SELECTED ARTICLES

LALANG GRASS (IMPERATA ARUNDINACEA) AS A PAPER-MAKING MATERIAL*

LALANG grass (*Imperata arundinacea* Cyr.) is a very troublesome weed in many parts of the Eastern Tropics, especially in Malaya and Ceylon, and occurs abundantly also in the Island of New Guinea, in South Queensland, parts of India, Indo-China, &c. In view of its great abundance in many places, often to the exclusion of other plants, the grass has frequently been suggested as a source of pulp for paper-making, and the tests that have been carried out have indicated that it is a very promising material for this purpose, comparable with Algerian esparto. The long distances over which the grass would have to be brought would preclude its use as a substitute for esparto in English mills, and it would be necessary to convert it into pulp close to its source.

One of the earliest attempts to utilise *Imperata arundinacea* was in 1891, when a concession for working the grass in Johore was granted by the Sultan. Analyses of the material were made in London by Cross and Bevan, who reported that the value of the material was " equal to the highest qualities of the esparto grass " (*Agric. Bull., S.S.* and *F. M. S., 1907*, **6**, *379–380*). The Aynsome Technical Laboratories examined a sample from Singapore and stated that paper suitable for printing could be made from it (*ibid., 1908*, **7**, *585–587*), whilst Messrs. John Dickinson & Co., Ltd., reporting on a sample of half-stuff prepared from the grass in Singapore, said that " as a paper-making material it seems to occupy an intermediate position between Spanish esparto and good straw fibre " (*Kew Bull.*, 1909, 55–59). A sample of the grass from the Federated Malay States was examined at the Imperial Institute in 1917 (this Bulletin, 1918, **16**, 271–273). The results showed that lalang grass gives a good yield of pulp which has excellent felting qualities and produces a strong opaque paper which does not shrink on drying. In yield of pulp and character of the fibres the Malayan lalang compared favourably with Algerian esparto, but it required slightly more drastic treatment than the latter if the pulp is to be bleached and used for the manufacture of white paper. In spite of all these favourable reports no commercial developments appear to have taken place in Malaya.

* Reports of recent investigations at the Imperial Institute. *Bulletin of the Imperial Institute*, Vol. XXXV., No. 3, July-September, 1937

Imperata arundinacea was examined by Raitt in the course of his researches on the Savannah Grasses of Northern and Central India (*Ind. For., Rec., 1913*, **5**, *93*). In this case, however, he found that although the Indian grass gave a good yield of pulp, the latter proved weak and difficult to bleach.

An Italian worker, Ferdinando Vignolo-Lutati (*Ann. Acad. Agric. Torino, 1915*, **58**, *68–76*), has reported that the cellulose of *Imperata cylindrica* (= *I. arundinacea*) grown in Italy is very similar to that of esparto, and that no greater consumption of chemicals is required to produce paper-pulp from it than from esparto.

In Queensland *I. arundinacea* has been used commercially for the production of paper pulp, and in 1919 the Queensland Pine Co. were stated to be producing 10 tons of pulp weekly (*Can. Weekly Bull. Tr. Comm.*, 1919, **21**, 975). The grass has also been stated to be employed for the manufacture of paper in Indo-China (*Bull. Agric. Inst. Sci. Saigon*, 1919, **1**, 188).

The most recent development in the commercial utilization of the grass was the formation in 1936 of an Australian Company with a nominal capital of £3,000,000 to erect pulp mills and manufacture paper pulp from *I. arundinacea* in Papua and New Guinea and to manufacture fine writing and printing papers in Australia. The grass is known in Papua as " kurukuru " and New Guinea as " kunai ". According to a report in the local press the Company have secured the lands required from the Administration of Papua, including 45,000 acres at Collingwood Bay, in the north-eastern division, where the first unit of plant with an output of 20,000 tons of bleached pulp per annum is to be erected. The lands secured are sufficient, it is claimed, for the establishment of three such units. It is stated that extensive areas in the Mandated Territory of New Guinea have also been surveyed.

A sample of the grass from Papua was examined at the Imperial Institute in 1918 (this Bulletin, 1919, **17**, 155–157). The results, both in respect of yield and quality of the pulp, were not quite as good as those which were obtained with the Malayan grass referred to previously, but this is possibly to be attributed to the sample being in rather poor condition when received.

