hydration- dehydration treatments, could be based on the concept of free- radical pathology as a vital factor in seed deterioration (Basu, 1976). The basis of free-radical pathology is the presence of unpaired electrons on the radicals. Perhaps, in hydrated seeds, the free radicals become mobile enough to recombine into harmless non- radical products (Ehrenberg, 1961) and thereby, further deterioration of seeds could be controlled.

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# HETEROSIS IN WATERMELON (Citrullus lanatus Thunb. Mansf.)

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## MATERIALS AND METHODS

Six inbred parental genotypes viz., Pudur-2 ($P_1$), Honey Island Yellow Flesh ($P_2$), Asahi Yamato ($P_3$), Sugar Baby ($P_4$), Maruthamalai-I ($P_5$) and H.W.I ($P_6$) representing a wide geographic diversity selected for this study were obtained from various sources and were used for the experiment. After selfing fox six generations, the six parental varieties were crossed in all possible combinations ($n^2$-n) in diallel fashion during winter 1987- '88 (December-March). A total of thirty hybrids (direct and reciprocals) along with their parents were raised in a randomized block design replicated twice during summer (March-June) 1988. A spacing of 2.50 m between two rows of furrows and the intra row spacing of 0.90 m were adopted. Five plants excluding the border ones in each cross combination and in each replication, out of fifteen plants were selected at random and tagged for recording observations. Standard horticultural practices and plant protection measures were followed in the experimental field as suggested by the Faculty of Horticulture (Anon, 1985). Observations were recorded on 10 economically important characters in all the hybrids and their parents. The mean values of the recorded data were used for computing heterosis. The magnitude of positive heterosis for traits such as number of fruits per vine, average fruit weight and yeild per vine, T.S.S. and ascorbic acid was calculated by using highest values. While in the case of characters like vine length, crop duration, days taken for the first female flower to appear and node number of first female flower, negative heterosis was calculated by utilizing the minimum values.

## RESULTS AND DISCUSSION

Mean performance of the parents and hybrids for different economic characters studied are presented in Table 1. The magnitude of heterosis of different characters was estimated as the performance of $F_1$ in comparision with the mid-parent (di), higher parent (dii) and best parent (diii) and are presented in Tables 2 to 4. Among parents, $P_1$ was found superior in 7 out of 10 characters studied. The best parent $P_1$ had earliest crop duration of 75 days, earlier production of first female flower (32.15 days), maximum number of fruits per vine (4.00), higher average fruit weight (5.250 kg), higher fruit yield per vine (15.250 kg) and higher ascorbic acid content (13.95 mg/100 g). Among the hybrids, $P_2 \times P_4$ has recorded high mean expression for different yield component traits viz., number of fruits per vine (4.00), average fruit weight (6.350 kg), fruit yield per vine (19.550 kg) and total soluble solids (9.75).

Although parents $P_1$ and $P_3$ recorded comparatively high mean parental performance, the hybrid combination involving $P_2$, $P_4$, $P_5$ and $P_6$ were found promising with high heterotic effects in the hybrid progenies. The hybrids with either high x low or low x low combinations had better expression of heterosis for the majority of the characters. The high x high combination viz., $P_4 \times P_5$ favoured only RGR. Misra *et al.* (1976) observed that the parents having high *per se* performance did not always produce hibrids with high hybrid vigour, which may be due to mutual cancellation of the gene effects or the involvement of a large number of inter alletic interactions. In the present study various hybrids exhibited both positive and negative heterosis of varying magnitude for all the economic character studied. In any cross combination the magnitude and direction of heterotic potentiality depends upon the choice of the parents and their genetic make up. According to Murugesan (1988) heterosis is the co-ordinated system of interaction operating between male and female parent which is expressed in the hybrid progenies. End results may be positive or negative and it depends upon the choice of the parents and their sexual relationship while crossing.

