MJS, Vol. 3, No. 1, May. 2004 - Oct. 2004 pp. 11-19
ISSN 0975-3311
https://doi.org/10.12725/mjs.5.3

INFLUENCE OF ORGANIC AMENDMENT AND INORGANIC SOURCES IN RELATION TO CROP YIELD OF RAGI AND SOIL CHARACTERISTICS

*Gopal Dasar **G.N. Gajanana, ***Basavaraj

ABSTRACT

A field experiment was conducted on a sandy clay loam soil during summer season to characterize the soil crust and to alleviate soil crust with organic waste and other amendments to improve the yield. Maize residue treatment recorded significantly higher grain and straw yield, seedling emergence, reduction in the crust strength and increase in the moisture content of crust was observed due to maize residue incorporation. Soil crust contains higher amount of finer fractions, sesquioxides, iron, dispersion ratio and lower amount of organic matter The problem of soils crusting is common in agricultural soils under a

* Assistant Professor of Soil Science and Agricultural Chemistry, University of Agricultural Sciences, College of Forestry, Sirsi.

** Associate Professor of Soil Science and Agricultural Chemistry, University of Agricultural Sciences, G.K.V.K., Bangalore-65.

*** University of Agricultural Sciences. Dharwad-8.

wide range of climate conditions. Soil crust is a hard layer formed on the surface due to impact of rain drops and subsequent drying. Though the seeds germinate below the crust, seedlings are not able to exert sufficient upward pressure to pierce through the crust resulting in pre-emergence death of seedlings, crusts are known to adversely affect seedling emergence, early growth of seedling oxygen supply, moisture inilliteration but increase erosln and run off.

A good crop stand is a pre-requisite for higher production which depends on proper germination and emergence. During Kharif season soil crusting poses serious problem to seedling emergence in alfisol of dry land areas.

Investigations carried out so for on the development of hard soil crust, have largely attributed this phenomena to soil dispersion and deteriorated soil structure, rainfall intensity and wetting and drying cycles. Soil crusts are characterized with greater mechanical strength, low porosity, high bulk density, low degree of aggregation, high amount of silt and clay, higher amount of sesquioxides and lower amount of organic matter. Crust formation in cultivated soil is not a desirale phenomena from the point of crop emergence, growth and other soil characteristics.

The role of organic substances in alleviating soil crust formation has not been studied adequately with a view for higher production. Hence, the study was initiated.

Materials and Method

The experiment was laidout in a randomized complete block design at Gandhi krishi Vigana Kendra, Bangalore with four replications and seven treatments, the plot size was 1.8 x 2.0 m. Calculated quantity of seeds were sown in rows of 30 cm distance from row to row and 10 cm between seed to seed. PR-202 variety of ragi seeds were used in the experiment. The soil crust was developed artificially by adding water to simulate 20 mm of rainfall. Immediately after sowing irrigation water was applied using rose can at a height of four feet in such away that it simulated the natural rainfall. The quantity of water added was equal to 20 mm of rainfall in case of all the plots. The residues were incorporated in the soil is moist conditions and were allowed to decompose for 21 days. Potassium chloride (T6) was applied at the time of sowing after gap of 21 days sowing was done at the rate of 10 kg/ha at the time of sowing 50 per cent N as urea, the entire P_2O_5 as super phosphate and entire K_2O as muriate of potash were applied (50:50:25 kg/ha) The remaining half of the nitrogen was applied 40 days after sowing the crust strength, per cent moisture content and seedling emergence were recorded on 5^{th} 8^{th}, 12^{th} day. After twelve days of observation the plots were irrigated once in every

8 days interval by flooding. After the crust strength measurement, samples of the soil crust and soil below crust were collected on 5^{th}, 8^{th} and 12^{th} day alter sowing were pooled and analysed as per the standard method of analysis.