As already mentioned, *Imperata arundinacea* is common in Ceylon, and with a view to ascertaining the suitability of the grass occurring there as a source of paper pulp, a sample under the name of " Illuk " grass, was forwarded to the Imperial Institute by the Registrar-General and Director of Commercial Intelligence in September, 1936. The report on the material is given below.

ILLUK GRASS FROM CEYLON

The sample received consisted of bundles of dried grass about 4 ft. long, varying in colour from cream to pale brown. In nearly all cases the bundles consisted of the leaves of the plant cut above the level of the junction with the leaf-sheaths, but occasionally the leaf-sheaths were present. The lamina of the leaf, about ½ in. across at its broadest point, commonly extended for about half the length of the leaf (in its upper part) as cut, and gradually tapered to the stout, stiff midrib which had the appearance of a leaf-stalk. The stalk-like midribs were more or less cylindrical and about 1/32 in. in diameter.

A representative portion of the sample was chemically examined with the following results :—

	Per Cent.
Moisture	8·8
Ash	6·1
Cellulose, in material as received	42·1
Cellulose, expressed on the moisture-free material ..	46·2

The dimensions of the ultimate fibres were found to be as follows :—

	Length mms.	Breadth mms.
Maximum	3·0 ..	0·0155
Minimum	0·2 ..	0·0047
Average	0·9 ..	0·0074
Mostly	0·5 to 1·5 ..	0·006 to 0·009

The ratio, average length/average breadth was 122 : 1.

The ultimate fibres resembled those of esparto in being fine fibres with tapering ends ; the lumens were exceedingly fine, and often indistinguishable. A few broader more ribbon like fibres were present.

Pulping Trials.—The grass after cutting in a chaff-cutter was digested with caustic soda under conditions approximating to those employed commercially for the production of pulp by the soda process. The conditions employed and the yields obtained are given in the following table :—

		Trial A	Trial B
Parts of caustic soda used per 100 parts of—			
Grass		16 ..	16
Solution		3 ..	3
Conditions of digestion—			
Time	hours	4 ..	3
Temperature	°C	140 ..	140
Parts of caustic soda consumed per 100 parts of grass		9·5 ..	9·4
Yield of moisture-free pulp—			
Calculated on grass as received—			
Unbleached	per cent.	39·8 ..	42·0
Bleached	per cent. ..	32·9 ..	38·4
Calculated on moisture-free grass—			
Unbleached	per cent. ..	43·6 ..	46·1
Bleached	per cent.	36·1 ..	42·1

Trial A.—Under these comparatively mild conditions a well-boiled pulp was obtained which furnished an opaque, well-closed sheet, of greyish-cream colour and possessing satisfactory strength. No shrinkage of the sheets occurred on air-drying. The pulp bleached very easily to a good white colour and furnished paper similar in other respects to the unbleached paper.

Trial B.—Since trial A had resulted in a well-boiled pulp, a second digestion was carried out to ascertain whether satisfactory results could be obtained under even milder conditions of treatment. The time of digestion was accordingly reduced to 3 hours whilst other conditions remained unaltered. These conditions of digestion proved just sufficient to produce a well-boiled

pulp, and an increased yield of about 2 per cent. of unbleached pulp was obtained. The pulp, moreover, bleached readily and gave bleached and unbleached papers similar in character to those obtained in trial A.

The results of this investigation of Illuk grass show that it furnishes a fairly good yield of pulp by the caustic soda process from which paper of satisfactory quality can be made. It requires only a mild treatment of normal character.

In the form of the present sample the grass has the advantage of being free from roots and adherent impurities, such as are normally liable to contaminate commercial esparto and straw respectively.

The yield of bleached pulp from the sample was somewhat lower than that obtained under comparable conditions at the Imperial Institute from Algerian esparto (42·1 per cent. as compared with 46·6). In character the ultimate fibres somewhat resemble those of esparto, but the paper produced from the pulp in this experiment differed from esparto paper in being harder and less bulky. The bleached pulp, either alone or in admixture with other materials would be suitable for the manufacture of writing, book and printing papers.