Further Notes Concerning The Central Australian Cabbage Palm – Livistona Mariae

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In this journal (*Principes* 2:92-94, 1958) some general comments were given earlier concerning the habits and habitat of *Livistona Mariae*. Since these were written, a visit has been made to Palm Valley as part of an overall botanical reconnaissance of the northwest of South Australia and southern central portions of Central Australia. Whilst in Palm Valley, the opportunity was taken to make further observations and to collect a small quantity of seed. This seed was obtained with a view to carrying out a few germination tests; not only to discover the type of seed which was viable, but to enquire into the stages of germination.

General Observations

The natural soil of Palm Valley is, as one would expect, river-washed sand and gravel. About 6-9 inches below the surface, heavier material is found, and stones often 4-5 inches in diameter occur. The surface of the soil is covered with decaying organic matter. In the palm thickets (Fig. 30) this debris has built up to a considerable thickness. It is often several feet above the general level of the river bed, and unless the river is in very high flood, very little of this matter is lost by water.

The bed of the Finke River, which forms the gorge and habitat where *Livistona* grows, is approximately two miles long, and up to 200 yds. wide. There are, however, one or two outliers still within the general gorge area, but quite separate, and forming "islands."

In the field a large number of seedlings of this palm were seen. These occurred in various places: in dense colonies under palms, as rows of seedlings which have grown from seed washed into rock crevices; or as individual seedlings in isolated small pockets of soil in the rock mass.

The age to which palms grow before dying is not known. A careful investigation was made in Palm Valley, but very few fallen trunks were noted. Most certainly none had fallen in recent years. It is likely, however, that trees live to a considerable age, because palms of 50 or 60 feet high had only commenced to develop the root mound which most palms produce as they reach maturity. In half a dozen cases only were these root mounds of any consequence (Fig. 28). In these instances they were 4-6 feet through at the base and about 5 feet high. Other than this, the trunks appeared to develop straight from the soil level.

The old fronds initially remain on the trunks, bend downwards, and become appressed around the trunk like an apron, where they die. As in *Washingtonia*, these old fronds stay in position until blown off by strong winds, but in the centre of the thickets where wind velocity is greatly reduced, the fronds remain adhering to the trunk. However, as the palm grows and the crown and trunk are taken above the protective stand, the dead leaves either fall or are blown off, leaving the trunk bare (Fig. 26).

One feature rarely noted amongst

stands of palms was the number of curving, twisted, and crooked trunks. From observations it was not possible to decide what had caused the trunks to grow in this position (Fig. 30, right), although interference by other plants cannot be overlooked. Reference to the plate (Fig. 52) in my previous article will show that the tall palm is greatly arched; but as the photo shows (Fig.

26. Palms show the retained apron of old fronds in the centre of a thicket, but bare trunks above and to right.

29) the trunks are in the form of an "S." The height of these palms is approximately 60 feet.

Seedlings in the Field

The initial seedling leaf is single, and except for some broadening towards the apex, the next three to six leaves are undivided. This broadening of the lamina proceeds, then the leaf divides at the tip, and in the 10th or 12th leaf a palmate frond develops. The young leaves have weak spines along their edges but these quickly disappear. As the subsequent leaves occur, the spines become more rigid and stronger along their petioles, until those along the stalks of the initial palmate fronds are quite strong and sharp and are small replicas of those to be seen along the mature leaf stalks.

The leaves of the seedlings growing amongst the mature palms are green and never assume a reddish hue. It was noted, however, that in those seedlings growing away from the main colony of palms the leaves were a deeper colour, and in one or two instances they had already commenced to turn reddish. It would appear that the young plants assume the reddish tinge to dull red and almost cinnamon red only when growing in fully exposed sites, and more especially when growing as individual seedlings well separated from the main palm colony (such as in rock crevices or pockets). On the other hand, without exception, the seedlings growing in exposed sites had red leaves, and it was not until these plants commenced to produce a trunk that the colour of the leaves changed from red to a glaucous colour.

It would appear, therefore, that to produce red juvenile or young foliage under cultivation it is essential to grow seedlings in a hot fully exposed site, and probably in a soil deficient in organic matter.

