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Crop Losses in Coconut Through Button Shedding and Immature Nutfall

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SUMMARY—A coconut bunch commencing with an average of 16 female flowers or potential nuts, loses 23.8% of these nuts during the first two-months, 40.1% during the second two-months and 1.9% during the third two-months of development. Thereafter nut losses through shedding is negligible.

Immature nutfall is relatively heavy during the periods February/March and August/September which follow closely the two dry periods of the year and are therefore periods of moisture stress.

The ultimate loss of nuts that a bunch (or a group of bunches leading to a pick) suffers as a result of button shedding and immature nutfall is determined by what early stage of development it is in when it meets either of these periods of moisture stress. The first and fourth picks whose second two-months of development (the most susceptible stage) coincides with a period of moisture stress suffers the highest nut losses. The second and fifth picks whose first two-months of development (the next susceptible stage) coincides with a period of moisture stress suffers the next highest nut losses. The third and sixth picks whose third two-months of development (still less susceptible stage) coincides with a period of moisture stress suffers the lowest nut losses.

The typical crop pattern in the main coconut areas of Ceylon, with a maximum during May/June (the summer) and less and less towards the beginning and end of the year, is now better understood. The idea of daylength being the determining factor is considered untenable.

It is suggested that by eliminating moisture stress during the dry periods January/February and July/August, a minimum of 25% yield increase can be ensured.

INTRODUCTION

In a given coconut plantation, the genetic potential and the soil-climatic environment, which are the key factors influencing yield, are fixed. Yet within the same plantation, crops do vary considerably from pick to pick. Such crop variations are conditioned by the cumulative effect of weather-oriented seasonal variations

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in the crop components —namely (1) the number of bunches, (2) the number of female flowers per bunch, (3) the rate of pollination and (4) button shedding and immature nutfall.

In this article it is proposed to record some of our recent observations on crop variations arising from button shedding and immature nutfall, and also the factors determining the crop pattern within the year.

MATERIALS AND METHODS

The data presented herein were obtained from a uniformly managed block of 166 palms (Calibration Trial), at Ratmalagara Estate of the Coconut Research Institute of Ceylon. In this experiment, every inflorescence of every palm is tagged when the spathe opens and the number of female flowers recorded. From then onwards, once every two months, the number of nuts remaining in the bunch is recorded, until the bunch is ripe and harvested. This provides a record of button shed and the immature nutfall at various stages of development of each bunch. Such case histories of developing bunches are available for 10588 spathes that opened during the five-year period 1965-1969. The spathes that opened in 1969, were followed upto their maturity in 1970.

RESULTS

1. Progress of a developing bunch—the general pattern

The visual cycle of development of a bunch of coconuts commences from the time the spathe opens carrying a number of female flowers which are all potential nuts. After about three weeks, these female flowers become receptive. Some of them get successfully pollinated to form nuts, and rest fall off. This type of nutfall is termed button shedding. Those female flowers that get successfully pollinated to form nuts are, in the early stages, highly susceptible to moisture stress and other extraneous enemies in the form of pathological or entomological agents. As a result, further losses of immature nuts occur from time to time. Finally only about a third of the nuts remain in the bunch up to maturity.

Table 1 shows the extent of losses in nuts arising as a result of button shedding and immature nutfall at various stages of development.

It is observed that a bunch starting with an average of about 16 female flowers in the bunch loses about 4 nuts in the form of buttons during the first two-months period, about 7 immature nuts during the next two-month period, and a negligible number of more mature nuts during the third two-month period, leaving on the average not more than a paltry four to five nuts to proceed to maturity and harvesting. Losses through immature nutfall after the sixth month is less than 1% and these probably are in the form of barren nuts. Thus not more than a third of the female flowers finally end up as ripe nuts.

2. Progress of nutfall in the different picks

The general pattern of nutfall described in the earlier section, may not necessarily apply to all the picks alike. The six picks of this experimental block were done regularly during fixed periods. The first pick was done at the end of January, the second at the end of March, the third at the end of May and so on every two months. Thus there will be six developing cycles pertaining to these six picks—each overlapping the one preceding it with a constant lag of two months. The spathes opening during the period December/January of a given year will mature during the first pick of the subsequent year; the spathes opening during the period February/March will mature during the second pick of the subsequent year; so on and so forth.

