LIFE HISTORY OF THE COCONUT PALM ON THE WEST COAST OF INDIA : A STUDY

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ABSTRACT

A study on the life history of the tall coconut palm on the West Coast of India from the seednut to the adult palm stage under regular planting has indicated that (1) there is a setback in the growth of the seedling in the nursery at the fifth month from the time of germination which is attributed to the complete utilisation of the endosperm by the seedling and a gradual change over to full dependence on photosynthesis for nutrition and (2) there is again another setback in the growth of the seedling after transplanting which is attributed to the transplanting shock due to the damage to the roots and disturbance caused during transplanting. These setbacks in growth in the seedling stages in the nursery as well as in the field lead to delay in flowering and attaining the stabilised yield period. The palm attains yield stability in the 19th year after flowering. The maximum yield period of the palm is during 19th to 41st year after flowering which is followed by the steady lower yield period of about 20 years afterwhich there is slow decline in yield. The growth of the palm declines as the palm advances in age. The study has indicated the need to avert the setbacks in growth in the early stages of its life cycle by either early transplanting in areas wherever possible or by paying proper attention to timely irrigation and fertilisation of the seedlings in the nursery as well as in the field so that the time lag between planting and flowering is reduced to the minimum which will bring early benefit to the planters.

INTRODUCTION

Research workers should have an idea of the life history of the crops on which they are working in order to effect improvements during their developmental stages and thereby try to increase their yield efficiency in the case of annual and biennial crops it may be possible but in the case of perennials especially in a perennial palm like coconut with its long life cycle, it is impossible since the study of even one generation of the crop takes a man's life time. In spite of it, one should have at least a fair knowledge of the life history of this versatile palm to effect improvements which are likely to last for a long time due to its perennial nature. In this paper an attempt has been made to study the life history of the coconut palm from the nut stage to the adult palm stage till it is about 60 years old when it reaches senility with the information and data available from recent studies and old records maintained at

the Central plantation Crops Research institute, Kasaragod. This study pertains to the growth of West Coast tall palms under regular planting in sandy loam soil and under the climatic conditions prevailing in Kasaragod. The palms were raised under rainfed conditions as raised by farmers in Kerala. The growth pattern may vary in those coconut growing tracts where soil and climatic conditions and methods of raising are different.

SEEDNUT STAGE

Coconut is at present propagated only through seed. On the West Coast of India seednuts are collected from regular bearing and high yielding palms during the summer months January to May and stored till they are planted in the nursery in June or July when the South West monsoon sets in. Seednuts harvested in summer months are reported to show relatively better development than those harvested in the other months of the year. They are preferred judged from early germination, total germination and quality of seedlings. The monsoon season is preferred for sowing as the environment is favourable and the weather conditions are helpful for germination of seednuts and the growth of the seedlings. This will also help to avoid watering of the nursery.

SEEDLING STAGE (in the nursery)

The seednuts harvested during January to May are stored in sand under shade and planted in the nursery with the break of the South West monsoon. Since the tall palm is highly cross pollinated in nature and the seednuts are harvested in different months, there is considerable variation in germination of the seednuts. Earlier harvested nuts germinate early and later harvested ones germinate late. Studies have shown that more than 90% of the nuts harvested during January to March germinate by October while those of April harvest by November and those of May by December (Satyabalan 1983 a).