Among the 30 hybrids studied, only three hybrids viz., $P_2 \times P_4$, $P_4 \times P_6$ and $P_6 \times P_5$ which exhibited significant heterosis for fruit yield per vine also manifested heterosis for other yield component characters like number of fruits per vine and average fruit weight as well as important quality attributes like T.S.S. and ascorbic acid content of fruit. Among three, the hybrids $P_2 \times P_4$ (Honey Island Yellow Flesh x Sugar Baby) and $P_4 \times P_6$ (Sugar Baby x H.W.1) had better standard heterosis ie. 27.13 per cent and 6.18 per cent respectively for fruit yield per vine. Results of Brar and Nandpuri (1978) and Bhathal and Sandhu (1984) also provided supporting evidence of heterotic effect for fruit yield and fruit number per vine. The above two hybrids also expressed with maximum negative standard heterosis (-10.89 per cent and -6.69 per cent respectively) for days to first female flower production (Earliness) and maximum positive standard heterosis (14.71 per cent and 5.88 per cent respectively) for T.S.S. content of fruit. Earliness in $F_1$ hybrids of watermelon was recorded by Mohr (1963), Ivanoff (1963), Zuewa (1964) and Manukjan (1966). Brar and Sidhu (1977) reported 9.44 per cent heterosis for total soluble solids in the hybrid Shipper x Durgapura Mitha.

In the present study significant reciprocal difference was observed for all the characters studied except fruit yield per vine. The reciprocal difference might be because of cytoplasmic inheritance or maternal effect. As the parents involved in the present experiment exhibited wide genetic diversity, the cytoplasmic differences were quite