The progress of these six groups ending up in the six picks—what yield potential they started with, at what stages nut losses occurred and how they ended up at harvest—is shown in Fig. 1 and Table 2.

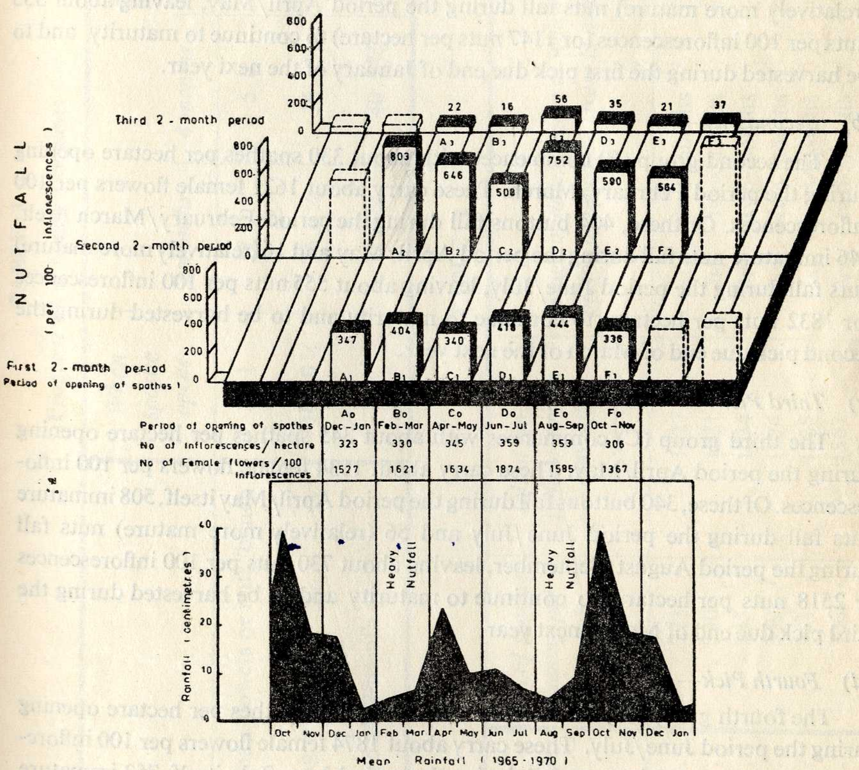

Fig. 1. Seasonal Immature Nutfall

The progress of each of the groups is indicated under a common letter either A, B, C, D, E or F corresponding respectively to the six picks within the calendar year. The number suffix given to each letter shows the different stages of development of each group. For instance A_0 refers to the yield potential of the first group when the spadices open—that is the number of inflorescences, and the number of female flowers per 100 inflorescences; A_1 refers to the nutfall within the first two months, A_2 the nutfall within the second two-month period and A_3 the nutfall within the third two-month period. The progress thereafter is not shown as the nutfall after six months is negligible.

(*a*) *First Pick*—

The first group (A) commences with about 323 spathes, per hectare (2.47 acres) opening during the period December/January. These carry about 1257 female flowers per 100 inflorescences. Of these 347 buttons fall during the period December/January itself, 803 immature nuts fall during the period February/March, and 22 (relatively more mature) nuts fall during the period April/May, leaving about 355 nuts per 100 inflorescences (or 1147 nuts per hectare) to continue to maturity and to be harvested during the first pick due end of January of the next year.

(*b*) *Second Pick*—

The second group (B) commences with about 330 spathes per hectare opening during the period February/March. These carry about 1621 female flowers per 100 inflorescences. Of these, 404 buttons fall during the period February/March itself, 646 immature nuts fall during the period April/May and 16 (relatively more mature) nuts fall during the period June/July, leaving about 555 nuts per 100 inflorescences (or 1832 nuts per hectare) to continue to maturity and to be harvested during the second pick due end of March of the next year.

