A STUDY ON THE GROWTH AND YIELD OF UNDERPLANTED WEST COAST TALL COCONUT PALMS IN KERALA

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ABSTRACT

A study on the growth and yield of West Coast Tall coconut palms underplanted early in a garden wherein the palms have not attained senility in Kerala has indicated that (1) there is a severe setback in the growth of the seedling after transplanting in the field and (2) the rate of growth of the stem of the under planted seedling is high, when compared to those of regular or newly planted ones. This is attributed to the combined effect of the transplanting shock as well as the shade and root effects of the young neighbouring palms in the garden. The set back in growth during the juvenile stage of the seedling and the prolonged vegetative phase of the palm lead to further delay in flowering and attaining the stabilised yield period. Under such underplanted conditions the palm attains yield stability in the 28th year after flowering and the yield of nuts also seems to be low. The study has indicated the need to avert the setbacks in growth by under planting at the proper time when the palms in the garden attain senility with proper spacing to avoid the shade and root effects of the neighbouring palms and by paying attention to other problems which require special consideration in underplanting. It is better to consider these problems when underplanting or replanting diseased palms under the Coconut Replanting Project in Kerala so that the planted seedlings may bear early and turn out to be more productive and maintain a high level of production in the subsequent period.

INTRODUCTION

A study on the life history of the coconut palm under regular or new planting on the West Coast of India has indicated that the yield of the palm tends to decline after a period of 60 years from the time of flowering due to the onset of senility (Satyabalan 1984 a). It is only at this stage that underplanting of seedlings in a coconut garden becomes necessary in order to maintain a high level of production during the subsequent years. But in Kerala since fresh area suitable for coconut is not available for fresh planting, underplanting of coconut seedlings is done without taking into consideration the age of the palms and the space available between them in the plantation. Also there is a feeling among the farmers that by planting more palms in a garden, they may get more nuts from the plantation. According to Patel (1938) the general practice is to underplant a garden when it is 20 to 30 years old. Satyabalan *et al* (1972)

studied the yield variation of such early underplanted palms, the period they take to attain regularity in yield and the relationship of yield with the age and growth characters of the palms. From the study it was evident that the growth and yield performance of such underplanted seedlings are affected by the root and shade effects of the neigbouring palms. In this paper an attempt has been made to study the growth and yield of such underplanted palms in a garden from the time of planting till they were 50 years old and compare them with those of regular or newly planted ones in order to find out the effects of early underplanting which results in over-crowding of the garden.

SEEDNUT AND SEEDLING STAGES IN THE NURSERY

The mode of germination of the seednuts and the growth of the seedlings in the nursery from the time of germination till they are ten months old have been described and discussed earlier (Satyabalan 1983, 1984a and 1984b). It has been reported that the seedling suffers a setback in growth in the nursery when it is four or five months old from the time of germination and the setback continues in the nursery till the seedling is transplanted in the garden.

JUVENILE STAGE (in the field)

The seedlings are underplanted during the monsoon period, June to september, as planting during this period helps in the quick establishment of the seedlings. But the seedlings are underplanted indiscriminately in the vacant areas available between palms without any consideration of the spacing recommended for planting. As they are underplanted in a garden in which the palms are young, no shade is provided because enough shade is available for them from the neighbouring palms. The seedlings are irrigated once or twice a week in summer for one or two years. They are raised under rainfed conditions in soils of average fertility.

