# EFFECT OF MIXED CROPPING WITH CACAO IN COCONUT ROOT (WILT) AFFECTED GARDEN

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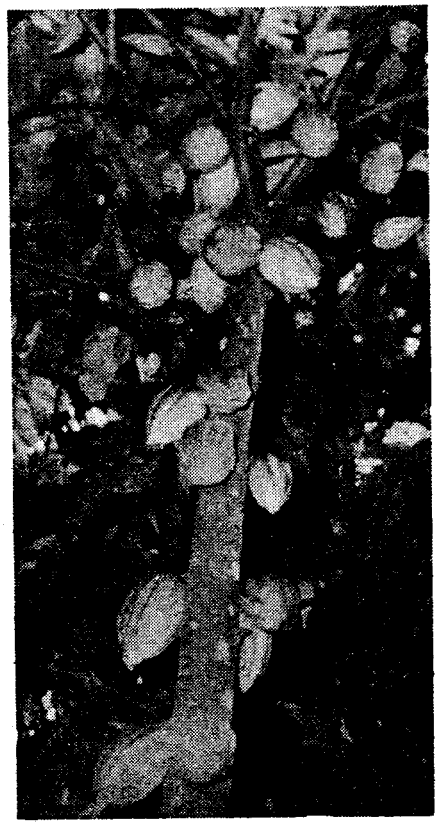

Root (wilt) disease of coconut has affected about 12 million palms in about 250,000 ha which accounts for nearly one third of the total area under coconut in Kerala. The economic losses due to the disease are estimated at Rs. 300 million annually. The etiology of this complex malady is yet to be fully understood and as such no specific control measures could be recommended against it. However, there are reports from disease-free tracts, that cacao can be profitably raised as a mixed crop in the coconut gardens. Bhat and Leela (1968) and Rodrigo and Mangabat (1964) have found that cacao is a profitable intercrop with arecanut and coconut, respectively. Bhat and Bavappa (1971) indicate promising results from cacao-coconut mixed planting. Rectar, Leach and Peng (1971) have concluded that the interplanting of coconut with cacao is an attractive proposition as it contributes to crop diversification and opens opportunities for increased revenues. But no data are available on the feasibility or otherwise of raising cacao as a mixed crop in coconut gardens affected by root (wilt) disease. Hence studies were initiated to investigate the effect of growing cacao as a mixed crop in root (wilt) affected coconut garden, with reference to the change in soil fertility, yield response of coconut and cacao and the economic gains.

## Materials and Methods

Sixteen-year old root (wilt) affected garden (0.7 ha) was used for raising cacao (*Theobroma cacao* L.) under rainfed condition. The pre-and post-experimental conditions on the foliar symptoms of the coconut palms were recorded by adopting scoring techniques evolved by George and Radha (1973). The climate is humid tropical with an annual rainfall of 2284 mm received in 120 rainy days. The soil type is loamy sand with pH 5.3 The fertility status of nutrients of the soil is N 44, P 12 and K 21 ppm respectively. The Fe, Mn, Zn and Mo and Bo were 5, 4.2, 0.5, 0.02 and 0.17 ppm respectively. The analysis was made by the method suggested by Jackson (1967). The CEC was 2 meq/100 g soil.

Six month old cacao seedlings of "Forestero" variety were planted at a spacing of 3 m in 1975 under three systems of planting viz. single hedge (one row of cacao in between coconut accommodating 500 plants/ha), double hedge (two rows of cacao in between coconuts, accommodating 700 plants/ha), and mixed single (cacao planted in between the rows of coconut in triangular system accommodating 744 plants /ha). Cacao plants were manured with 12 kg farmyard manure [FYM] and N 100, $P_2O_5$ 40 and $K_2O$ 140 g/plant/year. Coconut was given the recommended doses of manures such as 25 kg FYM and N @ 340, $P_2O_5$ 170 and $K_2O$ 680 g/palm/year.

To study the soil fertility changes, soil samples were collected at the start of the experiment [1975] and in 1978, at different depths 0-25, 25-50 and 50-100cm from 1.5 and 4 metre away from the base of the palms. Soil samples were analysed for pH, available N, P, K and ex. Ca and Mg (Jackson, 1967).

## Results and Discussion

Data [Table 1] showed that growing cacao resulted in a general increase in soil pH towards the surface. There was also a build up in the soil nutrient status which was more pronounced at 4 m than at 1.5 m away from the base of palm. The large quantity of shed leaves of cacao might have presumably contributed to the added soil fertility [Eerstman 1968]. Among the systems of planting cacao, double hedge system registered low status of nutrients, perhaps due to the effective utilization of nutrients [Table 1] and higher yields of crops [Table2 ] per unit area.

