RESEARCH PAPER International Journal of Agricultural Sciences, January to June, 2010, Vol. 6 Issue 1 : 246-249

Effect of tillage management in rice (*Oryza sativa*)- groundnut *(Arachis hypogaea* L.*)* cropping system

H.M. VIRDIA* AND H.D. MEHTA
Regional Rice Research Station, Navsari Agricultural University, VYARA(GUJARAT) INDIA

ABSTRACT

A field trial was conducted during 1997 to 2007 at Vyara-Gujarat, to study effect of tillage management in rice (*Oryza sativa*)- groundnut (*Arachis hypogaea*) cropping system. Ploughing 6" deep every season or every year proved a better for higher grain and groundnut pod yield. Further effect of tillage frequency was not observed on rice crop but groundnut crop responded significantly to tillage. Deep ploughing once or twice in year improve rice based equivalent gross income, net return and benefit: cost ratio. Additional expenditure (aprox Rs. 3000) for ploughing was compensated by additional net income (aprox Rs. 5000)

Key words : Ploughing, Rice, Groundnut, Tillage management, Cropping system

INTRODUCTION

In south Gujarat there is a vast scope to expand the groundnut area in rice (*Oryza sativa* L.) fallow ecosystem during the summer season. Inclusion of groundnut (*Arachis hypogaea* L.) like legumes in the cropping system not only increases the overall productivity but also improves physico-chemical properties of the soil. Groundnut is a premier oilseed crop of India, it is energy rich crop but mostly it is grown under energy- starved conditions. Rice is predominantly grown by transplanting after puddling. Puddling considered pre-requisite for transplanting which deteriorates the soil structure, physical condition development of hard pan, decrease the soil aggregates and pore size there by restricting germination and rooting of the succeeding crops (Giri *et al.*,1993). Therefore, land preparation for succeeding crop become difficult and requires more energy to attain proper soil tilth for succeeding crops. Poor soil physical condition caused by puddling is the major limiting factor for successful cropping in rice- fallow (Tripathi *et al.,* 2003). Tillage is very much essential to break hard pan in rice field, incorporation the organic source as well as to mix the fertilizer in the soil. Deep tillage practice improves physic chemical properties of soil, providing good nutrition opportunity by maintaining soil structure, increasing pore space, which improve soil aeration and resulted in deep loose soil, more moisture storage for succeeding crops in rice-cropping system but now-a- days mindset of farmers and scientist has changed to reduce the number of tillage operations to minimize the cost of production. Tillage in rice- based cropping system assumes great importance due to disturbed soil structure caused by the puddled conditions. The intensive tillage operations after the harvest of transplanted rice not only require huge amount of energy and time but also increase the cost of production. To make the system economically viable, it is essential to reduce the cost of production. Under such circumstances, proper tillage practice could be a valid option to reduce the cost and establishment and yield of crops. Keeping these points in view, the present investigation was under taken.

MATERIALS AND METHODS

A field experiment was conducted at Regional Rice Research Station, Navsari Agricultural University, Vyara (Tapi-Gujarat) during the 1998 to 2007. The soil was clayey, medium in organic C (0.66%) available P_2O_5(48.35 kg/ha) and high in available K_2O(274.93 kg/ ha) and neutral in reaction (pH 7.3; Ec 0.18). Five treatments *viz.*, T_1, conventional 3" deep tillage; T_2, ploughing 6" deep every season; T_3, ploughing 6" deep every year; T_4, ploughing 6" deep after every two years; T_5, ploughing 6" deep after every three years were tested in Randomized Block Design with four replications. The gross plot size was 7.8 m x 9.6 m. Deep tillage consisted of ploughing by mould bold tractor drown plough. Conventional tillage involved cultivator by tractor as per treatment. Rice is transplanted in puddled field and after harvest of rice crop respected treatment was given. Rice variety 'GR-3' was transplanted in July at 20x15 cm spacing with two seedlings/hill and fertilized with 80kgN and 30kgP/ha through diammonium phosphate (DAP) and ammonium sulphate, the crop harvested in October. Groundnut variety 'GG-2' was sown as summer crop in January at seed rate 100kg/ha by seed drill in rows 30 cm. and fertilized with 25 kgN and 50kgP/ha through DAP

*** Author for correspondence.** Present Address : Krishi Vigyan Kendra, Navsari Agricultural University, NAVSARI (GUJARAT) INDIA

and Urea, the crop was harvested in late May or early June. Yields were recorded at harvest for both the crops. Paddy based equivalent yield were worked out considering prevailing market price of main and by product of both the crops and based on it economics was calculated. The data for individual year were pooled and statistically analyzed.

RESULTS AND DISCUSSION

The results obtained from the present investigation are summarized below :

Yield:

Grain yield of paddy (Table 1) exhibited non significant difference under different tillage methods in pooled as well as most of the years. It could be due to common practices of puddling in all the treatments which nullified the effect of various tillage treatments followed before puddling. However, every year 6'' deep ploughing (T_3) gave higher grain yield of paddy, while lower grain yield of paddy was obtained with conventional 3'' deep tillage (T_1). This might be due to effect of deep tillage which break hard pan developed in paddy field due to puddling, this may increase infiltration and permeability of soil, these may improve leaching of excess salt from root zone as well as increase feeding zone of paddy roots under deep tillage than conventional tillage practices which ultimately reflected in yield.