The growth of the seedlings germinated during different months in the nursery has been studied from the time of germination till the seedlings were ten months old. Important growth characters of the seedling like collar girth and leaf production observed in each seedling every month from the time of germination for a period of ten months has given indications of their monthly growth rate in the nursery. The data on collar girth in seedlings germinated during July to November observed during each month from the time of germination till they were ten months old are presented in Table 1. Similar data on leaf production in the same seedlings germinated during July to November observed during each month from the time of germination till they were ten months old are presented in Table 2. These data show that the rate of growth as indicated by the growth characters in the seedlings germinated during different months is fairly high in the beginning but goes on decreasing slowly till the fourth or fifth month and thereafter slowly increases which indicates that there is a setback in growth from the fourth or fifth month (Satyabalan 1983 b). Foale (1968 a) has referred to this setback in growth of the seedlings in the nursery which he (1968 b) attributes to the complete utilisation of the endosperm by the seedling till the fourth or fifth month from the time of germination and afterwards a gradual change over to full dependence on photosynthesis. During the change over the seedling suffers a setback in growth from which it slowly recovers when the roots develop and the seedling begins to depend on photosynthesis for its nutrition. This setback in growth of the seedlings may not be noticed or visible but it is evident from the data presented in the tables. The effect of the early setback in growth continues and affects its later development also because the nursery which is mainly made up of sand is not fertilised. During snmmer months the seedlings are irrigated twice a week and shaded to prevent sun scorch. The seedlings are allowed to grow in the nursery till the beginning of the South West monsoon. The half starved seedlings are removed from the nursery and transplanted in the field during the monsoon period. The seedlings are not pulled out of the nursery by force but the roots are neatly cut and the seedlings with the nuts are gently removed. Seedlings are selected on the basis of their vigorous growth characters like collar girth and leaf production for transplanting in the field.

JUVENILE STAGE (in the field)

In the Kerala the seednuts are sown in June and the seedlings

are transplanted during the monsoon period June to September of the following year. Planting during the monsoon period helps in the establishment of the seedlings. As there is sufficient moisture in the soil, no irrigation is required. Under regular planting the seedlings are planted in the open field with a spacing of 7.2m between seedlings. As they are planted in open field, some shade is provided to them during summer months for the first one or two years after planting to protect them from the scorching sun. They 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 the seedling is mainly indicated by its leaf production. Since the time of germination is not generally noted, the seedlings will be of different age at the time of transplanting. Hence the total number of leaves produced by the seedlings and the number of functioning leaves on the seedlings will vary at the time of transplanting. In Table 3 are presented the mean data on leaf production till the time of transplanting, number of functioning leaves on the seedling at the time of transplanting and the number of leaves produced every year from the time of transplanting till they were ten years old. The total number of leaves produced by the seedlings from the time of germination till the time of transplanting ranged trom 6 to 10 and the mean was 7.5. At the time of transplanting the number of functioning leaves on the seedlings ranged from 5 to 8 and the mean was 5.6. After they were transplanted during monsoon period, they had produced 1 to 2 leaves only till December of the year of transplanting. During the first year after planting they produced 3 to 5 leaves and during the second and third years they produced 4 to 7 leaves indicating a setback in growth. During the fourth year also they produced only 4 to 8 leaves which indicated that the normal growth rate had not been attained. Only during the fifth year when they produced 6 to 10 leaves the number they had produced from the time of germination till they were removed for transplanting from the nursery they seemed to have attained their normal growth rate which itself was low because of the early setback in growth in the nursery. Thus for about five years after transplanting, the growth of the seedling was adversely affected. Jaunet (1968) in Ivory Coast observed a decrease in the number of leaves produced during the two years which followed transplanting and attributed the reduction in the rhythm of growth to the shock or impact of the transplantation. This setback in growth is attributed to the transplanting shock due to damage to the roots and the disturbance caused during transplanting. According to Romney *et al* (1968) older seedlings suffer a greater transplanting shock becausee they rely on their roots which are usually damaged during lifting from the nursery. Sumbak (1970) has reported that in New Britain coconut transplants with up to 4leaves made better growth than crow's beak transplants whereas older transplants suffered considerably from transplanting shock. The seedling thus suffered twice in its development, the first time in the nursery and the second time in the field after transplantation. The shock lasted for about five years in the sandy loam soil and might last for a longer period in the case o fsandy soil. These setbacks in the development of the seedling naturally lead to delayed flowering which in turn result in delay in attaining the stabilised yield stage.

After recovering from the shock, the seedlings maintained their growth producing 7 to 12 leaves during the sixth and seventh year after transplanting. During the eighth, ninth and tenth year they had produced 8 to 12, 9 to 13 and 10 to 13 leaves respectively. In the adult palm about one leaf is produced in a month. Hence a few seedlings attained the stage of initial flowering during the sixth year. During the period of ten years after transplantation the seedlings had produced about 82 leaves and about 90 leaves from the time of germination. But for the setbacks in growth, they would have produced more leaves and would have attained the initial flowering stage much earlier. The juvenile phase of the palm is thus extended to a longer period resulting in delayed flowering.

