90 x 60	30 x 10	22.5	45 x 15
Seed rate (kg/ha)	25	50	5	100	125	12
Fertilizer N:P:K (kg/ha)	100:30:0	75:25:0	75:50:0	25:50:0	120:60:0	80:40:0

(GCH-4), groundnut (GG-2), wheat (GW 366) and sorghum (GJ-38)] (Table 2).

Two seedling of paddy were transplanted per hill. Castor and wheat were sown as *Rabi* crops immediately after rice crop harvested and groundnut and sorghum were taken as summer crops and sown during January. Need based agronomical and plant protection measures were adopted, no post sowing/ transplanting irrigation was given to rice except in the 1st year in T.P. conduction, where one irrigation was given during dry spell of the rainy season. While in following season *Rabi*/summer crops were grown with irrigation as per crops requirement. To compare crop sequences, the yield of crops were converted into rice equivalent on price basis (Varma and Mudgal, 1983). Production efficiency values in terms of kg/ha/day were worked out by total production in a crop rotation divided by total duration of crop in that rotation. Land use efficiency was obtained by taking total duration of crop in individual crop rotation divided by 365 days (Tomar and Tiwari, 1990).

RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been summarized under following heads:

Yield of crops:

Transplanting situation gave higher yield of paddy as well as individual crops of the *Rabi*/summer crops as compared to drilled situation (Table 3 and 5). It might be due to higher amount of fertilizer used in transplanted condition then drilled condition as well as reduced condition in submerged condition may be effective on availability of nutrient to next crops and their beneficial effect on subsequent crops. Ho and Romli (2000) also reported slight loss in paddy productivity with direct-seeded than transplanting condition.

Total biological yield:

All the sequences under study reported more total biomass production under transplanting situation as compared to drilled situation (Table 5). It might be due to more fertilizer application to rice crops under T.P. and their residual effect on subsequent crops. The maximum biomass production was reported with paddy-castor sequence in both the situations, while lower biomass was obtained with paddy-wheat sequence. It might be due to differences in growth characteristics of various crops.

Land-use efficiency and production efficiency:

Land use efficiency of all four crop sequences under both the situations revealed that highest land utilization efficiency was observed in paddy-sorghum sequences followed by paddy-castor, paddy-groundnut and paddy-wheat (Table 5). Higher production efficiency was obtained with paddy-groundnut cropping sequence, followed by paddy-castor, paddy-wheat and paddy-sorghum in both the situation (Table 5). This might be due to more price of groundnut and castor than cereals, which reflects in paddy equivalent yield and on production efficiency of sequences. It indicates oilseeds are more remunerative than cereals.

Paddy equivalent yield (kg/ha):

Paddy equivalent grain and straw yield was worked

Table 3 : Yield of paddy and paddy based *Rabi* / summer crops (kg/ha)

Treatments	2003-04		2004-05		2005-06	
	Paddy	*Rabi*/ summer	Paddy	*Rabi*/ summer	Paddy	*Rabi*/ summer
T.P. situation						
Paddy – Groundnut	4705	4180	4790	4252	4535	3571
Paddy – Castor	4479	3770	4649	2494	4620	2771
Paddy - Wheat	4422	4252	4592	4067	4337	3798
Paddy – Sorghum	4592	3778	4677	2778	4393	3741
Drilled situation						
Paddy – Groundnut	3945	4181	3996	3572	3954	3019
Paddy – Castor	3812	2523	3883	3090	3854	2622
Paddy - Wheat	3770	3968	3600	4053	3713	4067
Paddy – Sorghum	3755	2494	3628	2607	3500	2480

out and its is presented in Table 4 and 5 indicated that between two situations transplanting situation, gave significantly higher grain and straw equivalent yield in all the years under study as well as in pooled data.

Among various cropping sequences tested, paddy-groundnut cropping system reported significantly the highest equivalent grain and straw yield followed by paddy-castor. Paddy-groundnut system reported nearly double equivalent grain yield than paddy-sorghum system, while that with paddy-castor system nearly one and half time higher. This might be due to more return from oilseeds as price of oil increased due to increasing demand of society and decreasing area under *Kharif* oilseeds due to other more remunerative cash crops like cotton in the oilseeds growing area of state.

