MANAGEMENT OF DISEASED GARDENS

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Root(wilt) disease causes slow but steady decline in productivity of coconut palms. Reduction in yield in the disease affected palms is reported to be proportionate to the intensity of the disease and it varies from 10-80% (Anonymous, 1976). In the absence of specific measures for control of the disease of uncertain etiology but of debilitating nature, improvement of agricultural practices to achieve economic returns is of importance. The results of research showed that a package of agrotechnology could be drawn out for mitigating and/or checking the losses due to disease. ~~Beneficial~~ effects of proper nutritional management, inter and mixed cropping with compatible crops and mixed farming in root (wilt) affected gardens has been proved.

FERTILIZER MANAGEMENT

Radha and Shanta(1976) reported that by the application of NPK at 240g N, 240g P_2O_5 and 480g K_2O with 50 kg of green leaf per palm per year and lime at 1.25 t/ha increased the yield of affected palms by four nuts per year, while that of comparatively healthy palm by eight nuts during the same period. In the absence of manuring and cultivation, the annual reduction in yield was to the extent of eleven nuts per palm. Application of 0.5 kg magnesium sulphate or 2.0 kg dolomite per palm was effective in reducing yellowing of palms (Radha,1977). Fertilizer trials carried out in a disease affected garden at CPCRI Regional Station,Kayangulam with three levels of NPK, two levels of MgO and with a uniform dose of cowdung at 50 kg per palm showed that in a sandy soil, the lowest level of 350g N, 300g P_2O_5 and 600g K_2O with 500g MgO could be an economic dose(Anonymous,1978a). This is in partial agreement with the precent recommendation (except for P) of 340g N, 170g P_2O_5 and 680g K_2O for root (wilt) affected tracts(Anonymous,1978b) In the light of the above studies, application of 50kg of cowdung, 340g N, 170g P_2O_5, 680g K_2O and 3 kg of magnesium sulphate with 50 kg of organics per palm per year may be recommended for sandy

disease affected tracts. Cecil, Pillai, Mathew and Kamalakshy Amma (1978) studied the effect of application of N,P,K,Ca & Mg on young WCT palms in root(wilt) affected area. Fractional quantities of three levels of NPK fertilizer and two levels of Mg were applied for the seedling stage and a seven year old study proved that for young WCT palms the lowest level of 500g N, 300g P_2O_5 and 1000g K_2O with 50 kg of cowdung was adequate for proper growth of young palm. Application of 500g MgO/palm was beneficial for early flowering and increased yield. But disease incidence occurred irrespective of treatments rising to about 19% by the seventh year. In a similar trial with Dwarf Orange x West Coast Tall hybrids(DxT), the optimum economic dose was again 500g N, 300g P_2O_5 and 1000g K_2O, and 500g MgO with 50 Kg cowdung (Kamalakshiamma et al unpublished). Disease incidence occurred again irrespective of treatments, but was less(only 5%) compared to WCT of comparable age. D x T was also superior in yield recording an average of 140 nuts per/palm as against 80 nuts in WCT. The superior performance of the hybrid with respect to disease tolerance and yield is to be watched for a few more years before it could be recommended for root(wilt) affected tracts. Thus in young palms growing in sandy soils a dose of 500g N, 300g P_2O_5, 1000g K_2O, 500g MgO with 50 kg of cowdung/farm yard manure could be taken as an economic dose.

INTERCROPPING, MIXED CROPPING AND MIXED FARMING

The profitable utilization of the interspaces in coconut gardens by intercropping, mixed cropping and mixed farming practices has been tried with the idea of compensation for the reduction in yield due to root(wilt) disease and to find out the effect on the main crop.

INTERCROPPING

Gopalasundaram and Nelliat(1979) have recently reviewed the work done on intercropping in coconut gardens. Experiments conducted at CPCRI Regional Station, Kayangulam - an area where coconut is affected with root(wilt) disease have revealed that tuber crops like tapioca, elephant yam and yam can be grown profitably as intercrops under disease affected conditions (Menon and Nayar,1978). The experiment was conducted in 16 year old coconut garden spaced 7.5 m x 7.5 m apart.

