Table 4. Hybrids identified based on mean performance, *sca* effects and heterosis

Mean performance	*sca* effects	heterosis
ADT 39/ADT 41 (3)	TKM 9/Pusa Basmati 1 (4)	TKM 9/ADT 41 (4)
ADT 39/Pusa Basmati 1 (3)	ADT 37/Kasturi (3)	TKM 9/Pusa Basmati 1 (5)
IR 50/Pusa Basmati 1 (4)		ADT 39/Pusa Basmati 1 (3)
I W Ponni/ADT 41 (3)		IR 50/ADT 41 (3)
I W Ponni/Pusa Basmati 1 (4)		IR 50/Pusa Basmati 1 (3)
I W Ponni/Kasturi (3)		IR 50/Kasturi (3)
		I W Ponni/Pusa Basmati 1 (3)

Figures in paranthesis indicate suitability of hybrids for number of characters ; I W Ponni : Improved White Ponni

above, IR 50/Pusa Basmati 1 and Improved White Ponni/Pusa Basmati 1 are the two hybrids identified for heterosis breeding which combine grain traits and grain yield.

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WATER RETENTION CHARACTERISTICS OF SOME IMPORTANT SOIL GROUPS OF KAMARAJAR DISTRICT, TAMIL NADU

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ABSTRACT

Water retention characteristics of soils representing soil subgroups Typic Chromusterts, Typic Ustropept, Udic Haplustalf, Typic Haplustalf, Vertic Haplustalf and Typic Ustorthent in Kamarajar district of Tamil Nadu were evaluated and the influence of clay, total porosity, exchangeable sodium percentage, CEC, organic carbon, electrical conductivity and aggregate stability were studied. The results indicated that clay content in the soil is the major contributing factor to variations in water retention characteristics, to the extent of 83 to 91 per cent.

KEY WORDS : Water retention characteristics, soil subgroups

The amount of water retained in the soil is a function of matrix suction. Pore size distribution dominates water retention in low tension ranges of 0. to 1 bar, but the pore-space system itself is dependent on soil structure and bulk density. Clay plays a major role in influencing water retention (Lal, 1979) and the water retained at any tension from 0.33 to 15 bar depends on the type of clay. The present study was undertaken during 1991 to evaluate the pattern of water retention in relation to total porosity, exchangeable sodium percentage (ESP), cation exchange capacity (CEC), organic carbon (OC), electrical conductivity (EC) and aggregate stability (AS) in soil, and to examine the extent of quantifiable relationship between the above parameters and the water retension at field capacity (33 kpa) and wilting coefficient (1500 kPa).

MATERIALS AND METHODS

Twenty one profiles representing the soil subgroups (1) Typic Chromustert, (Tcsv), Typic Ustropept (Tutp), 3) Udic Haplustalf (Unsf), 4) Typic Haplustalf (Thef), 5) Vertic Haplustalf (Vhsf) and 6) Typic Ustorthent (Tuot) in Kamarajar district of Tamil Nadu were exposed. A total of 42 bulk soil samples from the first 2 natural horizons

Table 1. Physico-chemical properties of soils

Properties	Range	Mean	Standard deviation (±)
Clay (%)	3.90 - 65.60	26.89	15.74
EC (dSm^{-1})	0.10 - 2.50	0.99	0.91
ESP	3.20 - 29.60	12.71	8.33
CEC (c mol (p^{+}) kg^{-1})	7.10 - 40.40	21.52	11.70
OC (%)	0.10 - 0.69	0.35	0.14
Total porosity (%)	18.60 - 53.20	38.40	9.60
Aggregate stability (%)	9.30 - 90.70	43.03	19.32
Water retention at 0 kPa (%)	13.10 - 62.20	16.62	18.41
Water retention at 33 kPa (%)	6.80 - 56.00	23.79	13.30
Water retention at 100 kPa (%)	4.00 - 53.80	21.01	12.72
Water retention at 400 kPa (%)	1.00 - 49.30	18.20	11.86
Water retention at 800 kPa (%)	1.30 - 41.80	24.17	19.03
Water retention at 1200 kPa (%)	1.40 - 32.80	13.63	8.53
Water retention at 1500 kPa (%)	1.00 - 28.50	12.05	7.20

of each profile was collected and processed. Clay, EC, ECE, OC and ESP were estimated as per usual methods. Water retention characteristics was estimated using pressure plate and pressure membrane apparatus at 33, 100, 400, 800, 1200 and 150 kPa suctions in the indisturbed soil cores (7.5 cm dia and 1 cm height) as per the method described by Richards (1964). Clay content was estimated by the International Pipette Method (Piper, 1966) and reported on moisture free basis. Porosity was estimated in separately collected undisturbed cores (7.5 cm diameter and 7.5 cm height) following the usual method. Correlations between relevent parameters (sub groupwise) were worked out as per the method described by Fisher (1936). The contribution of the above parameters to the water retention characteristics was determined by multiple regression analysis.

