

THE EFFECT OF MONOSPECIFIC GRASS SWARDS ON THE YIELD OF COCONUTS IN THE NORTH WESTERN PROVINCE OF CEYLON

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SUMMARY

Intensification of agriculture would assume importance in the foreseeable future to meet the food requirements of the increasing population in Ceylon. Coconut lands would offer some opportunity for intercropping, of which, animal production is a distinct possibility.

Two preliminary experiments assessing the effect of mono-specific grass swards on the yield of coconut relative to the natural weed population are described. With increase in the dry matter yield of herbage there was a decrease in the yield of coconuts. Soil moisture competition would not be a serious problem in the cultivation of pasture under coconuts in the low country wet zone of Ceylon, but nutrient competition would be considerable; this could be overcome by additional application and placement of fertilizers. In such intercropping the total yield or income per acre should be the deciding factor.

In a country of the size of Ceylon (25,000 sq.miles) with a population of 11.7 millions, increasing at the rate of 2.7 per cent per year, there would be a limit to extensive cultivation in the foreseeable future. Coconuts occupy over a million acres in the low country, and these lands offer prospects of intensive cultivation. During the juvenile stage of a plantation and later, under mature stands above thirty years of age, sufficient light reaches ground level for thick growth of weeds. In fact, intercropping during the juvenile stage, and an unorganised form of milk and meat production under mature stands do exist.

Further, the bulk of the cattle population of the island is situated in the coconut growing areas. These cattle are mainly the indigenous breed called *Sinhala*. The males are used for traction and the females are sometimes milked. These animals also provide the major portion of the beef requirements of the country. They roam and subsist on the palatable weeds that grow in the coconut plantations and neighbouring waste lands. The ungrazed weeds depress coconut yields and hinder normal estate practices, and are kept under control with considerable expense.

With a view to replacing the weeds with more useful pasture plants, which would provide better feed to these cattle, thus improving their performance resulting in increased income from cattle to the owner and animal products to the country, a programme of pasture development under coconuts has been initiated.

A pasture sward would compete with the coconuts for the essential factors for growth, such as soil moisture, nutrients, light and carbon dioxide, if the supply of any one or more of these factors are below the combined demands of the association. In view of the spatial arrangement of the leaves of the coconut palms and pasture plants there would be no competition for light

and carbon dioxide detrimental to the yield of coconuts. On the other hand, there could be considerable competition for soil moisture and nutrients. This competition, however, has to be assessed in relation to that to which the coconuts are exposed when the land is under weeds.

This paper reports two preliminary experiments carried out to assess the effect of mono-specific grass swards on the yield of coconuts.

EXPERIMENTAL

One experiment was carried out at Lunuwila, where the soil was a lateritic gravel, with mean annual rainfall of 75 inches received from the South West and North East monsoons, with short dry spells in between. The other was at Madampe, with a lateritic loamy soil and mean annual rainfall of 65 inches with a distribution similar to that at Lunuwila.

Experiment I

This compared the effect of three grasses:—*Brachiaria brizantha* (Hochst.) Slapt. (signal grass), *B. miliiformis* (Presl.) A.Chase. (cori grass) and *Panicum maximum* (Jacq.) (Guinea grass) against normal estate weeds, as control, on the yield of coconuts at Lunuwila. The plots were 1.5 acres in extent and planted to the grasses in Oct./Nov. 1955.

All palms in the plots received 10 lb. of a mixture of equal parts by weight of ammonium sulphate, rock phosphate and muriate of potash (60%) biennially in a circle round the base. The plots further received 1 cwt. ammonium sulphate in Oct./Nov. and 1 cwt each of ammonium sulphate and muriate of potash in May/June per acre per year broadcast. The palm manuring was based on the practice at this estate at the time of commencement of the experiment. The broadcast application was based on the findings of PALTRIDGE and SANTHIRASEGARAM (1957) from pot experiments with various test plants on these soils, where no response to phosphate was recorded. Prior to application of the broadcast fertilizer the plots were lightly harrowed each season.