The rate of growth following the production of the initial leaf is not known, but it undoubtedly depends on the water supply. Rain in this region is by no means regular, although there is probably a certain amount of underground water which the roots of these plants can draw on freely. When the seedling has developed a trunk approximately the diameter of the mature palm, the trunk commences to elongate. This may take at least 10 to 12 years in the field. At this stage the petioles may still be coloured, but the lamina commences to change from red to glaucous colour, and when the trunk is about 6 feet high normal green leaves are produced.

Undoubtedly the rate of growth also determines not only the age but the height at which this palm reaches maturity (flowers). Numerous specimens were examined, but none had produced flowers if the trunk was under 15 feet. However, palms of 25-30 feet showed old flower heads present and it is likely that somewhere about this height they commence to flower.

It was previously stated that flowering is "probably annual." In the main this statement remains substantially true, because at this height the palms are likely to be drawing freely on underground water supplies and are therefore no longer dependent on seasonal rains. Prolonged droughts only would curtail regular growth and flowering.

A large number of seedlings was excavated in an endeavour to trace their root growth and root development during the young years. Following germination, roots descend rapidly. The crown was at least 4-6 inches below the soil level and the roots of seedlings having three or four leaves extended to at

least 18 inches deep. By this stage there was also considerable lateral root spread. As can be seen from the accompanying photograph (Fig. 32), the development of the seedlings following the production of the shoot and fourth leaf is fairly regular, but the trunk development is extremely slow.

Germination of Seed

From the seed collected in the field, a quantity was sown under controlled conditions at the Adelaide Botanic Garden. Before sowing the seed was sorted into five groups. (See Fig. 27.)

Group A: The thin but fleshy exocarp of brownish-plum colour was entire. This was present season's seed.

Group B: Exocarp covering was slightly chipped, brownish-black in colour, but at least 75 per cent of the individual seed was covered. Probably present season's seed.

Group C: The covering had started to rot away, was comparatively thin, grey coloured, and in some instances covered less than approximately 50 per cent of the seed. This could be seed of previous years (seasons).

Group D: The covering was entirely removed, and represented fresh seed.

Group E: This comprised obviously old seed. The fruit was in some instances deeply pitted or indented, black in colour, and when cut in half before sowing, it appeared either dead or almost so.

The five lots of seed were sown on 1st August in our usual seed soil mixture (based on John Innes Standard) in 4-inch pots which were plunged into bottom heat of 80° F. Ten seeds of each type were sown to a pot.

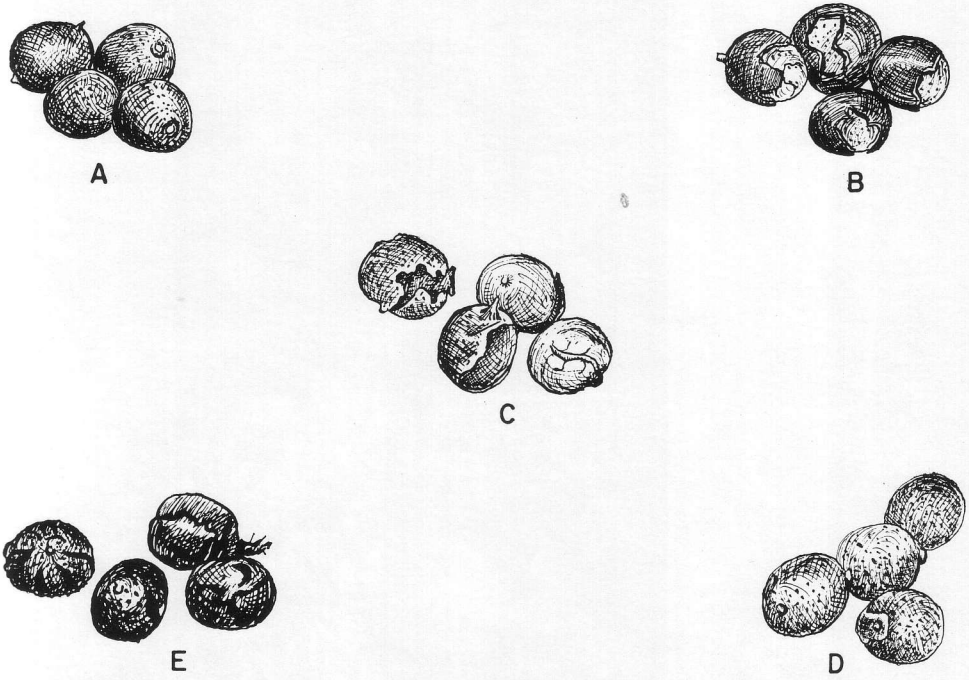
Five weeks later (5th September) no seedlings had occurred in groups A and E. In group B there were two seedlings, and in groups C and D one seedling in each had appeared above the ground.