Table I. Mean performance of parents and hybrids

| Parents / Hybrids | Vine length | Days for first female flower | Mode No. of first female flower | No.of fruits per vine | Average fruit weight (Kg) | Yield duration (days) | Crop duration (days) | T.S.S. (%) | Sugar acid ratio | Ascorbic acid (mg/ 100g) |
|---|---|---|---|---|---|---|---|---|---|---|
| $P_1$ | 3.51 | 32.15 | 21.65 | 4.00 | 5.250 | 15.250 | 75.00 | 8.50 | 15.73:1 | 13.95 |
| $P_2$ | 2.79 | 35.00 | 17.65 | 3.40 | 4.720 | 14.228 | 85.50 | 7.50 | 17.82:1 | 9.77 |
| $P_3$ | 2.49 | 42.85 | 19.90 | 2.40 | 2.607 | 6.750 | 82.90 | 10.00 | 37.99:1 | 8.99 |
| $P_4$ | 2.30 | 40.50 | 20.20 | 3.50 | 2.760 | 9.900 | 78.80 | 7.00 | 21.31:1 | 11.15 |
| $P_5$ | 3.01 | 40.00 | 19.35 | 3.00 | 4.200 | 11.800 | 82.20 | 9.00 | 16.43:1 | 12.43 |
| $P_6$ | 3.08 | 42.50 | 22.00 | 3.00 | 3.075 | 10.650 | 85.50 | 8.50 | 18.03:1 | 8.31 |
| $P_1 \times P_2$ | 3.02 | 40.65 | 24.50 | 2.00 | 1.450 | 2.950 | 81.70 | 8.00 | 32.51:1 | 7.88 |
| $P_1 \times P_3$ | 3.53 | 39.15 | 22.00 | 3.00 | 3.105 | 6.170 | 82.90 | 9.00 | 26.43:1 | 9.59 |
| $P_1 \times P_4$ | 2.55 | 42.80 | 17.65 | 2.75 | 2.078 | 4.387 | 77.75 | 6.50 | 18.45:1 | 9.94 |
| $P_1 \times P_5$ | 2.73 | 31.65 | 18.35 | 2.50 | 3.315 | 5.973 | 76.95 | 7.00 | 15.06:1 | 13.49 |
| $P_1 \times P_6$ | 2.74 | 43.85 | 20.65 | 2.35 | 2.098 | 3.982 | 80.25 | 6.50 | 18.96:1 | 8.56 |
| $P_2 \times P_1$ | 3.78 | 34.50 | 18.65 | 2.50 | 4.473 | 7.710 | 69.75 | 9.00 | 34.15:1 | 9.65 |
| $P_2 \times P_3$ | 3.08 | 39.00 | 20.30 | 2.00 | 1.643 | 3.143 | 75.25 | 6.50 | 15.18:1 | 7.01 |
| $P_2 \times P_4$ | 3.85 | 28.65 | 14.00 | 4.00 | 6.350 | 19.550 | 82.85 | 9.75 | 39.40:1 | 12.85 |
| $P_2 \times P_5$ | 3.84 | 32.65 | 17.65 | 2.75 | 2.210 | 4.610 | 82.80 | 6.00 | 13.57:1 | 952 |
| $P_2 \times P_6$ | 2.95 | 39.00 | 22.50 | 2.25 | 2.115 | 5.144 | 74.25 | 5.00 | 7.53:1 | 8.45 |
| $P_3 \times P_1$ | 1.90 | 46.65 | 20.80 | 2.50 | 1.975 | 3.963 | 76.65 | 4.50 | 7.08:1 | 11.69 |
| $P_3 \times P_2$ | 2.22 | 36.45 | 20.35 | 2.25 | 1.685 | 3.356 | 67.50 | 6.00 | 15.75:1 | 9.80 |