(*c*) *Third Pick*—

The third group (C) commences with about 345 spathes per hectare opening during the period April/May. These carry about 1634 female flowers per 100 inflorescences. Of these, 340 buttons fall during the period April/May itself, 508 immature nuts fall during the period June/July and 56 (relatively more mature) nuts fall during the period August/September, leaving about 730 nuts per 100 inflorescences or 2518 nuts per hectare) to continue to maturity and to be harvested during the (hird pick due end of May of next year.

(t*d*) *Fourth Pick*—

The fourth group (D) commences with about 359 spathes per hectare opening during the period June/July. These carry about 1874 female flowers per 100 inflorescences. Of these, 418 buttons fall during the period June/July itself, 752 immature nuts fall during the period August/September, and 35 (relatively more mature) nuts fall during the period October/November, leaving about 669 nuts per 100 inflorescences (or 2402 nuts per hectare) to continue to maturity and to be harvested during the fourth pick due end of July of the next year.

TABLE 1

Progress of a bunch Coconuts

	When spathe opens	*At the end of*				
		2 months	*4 months*	*6 months*	*8 months*	*10 months*
Mean No. of female flowers or nuts/bunch	16.1	12.3	5.8	5.5	5.4	5.3
% nuts remaining in bunch	100.0%	76.2%	36.1%	34.2%	33.5%	33.1%
% nutfall during each 2-month period ..		23.8%	40.1%	1.9%	0.7%	0.4%

TABLE 2

Period of opening of spathes	*No. of spathes opening per hectare**	*Initial No. of female flowers per 100 inflore-scences*	*Stage of development at which period of moisture stress is met*	*Total nut losses within first six mths. (per 100 inflorescences)*	*Final harvest nuts per hectare*
Dec./Jan. ..	323	1527	2nd. two-months	1172	1147
Feb./March ..	330	1621	1st. two-months	1066	1832
April/May ..	345	1634	3rd. two-months	904	2509
June/July ..	359	1874	2nd. two-months	1205	2402
Aug./Sept. ..	353	1585	1st. two-months	1055	1871
Oct./Nov. ..	306	1367	3rd. two-months	937	1316

(*Hectare = 2.47 acres)

(*e*) *Fifth Pick*—

The fifth group (E) commences with about 353 spathes per hectare opening during the period August/September. These carry about 1585 female flowers per 100 inflorescences. Of these 444 buttons, fall during the period August/September itself, 590 immature nuts fall during the period October/November and 21 (relatively more mature) nuts fall during the period December/January, leaving about 530 nuts per 100 inflorescences (or 1871 nuts per hectare) to continue to maturity and to be harvested during the fifth pick due end of September of next year.

(*f*) *Sixth Pick*—

The sixth group (F) commences with about 306 spathes per hectare opening during the period October/November. These carry about 1367 female flowers per 100 inflorescences. Of these, 336 buttons fall during the period October/November itself, 546 immature nuts fall during the period December/January, and 37 (relatively more mature) nuts fall during the period February/March, leaving about 430 nuts per 100 inflorescences (or 1316 nuts per hectare) to continue to maturity and to be harvested during the sixth and final pick due end of November of next year.

3. Influence of the weather on button shedding and immature nutfall

In Fig. 1, it is clear that button shed within the first two months of development is relatively heavier during the periods February/March and August/September. Similarly immature nutfall within both the second two-months and the third two-months of development is also heavy during the same two periods. Whatever the stage of development, there is relatively more nutfall during the periods February/March and August/September.

The incidence of rainfall in the area (Fig. 1) indicates that the periods January/February and July/August are the dry periods of the year. Therefore the periods February/March and August/September that follow in the wake of these dry periods are invariably periods of moisture stress and the higher incidence of button shedding and immature nutfall observed during these two periods may be the result of this moisture stress.

Thus the ultimate loss of nuts that a bunch (or a group of bunches leading to a pick) suffers as a result of button shedding or immature nutfall will depend on what stage of its development has to face either of these two periods of moisture stress. If the coincidence occurs at a highly susceptible stage of development, nut losses would be heavier than otherwise.

