Table 2. Long term effect of organics and inorganics on total P and K content (%) of soil at different depths (cm)

Treatment	Depth (cm) 0 - 15		15 - 30		30 - 45	
	Total P	Total K	Total P	Total K	Total P	Total K
50% NPK	0.075	0.215	0.035	0.245	0.025	0.255
100% NPK	0.055	0.235	0.045	0.280	0.013	0.260
150% NPK	0.063	0.260	0.052	0.280	0.025	0.280
100% NPK + Hand weeding	0.055	0.233	0.047	0.283	0.025	0.243
100% NPK + $ZnSO_4$	0.060	0.243	0.045	0.248	0.025	0.253
100% NP	0.035	0.243	0.052	0.237	0.027	0.245
100% N	0.030	0.237	0.055	0.243	0.025	0.248
100% NPK + FYM	0.065	0.260	0.058	0.243	0.227	0.290
100% NPK (-S)	0.025	0.233	0.065	0.280	0.047	0.245
Control	0.025	0.245	0.045	0.215	0.025	0.285

Sources	CD	
	Total P	Total K
T	0.010	0.005
D	0.004	0.003

practices it was not marked probably due to very high initial potash level in the soil of the long term fertiliser experiments, Coimbatore.

While comparing the total K content in soil with depth, it increased. The lower total K content observed at the surface could possibly be attributed to the release of non-exchangeable K and fixed K fraction in the soil solution to maintain the dynamic equilibrium among the different forms.

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IMPACT OF FERTILISATION AND INTENSIVE CROPPING ON PHYSICAL PROPERTIES OF VERTIC USTROPEPT SOIL

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ABSTRACT

Conjoint use of FYM with NPK over a long period had improved the physical properties of the soil, when compared to the application of inorganic fertilisers alone. Hydraulic conductivity of the soil increased while bulk density decreased. In respect of water holding capacity, the NP treatment recorded higher value as against N alone and it increased with depth.

It has been realised that increased production was achieved at the cost of soil health and that sustainable production at higher levels become possible only when the factors responsible for the maintenance of soil health are adequately taken care of. Continuous heavy application of chemical fertilisers deteriorates the soil health in the long run but in combination with organics brings many beneficial effects in physical, chemical and biological properties of soil. The long term fertiliser experiments provide reliable data to study the impact of continuous fertiliser application on soil properties besides the yield and productivity of soil.

MATERIALS AND METHODS

The experimental soil, a calcareous black clay loam with a pH of 8.0 (Vertic Ustropept) belonged to Peelamedu soil series. The experiment conducted during 1994, consisted of ten treatments (50% NPK- T_1, 100% NPK - T_2, 150% NPK - T_3, 100% NPK + HW - T_4, 100% NPK + $ZnSo_4$ - T_5, 100% NP-T_6, 100% N-T_7, 100% NPK + FYM - T_8, 100 NPK (- S)- T_9 and control - T_{10}) replicated four times in a randomised block design and the cropping sequence adopted was ragi - maize - cowpea under irrigated condition. Urea, single super phosphate and muriate of potash were the sources of N,P and K in all the treatments except in the case of treatment T_9 where the source of P was diammonium phosphate. Representative soil samples were collected from each plot at three depths *viz.*, 0-15, 15-30 and 30-45 cm after the 53rd crop of maize in a long term fertilizer experiment for the determination of various physical properties.

RESULTS AND DISCUSSION

Bulk density

Application of 100 per cent NPK with FYM reduced the bulk density (Table 1). This is in accordance with the findings of Muthuvel *et al.* (1982). Further a reduction was observed in bulk density due to the application of inorganic fertilisers as compared to the control. This is attributed to the increased biomass production with consequent increase in the organic matter content of the soil. Similar findings have earlier been reported by Lal and Mathur (1992) and Venkatesh Bharadwaj and Omanwar (1992). However, an increase in bulk density was evidenced at different levels as compared to the bulk density observed in plots receiving 100 per cent NPK + FYM. Probably, the addition of inorganic fertilisers deteriorated the soil structure (Prasad and Singh, 1980)

Particle density

There was decrease in particle density (Table 1) in plots receiving 100 per cent NPK fertiliser alone suggesting that FYM application has improved the soil aggregation. Thus an inverse

Table 1. Long term effect of organics and inorganics on bulk density (BD) and particle density (PD) of soil (g cc-1) at different depths

Treatment	15 cm		30 cm		45 cm		Mean	
	BD	PD	BD	PD	BD	PD	BD	PD
50% NPK	1.48	2.73	1.50	2.68	1.34	2.67	1.44	2.69
100% NPK	1.51	2.65	1.51	2.68	1.39	2.59	1.48	2.64
150% NPK	1.52	2.63	1.51	2.67	1.27	2.62	1.43	2.64
100% NPK+HW	1.53	2.66	1.53	2.57	1.38	2.66	1.48	2.63
100% NPK + $ZnSO_4$	1.54	2.58	1.51	2.70	1.35	2.68	1.47	2.65
100% NP	1.54	2.61	1.56	2.67	1.42	2.66	1.51	2.64
100% N	1.56	2.70	1.52	2.68	1.35	2.65	1.48	2.68
100% NPK+FYM	1.47	2.62	1.47	2.59	1.30	2.63	1.41	2.61
100% NPK (-S)	1.56	2.72	1.57	2.62	1.32	2.64	1.48	2.66
Control	1.58	2.64	1.53	2.64	1.44	2.63	1.52	2.63
D Mean	1.53	2.66	1.52	2.65	1.36	2.64		