RESULTS AND DISCUSSION

The physicochemical properties and water retention characteristics of soils are presented in Table 1. The water retention characteristics of typical sybgroups are depicted in Fig.1a and b. The water retention at 33 kPa in the soils ranged from 37.0 to 57.0, 7.1 to 10.8, 20.1 to 23.8, 25.6 to 30.5, 22.3 to 33.0 and from 6.0 to 16.7 per cent in the soil subgroups Tcsv, Tutp, Uhsf, Thsf, Vhsf and Tuot respectively. The simple correlation between clay content of specific subgrops and matrix suction values (Table 2) shows that the moisture content at 33 kPa was significantly and positively correlated in all the subgroups. At 1500 kPA water retention ranged from 19.6 to 28.5, 2.0 to 4.3, 9.1 to 11.9, 12.7 to 15.4, 11.1 to 15.7 and from 1.0 to 8.2 pe cent in the subgroups Tcsv, Uhsf, Thsf, Vhsf anc Tuot respectively. Highly significant and positiv correlation was observed between clay and 150(kPa moisture in these subgroups also.

When correlation coefficients were worked out on specific subgroup basis, clay showed significant positive correlation in all the subgroups, the variation in the dependable parameter being more than 90 per cent. This indicated that irrespective of variations in soil properties in soil subgroups, water retention characteristic was mostly a function of clay content.

Quantity of water retained in soil at 33 kPa tension gave positive correlations with clay (0.95**), ESP (0.49**), CEC (0.67**), TP (0.75**) and AS (0.47**) and there was no correlation with EC and OC (Table 3). Similarly, water retention in soil at 1500 kPa tension was also found to be significantly correlated with clay (0.91**), EC (0.38*), ESP (0.52**), CEC (0.64**), TP (0.67**) and AS (0.46**). The correlation with OC was insignificant. Under both the tension levels, the highest correlation was recorded with clay

Table 2. Simple coefficient of correlations

Subgroup	Clay Vs -33 kPa water	Clay Vs -1500 kPa water
Typic chromustert	0.940**	0.901**
Typic Ustropept	0.943**	0.919**
UUdic Haplustalf	0.908**	0.921**
Typic Haplustalf	0.979**	0.992**
Vertic Haplustalf	0.987**	0.983**
Typic Ustorthent	0.987**	0.983**