Gross realization (Rs./ha):

Gross realization was calculated on paddy equivalent grain and straw yield (Table 6 and Fig. 1 and 2) revealed that significantly the higher gross and net realization was obtained with transplanting situation (Rs. 82599 and Rs. 55599)

Among cropping sequences, paddy-groundnut sequence gave significantly the higher gross and net realization followed by paddy-castor sequence. Paddy-sorghum cropping sequence gave significantly lower gross and net realization which remained at par with paddy-wheat sequence (Table 5 and 6). The higher net return from paddy-groundnut and rice-castor crop sequence were due to higher price of oilseeds as well as low cost of production as compared to low selling price of cereals and more cost of cultivation of cereal crops as it requires

Table 4 : Paddy equivalent yield (kg/ha)

Treatments	2003-04		2004-05		2005-06	
	Grain	Straw	Grain	Straw	Grain	Straw
Situation						
Transplanting	11505	7605	12685	8102	11199	7934
Drilled	10616	6712	10478	6769	9694	6159
S.E ±	305.60	97.2	301.7	98.1	105.6	50.6
C.D (P=0.05)	N.S.	437	1358	441	475	228
Crop						
Groundnut	17681	9244	16668	9240	14679	8681
Castor	10423	5953	12840	6138	10916	5542
Wheat	8945	5714	8940	5976	8613	5849
Sorghum	7193	7724	7878	8390	7577	8113
S.E ±	326.30	234.50	330.50	185.50	302.0	134.2
C.D (P=0.05)	970	697	982	551	897	399
S.E ± (Sit. x Crop)	461.50	331.70	467.40	262.40	427.00	189.80
C.D. (P=0.05)	N.S.	N.S.	N.S.	N.S.	N.S.	563.90

N.S.- Non significant

Table 5 : Yield, rice-equivalent yield, land use efficiency and production efficiency of different crop sequences

Treatments	Yield (kg/ha)				Total biological yield (kg/ha/ Year)	Paddy equivalent yield (kg/ha)	Land use efficiency (%)	Production efficiency (kg/ha/day)	Net return (Rs/ha)	Benefit cost ratio
	Kharif season		*Rabi*/summer season							
	Grain	Straw	Grain	Straw						
Transplanting situation										
Rice-Groundnut	4676	5962	4001	8286	22925	17348	72.06	65.96	86829	3.71
Rice-Castor	4582	5773	2995	10890	24240	12074	75.89	43.59	55607	3.10
Rice-Wheat	4450	5726	4039	4204	18419	9270	61.64	41.20	37552	2.37
Rice-Sorghum	4554	5645	3432	9968	23599	8493	78.90	29.49	42407	2.93
Drilled situation										
Rice-Groundnut	3968	4838	3590	7379	19775	15338	69.32	60.62	73857	3.41
Rice-Castor	3850	4649	2744	9333	20576	10712	75.34	38.95	47146	2.88
Rice-Wheat	3694	4668	4029	4261	16652	8396	62.74	36.60	32383	2.24
Rice-Sorghum	3628	4639	2527	7634	18428	6605	77.81	23.27	29807	2.45

Table 6 : Paddy based equivalent yield and economics

Treatments	Paddy equivalent grain yield (kg/ha)	Paddy equivalent straw yield (kg/ha)	Gross realization (Rs./ha)	Cost of cultivation (Rs./ha)	Net realization (Rs./ha)	Benefit cost ratio
Situation						
Transplanting	11796	7881	82599	27000	55599	2.06
Drilled	10263	6546	71396	25600	45796	1.78
S.E ±	175.9	179.9	1132.6	-	1131.8	-
C.D. (P=0.05)	574.6	1095	3526	-	3523	-
Crop						
Paddy-Groundnut	16343	9955	111643	31300	80343	2.57
Paddy-Castor	11343	5878	77176	25800	51376	1.99
Paddy-Wheat	8833	5846	61767	26800	34967	1.31
Paddy-Sorghum	7549	8078	57406	21299	36107	1.70
S.E ±	560.4	112.2	3478.2	-	3477.9	-
C.D. (P=0.05)	1639	317	12037	-	12036	-

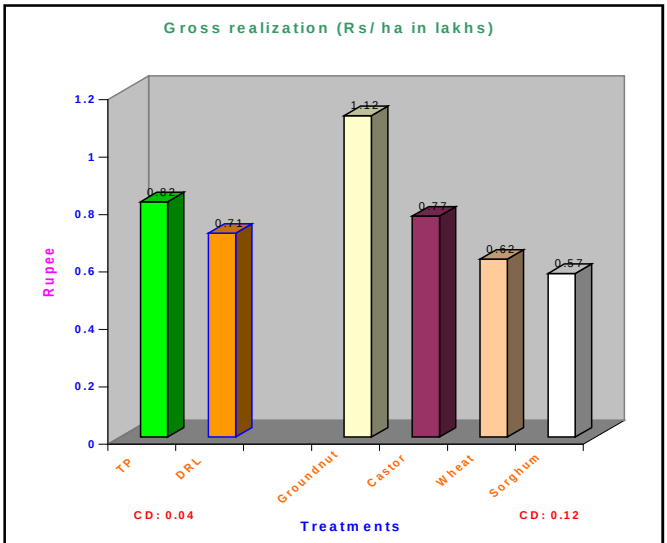

Fig. : 1 Gross realization (Rs./ha in lakhs)