| $P_3 \times P_4$ | 3.41 | 44.20 | 23.35 | 2.00 | 1.260 | 2.760 | 73.25 | 7.50 | 16.83:1 | 10.30 |
| $P_3 \times P_5$ | 2.21 | 41.80 | 21.65 | 2.00 | 1.148 | 2.648 | 80.45 | 7.00 | 19.43:1 | 13.16 |
| $P_3 \times P_6$ | 2.57 | 46.85 | 22.00 | 2.50 | 1.598 | 3.397 | 76.90 | 6.50 | 13.55:1 | 13.16 |
| $P_4 \times P_1$ | 3.76 | 31.65 | 13.15 | 3.50 | 2.730 | 6.825 | 82.05 | 5.50 | 11.35:1 | 8.68 |
| $P_4 \times P_2$ | 2.40 | 43.30 | 21.30 | 2.50 | 3.280 | 5.570 | 71.05 | 4.50 | 8.42:1 | 13.13 |
| $P_4 \times P_3$ | 1.80 | 33.65 | 16.60 | 2.00 | 1.255 | 2.755 | 74.70 | 5.00 | 10.93:1 | 9.69 |
| $P_4 \times P_5$ | 1.79 | 41.15 | 20.85 | 2.50 | 1.715 | 3.579 | 73.45 | 7.00 | 21.42:1 | 9.12 |
| $P_4 \times P_6$ | 2.84 | 30.00 | 14.65 | 3.50 | 5.765 | 16.413 | 76.00 | 9.00 | 25.28:1 | 12.65 |
| $P_5 \times P_1$ | 3.35 | 30.50 | 16.30 | 2.50 | 3.925 | 6.888 | 75.15 | 7.00 | 21.29:1 | 12.53 |
| $P_5 \times P_2$ | 2.67 | 34.35 | 20.50 | 2.00 | 1.932 | 3.432 | 76.65 | 7.00 | 27.57:1 | 10.84 |
| $P_5 \times P_3$ | 2.53 | 30.10 | 19.85 | 2.25 | 2.175 | 3.969 | 69.90 | 6.50 | 15.37:1 | 10.76 |
| $P_5 \times P_4$ | 2.49 | 45.75 | 21.50 | 2.00 | 2.000 | 3.500 | 76.35 | 6.50 | 21.20:1 | 10.93 |
| $P_5 \times P_6$ | 3.39 | 33.15 | 10.85 | 2.00 | 2.207 | 3.707 | 76.75 | 7.00 | 13.05:1 | 10.13 |
| $P_6 \times P_1$ | 2.01 | 39.85 | 17.00 | 2.50 | 1.410 | 3.115 | 70.85 | 6.50 | 16.36:1 | 10.58 |
| $P_6 \times P_2$ | 3.50 | 33.95 | 15.85 | 2.00 | 2.250 | 5.017 | 75.70 | 7.00 | 16.33:1 | 9.41 |
| $P_6 \times P_3$ | 2.09 | 37.50 | 19.20 | 2.25 | 2.318 | 4.063 | 73.55 | 8.00 | 18.34:1 | 8.30 |
| $P_6 \times P_4$ | 3.07 | 35.65 | 20.30 | 2.25 | 2.044 | 3.803 | 71.10 | 8.00 | 19.38:1 | 9.88 |
| $P_6 \times P_5$ | 4.13 | 34.20 | 20.65 | 3.50 | 5.113 | 14.783 | 75.85 | 8.50 | 28.26:1 | 12.44 |
| Mean | | | | | | | | | | |
| Parents | 2.86 | 38.83 | 20.21 | 3.22 | 3.769 | 11.430 | 81.65 | 8.42 | 21.22:1 | 10.77 |
| Hybrids | 2.87 | 37.42 | 19.12 | 2.52 | 2.554 | 5.590 | 75.97 | 6.93 | 18.95:1 | 10.44 |