Data [Table 2] revealed that by mixed cropping of cacao, there was no further deterioration in the disease condition of the palm. This may be attributed to the beneficial interaction and effect of intense microbial activity in the rhizosphere of coconut and the increased activity of nitrogen fixers and phosphorus solubilisers, thereby enhancing the soil fertility [Nair and Rao, 1977].

By mixed cropping with cacao, the yield of coconut could be enhanced by 30 per cent as compared to that of monocropping of coconut [Table 2]. Among the systems of planting maximum yield was obtained when double hedge system was adopted. The beneficial effects imparted by cacao to coconut may be attributed to decrease in soil temperature in coconut-cacao crop combination [Verghese *et al.*, 1978].

Maximum cacao yield was obtained from mixed single hedge followed by double hedge. Nair *et al.* [1975] and Kannan and Sudhakar [1977] reported the superiority of double hedge over single hedge in cacao. Maximum return was from double hedge by mixed single and single hedge [Table 2].

## Summary

Mixed cropping of cacao increased the soil fertility. There was no further deterioration of the disease condition of the palms. Increase in yield of palms was 30%. Net income was maximum when double hedge system of planting cacao was adopted.

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**Table - I**

Effect of growing cacao in root (wilt) affected coconut garden on the soil build up of nutrient within three years.

| Soil characters | | Single hedge | | Double hedge | | Mixed single hedge | |
|---|---|---|---|---|---|---|---|
| | | 1.5m* | 4m* | 1.5m* | 4m* | 1.5m* | 4m* |
| pH | 1 | — | 0.5 | — | 0.5 | — | — |
| | 2 | 0.5 | 0.6 | — | 0.5 | — | — |
| | 3 | — | — | — | — | — | — |
| Nitrogen (ppm) | 1 | 2 | 3 | — | — | 5 | 2 |
| | 2 | — | 3 | — | — | 5 | 5 |
| | 3 | — | 1 | — | — | — | 5 |
| Phosphorus (ppm) | 1 | 2 | 5 | — | — | 5 | 2 |
| | 2 | 5 | — | 7 | — | — | 6 |
| | 3 | 5 | — | — | — | — | 5 |
| Potash (ppm) | 1 | 6 | 10 | — | 6 | 1 | 4 |
| | 2 | — | 1 | 1 | — | 2 | — |
| | 3 | 2 | 2 | — | 1 | — | — |
| Calcium (meq/100g) | 1 | — | 0.3 | 1.2 | — | 1.5 | 0.9 |
| | 2 | — | 0.1 | 1.0 | 0.2 | 1.4 | 1.0 |
| | 3 | — | — | 0.1 | 0.1 | 1.4 | 0.8 |
| Magnesium (meq/100g) | 1 | — | — | 0.8 | 0.5 | 0.4 | — |
| | 2 | — | — | 0.6 | 0.6 | — | — |
| | 3 | — | — | 0.4 | 0.2 | 0.2 | 0.1 |

1—0—25 cm depth 2—25—50 cm depth 3—50—100 cm depth

*Away from the base of the coconut palm

**TABLE - 2**

Effect of mixed cropping of cacao in adult coconut root (wilt) affected garden on disease intensity of palms, yield response and economics

| | Disease Index | | Yield per ha | | Increase in yield over pre-exptl. period | Yield per ha | Cost of cultivation including cacao | Return from coconut @ 90 p per nut | Return from cacao @ * Rs 35/- per kg (dry beans) | Gross return | Net return |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pre-expt. 1975 | Post expt. 1978 | Pre-expt. 1975 | Post-expt. 1978 | | | | | | | |
| 1. Coconut alone | 35 | 34 | 39 | 41 | 5.1 | 7175 | 2850 | 6475 | — | 6457 | 3607 |
| 2. Coconut + Cacao single hedge | 33 | 30 | 48 | 61 | 27.1 | 10675 | 5100 | 9607 | 3850 (110 kg) | 13457 | 8357 |
| 3. Coconut + cacao double hedge | 28 | 26 | 47 | 62 | 32.8 | 10850 | 5560 | 9765 | 6860 (196 kg) | 16625 | 11065 |
| 4. Coconut + Cacao Mixed single hedge | 32 | 30 | 40 | 54 | 35.0 | 9450 | 6660 | 8505 | 8330 (238 kg) | 16835 | 10175 |

* Price of dry cacao beans prevailing in 1978