The pod yield of groundnut were significantly higher under treatment T_2 (ploughing 6'' deep every season) which remained at par with treatment T_3 (ploughing 6'' deep every year) but superior to other treatments. The lower groundnut pod yield was obtained with treatment T_5 followed by T_4 and T_1. The higher yield with frequent deep tillage might be because that would have created a favorable physical environment for the increased mineralization and mobility of fertilizer and by greater moisture stored / water use efficiency with deep tilled soil (Saxena *et al.*, 1997). Tillage assumes great importance due to disturbed soil structure caused by the puddle conditions created in the previous rice crop (Gupta *et al.*, 2007). Puddling leads to destruction of macro-pores and reduction in permeability. Deep tillage may be the alternative to improve pore space and there by improving infiltration and permeability of soil for succeeding crop. Groundnut being a legume crop requires good soil aeration for better growth and function of *Rhizobium* bacterial association and atmospheric nitrogen fixation ultimately better root as well as crop establishment, it reflected in yield improvement with frequent deep tillage practices. The higher yield with deep tillage treatment may be also due to better seed bed which resulted in better germination and this reflected in yield of groundnut. Further more yields with tillage might be owing to lowering of extent of soil moisture loss from the soil and consequently soil moisture was conserved for longer duration in favour of crop growth. Pratibha *et al.* (1998), Kalita *et al.* (2005) and Arya *et al.* (2005) also reported similar observation in case of sunflower, linseed and chickpea after wet-season puddle rice, respectively.

The straw yield of paddy and haulm yield of groundnut (Table 2) were recorded higher with every season deep ploughing (T_2) and every year deep ploughing (T_3), respectively. However, it failed to produce significant difference among various treatments. The higher yield of straw and haulm in deep plough treatment may be due to better soil condition under these treatment resulted in

Table 1 : Effect of ploughing frequency on paddy grain and groundnut pod yield

Treatment	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Pooled
Paddy grain yield (kg/ha)											
T_1	4690	5389	6249	4732	4938	4690	4852	4452	5862		5095
T_2	4825	5840	6496	4559	4848	4753	4780	4356	6088		5172
T_3	4712	5549	6551	4532	5727	4942	5159	4347	6178		5300
T_4	4915	5405	6236	4844	4807	4735	4991	4750	5998		5187
T_5	4870	4854	6315	4995	5141	4793	5051	4852	6043		5212
C.D. (P=0.05)	NS	NS	NS	114	179	NS	NS	NS	NS		NS
Groundnut pod yield (kg/ha)											
T_1		2507	1662	1139	1574	1560	812	915	1669	1127	1441
T_2		2307	1935	1154	1565	1991	956	1569	2300	1420	1689
T_3		2473	1549	1168	1493	1736	920	1452	2074	1353	1580
T_4		2388	1590	1163	1240	1461	794	1064	1804	902	1378
T_5		2523	1100	1130	943	1330	776	1421	1759	812	1310
C.D. (P=0.05)		NS	336	NS	99	194	NS	125	316	289	170

NS = Non significant

Table 2 : Effect of ploughing frequency on paddy straw and groundnut haulm yield

Treatments	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Pooled
Paddy straw yield (kg/ha)											
T_1	5321	5321	6922	5601	5502	4546	4744	5456	4848		5362
T_2	5366	5276	7939	5556	5321	4329	5335	6200	5253		5619
T_3	5096	5230	6787	5429	5186	4257	5650	6223	5474		5481
T_4	5321	5186	6516	5520	5276	5186	5222	5817	4478		5391
T_5	5051	5096	6742	5614	5321	4113	4744	5465	4437		5176
C.D. (P=0.05)	NS	NS	553	NS	NS	533	609	608	496		NS
Groundnut haulm yield (kg/ha)											
T_1		5127	6020	7621	4848	1849	3360	3315	2165	3486	4199
T_2		5465	6097	7170	4924	1939	3269	3526	2345	3364	4233
T_3		5736	6232	7846	4478	2074	3472	4144	2300	3342	4403
T_4		4807	6385	7441	4803	1759	3405	3229	2345	3170	4149
T_5		4712	6228	7441	4983	2074	3991	3206	2300	2909	4205
C.D. (P=0.05)		349	NS	NS	123	223	NS	577	NS	NS	NS

NS = Non Significant

longer moisture holding, better aeration, more nutrient uptake, which improve physiological activity of plant resulted in more vegetation, which reflected in straw/ haulm yield.

Economics:

Paddy based equivalent gross income (Table 3) was significantly higher from crop grown with treatment T_2 (every season 6'' deep ploughing) but it remained at par with crop of treatment T_3 (every year 6'' deep ploughing), while lowest gross income was obtained from treatment T_5(after every three year 6'' deep ploughing). The difference between highest and lowest gross income was Rs. 9770/-. It indicates that, timely required tillage may improve yield level which will result in more return.