By 27th September, the following germinations had taken place: Group A—one seedling commencing to show above the soil; Group B — two seedlings; Group C — one seedling; Group D — eight seedlings, five several inches high and three just breaking the soil level; Group E—no germination.

On 27th October, the following was the progress of the five batches of seed: Group A—two seedlings were growing, one freely with an upright leaf, the other slowly with an abnormal leaf (curled and prostrate); Group B—two seedlings produced, one growing strongly, the other very weak; Group C — two seedlings which subsequently died; Group D—nine seedlings well above the soil level, all growing very strongly; Group E—no germination.

On 19th November, approximately 15 weeks after sowing the seed, the pots were removed from the propagating pit, each was emptied, and a check was made on the number of seeds which had germinated, the condition of the seedlings and of the remaining seeds. The results were as follows:

Group A—Four seedlings produced, of which two seeds had germinated recently and were just pushing through the surface of the soil. The other two were well established. The seedling with the curled and prostrate leaf had continued to grow but at a rate slower than the other. The length of leaf in the vigorous seedling was 12 inches. Within the seed soil, five further seeds had recently germinated. One seed failed to germinate, but was still viable on dissection.



27. The various groups of seeds which were used in germination tests. Note the cracked appearance of Group E.

Group B—Of the ten seeds, four had germinated. Two of the seedlings had died, the two remaining were growing strongly. Within the seed soil two further seeds had germinated into strongly developing seedlings. The primary root was well developed and the shoot (plumule) was commencing to grow. Four viable seeds remained.

Group C—A total of six seeds germinated and one of these had produced a sturdy primary leaf well above the level of the seed soil. Of the remaining five seedlings, four had commenced to produce shoot growth above the ground, but subsequently died, and one had just broken the soil level. The four remaining seeds were rotten and infertile, and were quite likely dead before sowing.

Group D—All ten seeds germinated. Nine seedlings had each produced a vigorous primary leaf up to 14 inches long, including three seedlings which had commenced to produce a second leaf. One seedling had subsequently died. The primary leaves were green, somewhat channelled, and along their edges were fine but distinct bristles.

Group E—No germination. After carefully washing the seed soil, five rotten seeds only were recovered, the remainder had disintegrated. All were probably dead before sowing.

The above results are rather interesting (although the number of seeds used was limited). It would appear that the fleshy fruit covering may contain an inhibiting agent such as is known to exist in the fleshy covering of many fruits (e.g. Rosaceae) which prevents the seed from germinating until this has rotted. It will be noted that as this cover rotted, so germination occur-

28. These palms rarely produce "root mounds," and it would appear that external causes contribute to their development.

29. A view looking "straight" up the trunk of the palms shown in Figure 30.

30. Grove of *Livistona Mariae* showing seedlings (centre) and various stages of growth. Note twisted trunks on right. Tall palm in centre is approximately 55-60 feet high.