The bunches of the first pick whose spathes opened during December to January of the previous year faces the period of moisture stress (February to March) in their second two-months of development. Similarly the bunches of the 4th pick whose spathes opened during the period June to July of the previous year faces the other period of moisture stress (August to September), also in their second two-months of development. As the second two-months of development is the most susceptible stage, the total loss of nuts in these two groups should be very high.

Similarly the groups corresponding to the 2nd and 5th picks, commencing during the periods February/March and August/September respectively face a period of moisture stress within the first two-month period itself. As the first two-months of development in the next susceptible stage, the total loss of nuts for these two groups should be second highest.

The other two-groups corresponding to the 3rd and 6th picks face a period of moisture stress in the third two-month period of development, which is relatively the least susceptible stage. The total loss of nuts for these two groups should be the lowest.

These expectations are amply confirmed by the data presented in Table 2. The first and fourth picks whose second two-months of development coincided with a period of moisture stress suffered the highest nut losses; the second and fifth picks whose first two-months of development coincided with a period of moisture stress, suffered the second highest nut losses; and the third and sixth picks whose third two-months of development coincided with a period of moisture stress suffered the lowest nut losses.

DISCUSSION

Investigations carried out in the past to determine the possible influence of pathological, entomological and nutritional factors on button shedding and immature nutfall in coconut, have not led to any reasonably conclusive results except for some entomological causes which have been identified (Menon and Pandalai 1958). On the other hand, quite a number of workers have reported that the weather has a profound influence on the shedding of buttons and immature nuts. The only snag in their findings seem to be that they differ in their opinions as to what aspect of the weather is the causative factor. Gadd (1923) and MacDonald (1924) observe that drought causes nutfall, while Park and Fernando (1940) observe that nutfall is heavy during the rains. There is again the belief among local planters that rains following a drought give rise to serious nutfall.

We are inclined to believe that these apparently contradictory viewpoints are merely differences in interpretation given to the same phenomenon. A drought in relation to a given plant species is the minimum length of dry spell capable of inducing moisture stress in the plant, inhibiting to some degree or other its normal physiological processes. The ill effects of such a drought will exhibit themselves in the plant only after the lapse of this minimum period. Assuming then that abnormally high immature nutfall is caused by moisture stress, heavy immature nutfall can occur only after the lapse of this minimum length of dry spell. If we consider a situation wherein the dry period extends very much longer than this minimum length, heavy nutfall will occur during this latter period which happens to be dry and consequently an observer is led to conclude that nutfall is heavy during a drought. In another situation when rains come down after this minimum length of dry spell, heavy nutfall still occurs, but during the rainy season; and this may not necessarily be due to the rains as such, but due to the drought that preceded it. The third belief that rains following a drought causes heavy immature nutfall is also explained by the second situation. With more information coming from this experiment in due course, we propose to define what this minimum dry spell is—either as a number of rainless days or as a period without a minimum of a certain amount of rainfall.

In the present study too, heavy button shedding and immature nutfall followed in the wake of the two dry periods of the year. In the main coconut growing areas of Ceylon, the periods January/February and July/August are relatively dry, with the result that the periods February/March and August/September which follow them, are periods of moisture stress, causing or predisposing to heavy immature nutfall.

The findings of this study also provide a more concrete explanation of the hitherto unexplained "Crop pattern within the year". In the main Coconut growing areas of Ceylon consisting of the North Western, the Western and the Southern provinces, the rainfall is bimodal with two humps—one constituting the South-West monsoon rains of May/June and the other the intermonsoonal rains of October/November. On the other hand, the crop pattern in these areas is typically unimodal, with a maximum during May/June and becoming less and less towards the beginning and end of the year. This failure of the crop pattern to run parallel to the rainfall pattern led Salgado (1955) to suggest that day-length (which follows a similar trend as the crop pattern) is the determining factor. The untenability of this argument was however brought home to the senior author of this article, when he had information subsequently that in the Eastern province of Ceylon with almost the identical daylength pattern, the crop pattern was very different. The present study tells us more specifically why a particular harvest is large or small. We know what yield potential each crop has at time of commencement one year earlier. We also know that certain bunches meet a period of moisture stress when they are at a highly susceptible stage of development and hence lose many nuts through button shed and immature nutfall and that other bunches meet a period of moisture stress at a less susceptible stage and hence lose less nuts. Thereby we have a complete understanding of the differing dimensions of the six harvests. However what factors govern the concentration of more opened spathes during one season and not in another and what factors influence spathes opening in one season to have more female flowers per bunch than those opening in another season are still to be understood.