ADULT PALM STAGE

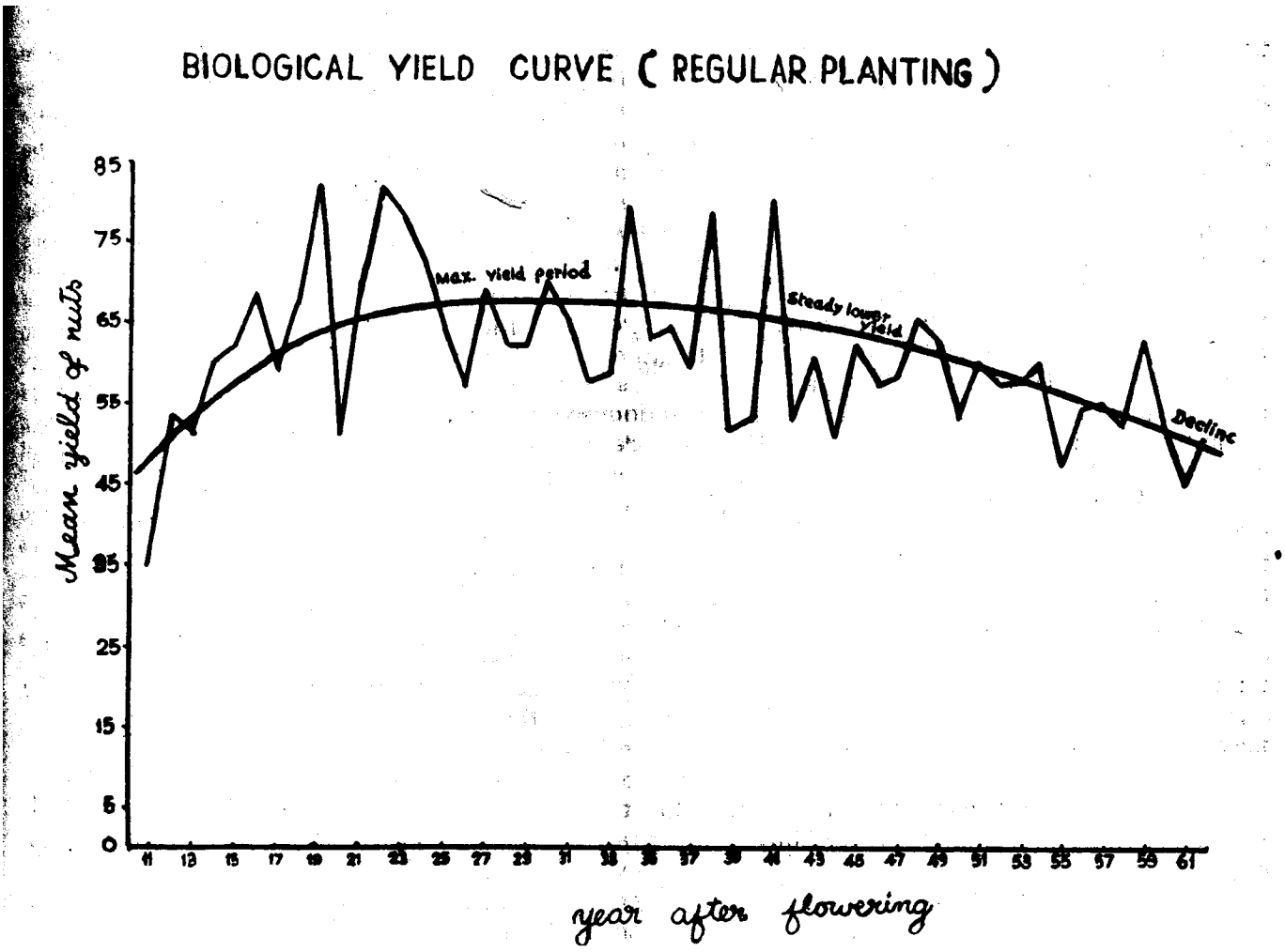
1) Growth of the palm during a period of 57 years

