

EXPERIMENTAL TECHNIQUE IN TRIALS WITH INTERCROPS - OKRA AND FRENCH BEANS

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Okra and french bean were intercropped to find out the optimum plot size to conduct intercropping experiments. A plot of 16 units each unit consisting of two okra plants planted at 15 cm apart and three bean plants sown at 10 cm apart was found to be optimum in case of analysis done with L.E.R., average nutritive value and protein content. In case of analysis of individual crop yields and calorie content per plot a larger plot size had to be used. Convenient plot size approach revealed that optimum plot size with minimum necessary replications would be ideal.

Lot of attention is being paid recently for research on intercrops, mainly due to the possible inbuilt safety mechanisms of such a cropping system especially in marginal lands. Intercropping system on irrigated garden lands with more intensive crop like vegetables have been found to be profitable because of the yield advantage of such systems (Prabhakar and Shukla, 1984; 1985). The statistical methods involved in planning and analysis of experiments on intercrops were reviewed by Mead *et al.* (1981). They have clearly mentioned the experience of scientists working on intercrops, that the variability of individual crops in such cropping system is more than when they are grown as sole crops. This indicated that the optimum plot size recommendations derived for individual crops would not be sufficiently large enough in case when the crops are grown together. The optimum intercropping combination is identified and experiments are to be conducted to find out the package of practices for such

a combination. Prabhakar and Shukla (1984, 1985) have reported that okra (*Abelmoschus esculentus* L. Monech) could be profitably intercropped either with beans (*Phaseolus vulgaris* L.) or Radish (*Raphanus sativus* L.). The present paper investigates the optimum plot size for an intercrop consisting of okra and beans.

MATERIALS AND METHODS

Okra (cv. Pusa Sawani) and beans (cv. Arka Komal) were grown as sole and intercrops during the monsoon season of 1986 at the experimental farm, Indian Institute of Horticultural Research, Bangalore. The soil of the experimental site was sandy clay loam with low N and P and medium in K status. The intercropping system received an uniform dose of 120 kg N, 80kg P₂O₅ and 50 kg K₂O per hectare. Okra seeds were sown on ridges opened at an interval of 60 cm. Two weeks after sowing of okra, bean seeds were sown on the vacant side of ridges. Two hand weedings were given and other plant

protection measures were taken regularly. Okra and bean pods were harvested as and when they attained marketable size. Two okra plants sown at 15 cm distance and three bean plants sown at 10 cm apart constituted one experimental unit for harvesting and recording yield data. It is usual in intercropping trials to analyse linear combinations of the yields of intercrops with varying weights (Ramanathan Chetty and Narayana Reddy, 1984). In the present case the analysis suggested by Smith (1938) and Hatheway (1961) was performed for (1) individual crop yield of okra in the intercropping system, (2) individual crop of beans in the intercropping system, (3) monetary returns from okra and beans from the individual plots with price as the weights, (4) protein content from individual unit plots with percent protein of okra and beans as weights, (5) calorie turnover from okra and beans with the calorie of individual crops as weights, (6) average nutritive value of okra and beans and (7) land equivalent ratio. For calculating this, individual crops of okra and beans were grown in nearby plots as sole crops. The weights used for calculation of different indices are given below:

| Crop | Monetary returns | Protein content | Calorie turn over | Av. Nutritive value |
|-------|------------------|-----------------|-------------------|---------------------|
| Okra | 1.00 | 1.9 | 25 | 4.009 |
| Beans | 1.00 | 1.7 | 26 | 4.227 |

RESULTS AND DISCUSSION

The coefficient of variation for different plot sizes and shapes for the different measures described above are given in Table 1. It is clear that when individual yield of intercrops are taken the coefficient of variation is large but for all linear combinations the coefficient of variation is much less. It is also interesting to note that for all the linear combination the values of C. V. were of almost the same order. Since an intercropping experiment is conducted to judge the superiority in some respect of a combination of intercrops rather than individual crops, a plot size based on the different linear combination indices would be more appropriate. Sixteen units arranged in a single row was found to give C. V. which did not produce commensurate reduction with further increase in plot size. The Fairfield Smith's law was fitted and the 'b' values for different parameters are given in Table 2. All the values are between 0.2 and 0.7 which according to Binns (1982) indicate that the efficiency of the experiment could be improved by increasing plot size as well as replication. The most important approach in such a case is that of Hatheway (1961). The convenient plot sizes for treatments ranging from 5 to 10 and replications ranging from 3 to 6 are given in Table 3. The convenient plot sizes are extremely large for okra alone, beans alone and calories. So if the statistical analysis proposes to