The crops raised for 3 years from 1975. Considering the overall response of palm, there was no reduction in yield due to intercropping. A slight increase in the mean yield of palm(11.8%)was noticed in the plot where elephant yam was cultivated and 2.2% in plot where yam was cultivated. The effect of intercropping on the palms in different disease intensity was also studied. In the control plot, during the course of three years, all the apparently healthy palms had developed disease symptoms. But in the intercropped plot some of the palms continued to be free from disease symptoms. The mean disease index for the control increased from 34.2 to 36.1, indicating advancement of the disease. Palms intercropped with tapioca also exhibited a similar trend, but slightly larger increase in disease intensity (32.1 to 37.3). Reduction in the overall mean disease index of palms in the area intercropped with yam from 29.3 to 28.4 though negligible was an encouraging observation. Tapioca H-165 gave an average yield of 15.93 tonnes of tuber/ha/yr. Elephant foot yam gave considerably low yield during the second and third years. Raising all the three crops was profitable but tapioca gave maximum profit. From the cost benefit analysis, it was found that coconut + tapioca combination gave the highest net return per rupee invested viz. 1:1.47. The higher disease incidence in the tapioca plot may be because of the fact that tapioca is a more exhausting crop, giving a mean yield of 15.93 tonnes when compared to the mean yields of elephant foot yam and yam viz. 5.4 and 5.5 t/ha respectively. Increase in disease incidence has caused reduced nut yield in the concerned plots. This warrants further experimentation to determine optimum manuring schedule for coconut/tapioca cultivation. The highest yield of tapioca when grown as intercrop was maintained in all the three years which was an indication that in spite of successive cropping, there may not be a substantial reduction in the yield of intercrops. Tapioca gave the maximum output per ha. But this was not reflected in the case of elephant foot yam and yam which necessitates suitable crop rotation for these two crops. Intercropping with tapioca gave about 50% more income compared to the other tuber crops. The slight reduction in yield of coconut was more than compensated by the total output from the tapioca plot. Thus, intercropping with tapioca, yam, and elephant foot yam was more profitable than growing coconut as a monocrop. Besides, this system helps in profitable and efficient utilization of land, soil nutrient, moisture and sunlight and enhances rural employment opportunities.

The result of the study reveals that intercropping in coconut garden is economically feasible even in root(wilt) disease affected tract and it does not adversely affect yield of coconut palms. The reduction in yield in elephant foot yam and yam which is presumed to be due to continuous cropping indicates the need for detailed studies on intercropping and crop rotation to evolve suitable cropping programme. The result also warrant further studies regarding the manuring schedule for coconut + tapioca cultivation.

MIXED CROPPING

The effect of coconut-cacao mixed cropping on yield of coconut and cacao has been evaluated. Yield of coconut increased by 30%, when compared to a monocrop of coconut. Among the system of planting, maximum yield was obtained when double-hedge system of planting was adopted, followed by mixed single and single hedge. The superiority of double hedge system over single hedge was reported by Nair et al. (1975). The beneficial effect of growing cacao in coconut garden has been attributed to an intense microbial activity in the rhizosphere of coconut. Increased activity of nitrogen fixers and P solubilisers improving the soil fertility has been reported (Nair and Rao, 1977). Decrease in soil temperature has also been noted(Verghese et al., 1978).

MIXED FARMING

The work done on mixed farming in root(wilt) affected tract has been recently reviewed(Nayar and Sahasranaman, 1978). Encouraging results have been obtained from a mixed farming programme consisting of cultivation of fodder grasses and legumes in the interspaces of coconut, maintaining milch cows and recycling of cattle wastes carried out in a root (wilt) affected garden at CPCRI Regional Station-Kayangulam. The objectives were to develop a system of mixed farming in disease affected coconut gardens with fodder grass and legumes for building up and maintaining soil fertility and to assess its effects, if any, on disease affected palms. Selection of most suitable fodder grasses and legumes for the area was done by screening trials. Studies conducted by Sahasranaman and Pillai, 1976) under rainfed conditions

