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Soil and Nutrient Losses in Runoff Water from Loamy Sand Soil of Middle Gujarat

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ABSTRACT

Study was conducted during the year 1975-76 and 1976-77 at B. A. College of Agriculture Farm, Anand to ascertain the extent of losses of soil and nutrients through runoff water from different moisture conserving practices. The losses of water as runoff were 249.08, 196.16 and 94.82 mm/ha from shallow ploughing, deep ploughing and ridges and furrows, respectively. The losses of soil from corresponding moisture conservation practices were 2.50, 2.71 and 1.29 tonne/ha, respectively. The nutrients losses viz., nitrogen, phosphorus and potassium from shallow ploughing were 6.64, 4.79 and 106.67 kg/ha, respectively. In the case of deep ploughing, the corresponding nutrients losses were 6.12, 3.75 and 82.96 kg/ha, while for ridges and furrows the figures were 5.75, 3.05 and 73.21 kg/ha, respectively.

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INTRODUCTION

Often, under semi-arid areas, the rate of rainfall exceeds the infiltration capacity of the soil at the time of torrential rains. This results in occurrence of runoff of excess water causing soil errosion and thereby removal of surface soil layer leading to the loss of nutrients and decreased yields. The losses can be ascertained by collection and analysis of the runoff water from the place of study. This will give idea about losses of different nutrients and their proportions. If appropriate measures could be taken to minimise water runoff, the enrichment ratio would be decreased, resulting in conserving the upper most soil layer (Barrows and Kilmer, 1963). The above concept was the guiding factor behind the present study.

MATERIALS AND METHODS

This study was conducted on the B. A. College of Agricultural Farm during the year 1975-76 and 1976-77 on sorghum and castor. The soil of experimental plot was sandy loam in texture having capacity to hold 12 per cent available soil moisture. It was low in total nitrogen and available phosphate. The status of potash was very high. The pH was moderately alkaline (Table 1).

TABLE 1

Chemical analysis of the soil of experimental area from 0.30 cm depth.

Item	*Year*	
	1975-76	*1976-77*
Total nitrogen, kg/ha	680.00	520.00
Available P_2O_5, kg/ha	52.00	59.00
Available K_2O, kg/ha	385.00	369.00
Organic matter, %	0.51	0.48
pH	8.00	8.10

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Meteorological data recorded during the period of investigation are presented in Table 2.

TABLE 2

Rainfall data recorded at the meteorological observatory of the College Farm of the Gujarat Agricultural University at Anand, during 1975-76 and 1976-77.

Month	*Rainfall, mm*		*Number of rainy days**	
	75-76	*76-77*	*75-76*	*76-77*
June	117.09	423.16	5	5
July	128.30	377.04	6	14
Aug.	284.30	562.40	9	12
Sep.	216.70	135.20	10	5
Oct.	83.20	—	3	—
Nov.	—	102.90	—	4
Dec.	—	—	—	—
Jan.	—	—	—	—
Feb.	—	—	—	—
Mar.	—	—	—	—
Apr.	—	—	—	—
May	—	—	—	—

*Any day receiving rainfall of more than 5 mm in 24 hours was considered as a rainy day.

The design of the experiment was a split-split plot with four replications. Each replication embedded combinations of three moisture conservation practices as the main plot treatments, two test crops as sub-plot treatments and two treatments of recycling of water occupying the sub-sub-plots.

The sorghum crop was fertilized with 80 kg N and 40 kg P_2O_5/ha, whereas castor crop was fertilized with 60 kg N and 60 kg P_2O_5/ha. Half the dose of nitrogen and full dose of phosphate were applied to the test crops as a basal dose. The remaining nitrogen was topdressed after 40 days of sowing/dibbling.

Empty asphalt drums were embedded in the soil keeping 5 cm above ground level in the direction of slope for each plot. The channels prepared from iron sheets were placed on the drums at the ground level of the plots to facilitate conveyance of runoff water from plots. The drums were covered with lids to check evaporation and avoid addition of direct rain water into them. Runoff water collected in the drums during each runoff event was measured with the help of measuring cylinders. For determination of soil and nutrient loss, samples of 100 cc of runoff water were taken per litre of runoff water. The runoff collections of all the events for a particular treatment were composited and preserved in a plastic jar. The samples were analysed for losses of soil, nitrogen (Modified Kjeldahl method), water soluble phosphorous and potassium (Flame emission spectrophoto meter) by the methods of Jackson (1973).

RESULTS AND DISCUSSION

The data indicated significant effects of different moisture conservation practices during both the years (Table 3).

The lowest water, soil and nutrients losses occurred under ridges and furrows treatment during both the years. The average water losses were 162.68 and 106.87 per cent higher under shallow ploughing (10 cm) and deep ploughing (30 cm) treatments, respectively, as compared with ridges and furrows layout. The corresponding percentages for soil loss were 93.49 and 109.91, respectively. Similarly in respect of nutrients losses, the losses of nitrogen were 15.36 and 6.39 per cent higher in shallow ploughing and deep ploughing as compared to the ridges and furrows. The corresponding percentage losses for phosphorus were 56.84

TABLE 3

Effects of different treatments on losses of runoff water, soil and nutrients in runoff water suspension.

