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JUTE PRODUCTS RESEARCH

DP/BGD/75/013

BANGLADESH

# Technical report: Application of biotechnology to the softening of jute cuttings (No. 2)*

Prepared for the Government of Bangladesh
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of J.A. Green,
Consultant in Microbiology

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United Nations Industrial Development Organization
Vienna

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# INDEX

ACKNOWLEDGEMENT

The Consultant wishes to thank Dr. G. Mohiuddin and the Staff of his Department for their interest and co-operation during this mission, all staff at BJRI for their friendliness and warm hospitality, and the UNIDO/UNDP Staff, Dr. A.M. Bhuiyan( Director) and Dr. Md. Ayubur Rahman( Director General BJRI) for their co-operation.

## MISSION SUMMARY

The Consultant visited BJRI from 28th June 1985 to 9th August 1985. The techniques demonstrated during the first Mission and the programme to develop an improved method for softening jute cuttings were developed further.

## INTRODUCTION

The purpose of this mission was to follow-up the first mission of Oct-Dec 1984 (See mission report DP/ID/SER.A/576, 29 March 1985). Prior to commencing this mission the Consultant held a briefing in Edinburgh with Dr. H. Stout. The Consultant left Edinburgh on 26th June and commenced activities at BJRI on 28th June 1985. Activities at BJRI ceased on 9th August 1985 and a debriefing was held in Vienna and with Dr. Stout in Edinburgh.

Thus the objectives of this mission were rather different from job description supplied (Appendix I) for the reasons outlines in the first mission report. The long-term objective was to assist BJRI (TRW) with the development of an applicable biotechnological process for the improved softening of jute cuttings, and the short-term objective of this mission was to consolidate the techniques demonstrated during the first mission and which were regarded as being necessary in the development programme for achieving the long-term objective.

## 1. Matters arising from the first mission

### A. Activity within the Microbiology Department

The first mission had been successful in stimulating activity within the Department, and despite the fact that one of the junior scientists was abroad on a Fellowship, work was progressing more vigorously than had previously been apparent. The response to suggestions made in the first mission report had been positive and new constructive ideas had been independently formulated . However these are important avenues of the R&D programme (particularly investigating the possibility of producing improved softening of cuttings by a modification of composting conditions) which are not being actively persued due to lack of staff. An increase in the numbers of staff deployed in the department would allow this and other avenues to be investigated. (see Recommendations)

B. Test for softening

Although a great deal is published and talked about softening it appears to the Consultant to be difficult to define and measure. As pointed out in the first mission report, the Consultant considers that subjective visual and tactile assessments of softening carried out in the laboratory are wholly inadequate for the proposed R&D programme. Experiments must be conducted on a large enough scale to allow meaningful physical measurement of softening. What these measurements might be is also problematic. Workers at IJIRA have used such measurements as spinning efficiency tensile strength. quality ratio to measure softening of fibre (1) and cuttings (2) and carding resistance and compressability was also applied to the measurement of fibre softening (1), although which measurement(s) give(s) the best indication of softening is unclear. During the period of this mission the Consultant attempted to arrange a visit to IJIRA to discuss this and other matters (see Section 2B ) but in the event this visit was difficult to arrange. However a letter was sent to IJIRA (Appendix II) asking what measurement in their experience, gives best indication of softening of cuttings and any response will be communicated BJRI. Only by applying such measurements can any laboratory or pilot-scale work have any relevance to the Jute Industry and it is essential for such meaningful measurements to be applied at BJRI.

C. Examination of the existing piling process and links between BJRI and the Industry

The approach most favoured by the Consultant to solve the softening problem was ( and is) to adapt the current piling conditions. This is because such a procedure would not involve introducing new technology into the Mills and would thus be most acceptable to the mill operators. To this end it was desirable to collect base-line data on some physical and microbiological changes during piling, and the team were encouraged to pay regular visits to mills for this (the Karim Jute Mill at Demra in particular). The team have attempted to carry out this work, but it is

apparent there is no reliable transport available within BJRI, that without the use of the UNDP vehicles, visits to the mills are not possible. It is essential that development work within BJRI (Tech) as a whole is geared towards the Industry and that close links are developed and maintained with it. The Microbiology Department has attempted to do this and BJRI (Tech) must ensure that transport facilities are available to make such links possible. (see Recommendations)

During the Consultant's first mission a visit was made to jute mills in the Khulna area, and in one such mill a trial was being performed on a commercially available product which the manufacturers claimed would promote softening when added to the batching oil-water emulsion. The product appeared by smell and colour to be based on molasses, which with the establishment of sugar refining industries in Bangladesh is becoming a readily available by-product. The effectiveness of this product should be ascertained by consultations with the mill and it could perhaps be used as a basis for developing an improved piling process.