Table 1. Coefficient of variation for different plot sizes and shapes

| Plot Size (Units) | Shape | Okra | Beans | Value | Protein | Calorie | Av. Nutritive value | L.E.R |
|----------------------|-------|------|-------|-------|---------|---------|------------------------|-------|
| 1 | — | 54 | 84 | 42 | 42 | 44 | 42 | 42 |
| 2 | 1:2 | 44 | 69 | 35 | 35 | 36 | 35 | 35 |
| 2 | 2:1 | 45 | 75 | 36 | 36 | 37 | 36 | 36 |
| 3 | 3:1 | 42 | 70 | 32 | 32 | 33 | 32 | 32 |
| 4 | 1:4 | 35 | 58 | 28 | 28 | 29 | 28 | 28 |
| 4 | 2:2 | 37 | 63 | 30 | 30 | 31 | 30 | 30 |
| 4 | 4:1 | 38 | 67 | 30 | 30 | 31 | 30 | 30 |
| 6 | 3:2 | 34 | 60 | 27 | 27 | 28 | 27 | 28 |
| 6 | 6:1 | 35 | 61 | 26 | 26 | 27 | 26 | 26 |
| 8 | 1:8 | 28 | 45 | 19 | 19 | 21 | 19 | 19 |
| 8 | 2:4 | 31 | 55 | 25 | 25 | 25 | 25 | 25 |
| 8 | 4:2 | 32 | 59 | 25 | 25 | 26 | 25 | 26 |
| 8 | 8:1 | 32 | 58 | 25 | 25 | 26 | 25 | 25 |
| 12 | 3:4 | 28 | 54 | 23 | 23 | 23 | 23 | 24 |
| 12 | 6:2 | 30 | 54 | 23 | 23 | 24 | 23 | 23 |
| 12 | 12:1 | 30 | 47 | 23 | 23 | 24 | 23 | 23 |
| 16 | 1:16 | 21 | 35 | 14 | 14 | 15 | 14 | 14 |
| 16 | 2:8 | 25 | 43 | 17 | 17 | 18 | 17 | 17 |
| 16 | 4:4 | 26 | 53 | 21 | 21 | 21 | 21 | 22 |
| 16 | 8:2 | 28 | 54 | 22 | 22 | 22 | 22 | 23 |
| 24 | 3:8 | 22 | 41 | 14 | 14 | 15 | 14 | 14 |
| 24 | 6:4 | 25 | 48 | 19 | 19 | 19 | 19 | 19 |
| 24 | 12:2 | 27 | 43 | 21 | 20 | 21 | 20 | 16 |
| 32 | 2:16 | 18 | 34 | 13 | 13 | 13 | 13 | 13 |
| 32 | 4:8 | 21 | 41 | 12 | 12 | 13 | 12 | 12 |
| 32 | 8:4 | 22 | 48 | 19 | 19 | 19 | 19 | 20 |
| 48 | 3:16 | 15 | 32 | 10 | 10 | 10 | 10 | 11 |
| 48 | 6:8 | 20 | 38 | 10 | 10 | 11 | 10 | 9 |
| 48 | 8:6 | 6 | 29 | 3 | 3 | 2 | 4 | 6 |
| 48 | 12:4 | 22 | 38 | 18 | 18 | 18 | 18 | 18 |
| 64 | 4:16 | 13 | 31 | 8 | 8 | 8 | 8 | 8 |
| 64 | 16:4 | 17 | 38 | 10 | 10 | 10 | 10 | 10 |
| 96 | 6:16 | 12 | 27 | 3 | 3 | 5 | 3 | 3 |
| 96 | 12:8 | 16 | 27 | 9 | 9 | 10 | 9 | 8 |

Table 3. Convenient plot size for experimentation with intercrops (Okra+French beans)

| Replication | Treatment | Okra | Beans | Monetary value | Protein content | Calorie turnover | Av. Nutritive value | L.E.R. |
|-------------|-----------|------|-------|-------------------|--------------------|---------------------|------------------------|--------|
| 3 | 4 | 127 | 69 | 5 | 22 | 187 | 3 | 6 |
| 3 | 5 | 124 | 67 | 5 | 21 | 181 | 3 | 6 |
| 3 | 6 | 122 | 66 | 5 | 20 | 177 | 3 | 6 |
| 3 | 7 | 121 | 65 | 5 | 20 | 174 | 3 | 6 |
| 3 | 8 | 120 | 65 | 5 | 20 | 173 | 3 | 6 |
| 3 | 9 | 120 | 64 | 5 | 20 | 172 | 3 | 6 |
| 3 | 10 | 119 | 64 | 5 | 20 | 171 | 3 | 6 |
| 4 | 4 | 111 | 60 | 4 | 18 | 157 | 3 | 5 |
| 4 | 5 | 109 | 59 | 4 | 17 | 154 | 3 | 5 |
| 4 | 6 | 108 | 59 | 4 | 17 | 152 | 3 | 5 |
| 4 | 7 | 107 | 58 | 4 | 17 | 151 | 3 | 5 |
| 4 | 8 | 107 | 58 | 4 | 17 | 150 | 3 | 5 |
| 4 | 9 | 107 | 58 | 4 | 17 | 149 | 3 | 5 |
| 4 | 10 | 106 | 58 | 4 | 16 | 148 | 3 | 5 |
| 5 | 4 | 101 | 55 | 4 | 15 | 139 | 3 | 5 |
| 5 | 5 | 100 | 54 | 4 | 15 | 137 | 3 | 5 |
| 5 | 6 | 99 | 54 | 4 | 15 | 135 | 3 | 5 |
| 5 | 7 | 98 | 54 | 4 | 15 | 137 | 2 | 5 |
| 5 | 8 | 98 | 53 | 4 | 15 | 134 | 2 | 5 |
| 5 | 9 | 98 | 53 | 3 | 14 | 134 | 2 | 5 |
| 5 | 10 | 98 | 53 | 3 | 14 | 133 | 2 | 5 |
| 6 | 4 | 94 | 50 | 3 | 14 | 126 | 2 | 4 |
| 6 | 5 | 93 | 50 | 3 | 13 | 124 | 2 | 4 |
| 6 | 6 | 92 | 50 | 3 | 13 | 124 | 2 | 4 |
| 6 | 7 | 92 | 50 | 3 | 13 | 123 | 2 | 4 |
| 6 | 8 | 92 | 50 | 3 | 13 | 123 | 2 | 4 |
| 6 | 9 | 91 | 50 | 3 | 13 | 122 | 2 | 4 |
| 6 | 10 | 91 | 50 | 3 | 13 | 122 | 2 | 4 |