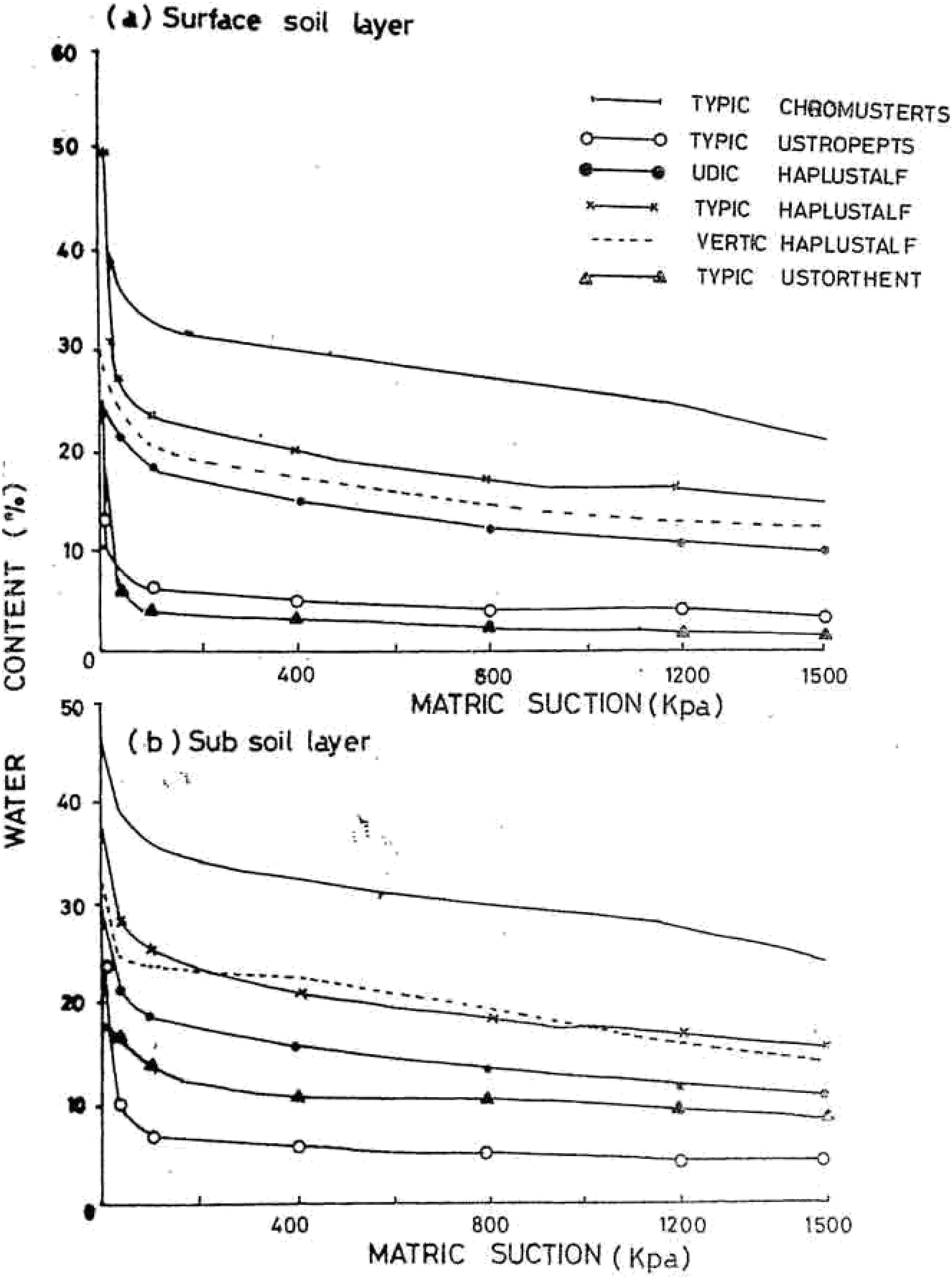

Fig 1 Moisture retention in some soil subgroups

Table 3. Regression and stepwise multiple regression equations indicating contribution of soil properties water retention characteristics

At 33 kPa		at 1500 kPa	
Equations	R^2	Equations	R^2
$Y = 2.13 + 0.81$ clay (X_1)	0.91**	$Y = 0.84 + 0.42 (X_1)$	0.83*
$Y = 20.25 + 3.58$ EC (X_2)	0.06 NS	$Y = 9.11 + 2.97 X_2$	0.14*
$Y = 13.82 + 0.78$ ESP (X_3)	0.24 NS	$Y = 6.36 + 0.45 X_3$	0.27*
$Y = 7.30 + 0.77$ CEC (X_4)	0.45**	$Y = 3.54 + 0.40 X_4$	0.41*
$Y = 24.37 - 0.74$ OC (X_5)	0.02 NS	$Y = 11.96 + 0.12 X_5$	0.02
$Y = -16.10 + 1.04$ TP (X_6)	0.56 **	$Y = -7.37 + 0.51 X_6$	0.46**
$Y = 9.83 + 0.032$ AS (X_7)	0.22 NS	$Y = 4.60 + 0.17 X_7$	0.22**
$Y = -0.004 + 0.79X_1 + 2.47X_2$	0.91	$Y = 1.24 + 0.41 X_1 + 2.41X_2$	0.92
$Y = -0.15 + 0.75X_1 + 0.21X_2 + 0.36X_3$	0.71	$Y = -1.53 + 0.39X_1 + 1.83X_2 + 0.09X_3$	0.93
$Y = -2.18 + 0.69X_1 + 0.01X_2 + 0.35X_3 + 0.14X_4$	0.97	$Y = -1.89 + 0.37X_1 + 1.73X_2 + 0.09X_3 + 0.05X_4$	0.83
$Y = -2.03 + 0.69X_1 + 0.45X_2 + 0.35X_3 + 0.12X_4 + 0.19X_5$	0.97	$Y = -2.31 + 0.38X_1 + 0.47X_2 + 0.09X_3 + 0.10X_4 + 0.52X_5$	0.95
$Y = -7.15 + 0.63X_1 + 0.59X_2 + 0.29X_3{}^{*} + 0.11X_4 + 0.05X_5 + 0.19X_6{}^{**}$	0.98	$Y = -6.50 + 0.33X_1 + 0.59X_2 + 0.04X_3 + 0.10X_4 + 0.72X_5 + 0.16X_6$	0.96
$Y = -7.79 + 0.63X_1 + 0.61X_2 + 0.30X_3 + 0.10X_4{}^{**} + 0.003X_5 + 0.19X_6{}^{**} + 0.02X_7$	0.99	$Y = -6.49 + 0.32X_1{}^{**} + 0.67X_2 + 0.05X_3 + 0.10X_4 + 0.74X_5{}^{*} + 0.15X_6{}^{**} + 0.002X_7$	0.96

followed by TP, CEC, ESP and AS. The variation in the percentage of water retained in the soil at 33 kPa and at 1500 kPa was 91 and 883 per cent respectively, while it was 24 and 27, 45 and 41 and 56 and 46 respectively for ESP, EEC, TP adn AS.