The growth of such underplanted seedlings as indicated by leaf production was studied from the time of planting in the field till they were eight years old. In Table 1 are presented the mean data on leaf production till the time of transplanting, number of functioning leaves on the seedling at the time of underplanting, and the mean number of leaves produced every year from the time of underplanting till they were eight years old. As a result of transplanting shock sustained by the seedling, the rate of production of leaf was low as was noticed in the case of seedlings under regular planting. After they were transplanted during the monsoon period, they had produced one to two leaves only till December of the year of transplanting. The total number of leaves produced by the seedlings from the time of germination till the time of transplanting ranged from 6 to 10 and the mean was 7.5 and the number of funotioning leaves on the seedlings ranged from 5 to 8 and the mean was 6.6 as in the case of regular planted seedlings. After transplanting also the rate of production was low. The underplanted seedlings had produced 3 to 5 leaves during the first year, 3 to 6 leaves during the second and third years and 5 to 8 leaves during the fourth and fifth years. The data indicate a low rate of leaf production in the case of these underplanted seedlings from the second year, lower than those produced under regular planting. The underplanted seedlings had produced 3 to 6 leaves with a mean of 4.3 leaves whereas in the case of regular planted ones the range was 4 to 7 with a mean of 5.5 leaves (Satyabalan 1984a). In the case of the underplanted seedlings only during the sixth year when they produced 6 to 10 leaves the number of leaves they had produced from the time of germination till they were removed from the nursery - they seemed to have attained their normal growth rate which itself was low because of the early setback in the nursery reported earlier (Satyabalan 1984 b). In the case of regular planted seedlings this growth rate was attained during the fifth year, which indicated that the underplanted seedlings were less vigorous in growth. During the seventh and eighth year they had produced 6 to 11 leaves only as against 7 to 12 leaves in the case of regular planted ones. The underplanted seedlings had produced 51.9 leaves during the period of eight years after underplanting and 59.4 leaves from the time of germination whereas the regular planted ones had produced 59.2 leaves from the time of transplanting and 66.7 leaves from the time of germination. This setback in growth of the underplanted seedlings may be due to the combined effects of the transplanting shock and the continuous shade effect of the neighbouring palms. This severe setback in growth further prolonged the juvenile phase of the seedlings and resulted in further delay in flowering.

ADULT PALM STAGE

1) Growth of the palm during a period of 42 years

The growth of the underplanted seedlings was studied by measuring the height - the length of the stem from the ground level to the base of the crown of leaves - of the palm. In Table 2 are presented the data on the height of the palms measured at the end of ten years after underplanting and after every quinquennium till the palms were 42 years old. During the period of ten years from the time of underplanting, the palms had attained a mean height of 150.0 cm, the mean rate of growth being 15.0 cm from the time of underplanting and 30.0 cm from the time of stem formation. During the next quinquennium the mean growth in height was 197.5 cm, the rate of growth being 39.5 cm per year. The palms attained a mean height of 165.0 cm during the next five year period when the mean growth per year came down to 33.0 cm. During the next quinquennium the mean growth per year was further decreased to 23.5 cm. The same growth rate of 23.5 cm per year was maintained during the following quinquennial period. The rate of growth further came down to 10.5 cm per year during the next five year period. The palms attained a mean height of 130.0 cm during the next seven years when the rate of growth per year increased to 18.6 cm. These data clearly indicate that underplanted palms had grown taller than the regular planted palms from the time of planting in the field during the same period of growth. This is evident from the data on the height attained by the underplanted as well as the regular planted palms during a period of 15 years from the time of planting and during every quinquennium till they were 35 years old presented in Table 3. This increase in height registered by the underplanted palms may be mainly due to the effect of the shade of the neighbouring palms which are taller than the underplanted seedlings. The avidity of the coconut palm for sunlight is very well known. Coconut palm is a sun plant and cannot tolerate shade. It tries to avoid shade and grow taller than the neighbouring palms to get maximum sunlight with the result the vegetative growth is increased which in turn delays the reproductive phase. Patel (1938) has stated that close planting is reported to favour tall stems. According to him, underplanted palms may commence to yield in about 15 years and maximum yields are obtained from them only when the old palms are removed. Menon and Pandalai (1958) have stated that when the palms are closely planted they take much more time to commence bearing. It is a common sight in over crowded and indiscriminately underplanted gardens that the palms are taller and unproductive due to delay in attaining the reproductive phase. Only those palms planted along the border which get sufficient sun light are found to be productive. Thus in the case of early and indiscriminately underplanted seedlings two types of growth are noticed. In the juvenile stage of the seedling, the rate of leaf production is low and in the adult palm stage the rate of growth of the stem is high both resulting in delay in attaining the reproductive phase when compared to regular planted palms.