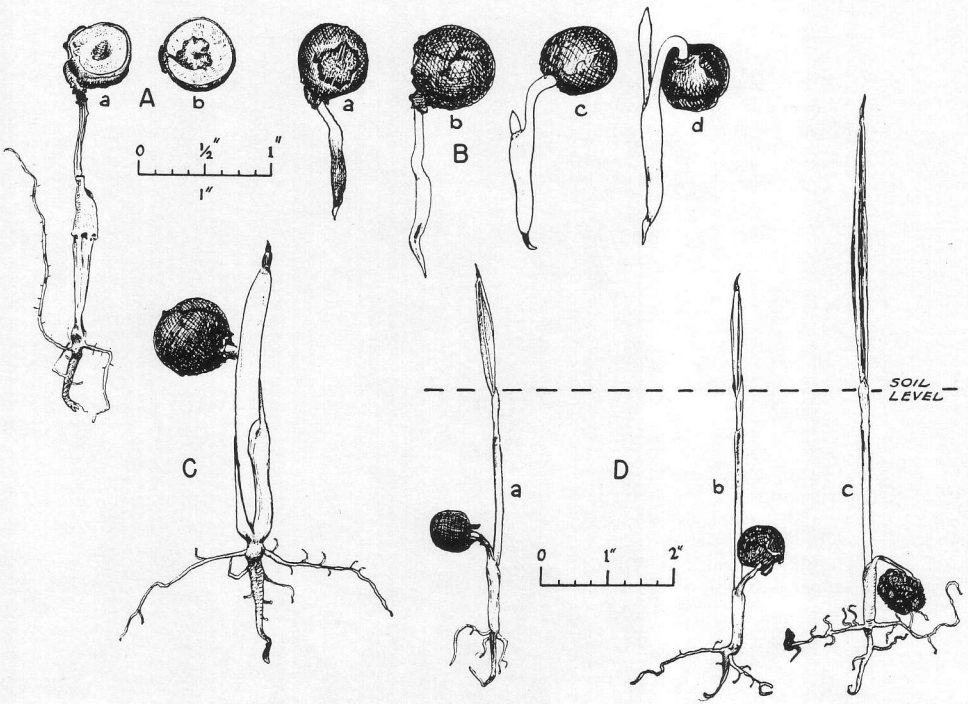
red. The five seeds of Group A which had germinated by the middle of November but had not yet produced shoot growth above ground level, showed strong deterioration of the seed cover.

It would appear essential before sowing seeds of *Livistona* (and possibly of other palms as well) that this soft succulent covering should be removed, and further, that fresh seeds only should be sown. This appears to be the explanation for the rather contrary results obtained in Group C, of which the four seeds which were rotten (and probably dead) were in actual fact old seed, while the fresh seed germinated.