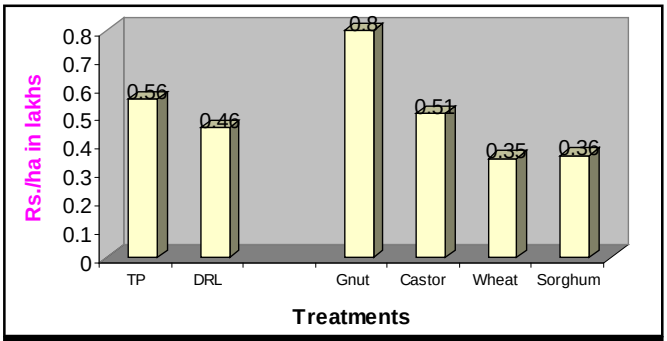

Fig. 2 : Net realization (Rs./ha in lakhs)

more inputs like fertilizer, irrigation, labour, etc. (Singh and Varma, 1998).

The benefit cost ratio reported in Table 6 revealed that transplanting situation gave more return per rupee invested (Rs.2.06) than drilled situation (Rs.1.78). Among

cropping sequences paddy-groundnut system reported higher return Rs.2.57 from a rupee expenditure for crop production followed by paddy-castor system in both the situations (Table 5 and 6).

Among various crops in sequence, after paddy under both the conditions showed that groundnut was more biologically efficient as well as cash ensuring and profitable crop sequence and fetched more return per unit, which also conformed earliest research of the Gujarat Agricultural University (Anonymous, 2004). Paddy-castor sequence in this study reported more remunerative after rice-groundnut sequence and again being a *Rabi* crop and less input consuming it reported more profitable than paddy-wheat and paddy -sorghum sequence. Considering non-availability of irrigation water in summer, *Rabi* castor after *Kharif* paddy were found effective, because if groundnut sown as summer crop it suffers due to lack of irrigation at pick pod development stage, which is considered critical stage for moisture in groundnut, resulted in shriveled kernels in pod and definitely effect on groundnut yield, which limits growing of groundnut crop as summer crop in the region.

Above result shows that, paddy-groundnut cropping system is most remunerative, however, those farmers who have scarce irrigation facilities during summer and not able to grow summer groundnut crop can go for *Rabi* castor after *Kharif* paddy for more return from the system.

Authors' affiliations
H.D. MEHTA, Regional Rice Research Station, Vyara, Tapi, SURAT (GUJARAT) INDIA

REFERENCES

Anonymous (2004). 40th Agresco Agronomy subcommittee meeting of GAU

Balasubramanian, V. and Hill, J.E. (2002). Direct seeding of rice in Asia: emerging issues and strategic research needs of the 21st century.(In); Direct seeding : *Research strategies and Opportunities*, 383 pp. Pandey *et al.* (eds). Proc. Internat. Workshop on direct seeding in Asian rice system, held during 25-28 January 2000, Bangkok, Thailand, IRRI. Los Banos. Philippines.

Faroda, A.S., Joshi, N.L., Singh, Raj and Saxena, Anurag (2007). Research management for sustainable crop production in arid zone – A review *Indian J. Agron.*, **52** (3) : 181-193.

Ho and Romli (2000). Impact of direct seeding on rice cultivation: Lessons from the Mudaarea of Malaysia(In): Proc. Workshop on direct seeding: *Research Strategies and Opportunities* held during 25-28 January, 2000, Bangkok, Thailand.

Singh, N.B. and Varma, K.K. (1998). Production potential and economic analysis of rice based cropping systems. *Indian J. Agron.*, **43** (2) : 199-203.

Tomar, S.S. and Tiwari, A.S. (1990). Production potential and economics of different crop sequences. *Indian J. Agron.*, **35** (1&2) : 30-35.

Tripath, R.P., Gaur, M.K. and Rawat, M.S. (2003). Puddling effect on soil physical properties and rice performance under shallow water table conditions of tarai. *J. Indian Soc. Soil Sci.*, **51**(2):118-124

Varma, S.P. and Mudgal, S.C. (1983). Production potential and economics of fertilizer application as a resource constraints in maize-wheat crop sequence. *Himachal J. Agric. Res.*, **9**(2) : 89-92.

****
****