2) Yield of the underplanted palms from the 11th to 50th year after flowering

The yield of the underplanted palms was recorded from the 11th year of their flowering and continued for a period of 50 years. The yield data represented in the biological yield curve (Fig. 1) indicate that the yield per palm increased fom 19.9 nuts from the 11th year of flowering to a maximum yield of 78.9 nuts in the 28th year. The underplanted palms appear to have attained yield stability in the 28th year after flowering because the yield of nuts had not increased beyond 79 nuts during the following 22 years. These data indicate that the underplanted palms had taken 28 years-nine years more to attain yield stability from the time of flowering than the regular planted palms. The regular planted ones had attained yield stability in the 19th year after flowering (Satyabalan 1984a). This delay in attaining the stabilised yield stage and the low yield when compared to those of the regular planted ones may be mainly due to the shade and root effects of the neighbouring palms. Studies on the rooting pattern of coconut by Kushwah *et al* (1973) have shown that the lateral spread of the roots of the palm did not exceed beyond two metres when grown either under cultivated or neglected conditions. According to Nelliat *et al* (1974) the crop canopy coverage of ground progressively decreases with the increase in height and results in increase in the amount of sunlight from the slant rays. Hence when underplanting in a garden spacing has to be taken care of in order to avoid both shade and root effects of the