Table 2. Percentage heterosis over the mid parent (di), higher parent (dii) and best parent (diii)

| Hybrid | Vine length (m) | | | Days for 1st female | | | Node No.of 1st female flower | | |
|---|---|---|---|---|---|---|---|---|---|
| | di | dii | diii | di | dii | diii | di | dii | diii |
| $P_1 \times P_2$ | -4.05 | 8.44 | -13.96 | 21.07 | 26.44 | 26.44 | 24.68 | 38.81 | 13.16 |
| $P_1 \times P_3$ | 17.60 | 41.85 | 0.43 | 4.40 | 21.77 | 21.77 | 5.90 | 10.55 | 1.62 |
| $P_1 \times P_4$ | -12.22 | 10.87 | -27.35 | 17.83 | 33.13 | 33.13 | -15.65 | -12.62 | -18.43 |
| $P_1 \times P_5$ | -16.19 | -9.15 | -22.22 | -12.27 | -1.56 | -1.56 | -11.57 | -7.56 | -15.24 |
| $P_1 \times P_6$ | -17.00 | -11.20 | -22.08 | 17.48 | 36.39 | 36.39 | -5.38 | -4.62 | -4.62 |
| $P_2 \times P_1$ | 19.94 | 35.55 | 7.55 | 2.76 | 7.31 | 7.31 | -5.09 | 5.67 | -13.86 |
| $P_2 \times P_3$ | 16.70 | 23.74 | -12.39 | -0.19 | 11.43 | 21.31 | 8.12 | 15.01 | -6.24 |
| $P_2 \times P_4$ | 51.23 | 67.17 | 9.54 | -24.11 | -18.14 | -10.89 | -26.02 | -20.68 | -15.33 |
| $P_2 \times P_5$ | 32.47 | 37.70 | 9.26 | -12.93 | -6.71 | 1.56 | -5.87 | 0.00 | -18.48 |
| $P_2 \times P_6$ | 0.60 | 5.92 | -15.95 | 0.65 | 11.43 | 21.31 | 13.49 | 27.48 | -3.93 |
| $P_3 \times P_1$ | -36.78 | -23.74 | -46.01 | 24.04 | 45.10 | 45.10 | 0.36 | 4.77 | -3.70 |
| $P_3 \times P_2$ | -15.75 | -10.66 | -36.75 | -6.36 | 4.14 | 13.37 | 8.39 | 15.30 | -6.00 |
| $P_3 \times P_4$ | 42.53 | 48.26 | -2.85 | 6.06 | 3.14 | 37.48 | 16.46 | 17.34 | 7.85 |
| $P_3 \times P_5$ | -19.67 | -11.27 | -37.18 | 0.91 | 4.50 | 30.02 | 8.93 | 9.07 | 0.00 |
| $P_3 \times P_6$ | -7.82 | 3.22 | -26.92 | 9.78 | 10.24 | 45.72 | 5.01 | 10.55 | 1.62 |
| $P_4 \times P_1$ | 29.26 | 63.26 | 6.98 | -12.87 | -1.56 | -1.56 | -37.16 | -34.90 | -39.26 |
| $P_4 \times P_2$ | -5.60 | 4.35 | -31.62 | 14.70 | 23.71 | 34.68 | 12.55 | 20.68 | -1.62 |
| $P_4 \times P_3$ | -24.76 | -21.74 | -48.72 | -19.25 | -16.91 | 4.67 | -17.21 | -16.58 | -23.33 |
| $P_4 \times P_5$ | -32.70 | -22.39 | -49.15 | 2.24 | 2.88 | 27.99 | 4.12 | 5.04 | -3.70 |
| $P_4 \times P_6$ | 5.58 | 23.48 | -19.09 | -27.71 | -25.93 | -6.69 | -30.57 | -27.48 | -32.33 |
| $P_5 \times P_1$ | 2.84 | 11.48 | -4.56 | -15.54 | -5.13 | -5.13 | -19.04 | -15.37 | -22.40 |
| $P_5 \times P_2$ | -8.29 | -3.67 | -24.36 | -8.40 | -1.86 | 6.84 | 9.33 | 16.15 | -5.31 |
| $P_5 \times P_3$ | -8.01 | 1.61 | -28.06 | -27.34 | -24.75 | -6.38 | -0.13 | 0.00 | -8.31 |
| $P_5 \times P_4$ | -6.31 | 8.04 | -29.20 | 13.66 | 14.38 | 42.30 | 2.12 | 8.31 | 0.69 |
| $P_5 \times P_6$ | 11.42 | 12.81 | -3.42 | -19.64 | -17.12 | 3.11 | -48.15 | -45.34 | -49.88 |
| $P_6 \times P_1$ | -39.15 | -34.90 | -42.88 | 6.76 | 23.95 | 23.95 | -22.11 | 21.48 | -21.48 |
| $P_6 \times P_2$ | 19.18 | 25.49 | -0.43 | -12.39 | -3.00 | 5.60 | -20.05 | -10.00 | -26.79 |
| $P_6 \times P_3$ | -25.07 | -16.10 | -40.60 | -12.13 | -11.76 | 16.64 | -8.35 | -3.52 | -11.32 |
| $P_6 \times P_4$ | 14.13 | 33.48 | -12.54 | -14.10 | -11.93 | 10.89 | -3.79 | 0.50 | -6.24 |
| $P_6 \times P_5$ | 35.58 | 37.27 | 17.52 | -17.09 | -14.50 | 6.38 | -1.31 | 4.03 | -4.62 |