and later by Nayar and Sahasranaman(1978) under rainfed and irrigated conditions proved the superiority of the two genotypes of hybrid napier viz. NB-21 and Pusa Giant, and Guinea grass var. 'Mackuenii'. Among the legumes tried Stylosanthes proved better but did not respond to irrigation and gave an average yield of 8 t of green fodder/ha/yr. The mean yield of NB-21 was 53 t/ha/year, Guinea grass was 49 t and Pusa Giant 45 t. Under irrigated conditions NB-21 gave maximum yield of 64 t, Pusa Giant 53 t and Guinea grass 51 t. Under rainfed condition Guinea grass proved superior with an yield of 47 t indicating the capacity of the grass to perform well in coconut garden. The breed of dairy cow recommended for southern Kerala, graded Brown Swiss(F_1) was maintained. There was 28% increase in nut yield by adopting mixed farming practice for a period of four years(Sahasranaman et al.,1976). It was also reported that the increase in yield was the highest in the palms of the disease early group (disease index 11-25) and the lowest in palms of the disease advanced group (disease index above 51). Increase in production of inflorescence as well as female flower was also reported (Anonymous, 1976b). In the mixed farming plot, amelioration of foliar yellowing of the root (wilt) affected palms was reported by Sahasranaman et al. (1976). But progressive increase in the other symptoms of the disease viz. flaccidity and necrosis was observed (Anonymous, 1976b) indicating that this practice had little curative effect on the disease. Study of the root growth of the palms in the mixed farming area (with grass and irrigation) and control (without grass and irrigation) indicated rejuvenation of roots in the former (Anonymous, 1976b). Mixed farming had little effect on the size of water stable soil aggregate when observed after five years. But significant increase in the organic carbon, available P, exchangeable Ca and Mg contents were noticed in the soil samples drawn at 0-50 and 50-100 cm depths (Sahasranaman et al., 1976). Increase in available K was noticed only at 50-100 cm depth. No significant change in available N and pH was observed after five years of mixed farming. A general increase in leaf nutrient status was also noticed especially that of potash. Considering the accepted critical levels (Fremond et al., 1966) the pretreatment values for ~~M~~ Ca & Mg in the leaf tissues were found to be low (with values of ~~0.2%~~ 0.2% and 0.12% respectively) and subsequent rise in level

to 0.42 and 0.22% respectively would have resulted in increased yield.

It was observed that beneficial microflora proliferated in all the treatment. The highest number of soil bacteria was observed in plots cultivated with Stylosanthes gracilis. The nitrogen fixing organisms were maximum in soil samples collected from plot with hybrid napier and Centrosema pubescens. Highest number of denitrifiers were found in plots cultivated with hybrid napier which is definitely disadvantageous when the crops is grown alone. But in combination with Stylosanthes, hybrid napier proved to be the best among the combined treatments because of the low status of denitrifiers and comparatively high proliferation of nitrifiers (Sahasranaman et al., 1976). Cost accounting revealed that the annual net profit per ha increased from Rs.860/- in the case of coconut alone (pre-experimental period) to Rs.2,780/- from coconut and dairying (Anonymous, 1976c). The cost benefit ratio worked out at 1 : 1.5. An increase in the employment generated from 150 man days per ha to 1000 man-days by mixed farming was also reported (Sahasranaman et al, 1976).

Thus, in the absence of complete control measures for root (wilt) disease, the agrotechniques tested and proved to be beneficial could be adopted with advantage. For the existing plantation in root (wilt) affected areas, the fertilizer schedule recommended is 340 g N, 170 g P_2O_5, 680 g K_2O, 500g MgO with 25-50 kg of organic manure, such as cowdung, farm yard manure, and green leaf. For young new plantation the recommendation is 500g N, 300g P_2O_5, 1000g K_2O, 500g MgO with 50 kg organics. Intercropping with tuber crops such as tapioca, elephant foot yam, and yam will be additional income and will not adversely affect coconut yield provided both are judiciously manured. Crop rotation could be thought of in the case of elephant foot yam and yam. Mixed cropping with cacao is similarly advantageous. Mixed farming by growing fodder crops like hybrid napier, Guinea grass and Stylosanthes, maintaining milch cows and recycling of the animal waste would be definitely advantageous in root (wilt) affected gardens for improving soil condition and subsequent improvement in yield, additional income from the dairy and tremendous increase in employment potential.

Due consideration of the research findings has been made in evolving the present strategy of containing the disease and preventing further spread into the healthy areas. The northern border at Trichur (where the disease incidence is minimum) has programmes of eradications all the affected palms to reduce the inoculum potential of the suspected pathogen, giving suitable phytosanitary treatments and replanting with quality seedlings. In the disease affected tracts, the strategy is to remove all the uneconomic palms which are yielding 10-15 nuts per palm(George, 1978) and replanting with quality seedlings. Since it has been proved that if the palms contract disease before bearing stage, the bearing age is delayed and the yield drastically affected (Ramadasan et al., 1971). Such palms are also removed and replanted. The constant association of leaf rot with root(wilt) disease with considerable damage to the crown and reduction in yield is taken care of by proper application of fungicides. Under both the conditions, recommended doses of fertilizers and organics are applied.

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