Results and Discussion

Seedling emergence or ragi in different treatments

The data indicates significant variation in the emergence of seedling due to different treatments. The seedling emergence was maximum in maize residue treated plots and all the treatments were significantly superior to control. The seedling emergence was better because of the favourable moisture status and low crust strength. AS shown in the (Table I) higher moisture content and low crust strength may be responsible for better germination. Ranganatha (1976) reported higher seedling emergence of ragi in FYM treatment and attributed it to increased moisture content reduction in crust strength and bulk density. Similarly many workers observed reduction in soil crust due to organic matter application (Parvathappa *et al.* 1988).

Table I Seedling emergence of ragi as Influenced by different treatments to alleviate soil crust

Treatments	Number of seedlings emerged per plot		
	5 DAS	8 DAS	12 DAS
T1FYM	83.00	106.00	105.00
T2 Maize residue	109.00	115.00	116.00
T3 Coir pith	75.00	77.00	78.00
T4Groundnuthusk	79.00	82.00	82.00
T5 Press mud	89.00	94.00	94.00
T6 Potassium	83.00	88.00	88.00
T7 Control	61.00	66.00	66.00
F Test	*		*
CD at 6%	3.10	2.50	2.58

DAS : Days after sowing

Soil crust strengh and moisture content

There, was significant variation in the crust strength and moisture content (Table II) of soil crust due to different treatments. Maize residue reduced the crust strength significantly than all the other treatments except addition of potassium. All the organic amendments significantly reduced the crust strength. Baver *et al* (1972) reported that organic matter application will reduce crusting by improving infilteration, air exchange and formation of stable soil aggregates which resist dispersion. The present study reveals that application of organic resides was helpful in reducing soil crust strength. Similar observations were also reported by Hazra (1986) and Gupta *et al* (1987). In the present study all the organic matter sources have increased the moisture content because of which crust strength was also reduced.

Table II. Crust Strength and its Moisture Content

Treatments	Crust strength (kg/cm^2)			Moisture content (%)		
	5 DAS	8 DAS	12 DAS	5 DAS	8 DAS	12 DAS
T1 FYM	2.34	2.57	2.98	7.43	7.58	4.48
T2 Maize residue	2.09	2.09	2.62	8.40	8.66	7.41
T3 Coir pith	2.69	2.74	3.27	6.29	6.66	4.03
T4 Groundnut husk	2.46	2.54	2.92	6.40	6.66	4.66
T5 Pressmud	2.41	2.60	2.79	6.98	7.20	4.72
T6 Potassium	2.26	2.67	2.76	5.01	5.57	4.82
T7 Control	3.18	3.52	4.00	4.24	4.87	3.58
F test	*	*	*	*		*
CD at 6%	0.21	0.27	0.23	0.62	0.34	0.22

DAS : Days after sowing

Grain and straw yield of ragi

Favourable conditions for germination and seedling emergence are important factors for good crop stand, which is a pre-requisite for better yield. The hard and compact layer will hamper the emergence of seedling thus reducing the yield of crops.

A significant increase in the grain and straw yield of ragi over control was observed in all the treatments (Fig. 1). The data in Table III indicates that reduction in the seedling emergence was one of the factor for variation in yield. Hazra (1986) reported a significantly higher forage yield of pearl millet than control due to addition of organic residues like ground nut husk, FYM, bajra stalk and dry grass.

Table III. Influence of alleviation of soil crust on grain and straw yield of ragi

Treatments	Grain yield (kg/ha)	Straw yield (kg/ha)
T1 FYM	2189.10	4199.70
T2 Maize residue	2847.60	6647.60
T3 Coir pith	1456.00	3042.30
T4 Groundnut husk	1878.30	4365.00
T5 Pressmud	2236.40	4663.40
T6 Potassium	1640.20	4794.90
T7 Control	664.70	2876.90
F test	*	*
CD at 6%	234.5	1208.90

The variation in yield can be attributed to variation in crust strength and its effect on moisture status, seedling emergence, and their rot growth. The findings are well backed by the findings of Unger and McCalla (1980) and Singh and Chaudhary (1985).

Mechanical Composition of soil crust and soil below crust.