Treatments	*Water runoff, mm/ha*			*Soil loss in runoff water, tonne/ha*		
	1975-76	*1976-77*	*Mean*	*1975-76*	*1976-77*	*Mean*
Moisture conservation practices (T)						
T_1 (Shallow ploughing)	215.63	282.54	249.08	2.35	2.65	2.50
T_2 (Deep ploughing)	167.94	224.37	196.16	2.54	2.88	2.71
T_3 (Ridges and furrows)	84.63	105.01	94.82	1.22	1.36	1.29
S.Em. ±	4.96	6.92	—	0.05	0.09	—
C.D. at 5%	17.18	23.96	—	0.18	0.22	—
C.V. %	12.73	13.58	—	12.21	11.11	—
Crop (C)						
C_1 (Sorghum)	150.55	2203.77	177.16	1.98	2.23	2.10
C_2 (Castor)	161.59	204.17	182.88	2.09	2.36	2.23
S.Em. ± 1	3.60	3.22	—	0.07	0.07	—
C.D. at 5%	N.S.	N.S.	—	N.S.	N.S.	—
C.V. %	11.30	7.72	—	17.34	15.89	—

Nitrogen loss in runoff water, kg/ha			*Water soluble phosphorus loss in runoff water, kg/ha*			*Potassium loss in runoff water, kg/ha*		
1975-76	*1976-77*	*Mean*	*1975-76*	*1976-77*	*Mean*	*1975-76*	*1976-77*	*Mean*
6.91	6.36	6.64	4.30	5.28	4.79	85.83	127.52	106.67
6.19	6.05	6.12	3.58	3.91	3.75	75.18	90.75	82.96
6.31	5.20	5.75	2.87	3.24	3.05	68.46	77.98	73.21
0.13	0.17	—	0.12	0.15	—	1.74	3.11	—
0.44	0.58	—	0.42	0.51	—	6.01	10.77	—
7.80	11.52	—	13.62	14.28	—	9.08	12.61	—
6.46	5.97	6.21	3.44	3.93	3.68	79.01	96.42	87.72
6.46	5.78	6.12	3.73	4.36	4.04	73.96	101.08	87.52
0.13	0.13	—	0.19	0.19	—	2.06	2.45	—
N.S.	N.S.	—	N.S.	N.S.	—	N.S.	N.S.	—
9.63	10.52	—	26.02	23.04	—	13.23	12.18	—

and 22.26 and for potassium they were 45.71 and 13.32 per cent, respectively.

The significantly the lowest water and soil loss under ridges and furrows may be due to the fact that after ploughing, the land surface remained flat in case of shallow ploughing and deep ploughing treatments as compared to the plots carrying ridges and furrows. Minimum runoff losses from ridge—furrow plots was obviously due to greater opportunity time for infiltration. Secondly, plots with ridges and furrows were also subjected to deep ploughing. These results are in agreement with those reported by Yadav (1976) in his studies on inter row water harvesting.

The highest soil loss was observed under deep ploughed plots, as compared to the rest of the treatments as a result of loosening of soil which was more vulnerable to erosive action of water.

The highest amount of nitrogen, phosphorus and potassium were lost from the shallow ploughed plots followed by deep ploughing and the least from the plots with ridges and furrows. This was obviously due to the higher runoff under shallow ploughing as compared to ridges and furrows. Thus loosening of soil to a greater depth was favourable for reducing the ru noff which indirectly reduced the loss of nutrients in runoff. This is in confirmity with the results reported by Bedell *et al.* (1946), Romkens *et al.* (1973) and Timmons *et al.* (1973) who have reported reduction in nutrient losses by ploughing and conservation management practices. Siemens and Oschwald (1976) also concluded that the losses of nitrogen and phosphorus in surface runoff differed significantly between tillage treatments.

The determination of water loss, soil loss and nutrients content in runoff water as affected by test crops indicated no significant difference during the course of study. This may be due to limited length of the experimental plot to 3.6 m. Hence the velocity of runoff water was the minimum which did not permit the test crops to manifest their effect on runoff studies. None of the interactions were significant.

This clearly brought out the fact that for conserving the rain water and to prevent the losses of soil and nutrients in runoff water under loamy sand soils of middle Gujarat, it is advantageous to plough the soil to a depth of 30 cm and prepare ridges and furrows layout.

REFERENCES

Barrows, H. L. and V. J. Kilmer (1963) Plant nutrient losses from soil by water erosion. *Advance Agron.* **15:** 303-316.

Bedell, C. D., H. Kohnke and R. B. Hickok (1946). The effect of two farming systems on erosion from crop land. *Soil Sci. Soc. Amer. Proc.* **11:** 522-526.

Jackson, M. L. (1973) Soil chemical analysis. Pub. Prentice-Hall of India Prv. Ltd., New Delhi.

Reddy, D. Subbarami, D., Ramachandra Reddy and G. Venkatanadha Chry (1977). A note on the effect of deep ploughing on basic infiltration rate of soil, root growth and grain yields under rainfed agriculture at Anantapur. *Annals Arid Zone.* **16**(1): 149-152.

Romkens, M. J. M., D. W. Nelson and J. V. Mannering (1973) N and P composition of surface runoff as affected by tillage method. *J. Environ. Qual.* **2:** 292-295.

Siemens, J. C. and W. R. Oschwald (1976) Erosion for corn tillage systems. *Trans. ASAE.* **19** (1): 69-72.

Timmons, D. R., R. E. Burwell and R. F. Holt (1973) N and P losses in surface runoff from agricultural land as influenced by placement of broadcast fertilizer. *Water Resour. Res.* **9:** 658-667.

Verma, H. N., Ranjodh Singh, S. S. Prihar and T. N. Chaudhary (1979). Runoff as affected by rainfall characteristics and management practices on gently slopping sandy loam soil. *J. Indian Soc. Soil Sci.* **27** (1) : 18-22.

Yadav, R. C. (1976) Inter-row water harvesting beneficial for maize. *Indian Fmg.* **26** (4) : 5-7.