Almost similar result was observed in case of paddy-based equivalent net return, however, highest net return(Rs.55155) was obtain from the crop sown after every year 6'' deep ploughing(T_3),which remained at par with every season 6'' deep ploughing(T_2). This variation in gross and net return between these two treatments was due to saving in operational cost under respected treatment. The cost of rice-groundnut cropping system varied from Rs.33717 to Rs.37050/ha (Table 4). The variation in cost of cultivation was brought mainly by the type and frequency of tillage implement used, which was a costly input. Thus, the cost of cultivation was lowest with after every three year deep ploughing(T_5) plot and was identically increased as the intensity of tillage increased. Maximum cost (Rs.37050) was incurred under

Table 3 : Effect of ploughing frequency on gross income and net income (Rs.ha) under paddy-groundnut sequence (Paddy base equivalent)

Treatment	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	Pooled
Gross income (Rs/ha)										
T_1	110782	96487	88470	83108	85886	63957	66586	85277	82707	84806
T_2	106872	105862	92217	81706	95635	67943	83527	101353	92632	91972
T_3	110011	94927	90666	79685	95473	69003	83672	95662	92230	90148
T_4	109817	94372	88334	75311	82211	64678	72209	90910	77079	83880
T_5	112284	78166	88600	69454	82053	62996	80759	89642	74964	82102
C.D. (P=0.05)	NS	10649	2156	2832	5203	NS	5059	7536	6491	4711
Net income (Rs/ha)										
T_1	76871	62577	54559	49197	51975	30046	32675	51366	48796	50896
T_2	69895	68885	55240	44729	58658	30966	46550	64376	55655	54995
T_3	75018	59934	55673	44692	60480	34010	48679	60669	57238	55155
T_4	75726	60281	54243	41220	48120	30587	38118	56818	42988	49789
T_5	78553	44435	54870	35723	48323	29266	47028	55912	41234	48372
C.D. (P=0.05)	NS	10649	NS	2832	5203	NS	5059	7536	6491	4711

NS = Non significant

Table 4 : Economics under various treatments (Rice based equivalent) pooled

Treatments	Gross income (Rs/ha)	Total Cost (Rs/ha)	Net income (Rs/ha)	CBR
T_1	84806	33850	50896	1.50
T_2	91972	37050	54995	1.48
T_3	90148	35050	55155	1.58
T_4	83880	34050	49789	1.46
T_5	82102	33717	48372	1.44

every season deep ploughing (T_2), Kumar *et al.* (2005) also observed that frequency of tillage increase cost of cultivation. About Rs. 3000/- additional expenditure for ploughing may give nearly Rs. 5000/- additional net income.

The benefit cost ratio was almost similar and fall within the range of 1.44 to 1.58 (Table 4). The higher benefit cost ratio of 1.58 was obtained from the every year deep ploughing(T_3) treatment. This was due to saving in cost of unnecessary ploughing as well as positive effect of timely and required ploughing on yield improvement under the rice-groundnut system.

REFERENCES

Arya, R.L., Kumar Lalit, Singh, K.K. and Kushwala, B.L. (2005). Effect of fertilizers and tillage management in rice (*Oryza sativa*) – chickpea. (*Cicer arietinum*) cropping system under varying irrigation schedules. *Indian J. Agron.*, **50**(4) : 256-259.

Gini, G.S., Acharya, G.P., Regmi, A.P. and Hobbs, P.R.(1993). Results of long term rice-wheat soil fertility experiment in the *tarai* of Nepal (In) Proceedings of a workshop on wheat in the Heat Stressed Environment : Irrigated, Dry Ares and Rice – Wheat farming systems held at Nashipur, Bangladesh, during 14-15 February 1993.

Gupta, Meenakshi, S., Bati, Amarjit, Sharma, B.C., Kachroo, D. and Bharat Rajeev (2007). Productivity, nutrient uptake and economics of Wheat (*Triticum aestivum*) under various tillage and fertilizer management practices. *Indian J. Agron.* **52**(2) : 127-130.

Kalita, H., Bora, P.C. and Debnath, M.C. (2005). Effect of sowing date and tillage on soil properties, nutrient uptake and yield of linseed (*Linum usitatissimum*) growth in winter rice (*Oryza sativa*) fallows. *Indian J. Agron*., **50**(1) : 70-72

Kumar, Sandeep, Pandey, D.S. and Rana, N.S. (2005). Economics and yield potential of wheat (*Triticum aestivum*) as affected by tillage, rice (*Oriza sativa*) residue and nitrogen management option under, rice-wheat system. *Indian J.Agron.*, **50**(2): 102-105

Pratibha, G., Pillai, K.G. and Satyanarayana, V. (1998). Effect of tillage included physical edaphic properties in relation to crops after puddled rice. *Indian J. Agric. Sci.*, **68**(2) : 62-65.

Saxena, Anurag, Singh, D.V. and Joshi, N.L.(1997). Effect of tillage and cropping systems on soil moisture balance and pearl millet yield. *J. Agron. & Crop Sci.*, **178** : 251-257

Tripathi, 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) : 118-24.

Received : September, 2009; Accepted : November, 2009