The seedlings when they attain the adult palm stage produce on an average about 11 to 12 leaves in a year which is almost constant. This rate of production of about a leaf in

a month continues till the palm attains senility. Since the leaf production is now more or less constant, the growth of the palm is well indicated by the height- the length of the stem from the ground level to the base of the crown of leaves - of the palm rather than the girth which does not appreciably change with age. Normally in a tall palm the stem begins to form in about five years after planting and is active throughout the life of the palm since it produces a single axis which remains unbranched in this single stemmed palm. In Table 5 are presented the data on the height of the palm measured at the end of fifteen years after planting and after every quinqennium till the palms were 57 years old. During the period of 15 years from the time of planting, the palms attained a mean height of 335.00 cm, the mean rate of growth being 22.33 cm from the time of planting and 33.50 cm. from the time of stem formation. According to Menon and Pandalai (1958) the stem grows at a relatively rapid rate in the earlier years till the palm commences to bear. During the next quinquennium the average growth in height was 120.00cm, the rate of growth being 24.00cm per year. The palm attained a mean height of 105. 00 cm during the next five years, the mean growth rate per year decreasing to 21.00 cm. The mean growth rate again decreased to 85.00 cm during the next five year period, the rate of growth being 17.00 cm per year. The growth rate further decreased to 80.00 cm during the next quinquennium with the rate of growth declining to 16.00 cm per year. The palm attained a mean height of 60.00 during the next five year period, the rate of growth came down to 12.00 cm per year. A slight increase in growth rate was recorded when the palms were 40 to 45 years old when the rate of growth per year increased to 14.00 cm per year. This may be due to some favourable weather conditions or agronomical treatments the palms had received during this quinquennium. The rate of growth decreased further to 8.57 cm per year during the period when the palms were 50 to 57 years old. The decline in growth rate was naturally due to the onset of senility. The palms had grown to a mean height of 9.6 m during the period of 57 years. Patel (1938) has correlated the growth of the stem with age and concluded that there is a gradual reduction in the vertical growth of the stem as the tree advances in age. The mean height of 9.6 m with a range of 6.8 to 13.0 m attained during a period of 57 years may seen to be low but in a regular planting with a good spacing where there is no shade, the palms will not grow very tall. Patel (1938) has stated that close planting is reported to favour tall stems. Only in the case of overcrowded gardens the palms tend to grow taller to get at sunlight as they cannot tolerate shade.

2 Yield of the palm from the 11th to 62nd year after flowering

When the palms attain the adult palm stage, they flower and begin to produce nuts. In a plantation all the palms do not flower at the same time because of genetical variability and other factors. The tall variety of coconut normally begins to bea about 5 to 7 years after planti During the earlier years a flowering the yields will poor since fewer number spadices are produced and t do not have any female flow or have only a very sm number. The yield of nuts the palms was recorded fr the eleventh year of their flo ering and continued for a peri of 62 years. The yield d represented in the biologi yield curve (Fig. 1) indicate t the yield per palm increas from the minimum of 35.2 n from the eleventh year of flo ering to maximum yield of 8 nuts in the 19th year. From t 20th year to the 62nd y after flowering the yield of n varied from 45 to 82 nuts. T indicates that in the 19th y after flowering or about 24 25 years after planting, the pal appear to have attained yie stability because in later yea the mean yield of nuts had n gone above 82 nuts. Patel (193 has stated that full yield obtained after 25 years after pla ting. Further scrutiny of t data indicates that from the 20 year to the 41st year aft flowering, the yield had varie from 50.9 nuts to 82.0 nuts p palm per year. This period the maximum yield period the palm. During the ne twenty years, that is from th 42nd year to the 59th ye after flowering, the yield varie from 47.9 to 65.8 nuts per pal per year which indicates a perio of steady lower yield possibi due to the onset of senility the palms. From the 60th ye onwards there was further declin in yield. The biological yiel curve indicates the maximu



yield period and the period of steady lower yield leading to slow decline as a result of the palms getting senile. The yield varies throughout the economic life of the palm. The economic bearing period of the tall variety, according to Menon and Pandalai (1958) may be 40 to 50 years or more. The yield variation of the palm depends not only on the seasonal variation but also on other factors causing secular trends. The curve indicates the characteristics peculiar to the palm like irregular bearing, tendency of the yield distribution over the years and yield pattern varying with the age of the palms. The information obtained is indicative rather than the exact as the shape of the curve varies with varying conditions.