Sources	CD	
	Bulk density	Particle density
T	0.09	0.05
)	0.06	NS

Table 2. Long term effect of organics and inorganics on total porosity (%) water holding capacity (WHC) and hydraulic conductivity (HC)

Treatment (T)	15 cm			30 cm			45 cm			Mean
	TP	WHC	HC	TP	WHC	HC	TP	WHC	HC	TP
50% NPK	50.69	46.00	0.80	51.11	48.00	0.79	47.67	48.00	2.77	49.82
100% NPK	52.81	45.50	0.77	52.24	49.00	0.72	48.10	49.00	0.72	51.05
150% NPK	54.59	47.50	0.78	55.84	50.50	0.76	51.25	49.75	0.73	53.89
100% NPK+HW	55.49	45.00	0.83	53.48	47.50	0.76	48.79	50.07	0.79	52.58
100% NPK + $ZnSO_4$	56.16	47.08	0.79	55.39	49.00	0.74	50.05	50.00	0.75	53.87
100% NP	51.09	45.00	0.81	51.72	47.00	0.87	47.91	47.00	0.87	50.24
100% N	53.78	44.00	0.82	56.25	51.00	1.78	53.37	52.00	1.73	55.73
100% NPK+FYM	57.59	48.75	2.06	56.25	51.00	1.78	53.37	52.00	1.73	55.73
100% NPK (-S)	52.00	47.50	0.71	50.57	46.00	0.70	52.00	51.50	0.67	53.12
Control	53.21	42.00	0.68	53.89	46.50	0.63	50.42	46.00	0.64	52.51

Sources	CD		
	TP	WHC	HC
Treatment (T)	1.66	2.51	0.13
Depth (D)	0.91	1.38	0.07
T X D	NS	NS	NS

relatonship between the organic matter content and particle density of the soil could be observed which corroborated with the findings of Korschens and Greilich (1981). The particle density was the highest in plots receiving inorganic fertilisers alone as against the observed under 100 per cent NPK + FYM, thus confirming the favourable influence of FYM when applied with 100 per cent NPK in reducing soil density. It is worth mentioning that particle density did not vary much with depth.

Total porosity

Conjoint application of 100 per cent NPK with FYM increased the total porosity of soil also (Table 2) as compared to the other treatments, showing the favourable influence of FYM in enhancing the total porosity. This is in consonance with the findings of Bhatia and Shukla (1982) who reported that continuous addition of organic manures not only influenced the bulk density but also brougt a favourable change in the total porosity of soils which inturn influenced the other soil physical properties. A reduction in total porosity was also evident with soil depth, probably due to the compaction of soil with higher accumulation of clay and silt at lower depths.

Hydraulic conductivity

The improvement in hydraulic conductivity (Table 2) observed due to the application of FYM with 100 per cent optimum NPK in the present investigation corroborated with the the findings o Loganathan (1990). It is well known that bette aggregation and increased porosity as a consequence of the addition of organics are bound to have a favourable influence on the hydraulic conductivity which influences the soil water dynamics especially in black soils of India where water conductance is a problem during rainy periods. Improvement in hydraulic conductivity of black soils due to cotinuous addition of organics in combination with inorganics as compared to inorganics alone was earlier reported by Nambiar and Ghosh (1984). With depth the hydraulic conductivity was found to be non- significant.

Water holding capacity

Water holding capacity was the highest in plots receiving 100 per cent NPK + FYM (Table 2) probably due to the improvement in the structural condition of the soil. According to Bhatnagar *et al.* (1992) the long term manuring has influenced considerably the water retention and release. Application of NP also increased the water holding capacity when compared to N alone. This could be ascribed through its influence on pore space. Further, it was evident that water holding capacity increased with depth, which is quite expected because of higher accumulation of clay in the layers below the surface. This could also be attributed to the quantity and type to clay mineral.

In the present case it might be due to the presence of smectite clay mineral.

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HETEROSIS STUDIES FOR GRAIN YIELD CHARACTERS IN SWEET SORGHUM

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ABSTRACT

Superior cross combinations for seven grain yield related characters were selected by heterosis study from 42 cross combination of sweet sorghum (7 x 7 diallel cross of six sweet sorghum variety and one grain sorghum variety). The cross combination AKSS 5 x SSV 84 for more plant height, HES 4 x SSV 108 for earliness and CO 26 x AKSS 5 for better grain yield is recommended from the study.

KEY WORDS : Sorghum, Heterosis, Grain, Yield

Plant breeding research in sweet sorghum is a recent development. Identification of superior genotypes is of immediate necessity for further improvement through breeding programmes. Heterosis was recognised in sorghum only in 1927 by Conner and Karper (1927). Heterosis study is the one method widely utilised for the selection of superior cross combination. Hence, the present study was taken up to select superior hybrids for grain yield characters based on heterosis in sweet sorghum.

MATERIALS AND METHODS

Experimental materials consist of six sweet sorghum varieties *viz.*, SSV 84, SSV 74, SSV 108, [illegible] variety (CO 26). The seven parents have been crossed in a 7 x 7 diallel mating design. The resulting 42 hybrids along with seven parents were raised in randomised bloch design with three replications. Observations were recorded for seven grain yield related characters. Heterosis over mid parent (relative heterosis), over better parent (heterobeltiosis) and over standard parent (standard heterosis) were calculated. Significance for heterosis was tested by 't' test as per the formula given by Wynne *et al.* (1970). The study was conducted during 1990-92.

RESULTS AND DISCUSSION

Heterosis value of different hybrid combinations is given in the Table 1. In respect of