The plots of *Brachiaria* spp. were grazed with two adult Sinhala cows, commencing 28 days after fertilizer application each season, till such time as no feed was available. The *P. maximum* plots were fenced into six strips, and whenever the grass commenced flowering, were grazed with eight adult Sinhala cows. Usually a round of grazing of this species was completed within a fortnight. As each strip was grazed the stubble was cut down to a height of six inches. The weed control was not grazed.

In all plots 40 palms in the centre were considered in computing yield. The dry matter yield of herbage was estimated with 12 random quadrats cut prior to commencement of grazing each season.

Experiment II

This assessed the effect of *B. brizantha* on the yield of coconuts at four intensities of grazing, compared to normal weeds (control) at Madampe. The levels of grazing were: no grazing (grass control), 2 cows/ac., 2 cows/1.5 ac. and 2 cows/2 ac.

The weed control and grass control plots were 0.5 ac. in extent while the others were of the area shown above. The grass was planted in 1959. Each plot received 1 cwt ammonium sulphate in May/June and 1 cwt each of ammonium sulphate, rock phosphate and muriate of potash in Oct./Nov. per acre per year broadcast. There was no fertilizer applied exclusively for the palms as in the previous experiment. The fertilizer practice adopted was based on the findings of SAL-

GADO (1953) with coconuts in the field and SANTHIRASEGARAM (1965) from pot experiments with various test plants on these soils, where both recorded deficiencies of nitrogen, phosphorus and potassium.

The plots were grazed from January to March and again from July to September each year at the intensities indicated.

In all plots, 16 palms in the centre were considered in computing yield. Dry matter yield of herbage was recorded as in the previous experiment.

RESULTS

Experiment I

The number of nuts per acre per year are presented in *Table 1* for the year of commencement (1956), the final year (1963) and the mean of the eight years. The table also shows the mean dry matter yield of herbage over the years. Treatment effects were measured by fitting linear regressions and the regression coefficients (*b values*) which were all positive showing that the yield under all treatments increased with time, and the mean rate of increase per year of the plots with grass relative to the weed control, are shown in *Table 2*.

TABLE 1
The yield of coconuts (nuts/acre) and mean dry matter yield of herbage (lb./acre)

<i>Treatments</i>	<i>No. of nuts/acre</i>			<i>Herbage (D.M.lb./ac)</i>
	1956	1963	<i>Mean of 8 years</i>	<i>Mean of 8 years</i>
Weed (control)	3068	4641	3512	9719
B.brizantha	3001	4854	3737	7773
B.miliiformis	2806	4867	3726	7952
P.maximum	2742	3697	3243	14672

TABLE 2
Linear regression coefficient (*b values*) and rate of change in yield of coconuts with time

<i>Treatment</i>	<i>b values</i>	<i>Rate of change per year</i>
Weed (control)	219.4	0
B.brizantha	232.6	13
B.miliiformis	231.8	12
P.maximum	120.7	— 99

The *Brachiaria* spp. appear to have had no effect on the yield of coconuts, while *P. maximum* had caused a mean annual loss of 99 nuts per acre. The effect of the grasses on the yield of coconuts was related to the dry weight of herbage produced. Those producing more dry matter than the weed control had a depressive effect while those producing less dry matter increased the yield of coconuts. The yield of coconuts with time, in the various treatments, are shown in Fig. 1, where two year moving averages of the yield of nuts were calculated to eliminate bienniality in coconuts (ABEYWARDENA 1962), and the yield for 1956/57 taken as 100, and those of subsequent years calculated as percentages of it. The upward trend from 1958/59 onwards may be attributed to the effect of the broadcast manure applied to the plots, which was in addition to the normal estate manuring of the palms. In the case of *P. maximum* however, there appears to be a stabilization of yield from 1960/61 onwards while the other treatments continue to exhibit an upward trend.