CONCLUSION

From the observations made on the growth characters of the palm during its life cycle-from the seedling stage in the nursery to the adult palm stage in the field – there are certain stages during when improvements can be effected in its growth which may increase their yield efficiency. The first to strike our attention is the setback in growth of the seedlings in the nursery when they are about five months old from the time of germination. This has to be avoided if the seedlings have to maintain their vigorous growth. Since the nursery is not fertilized this setback in growth continues and considerably affects further growth of the seedling also. To avoid this setback, the seedling has to be either transplanted early, that is at the fourth or fifth month from the time of germination or the nursery has to be suitably fertilized to minimise the effect of the setback in growth and help the seedling to maintain its normal growth rate. At present the nursery is not fertilised nor early

transplanting is done. According to Menon and Pandalai (1958), the nursery is not fertilised as it is felt that the intrinsic merit of the seedling is likely to be masked to some extent making proper selection of seedlings difficult (Sampson 1923, John 1952). Thampan (1975) has stated that recent studies on the nutrient requirements of seedlings indicate that fertilisation is necessary if seedling vigour is to be maintained in the nursery. Early transplanting is not done since irrigation facilities are not available for the seedlings transplanted before the onset of the monsoon. Hence the seedlings are retained in the nursery till they are transplanted during the monsoon period. But for the setback in growth, the seedlings would have maintained their normal growth.

The second aspect that should receive our attention is the effect of the transplanting shock on the growth of the seedlings after they are transplanted in the field, for a long period of five years. This shock sustained as a result of damage to roots and disturbance caused during transplanting lasts for about five years and considerably delays further development resulting in delayed flowering. This shock is to be avoided either by early transplanting at the fourth or fifth month wherever conditions permit or its effect on the growth of the seedling should be considerably reduced with proper attention to timely irrigation and fertilisation both in the nursery as well as in the field. This will help the seedling to attain its initial flowering stage much earlier. Most of the earlier workers have recommended early transplanting of coconut seedlings from the nursery to the field to avoid the transplanting shock sustained by the removal of older seedlings from the nursery (Satyabalan 1983 c). The effect of the shock is so much that it takes about 19 years from the time of flowering to attain its yield stability. Otherwise the palms would have flowered and attained yield stability much earlier. To a coconut planter the most important issue is the number of years after which full yields are obtained. In a perennial crop like the coconut where the planters have to wait for a long time to get some benefit, efforts must be made to reduce the time lag between planting and flowering by early transplanting wherever possible or by adopting proper cultivation methods which will avoid the setbacks in growth experienced by the palm in its life cycle.

As mentioned earlier this study is only an attempt to have a fair knowledge of the life cycle of this versatile palm. It has helped to identify the impediments which hinder its normal growth during its life cycle. All efforts should be made to remove them which will certainly help the palm to flower and attain its stabilised yield stage earlier. In fact the delayed flowering and the long time to attain stabilised yield are mainly responsible for the total neglect of this palm by the planters who simply allow them to grow and do not pay much attention to its cultivation in the early stages of its growth. Hence the coconut palm can be said to be grown but not cultivated in most of the tracts where it grows.

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TABLE 1

Collar girth in seedlings from seednuts germinated during July to November

onth from the e of germi-ation	Collar girth in cm.	Number of seedlings germinated in July (35)	August (263)	Sept. (145)	Oct. (155)	Nov. (51)
1	5 cm & below	6	137	76	100	39
	5-6 cm	14	108	65	46	10
	Above 6 cm	15	18	4	9	2
2	6 cm & below	3	113	52	85	30
	6 - 7cm	19	122	82	64	16
	Above 7 cm	13	28	11	6	5
3	7 cm & below	12	110	71	92	33
	7 - 8cm	19	112	61	60	14
	Above 8 cm	4	41	13	3	4
4	8 cm & below	15	137	71	105	31
	8 - 9 cm	15	95	60	44	14
	Above 9 cm	5	31	14	6	6
5	9 cm & below	17	148	92	116	34
	9 – 10 cm	14	80	44	36	12
	Above 10 cm	4	35	9	3	5
6	10 cm & below	20	170	107	127	36
	10 - 11 cm	13	69	30	23	12
	Above 11 cm	2	24	8	5	3
7	11 cm & below	20	189	105	127	36
	11 - 12 cm	10	54	31	23	13
	Above 12 cm	5	20	9	5	2
8	12 cm & below	23	183	104	129	42
	12 - 13 cm	7	57	26	18	7
	Above 13 cm	5	23	15	8	2
9	13 cm & below	20	182	115	130	44
	13 - 14 cm	9	52	15	18	6
	Above 14 cm	6	29	15	7	1
10	14 cm & below	21	172	108	141	44
	14 - 15 cm	7	52	25	10	3
	Above 15 cm	7	39	12	4	4
	Mean	13.61	13.49	13.25	12.47	12.29