le 3. **Percentage heterosis over the mid-parent (di) higher parent (dii) and best parent (diii)**

| Hybrid | No. of fruits per vine | | | Average fruit weight (kg) | | | Yield per vine (kg) | | | Crop duration (days) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | di | dii | diii | di | dii | diii | di | dii | diii | di | dii | diii |
| x P2 | -62.96 | -66.67 | -66.67 | -87.95 | -89.41 | -89.41 | -95.58 | -96.44 | -96.44 | 1.81 | 8.93 | 8.93 |
| x P3 | -9.09 | -33.33 | -33.33 | -28.12 | -50.47 | -50.47 | -43.30 | -66.66 | -66.66 | 5.00 | 10.53 | 10.53 |
| x P4 | -36.36 | -41.67 | -41.57 | -64.13 | -74.64 | -74.64 | -77.74 | -85.49 | -85.49 | 1.11 | 3.67 | 3.67 |
| x P5 | -40.00 | -50.00 | -50.00 | -41.76 | -45.53 | -45.53 | -66.37 | -73.33 | -73.33 | -2.10 | 2.60 | 2.60 |
| x P6 | -46.00 | -55.00 | -55.00 | -70.02 | -74.16 | -74.16 | -83.94 | -88.06 | -98.06 | 0.00 | 7.00 | 7.00 |
| x P1 | -44.44 | -50.00 | -50.00 | -7.01 | -18.28 | -18.28 | -49.37 | -59.15 | -59.15 | -13.08 | 7.00 | 7.00 |
| x P3 | -47.37 | -58.33 | -66.67 | -73.36 | -80.03 | -83.87 | -87.12 | -91.71 | -94.91 | -10.63 | -9.23 | 0.33 |
| x P4 | 22.45 | 20.00 | 0.00 | 114.86 | 66.15 | 25.88 | 177.05 | 107.09 | 27.13 | 0.85 | 5.14 | 10.47 |
| x P5 | -20.45 | -27.08 | -41.67 | -65.03 | -67.30 | -71.53 | -71.91 | -72.55 | -83.15 | -1.25 | 0.73 | 10.40 |
| x P6 | -43.18 | -47.12 | -58.33 | -32.30 | -34.32 | -50.24 | -59.28 | -63.49 | -77.59 | -13.16 | -13.16 | -1.00 |
| x P1 | -31.82 | -50.00 | -50.00 | -66.71 | -77.06 | -77.06 | -81.14 | -88.91 | -88.91 | -2.79 | 2.33 | 2.33 |
| x P2 | -34.21 | -47.92 | -58.33 | -71.62 | -78.73 | -83.88 | -83.32 | -39.27 | -93.41 | -19.83 | -18.58 | -10.00 |
| x P4 | -48.72 | -60.00 | -66.67 | -84.56 | -85.23 | -93.88 | -91.45 | -93.25 | -97.95 | -9.40 | -7.04 | -2.33 |
| x P5 | -41.18 | -50.00 | -66.67 | -94.42 | -96.00 | -96.52 | -96.91 | -97.99 | -98.82 | -2.54 | -2.13 | 7.27 |
| x P6 | -11.76 | -25.00 | -50.00 | -74.46 | -80.55 | -85.93 | -80.42 | -86.67 | -93.50 | -8.67 | -7.24 | 2.53 |
| x P1 | -9.09 | -16.67 | -16.67 | -42.43 | -59.29 | -59.27 | -49.34 | -66.97 | -66.97 | 6.70 | 9.40 | 9.40 |
| x P2 | -38.78 | -45.00 | -50.00 | -12.45 | -32.30 | -48.71 | -45.98 | -59.62 | -75.21 | -13.51 | -9.94 | -5.27 |
| 4 x P3 | -48.72 | -60.00 | -66.67 | -84.35 | -85.51 | -94.00 | -91.50 | -93.35 | -97.98 | -7.61 | -5.20 | -0.40 |
| 4 x P5 | -33.33 | -40.00 | -50.00 | -73.31 | -80.68 | -83.18 | -80.60 | -85.27 | -91.37 | -8.76 | -6.79 | -2.07 |
| 4 x P6 | 11.11 | 0.00 | -16.67 | 97.10 | 54.96 | 12.12 | 137.23 | 92.60 | 6.18 | -7.49 | -3.55 | 1.33 |
| 5 x P1 | -40.00 | -50.00 | -50.00 | -26.42 | -31.18 | -31.18 | -65.31 | -64.55 | -64.55 | -4.39 | 0.20 | 0.20 |
| 5 x P2 | -54.55 | -58.33 | -66.67 | -73.06 | -74.81 | -78.07 | -87.69 | -87.97 | -92.61 | -8.59 | -6.75 | 2.20 |
| 5 x P3 | -26.47 | -35.50 | -58.33 | -55.72 | -68.24 | -72.35 | -71.16 | -81.25 | -89.01 | -15.32 | -14.96 | -6.80 |
| 5 x P4 | -55.56 | -60.00 | -66.67 | -63.37 | -72.97 | -76.47 | -82.20 | -86.49 | -92.08 | -5.16 | -3.11 | 1.80 |
| 5 x P6 | -50.00 | -50.00 | -66.67 | -64.37 | -67.38 | -71.60 | -82.18 | -83.68 | -90.44 | -8.47 | -6.63 | 2.33 |
| 6 x P1 | -40.00 | -50.00 | -50.00 | -88.81 | -90.35 | -90.35 | -95.63 | -96.75 | -96.75 | -33.71 | -5.53 | -5.53 |
| 6 x P2 | -9.09 | -60.67 | -33.33 | -60.29 | -61.18 | -70.59 | -56.04 | -60.58 | -75.80 | -11.46 | -11.46 | 0.93 |
| P6 x P3 | -26.47 | -37.50 | -58.83 | -43.70 | -57.14 | -68.99 | -60.26 | -72.95 | -86.82 | -12.65 | -11.28 | -1.93 |
| P6 x P4 | -44.44 | -50.00 | 58.33 | -56.90 | -66.11 | -75.48 | -74.39 | -79.21 | -69.87 | -12.60 | -8.88 | -4.27 |
| P6 x P5 | 25.00 | 25.00 | -16.67 | 21.42 | 11.16 | -3.22 | 60.74 | 38.01 | -19.11 | -4.54 | -7.73 | 1.13 |