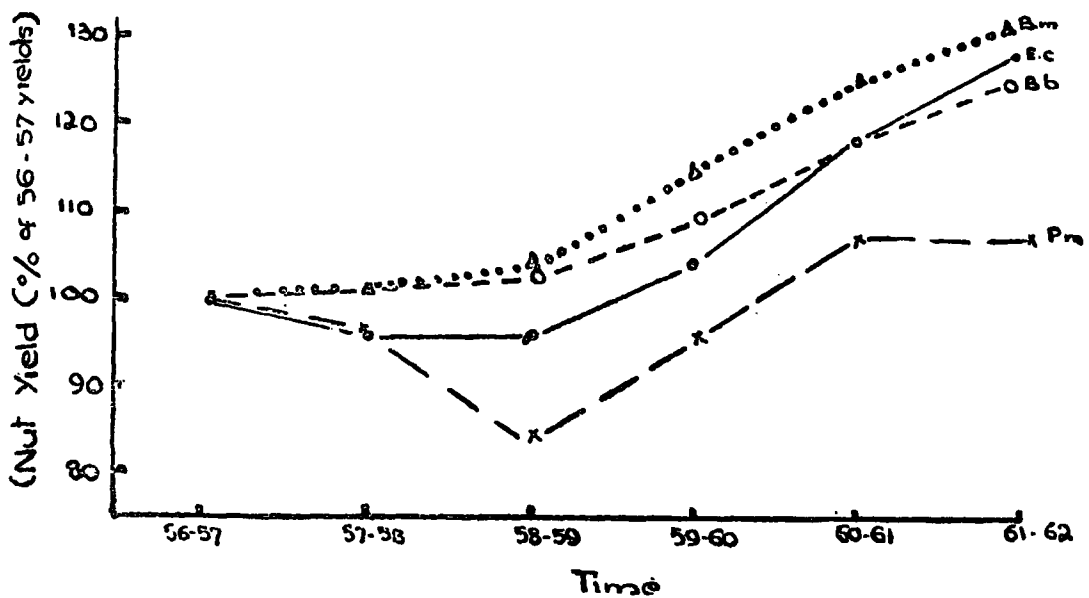


Fig. 1

Relative change of yield of coconuts with time under weeds and three grasses.

Experiment II

The number of nuts per acre for the year of commencement (1960), the final year (1963) and the mean over the four years, along with the mean dry matter yield of herbage, are presented in Table 3. Here too, linear regressions were fitted and the *b* values, which were positive for the weed control and negative for the grass plots, indicating a decline in yield with time, and this rate of decline in number of nuts per year, are shown in Table 4. The depressive effect of the non-grazed grass control was higher than those grazed, among which, there was no obvious trend with the intensities of grazing. Here too, with increase in the dry matter yield of herbage there was a decrease in the yield of nuts.

TABLE 3

The yield of coconuts (nuts/acre) and mean dry matter yield of herbage (lb./acre)

Treatments	No. of nuts/acre			Herbage (D.M.lb./ac)
	1960	1963	Mean of 4 years	Mean of 4 years
Weed (control)	4913	5253	5085	793
Grass (control)	3806	3393	3672	1921
Grass (grazed 2:1)	4451	4327	4549	1760
Grass (grazed 2:1:5)	4187	3914	4285	1531
Grass (grazed 2:2)	4426	4324	4504	1727

TABLE 4

Linear regression coefficient (b values) and rate of change in yield of coconuts with time

Treatments	b values	Rate of change per year
Weed (control)	59.5	0
Grass (control)	— 131.2	— 191
Grass (grazed 2:1)	— 25.6	— 85
Grass grazed (2:1:5)	— 66.0	— 126
Grass grazed (2:2)	— 35.5	— 95

DISCUSSION

The establishment of a pasture under coconuts leads to the replacement of the natural weed population. The effect of this replacement on the yield of coconuts would depend on the extent to which the pasture species compete with the coconuts for the growth factors relative to the weeds. While competition for the soil factors would depend on various characters of the pasture species, the quantity or the dry matter yield of herbage produced is easily measurable and the present discussion employs this character to study the competitive effect of pastures. The following three circumstances could then arise:—

- (i) Where $Y_p > Y_w$ then Y_c would decrease
- (ii) Where $Y_p = Y_w$ then Y_c would not be affected
- (iii) Where $Y_p < Y_w$ then Y_c would increase.