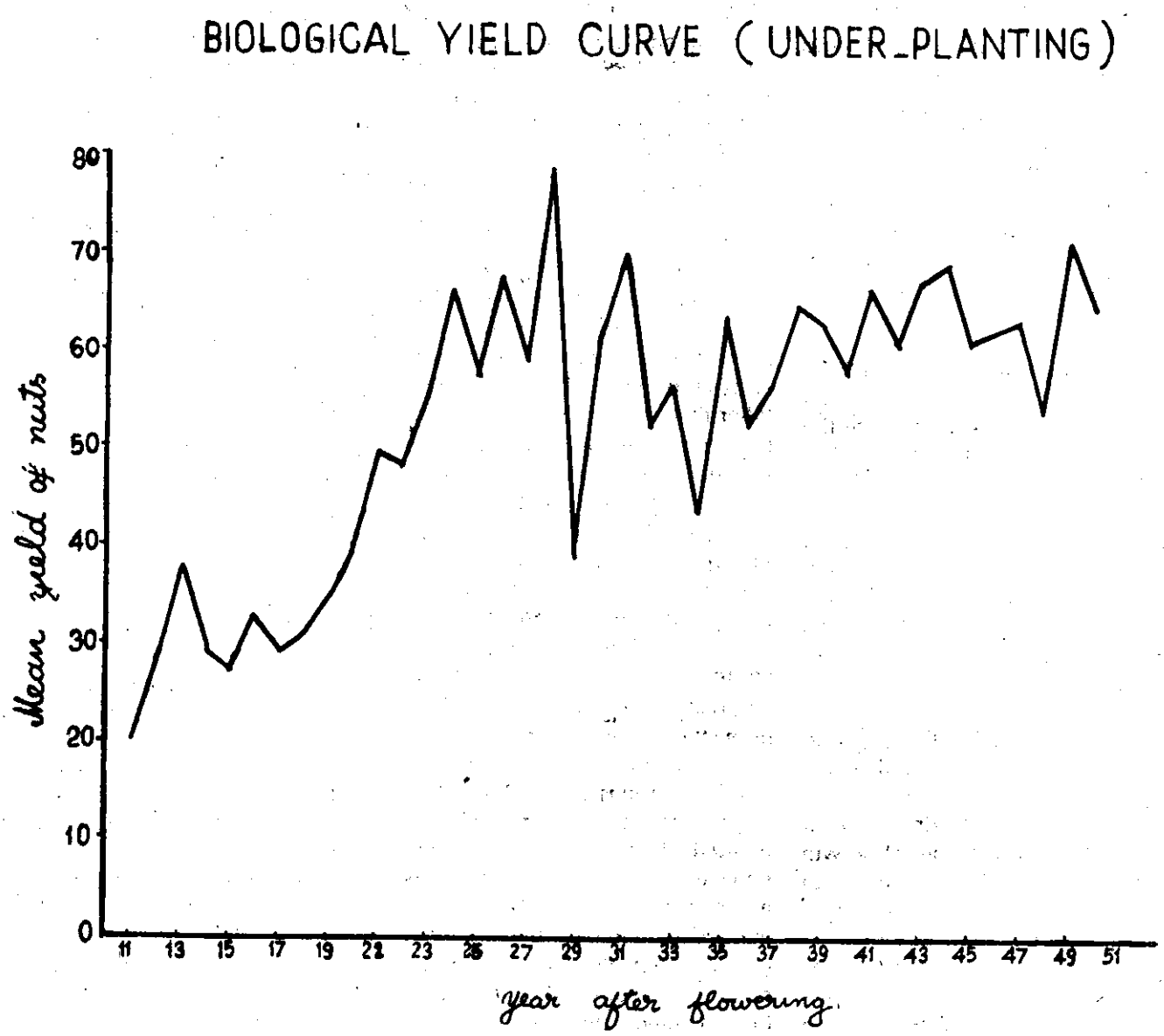

Fig. 1

neighbouring palms which result in competition for sunlight as well as for nutrition. Patel (1938) has reported that the underplanted trees compete with the old ones and therefore the yield of old trees would be reduced. *So it is best not to have any underplanting at all until the palms are atleast 60 to 70 years old.* Early underplanting may affect the vigorous growth of the underplanted seedlings and prolong their reproductive phase. The biological yield curve indicates the bearing pattern of the underplanted palms from the 11th year to the 50th year after flowering and the variation in the bearing pattern which in turn depends on the seasonal variation and other factors. The curve shows the peculiar characteristics of the palm like irregular bearing, yield distribution over the years and yield pattern during the period of 50 years under underplanted conditions. The information obtained is indicative rather than the exact as the shape of the curve may vary with varying conditions.

PROBLEMS IN UNDER-PLANTING

There are a number of problems that require special consideration in underplanting a coconut

plantation like time of planting, method of planting, use of elite planting material, manuring, removal of old palms and plant protection measures. These have been discussed in several publications on underplanting (Fernando 1950: Salgado 1951: Rodrigo *et al* 1952: Anon. 1961: Liyanage 1963: Gopinathan Nair 1964: Hubbard 1972). In Kerala replanting of diseased palms is being taken up under the Coconut Replanting Project which aims at planting high yielding coconut seedlings after removing the uneconomic palms in the coconut holdings in the State and raising them on scientific lines. It is better to consider the space and other problems discussed above so that the newly planted seedlings may grow vigorously and bear early and turn out to be more productive so that a high level of production is maintained in the subsequent period.

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TABLE - 1

Mean number of leaves produced by the seedling after underplanting in a garden

Total no. of leaves produced by the seedling till the time of under-planting	No. of functioning leaves at the time of underplanting in June	No. of leaves produced till December	No. of leaves produced during 1st yr.	2nd yr.	3rd yr.	4th yr.	5th yr.	6th yr.	7th yr.	8th yr.	Total no. of leaves produced from the time of planting	Total no. of leaves produced from the time of germination
7.5 (6 to 10)	5.6 (5 to 8)	1.2 (1 to 2)	4.5 (3 to 5)	4.3 (3 to 6)	4.9 (3 to 6)	6.2 (5 to 8)	6.3 (5 to 8)	7.5 (6 to 10)	8.3 (6 to 11)	8.7 (6 to 11)	51.9	59.4

(Figures given in parentheses denote the range)

TABLE - 2

Height of the palm from the time of underplanting till 42 years

No. of years of observations from the year of underplanting	Total height from ground level to base of crown and range	Increase in height	Mean increase in height per year
5	Stem not formed	—	—
10	150.0 cm (15.0 to 420.00 cm)	150.0 cm	30.0 cm
15	347.5 cm (60.0 to 720.0 cm)	197.5 cm	39.5 cm
20	512.5 cm (90.0 to 930.0 cm)	165.0 cm	33.0 cm
25	630.0 cm (240.0 to 1080.0 cm)	117.5 cm	23.5 cm
30	747.5 cm (330.0 to 1230.0 cm)	117.5 cm	23.5 cm
35	800.0 cm (420.0 to 1320.0 cm)	52.5 cm	10.5 cm
42	930.0 cm (570.0 to 1380.0 cm)	130.0 cm	18.6 cm

Figures given in parentheses denote the range

TABLE - 3

Mean height attained by the underplanted and regular planted palms during a period of 35 years from the time of planting and the difference in height.

Underplanted/ Regular planted	Period from the time of planting	Mean height of palms (cm)	Difference in height (cm)
1) Underplanted	15 years	347.5 cm	———
Regular planted	15 years	335.0 cm*	12.5 cm
2) Underplanted	20 years	512.5 cm	———
Regular planted	20 years	455.0 cm*	57.5 cm
3) Underplanted	25 years	630.0 cm	———
Regular planted	25 years	560.0 cm*	70.0 cm
4) Underplanted	30 years	747.0 cm	———
Regular planted	30 years	645.0 cm*	102.5 cm
5) Underplanted	35 years	800.0 cm	———
Regular planted	35 years	725.0 cm*	75.0 cm

*Satyabalan, K. (1948a)