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SOIL IMPROVEMENT IN RELATION TO DRYLAND AGRICULTURE IN WESTERN RAJASTHAN

I. ON INCREASING THE MOISTURE STORAGE IN SANDY DESERT SOILS

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Poor moisture storage capacity of the western Rajasthan soils has been linked to their developmental pattern. Pot culture and drum culture studies conducted in kharif 1972, have shown that sub-surface incorporation in soil of organic amendments like chopped pieces of *Calotropis procera* plants, and inorganic amendments like bentonite clay, increased the moisture storage in soil as also the yield of bajra (HB3).

INTRODUCTION

Principal soil association of western Rajasthan are, Aeolian brown soils, old Alluviums overburdened by Aeolian sands, Recent and sub-recent alluviums — at places covered by a thin layer of Aeolian sands, medium to fine textured shallow sedentary soil formations and sand dunes.

Under rainfed agriculture, one of the greatest problems encountered in this region is the very low moisture storage capacity of these soils. In moderately deep wind worked sandy soils of Jodhpur water storage capacity is low due to their sandy texture, structureless condition and low organic matter content. The losses of moisture in deep drainage are at times considerable because of rapid infiltration.

Along with the proven practices of mulching, bunding, run-off collection, weed control and water harvesting for the conservation of moisture, due emphasis should be given to the management of organic matter in these soils through inclusion of grasses in the crop husbandry programme. This practice, however, has not shown any soil improvement with continued use for 10 to 15 years, but it is possible that if continued for a longer period, this may show benefit.

Another approach towards increasing the moisture storage capacity of soils could be the application of soil amendments (both organic and inorganic). The surface soil layer in this region is, however, very much prone to wind erosion hazard and thus the application of such amendments, should have to be done in the subsoil, at about 30 cm depth from the surface. This may make the application of organic amendment more effective because of its mineralisation in subsoil which has comparatively higher moisture content.

Materials and Methods

An experiment to this effect was conducted in the kharif 1972, with different organic amendments. Test crop grown was bajra (HB3) in one meter deep drums (dia. 45 cm) in which soil was filled up to 60 cm depth. Treatments were replicated twice.

Calotropis procera, FYM and Tumba cake were tried as soil amendments. *Calotropis procera* is a naturally growing bush in Rajasthan desert. It contains latex which is acidic and polymeric in nature.

Sixteen-day-old bajra (HB3) seedlings were transplanted on 1-8-1972 @ six per drum. The crop was harvested on 7-10-1972. Data on soil moisture, phosphorus availability and yield are presented in Table I.

Table I

Soil moisture depletion, phosphorus availability and yield of bajra as affected by different soil amendments

Treatment	Water retention (in mm) after irrigation with 5 lt. water per drum on 20-9-72			Available P_2O_5(0–30) kg/ha at harvest	Yield (in g) per drum
	Moisture content on 28-9-72 60 cm layer	Moisture content on 6-10-72 60 cm layer	Moisture use between 28-9-72 to 6-10-72		
Calotropis	75.7	44.5	31.2	42	42.5
Calotropis+FYM+Tumba cake	72.0	25.2	36.8	47	43.0
FYM (surface)	64.3	22.1	35.2	30	31.5
FYM (Subsurface)	74.5	38.0	35,5	40	44.5
Tumba cake	58.4	34.6	23.8	39	24.0
Control	57.1	24.3	32.8	25	20.5
CD 5%	10.45				

Results and discussion

Results showed that *Calotropis* (in both the treatments) and FYM (both surface subsurface application) gave significantly higher yield than control. Subsurface application of FYM out-yielded all the treatments and the difference between subsurface and surface application of FYM was significant. Tumba cake was the least effective. The findings support the earlier assumption that incorporation of amendments in the root zone may be far more beneficial than the usual practice of surface application, in this region. Nevertheless, it may be desirable to test these findings under field conditions.

Table I clearly shows that all the treatments resulted in more moisture in the 60 cm soil column than control. *Calotropis* treatment showed 75.7 and 44.5 mm moisture as against control's 57.1 and 24.3 mm on 28-9-1972 (last irrigation) and

6-10-1972 (harvest), respectively. Total moisture depletion during this interval was also higher in case of amendments than in control which suggests that more water was made available to plants in case of these treatments.

Data also reveal the positive effect of organic amendments on the availability of phosphorus in these soils. All the treatments showed higher amount of available phosphorus at harvest, as compared to the control, the highest being 47 kg/ha. in *Calotropis*+FYM+Tumba cake treatment.

Bentonite Clay

Bentonite is essentially a Montmorillonite clay, a number of mines of which exist in western Rajasthan.

Heavy drainage losses in sandy subsoil may be controlled to some extent by the introduction of Bentonite clay at a soil depth of about 30 cm from the surface. The surface placement of Bentonite should be avoided as it may rather aggravate the moisture-loss during evaporation.

Pots (depth = 40 cm, and area = 0.1m^2) were filled with soil upto 30 cm depth. Three levels of Bentonite clay : 10 t/ha, 20 t/ha, and 40 t/ha. (100,200 and 400 in terms of pot)—each with surface and subsurface placement (15 cm depth)—and a control (in all seven treatments) were randomised in five replications.

Fertilisers @ N, 60kg; P_2O_5, 40kg; and K_2O, 20kg/ha. were applied. Sixteen-day old-seedlings of bajra (HB3) were transplanted on 1.8.1972 @ 4 seedlings per pot.

Each pot was irrigated with 2 lit. of water. In all four irrigations were provided, two before (1.8.72 and 14.8.72) and two after (6.9.72 and 17.9.72) the August monsoon spell. The crop was harvested on 7.10.72.

TABLE II

Depletion of soil moisture in pots and yield of bajra (HB3) as affected by Betonite application

Bentonite treatment	Moisture content on 1-9-72 (mm)	Moisture content on 19-9-72 (irrigation 3 lit/pot on 17-9-72) (mm)	Moisture content on 25-10-72 (mm)	Yield per pot (g)
10t/ha. subsurface	11.1	41.2	10.1	20.4
10t/ha. surface	10.7	40.5	8.4	20.4
20t/ha. subsurface	14.3	45.9	12.2	30.6
20t/ha. surface	13.4	42.2	8.2	21.2
40t/ha. subsurface	13.0	60.0	17.7	31,2
40t/ha. surface	19.3	50.8	15.9	21.2
Control	8.4	27.8	5.9	16.6
SEm±	3.3			
CD 5%	6.76			

Results show that Bentonite level of 10 t/ha. (both surface and subsurface) and 20 t/ha. and 40 t/ha. (surface) gave approximately equal yields which do not differ significantly from the control. On the other hand, levels of 20 and 40 t/ha, (sub-surface) out-yielded the control treatment significantly both, at 5% and 1% levels. The differences between these two treatments (20 and 40 t/ha.), however, were not significant. It may thus be inferred that subsurface application of Bentonite @ 20 t/ha. proved to be the most satisfactory in terms of grain yield.

More moisture was retained after the August spell of monsoon and also after the last irrigation on 17-9-1972 in Bentonite treatments as compared to control (Table II). Up to 20 t/ha. level, it was subsurface level of 20 t/ha. which retained maximum moisture at all the stages (i.e. 1-9-1972, 19-9-1972 and 25-10-1972) and also gave maximum yield.

Interestingly enough, wilting was more pronounced in control and in surface applications, prior to each irrigation.

In surface applications, probably, moisture was more prone to evaporation losses and therefore, less moisture was retained in the 30 cm soil column in pots.

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