**Table 4. Percentage heterosis over the mid-parent (di), higher parent (dii) and best parent (diii)**

| Hybrid | Total soluble solids (%) | | | Sugar-acid ratio | | | Ascorbic acid (mg/100 g) | | |
|---|---|---|---|---|---|---|---|---|---|
| | di | dii | diii | di | dii | diii | di | dii | diii |
| $P_1 \times P_2$ | -0.00 | -5.88 | -5.88 | 93.80 | 82.44 | 108.68 | -33.60 | -43.55 | -43.55 |
| $P_1 \times P_3$ | -2.70 | -10.00 | 5.88 | -1.59 | -30.42 | 68.02 | -16.43 | -31.29 | -31.29 |
| $P_1 \times P_4$ | -16.13 | -23.53 | -23.53 | -0.39 | -13.42 | 17.26 | -20.78 | -28.75 | -28.75 |
| $P_1 \times P_5$ | -20.00 | -22.22 | -17.65 | -6.36 | -8.34 | -4.29 | 2.27 | -3.30 | -3.30 |
| $P_1 \times P_6$ | -23.53 | -23.53 | -23.53 | 12.31 | 5.16 | 20.50 | -23.12 | -38.67 | -38.67 |
| $P_2 \times P_1$ | 12.50 | 5.88 | 5.88 | 103.58 | 91.64 | 117.10 | -18.63 | -30.82 | -30.82 |
| $P_2 \times P_3$ | -25.71 | -35.00 | -23.53 | -45.60 | -60.04 | -3.50 | -25.27 | -28.25 | -49.75 |
| $P_2 \times P_4$ | 34.48 | 30.00 | 14.71 | 101.65 | 85.19 | 150.83 | 22.88 | 15.30 | -7.89 |
| $P_2 \times P_5$ | -27.27 | -33.33 | -29.41 | -20.75 | -23.85 | -13.73 | -14.23 | -23.41 | -31.76 |
| $P_2 \times P_6$ | -37.50 | -41.18 | -41.18 | -57.99 | -58.22 | -52.13 | -6.20 | -13.51 | -39.43 |
| $P_3 \times P_1$ | -51.35 | -55.00 | -47.06 | -73.64 | -81.36 | -54.99 | 1.92 | -16.20 | -16.20 |
| $P_3 \times P_2$ | -31.43 | -40.00 | -29.41 | -43.57 | -58.55 | 0.10 | 4.48 | 0.31 | -29.75 |
| $P_3 \times P_4$ | -11.76 | -25.00 | -11.76 | -43.25 | -55.71 | 6.96 | 2.31 | -7.58 | -26.16 |
| $P_3 \times P_5$ | -26.32 | -30.00 | -17.65 | -28.50 | -48.79 | 23.66 | 22.83 | -5.83 | -5.70 |
| $P_3 \times P_6$ | -29.73 | -35.00 | -23.53 | -51.63 | -54.34 | -13.89 | 0.38 | -3.45 | -37.78 |
| $P_4 \times P_1$ | -29.03 | -35.29 | -35.29 | -38.73 | -46.75 | -27.88 | 4.60 | -5.91 | -5.91 |
| $P_4 \times P_2$ | -37.93 | -40.00 | -47.06 | -58.98 | -60.50 | -46.50 | -7.39 | -13.10 | -30.57 |
| $P_4 \times P_3$ | -41.18 | -50.00 | -41.18 | -63.13 | -71.23 | -30.51 | -9.46 | -15.21 | -34.66 |
| $P_4 \times P_5$ | -12.50 | -22.22 | -17.65 | 13.52 | 0.52 | 36.14 | 7.32 | 4.77 | -9.32 |
| $P_4 \times P_6$ | 16.13 | 5.88 | 5.88 | 28.53 | 18.63 | 60.68 | 28.79 | 12.38 | -10.22 |
| $P_5 \times P_1$ | -20.00 | -22.22 | -17.65 | 32.39 | 29.59 | 35.31 | -17.82 | -22.29 | -22.29 |
| $P_5 \times P_2$ | -15.15 | -22.22 | -17.65 | 60.99 | 54.69 | 75.24 | -3.11 | -13.48 | -22.90 |
| $P_5 \times P_3$ | -31.50 | -35.00 | -23.53 | -43.50 | -59.54 | -2.29 | 2.05 | -12.07 | -21.65 |
| $P_5 \times P_4$ | -18.75 | -27.78 | -23.53 | 12.35 | -0.52 | 34.74 | 3.33 | -2.01 | -12.69 |
| $P_5 \times P_6$ | -20.00 | -22.22 | -17.65 | -24.27 | -27.63 | -17.07 | -2.58 | -18.74 | -27.60 |
| $P_6 \times P_1$ | -23.53 | -23.53 | -23.53 | -3.07 | -9.24 | 4.01 | -4.92 | -24.16 | -24.16 |
| $P_6 \times P_2$ | -12.50 | -17.65 | -17.65 | -8.89 | -9.40 | 3.81 | 4.07 | -3.74 | -32.58 |
| $P_6 \times P_3$ | -13.51 | -20.00 | -5.88 | -34.53 | -51.73 | 16.56 | -4.02 | -7.68 | -40.50 |
| $P_6 \times P_4$ | 3.23 | -5.88 | -5.88 | -1.45 | -9.04 | 23.20 | 1.59 | -11.35 | -29.18 |
| $P_6 \times P_5$ | -2.86 | -5.56 | 0.00 | 64.06 | 56.78 | 79.66 | 19.94 | 0.04 | -10.86 |