(Y_p =dry matter yield of pasture, Y_w =dry matter yield of weeds and Y_c =yield of coconuts)

These three circumstances are postulated in the absence of any additional manuring or irrigation over and above that which is applied when the land is under weeds. From a practical point of view (ii) would not pose any problems and (iii) would be beneficial from the point of view of coconuts. Situation (i) would however be more general. *PENDLETON et al* (1957) showed that the yield of corn was reduced by 15 per cent when alfalfa was inter-planted and *SANTHIRASEGARAM* (1962) recorded 25 per cent reduction in yield of wheat when undersown to a pasture mixture. *SALGADO* (1944) observed 47 per cent reduction in the yield of coconuts when underplanted to a fodder grass. This extent of reduction by the fodder grass which is unusually high, was mainly due to the method of manuring adopted, where the coconuts in no-fodder plots received manure in a circle round the base while in the fodder-plots the equivalent quantity of manure was applied broadcast over the entire area. It has been shown by *NETHSINGHE* (1963) that uptake of nutrients was very much higher by coconuts when applied in a circle 5.5 ft. radius from the base of the palms than when the same quantity was broadcast over a greater area. Further such placement of fertilizer would restrict the amount that could be utilised by the pasture species.

In the experiment at Lunuwila reported here the coconuts received fertilizers round the base and a further quantity was applied broadcast. Under such fertilizer regime there was no difference in the yield of coconuts from weeds, *B.brizantha* and *B.miliiformis*, but there was some depression from *P.maximum*. In the second experiment where all the fertilizer was applied broadcast, there was considerable depression from *B.brizantha*; the depression from ungrazed plots was higher (28%) than from the grazed plots (13%), among which there was no obvious trend with the intensities of grazing.

At Lunuwila *SALGADO* (1944) showed that at high level of broadcast fertilization it would be possible to completely eliminate the depressive effect of *Pennisetum purpureum* on the yield of coconuts. It is therefore highly probable that with further application of fertilizers the depressive effect noted with *P.maximum* could also be eliminated. It must however be noted that in the present experiment the weed control treatment also received broadcast manuring in addition to that applied to the palms. It is not possible to measure the extent to which this additional manure brought about the upward trend in the yield of coconuts. Had the control treatment not received the broadcast fertilizer, then it is highly probable that in a relative sense there may not have been a depression from *P. maximum* and an increase in yield from the *Brachiaria* spp.; but in absolute terms increase in the quantity of fertilizer broadcast would eliminate the depression from *P.maximum*. It is then reasonable to suggest that at Lunuwila with a mean annual rainfall of 75", there would not be any competition for soil moisture between coconuts and pasture species. *SANTHIRASEGARAM* (1959) could not record any difference in the rate of soil moisture exhaustion among swards of *B.brizantha*, *Paspalum commersonii* and normal weeds, under coconuts at Lunuwila.

At Madampe the depression caused by the grass may be either due to competition for nutrients and/or soil moisture. The mean annual rainfall at this location is 65", and fertilizer was applied only broadcast. The smaller depression of the grazed swards compared to the ungrazed swards may be due either to removal of herbage at the onset of the dry season, thus reducing soil moisture competition, on faster recycling of nutrients. *WOLF* (1964) has shown that defoliation decreases root growth and thus reduces soil moisture exhaustion. Had the fertilizers been applied round the base of the palms in addition to broadcast manuring it may have been possible to reduce the depressive effect of the grass considerably.

It would then appear that at both locations competition for soil moisture between coconuts and grass would not be a serious problem. Madampe is in the northern end of the Wet Zone of Ceylon and it may be said that in the Wet Zone of Ceylon which comprises the greater portion of the coconut growing areas, soil moisture would not be a serious limitation to the satisfactory cultivation of pastures under coconuts.

Competition for nutrients would be an important consideration. Here the quantity of fertilizer and method of application are important factors. Competition for any nutrient in short supply would be operative; and that for nitrogen could be reduced or even added to the advantage of coconuts by the inclusion of an effectively nodulating legume into the pasture. Fertilizer placement for the coconuts and broadcast application for the pasture and the coconuts would further reduce competition for nutrients. These aspects are now under investigation.

In animal production or other form of intercropping with coconuts the important point to be considered would be the total yield or income from a unit of land. It may not be sound economics to adjust agronomic practices so as to eliminate all competitive effects of the intercrop on the main coconut crop.

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