The effect of various mechanical composition of the soil crust are presented in Table IV. The data indicate that soil crust have lower amount of coarse and fine sand than soil below crust. The silt and clay content are higher in soil crust than soil below the crust. Earlier studies indicates that soil crusts have more finer particles than soil below the crust (Ranganatha, 1976). The variations in different treatments can be attributed to the exposure to dispersion and compaction. Finer soil particles are susceptible for dispersion and when dried, hard on the surface resulting in a tough surface layer (Zaslavasky *et al* 1980)

Table IV. Mechanical composition of soil crust and soil below it

Treatments	Coarse sand (%)		Fine sand (%)		Silt (%)		Clay (%)	
	Soil crust	Soil below crust	Soil crust	Soil below crust	Soil crust	Soil below crust	Soil crust	Soil below crust
T1 FYM	37.36	38.60	31.70	34.85	9.80	8.66	20.66	17.86
T2 Maize residue	37.60	36.92	32.82	34.20	8.30	7.15	21.20	21.60
T3 coir pith	39.40	39.25	28.87	31.27	9.46	8.45	21.97	21.00
T4 Groundnut husk	35.35	39.17	32.43	32.32	9.77	8.10	22.17	20.27
T5 Pressmud	35.00	39.22	34.30	30.37	8.80	7.62	22.55	22.57
T6 Potassium	34.65	39.1	33.40	32.41	8.60	7.65	22.80	20.66
T7 Control	34.18	37.66	33.28	32.42	9.66	8.82	22.88	20.22
F test	*	*	*	NS	*	*	*	*
CD at 6%	0.96	1.00	1.12	%	0.22	0.20	0.96	1.74

Organic matter and major nutrient status or soil crust and soil below crust

The organic matter status (Table V) of soil crust was less than the soil below the crust. However the variation was not very distinct. There was significant variation in organic matter content of the soil in all the treatments except potassium and pressmud. It can be attributed to the orgnic nature of organic substance that are applied. Addition of organic wastes significantly increased the organic matter content of soil (Pandey *et al.*, 1985).

The available nitrogen content (Table V) was marginally lower in soil crust than soil below the crust marked variation in the nitrogen content was observed among the treatments studied. The increase in nitrogen content in the samples where organic residues were applied in addition to fertilizers can be attributed to nitrogen release from residues to the available nitrogen pool. Similar observation was also reported by Pandey *et al.* (1985).

The available phosphrous status Table V varied significantly in soil crust and soil below the crust. Organic residues increased the available phosphorus significantly over control. There was no significant variation between control and potash application treatment. The increase in the available phosphorus due to organic

Table V Organic matter and major nutrient status of soil crust and soil below it

Treatments	Organic matter (%)		Available Nitrogen (kg ha^{-1})		Available P_2O_5(kgha^{-1})		Available K_2O (Kg ha^{-1})	
	Soil crust	Soil below crust	Soil crust	Soil below crust	Soil crust	Soil below crust	Soil crust	Soil below crust
T1 FYM	1.18	1.25	211.68	215.60	88.53	90.66	216.47	219.59
T2 Maize residue	1.25	1.30	227.36	239.12	91.69	92.89	213.75	218.90
T3 Coir pith	0.92	0.98	184.24	199.92	88.12	88.44	213.88	218.56
T4 Groundnut husk	1.03	1.10	199.92	211.68	93.34	90.66	209.62	210.991
T5 Pressmud	0.92	0.97	184.24	196.00	8.12	88.56	208.64	211.04
T6 Potassium	0.86	0.89	166.80	164.24	82.96	83.38	226.43	229.60
T7 Control	0.85	0.89	166.80	172.14	82.96	83.38	210.69	210.66
F test	*	*	*	*	*	*	*	*
CD at 5%	0.07	0.09	20.01	21.05	2.34	2.31	5.73	7.27

substances can be attributed to reduction in the quantity of insoluble phosphates of iron and aluminum Suresh and Mathur (1988).

The potassium content (Table V) of soil crust and soil below the crust varied significantly due to different treatment receiving FYM, maize residue, coir pith and potassium. The increase in potassium can be attributed to release from clay minerals and contribution of potassium from organic residues. Increase in potassium due to organic residue application was also observed by Subramaniam and Kumaraswamy (1989).