Leaf production in seedlings from seednuts germinated during July to November

Month from the time of germination	Total No. of leaves produced	Number of seedlings germinated in				
		July (35)	August (263)	Sept. (145)	Oct. (155)	Nov. (51)
1	Nil	16	152	87	112	36
	1 & above	19	111	58	43	15
2	Below 2	4	70	38	64	23
	2 & above	31	193	107	91	28
3	Below 3	9	105	66	112	28
	3 & above	26	158	79	43	23
4	Below 4	17	154	102	137	42
	4 & above	18	109	43	18	9
5	3 & below	3	50	49	85	23
	4	26	152	81	61	24
	5 & above	6	61	15	9	4
6	4 & below	11	133	94	119	30
	5	23	110	44	35	19
	6 & above	1	20	7	1	2
7	5 & below	20	188	112	128	32
	6	13	69	32	23	17
	7 & above	2	6	1	4	2
8	6 & below	26	228	124	135	45
	7	8	33	21	20	6
	8 & above	1	2	—	—	—
9	7 & below	32	250	136	153	51
	8	3	12	9	2	—
	9 & above	—	1	—	—	—
10	7 & below	24	196	123	146	46
	8	10	59	20	9	5
	9	1	8	2	—	—
	10 & above	—	—	—	—	—
	Mean	7.14	6.95	6.73	6.38	6.43

TABLE 3

Number of leaves produced by the seedling after transplanting in the field

Total no. of leaves produced by the seedling till the time of trans-planting	No. of funct-ioning leaves at the time of trans-planting in June	No. of leaves produc-ed till December	No. of leaves produced during 1st yr.	2nd yr.	3rd yr.	4th yr.	5th yr.	6th yr.	7th yr.	8th yr.	9th yr.	10th yr.	Total No. of leaves produced till the tenth year from the time of trans-planting	Total no. of leaves produced till the tenth year from the time of germination
7.5 (6 to 10)	5.6 (5 to 8)	1.2 (1 to 2)	4.3 (3to5)	5.5 (4to7)	5.7 (4to7)	5.9 (4to8)	7.8 (6to10)	9.8 (7to12)	9.7 (7to12)	9.3 (8to12)	11.0 (9to13)	11.9 (10to13)	82.1	89.6

(Figures given in parenthesis denote the range)

TABLE 4

Height of the palm from the time of transplanting till 57 years under regular planting

No. of years of observation from the year of transplanting	Total height from ground level to base of crown and range	Increase in height	Mean increase in height per year
5	Stem not formed	—	—
15	335.0 cm (144.5 to 630.0 cm)	335.0 cm	33.5 cm
20	455.0 cm (220.0 to 820.0 cm)	120.0 cm	24.0 cm
25	560.0 cm (322.5 to 925.0 cm)	105.0 cm	21.0 cm
30	645.0 cm (402.5 to 1017.5 cm)	85.0 cm	17.0 cm
35	725.0 (472.5 to 1105.0 cm)	80.0 cm	16.0 cm
40	785.0 cm (532.5 to 1167.5 cm)	60.0 cm	12.0 cm
45	855.0 cm 582.5 to 1232.5 cm)	70.0 cm	14.0 cm
50	900.0 cm (612.5 to 1285.0 cm)	45.0 cm	9.0 cm
57	960.0 cm (660.0 to 1302.5 cm)	60.0 cm	8.6 cm