evident. Gopalakrishnan (1986) in bittergourd reported reciprocal difference in various plant characters. According to Russian scientists Lysenko and Prezent, reciprocal difference is one of the contradicting principle on Mendalism. Topham (1966) suggested that fenetic interaction in parents and hybrids were found to be responsible for the reciprocal differences. Hansen and Bagett (1977) explained that the reciprocal differences was an outcome of a small plant to plant difference at genotypic level within the Inbred.

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# FORAGE PRODUCTION IN SOLE AND MIXED STAND OF CEREALS AND LEGUMES UNDER RAINFED CONDITIONS

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## ABSTRACT

Field experiments were conducted during 1984-85 and 1985-86 under rainfed vertisols at Regional Research Station, Aruppukottai to identify the suitable cereal, and legume fodders either alone or with cereals viz., maize (African tall), sorghum (K 7) and Pearl millet (Co.6), legume cowpea (Co.4) and soybean (Co.1). Performance of cereal legume combination was better than pure stand. Maize + cowpea (2:1) with high fodder and protein production was the most suitable combination.


Sustainability in agriculture alone could usher in continued prosperity without environmental hazard. Integrated farming animal tree and other components besides cropping is the solution for sustainability especially in dryland. Livestock enterprise offer great scope for combinati n with cro husbandry. The