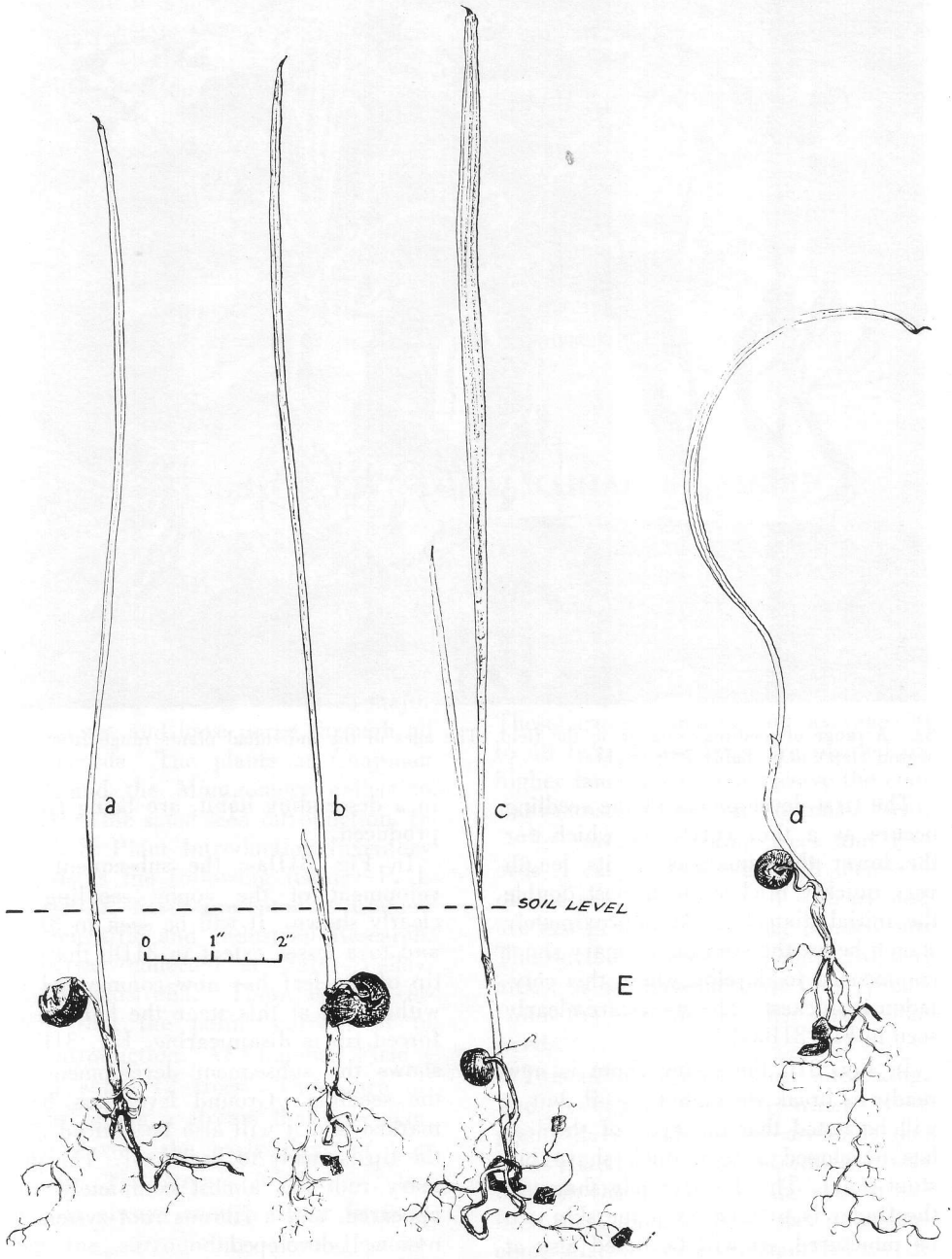
Development of Seedlings

In the above results, reference is made to some of the seedlings dying subsequent to germination. Two reasons can be advanced for this happening. The first is that the bottom heat was well maintained at 80° and on some days varied between 85° and 90°F. As this temperature is too high for the well-being of the seedlings, the pots should be removed to slightly cooler temperatures following germination.

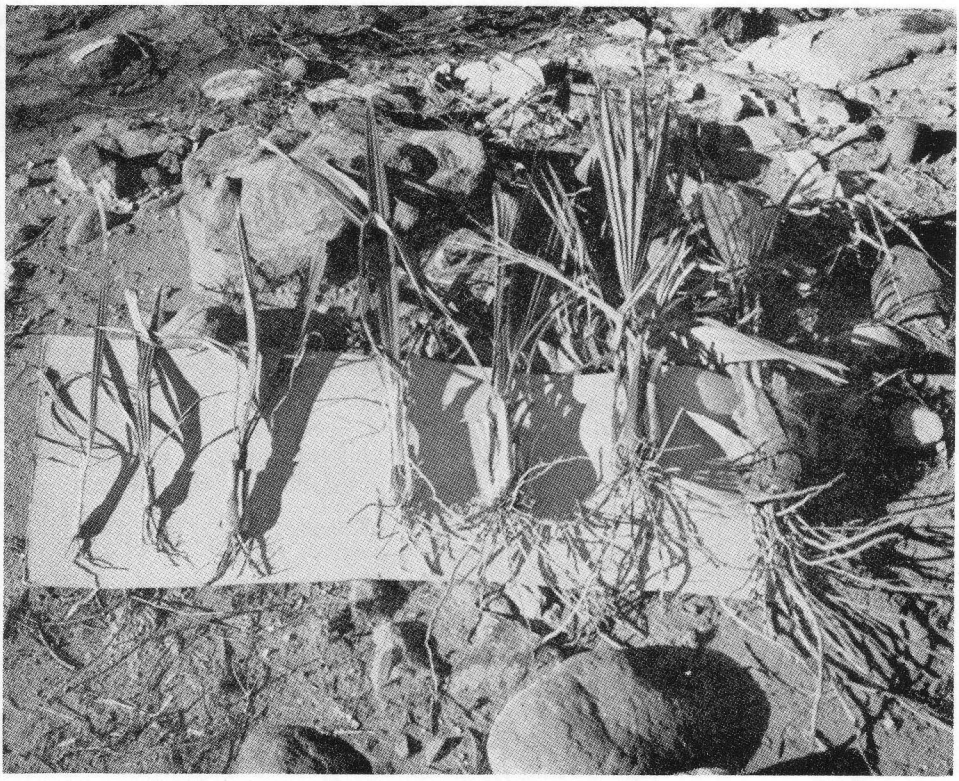
The second reason, either coupled with the above or independent, is that for a very short period the bottom layers of the seed soil dried out. The effect of this can be clearly seen in Fig. 31Aa. (Fig. 31Ab is a cross section of a fertile seed, showing the flesh still firm and shiny whereas the remains of the germinated seed were mealy.)