For accounting the variation in soil water retention at 33 kPa and 1500 kPa due to soil properties a stepwise multiple regression was worked out and the regression equations are furnished in table 3. There was significant linear relationship between Y and independant variables (F = 170.2** to 395.5** for 33 kPa; F = 110.0** to 197.0** for 1500 kPa). Out of seven, four variables (clay, ESP, CEC and TP) significantly influenced water retention at kPa 33. Clay contributed the most to the variation accounting for 91 per cent. The inclusion of EC, CEC and OC did not increase R^2 value, but inclusion of ESP with clay (equation 9) significantly increased R^2 value to 0.97 indicating that 97 per cent of the prediction in soil water retention at 33 kPa was due to variation in clay and ESP. Further inclusion of TP or TP and AS along with clay and ESP. increased the value of R^2 tp 0.98 and 0.99 per cent respectively indicating that almost the entire prediction (99 per cent) was governed by these four independant variables. De Jong *et al.* (1983) reported that at water retention at lower tension depends on pore size distributions.

The contribution of clay to prediction percent by water retention characteristics was 83 per cent at 1500 kPa tension. Similar observations wer recorded by Ali and Biswas (1971). Th contribution due to EC was 9.0 per cent increasin the R^2 value to 92 per cent. Thus salinity anc soluble salts concentration of soils play a majo role in determining the water retentio characteristics at 1500 kPa. The contribution of ESP, CEC, OC, TP and AS were very marginal. increasing the R^2 value upto 0.96. Evaluating the variations at these two tension levels, it was observed that the influence of soluble salts (EC) and organic matter at lower soil tension (33 kPa) was marked by clay content and clay plus exchangeable sodium respectively while at higher tension levels (1500 kPa) the variability due to EC was substantial (9.0 per cent) and due to organic matter variability was 2.0 per cent. Verma *et al.* (1987) observed that electrolite concentration modifies water transmission functions.

Thus, clay content in the soil is the main contributing factor to variations in water retention characteristics followed by ESP, CEC, total porosity and AS at 33 kPa and followed by EC, ESP, OC and TP. One unit increase in clay, increased the water retention capacity by 0.81 per cent at 33 kPa soil tension and by 0.42 per cent at 1500 kPa. It is thus evident that water retention characteristics of soils, irrespective of pedogenic variations and the soil matric tension, can be reliably predicted from the clay content alone to the extent of 83 to 91 per cent.

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GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE FOR POD YIELD AND ITS CONTRIBUTING TRAITS IN OKRA HYBRIDS

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ABSTRACT

Genotypic coefficient of variation, heritability and genetic advance of pod yield and seven other traits were estimated in 40 F_1's of okra. The characters like number of branches, number of pods and total pod yield per plant had higher genotypic as well as phenotypic coefficient of variation in both the environments. All the characters under study except days to first flower appearance and girth of pod were highly heritable in nature. High heritability coupled with high genetic advance was observed for plant height, number of pods and total pod yield per plant which indicated that these traits are more reliable for improvement through selection.

KEY WORDS : Okra, variability, heritability, genetic advance

Of the numerous vegetables grown in the country, okra (*Abelmoschus esculentus*(L.) Moench) also known as lady's finger, *gumbo* or *bhindi* is very popular vegetable. It is extensively cultivated throughout the continent for its long, slender and immature green frutis (capsule) during summer and rainy seasons. Deterioration takes place in old varieties and to overcome the problem, crop improvement is needed. Improvement in any crop depends on the magnitude of its genetic variability. A knowledge of the available variability within the species for the designed characters enables the breeder in determining the most potential genotype. The partitioning of the overall variances as genetic and non-genetic components becomes necessary for any effective breeding programme. It was suggested that genetic variability along with heritability should be considered for effective selection. Studies on the variability using genetic parameters like genotypic coefficient of variation, heritability and genetic advance are essential for initiating a breeding programme.

MATERIALS AND METHODS

The material used in the present study comprised of 40 F_1 hybrids obtained in a Line x tester programme. The experiments were conducted under two sets of environment. Under first set of environment (E_1), the sowing was done on 25 February 1994 as summer season crop and for second environment (E_2), the sowing was done on 10 July 1994 as rainy season crop. The material was grown in a randomised block design with three replications at the Vegetable Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. Observations on ten randomly selected plants of each hybrid were recorded for days to first flower appearance, node at which first flower appears, plant height (cm), number of branches/plant, number of pods/plant,