Sesquioxides, Iron and Dispersion of Soil Crust and Soil Below Crust

Sesquioxides

The sesquioxides content of crust was higher than soil below the crust (Table VI). The increase in sesquioxides can be attributed to increased amount of finer fractions in crust and the coatings of sesquioxides on other soil particles during in crust formation. Aubert (1963) opined that the ferrolytic crust of tropical region consists of oxides and hydroxides of Fe, Al and Mn with varying degree of kaolinite and quartz. Ranganatha (1976) observed higher sesquioxide in soil crust than soil below crust. The variation in sesquioxide of soii crust can be attirubted to variation in finer particles of soil crust.

Iron content

The iron content (Table VI) of the crust was higher than soil below the crust. Russel (1961) found that hardening of soil was caused by colloidal iron oxides.

Table VI Sesquioxides, Iron and dispersion ratio of soil crust and soil below it

Treatments	Sesquioxides (%)		Iron (%)		Despersion ratio	
	Soil crust	Soil below crust	Soil crust	Soil below crust	Soil crust	Soil below crust
T1 FYM	1.18	1.2S	211.68	215.60	88.53	90.66
T2 Maize residue	1.25	1.30	227.36	239.12	91.69	92.89
T3 Coir pith	0.92	0.98	184.24	199.92	88.12	88.44
T4 Groundnut husk	1.03	1.10	199.92	211.68	93.34	90.66
T5 Pressmud	0.92	0.97	184.24	196.00	8.12	88.56
T6 Potassium	0.86	0.89	166.80	164.24	82.96	83.38
T7 Control	0.8S	0.89	166.80	172.14	82.96	83.38
F test	*	*	*	*	*	*
CD at 5%	0.07	0.09	20.01	21.05	2.34	2.31

Dispersion ratio

The data on dispersion ratio (Table VI) indicate that crusts had higher dispersion ratio than soil below crust. This may be due to presence of higher colloidal particles in the crust. Zaslavasky *et al.* (1980) reported that the dispersed finer fractions of soil forms crust. The higher dispersion ratio can be attributed to the presence of finer particles in crust which are susceptible for dispersion.

References

1. AUBERT, G., 1963, *SOllSCl.,* M: 235-242.

2. BAVER, LD, GARDNER, W.H. AND GARDNER, W.R., 1972, *SoU Physics. Fourth Edition,* John Wiley and Sons, Inc., New York.

3. GUPTA, S.C., SCHNEIDER, E.C., LARSON, W.E.AND HADUS, A., 1987, Soil *Sci. America J.,* 207-212.

4. HAZRA, C.R., 1986, *J. Indian SOC. Soil Sci.,* 34:396-400.

5. PANDEY, S.P., HARISHANKAR AND SHARMA, V.K., 1985, *J. Indian SOC. Soil Sci.,* 33:179-181.

6. PARVATHAPPA, H.C., KANTHARAJ, M.L AND HEGDE, B.R., 1988, *Proc. inter. Conf. On Dry land Farming, Amarillo,* Texas, USA, Part VI, 461- 463.

7. RANGANATHA. B.R.. 1976, *M.Sc..(Agri.) Thesis.* University of Agricultrual Sciences, Bangalore.

8. RUSSEL, E.W., 1961, Soil conditions and plant growth 9[th] ed. Longmans Green and Co., London.

9. SUBRAMANIAN, K.S., AND KUMARSWAMY, K., 1989. *J. Indian Soc. Soil Sci..* 37:171-173.

10. SURESH LAL AND MATHUR. B.S.. 1988. *J.Indian Soc. SoilScL* 36:113-119.

11. UNGER, P.W. AND MCCALLA, T.M.. 1980, Conservation tillage systems. *Adv. Agron.,* 33:2-53.

12. ZASLAVASKY, D., ROZENBERG, L. AND SHAVIV, A., 1980, Engineering comprehensive report, 1975,1979, Pub. No. 310, Haifa, Israel.