What practical significance can be attached to these findings? This study was undertaken with a view to collect some background information necessary for our crop-forecasting studies and the results obtained have given us clues of much value. We feel that incidentally these findings offer more than a ray of hope to those enterprising planters who are now prospecting with the idea of irrigating their coconut lands. Sampson (1923) believed that nature provides a certain amount of safeguard to prevent exhaustion of the tree from overbearing and hence the reason why many of the female flowers or buttons are shed after fertilization and some of the nuts after setting, fall prematurely and a few others turn barren. Child (1950) seems to agree with Sampson when he states that the fall of nuts is a natural phenomenon since far more female flowers are produced than the palm could bring to maturity. We do not disagree with these pioneer workers that a certain palm or a cluster of palms may have a certain maximum bearing capacity under a given soil-climatic-management complex, but on the face of the present findings, we would wish to strike a more optimistic note. What in fact is this maximum bearing capacity? Is it what one now gets, about which nothing can be done or is it something higher, which can be achieved by doing something? A very modest estimate based on the nut losses due to moisture stress alone shows that if the soil moisture is maintained above a certain minimum during the dry periods January/February and July/August, as much as a 25% yield increase can be anticipated.

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FRENCH SCIENCE TURNS TOWARDS MASS MEDIA

For two days recently, some 80 research workers—amongst whom are two Nobel prize winners—and a score of scientific journalists were shut up together in a hotel at Nice, collaborating on a search for means of improving the relationship between scientists and science writers. The optimists expected a strict settling of accounts, but what they got was rather a group psychoanalysis—fairly unmethodical, but certainly salubrious. The pessimists, for their part, feared a more subtle form of fiasco; a purely academic debate from which no concrete result would be obtained. However, definite measures have been decided upon. It is true that these are still modest and their effects are uncertain. But at least a first step has been taken.

But would the Association of Scientific Journalists have succeeded in organizing the Nice Meeting so effectively if severe measures of austerity had not affected the French Research Laboratories? The indifference of public opinion to this financial crisis appears to have convinced the scientists that it was desirable to enhance the public image of French Research.

As might have been foreseen, the research workers reproached the Press with perpetrating inaccuracies, abusive simpliciations and premature conclutions. The journalists, on the other hand, deplored the indifference of the scientists to the most elementary rules of communication and their excessive preference for secrecy.

For scientists, the word "Press" conjures up an image with rather vague outlines. This had to be clarified, therefore, before getting at the crux of the matter. Several journalists addressed the meeting successively to explain the obligations intrinsic in the various media which they represented; agencies, dailies, monthlies, radio and TV and Medical information. The debate sometimes became stormy. In a trenchant manner (Monod), paternal (Kastler), or explosive (Abragam), some of the great names amongst French Scientists expressed their uneasiness about the disastrous effects which might result from too close co-operation between the research workers and, in particular, young research workers and the press. They were answered by others who denounced the 'mandarins' and their claims to a monopoly of publicity. The majority of participants however, came out in favour of an effort which should be directed simultaneously at the institutions and their current regulations and, what is more difficult, to changing the mentality of scientific circles.

The ban on journalists attending certain scientific meetings is to be lifted. Competent press officers are to be recruited in sufficient numbers. At present, the holders of these posts are nearly always administrators, without press experience, who combine these functions with several others. Moreover, they are kept away from both the decisions taken at the summit by the directors and from the basic activities in the laboratories. Their essential characteristic, therefore is to possess no information whatever to communicate on the organization which they represent.

It was also decided to set up a working group, composed equally of scientists and journalists, to deal with future problems.

Extract from a report by Michel Chodkiewicz appearing in Science Journal. Vol. 6 *No.* 2 1970 *page* 9.