31. Germination of *Livistona Mariae*. A, cross section of seeds; Aa, seed germinated but subsequently died—note mealy appearance of endosperm; Ab, viable but ungerminated seed: B, stages of germination—note that the plumule commences growth below the level of the seed: C, greatly enlarged and somewhat later stage of Bd, showing development of leaf sheath: D, various stages



of growth subsequent to the production of the leaf sheath—note hardened leaf tip at 8 weeks after germination: E, seedlings at 15 weeks after germination showing stages of second leaf, destruction of endocarp and (d) an abnormal leaf.



32. A range of seedlings dug up in the field. The ages of the individual plants range from one season (left) to probably 7-10 (right).

The first development of the seedling occurs as a thin cotyledon which for the lower three-quarters of its length very quickly thickens to almost double the initial diameter. At approximately 1 inch below the seed the primary shoot commenced to develop where this cotyledon is thickest. The stages are clearly seen in Fig. 31Ba-d.

In Fig. 31C the young shoot is now ready to break through the soil, but it will be noted that the apex of the leaf has developed a very thick sharp but stout point. This is extremely sharp. If the finger is pressed on it the skin can be punctured. It will be noted also at this stage that the primary root has commenced to shrivel and the first of the true roots, developing laterally but in a descending habit, are being freely produced.

In Fig. 31Da-c the subsequent development of the young seedling is clearly shown. It will be seen in 31Dc and to a lesser extent in 31Db that the tip of the leaf has now commenced to wither and at this stage the hard reinforced tip is disappearing. Fig. 31Ea-c shows the subsequent development of the seedling. Ground level has been marked and it will also be noticed that the tip is ready to break off. The primary root has almost completely disappeared, and a fibrous root system is now well developed.

It was previously stated that "contractile roots may be responsible for drawing the crown of the plant below

ground level." From the current investigations it is obvious that the crown is already below ground level, but it is not clear whether in actual fact contractile roots do pull the seedlings down further into the soil. Subsequent investigation is now being carried out by sowing seeds at different levels in an endeavour to discover this particular and other aspects. For example, under natural conditions most seeds germinate where they fall, namely *on the surface of the soil.* However other seeds which are washed into crevices or holes could be deeply buried and, while the seeds germinate, the depth of material above may be too great to allow the seedling to reach the soil surface before the endosperm is expended.

Acknowledgements

I wish to record my thanks to the Plant Propagator (Mr. R. M. Hardie) for caring for the seedlings during this investigation, and to Mr. L. Dutkiewicz for the drawings. The photos were taken by myself.

PLANTINGS OF LIVISTONA MARIAE IN AMERICA

The following is an extract from a letter from Mr. Nat J. De Leon, Miami, Florida, who writes:

"Further information concerning plantings of *Livistona Mariae:*—I have since combed the area, the three major collections, and have pored through all the records. The plants at Chapman Field and the Montgomery collection are from the same seed introduction. In the U. S. Plant Introduction Inventory records is the following listing: P. I. No. 95077, 'Seeds presented by Council for Scientific and Industrial Research, Canberra; collected at Palm Valley, Central Australia.' There can be no doubt that the palms correspond to this introduction. At Chapman Field I found some 12 trees. These are all planted along a stream that was man-made during the early days of that station. The stream is shallow, but there is always enough water in it to keep the surrounding ground moist. The trees average in height from 40 to 60 feet. Only the tallest of these fruited this year, and bore quite a heavy crop. I was also able to compare seed samples which check out. Incidentally, the original date in the inventory records is December 11, 1931. The trees at the Montgomery collection from the same seed lot are represented by about five trees. These are all smaller and average 30 to 40 feet. These trees are planted on higher land and do not receive the constant moisture found at Chapman Field.

"In further checking trees and records, I can conclude that all members of this genus do very well with us, and are fast growers when once planted out. This includes those from more tropical areas, as we have at least four species from the Philippines that grow like weeds."

This information is most interesting. The very rapid growth which these plants have made rather astounds me. If, as stated, the initial introduction was made in December 1931, the growth has been most remarkable. I can only conclude that where a constant supply of water is available, together with mild to warm conditions, growth is continuous rather than seasonal.