## 2. Activities During This Mission

### A. General Techniques

The general techniques described in the report of the first mission were further developed, particularly the collections of data on the microbiological changes occuring during the piling process, and the cultivation of fungi in laboratory-scale fermentation units. The former is seen as particularly important by the Consultant for the reasons outlined above.

### B. Visit to LJIRA

The Consultant attempted to arrange a visit to LJIRA in Calcutta during this mission, as from the published work and discussions with Dr. H. Stout it was concluded that as the group there has considerable experience in the biotechnological treatment of cuttings within the mills it would be

worthwhile to hold discussions with them. Although the visit did not take place, correspondence with the group at LJIRA has been undertaken and it is hoped that information of direct use to BJRI will result from this.

## RECOMMENDATIONS

### A. Previous recommendations

The Consultant reiterates the recommendations made in the report (DP/ID/SER.A/576) of the first mission. In particular, attention should be paid to recommendation B (that any future Traineeships should be used to gain experience in general microbiological techniques needed for the R&D programme) and recommendation C (that an appropriate level of manpower be made available to the department to allow it to carry out the several lines of investigation which promise to produce an improved method of softening).

### B. Transport facilities at BJRI

The central theme of the project of assistance by UNIDO to BJRI has been to enable and encourage BJRI to work closely with the Jute Industry to develop and introduce technologies that are of benefit to the Industry. However, transport facilities within BJRI do not appear to be available for staffvisits to mills and instead reliance is placed on UNDP vehicles for such visits. BJRI should examine its transport facilities and make available to its staff such transport as is needed to instigate and carry out development programmes in collaboration with the Jute Industry.

References:

1. GHOSH, B.L. and DUTTA. A.K.

The enzymatic softening and upgrading of lignocellulosic fibres. Part I.

J. Text. Inst. (1980) 2, 108 - 116

2. GHOSH, B.L. and DUTTA, A.K. (1983)

The enzymatic softening and upgrading of lignocellulosic fibres. Part II

J. Text. Inst. (1983) 2, 83 - 91

UNITED NATIONS

APPENDIX I

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO 18 June 1982

PROJECT IN THE PEOPLE'S REPUBLIC OF BANGLADESH

INTERNAL

**JOB DESCRIPTION**

DP/BGD/75/013/11-51/31.7.B

| | |
|---|---|
| Post title | Microbiologist |
| Duration | Three months |
| Date required | As soon as possible |
| Duty station | Dacca |
| Purpose of project | To assist the Bangladesh Jute Research Institute (Tech) to develop its microbiological research programme especially in the areas of nutritional problems associated with the growth of anaerobic bacteria. |
| Duties | The consultant will specifically be expected to:<br>1. Take part in the research work concerned with the removal of non-fibrous material from inadequately retted jute fibre;<br>2. Advise particularly on the provision of nutrients to give more profuse growth of bacteria associated with retting.<br>The consultant will also be expected to prepare a final report, setting out the findings of the mission and recommendations to the Government on further action which might be taken. |
| Qualifications | Post-graduate degree in Microbiology/Bacteriology; considerable experience in the study of nutritional aspects of anaerobic and aerobic bacteria, or bacteria of industrial importance. |
| Language | English |

..../..

Applications and communications regarding this Job Description should be sent to:

Project Personnel Recruitment Section, Industrial Operations Division
UNIDO, VIENNA INTERNATIONAL CENTRE, P.O Box 300, Vienna, Austria

Background Information

Jute is the most important export commodity of the country and also the raw material for the country's most important industry. The jute industry was completely nationalised in 1972 and has been making steady progress since then towards achieving the 1969-1970 production level, which was the highest in its history.

There are currently 77 jute mills in the country, of which 74 are in operation. The estimated production in 1974-1975 was 451,000 metric tons of jute fabric in the form of hessian, sacking and small quantities of carpet backing; this represents approximately 50% of actual installed capacity. Approximately 85% of this production goes to the export market, earning 55% of the country's foreign exchange. The industry provided employment for 200,000 people.

In the last ten years, and particularly in the early 1970s, jute has been subject to increased competition from synthetics, mainly from polypropylene. The successful market development of polypropylene in direct competition with jute can be attributed to its low price, ready availability and superior technical performance as a result of superior mechanical and physical properties. A typical example of the prevailing situation is in the area of primary carpet backing in the US market, where the share of jute has fallen from over 80% in 1967 to less than 30% in 1974. The decline in other markets and other traditional jute end-users has been equally precipitous.

While in the short term a policy of containment to minimise market losses on the part of the jute producing countries must necessarily focus on the price imbalance between jute and synthetic products, the survival of the jute industry will depend on the increase of its productivity and the development, through research, of better products and new end-users. This project has been designed with the latter aim in mind.

The Dacca Declaration of January 1973 envisaged the establishment of Jute International with a mandate to carry out joint research and development activities. UNDP subsequently fielded a Research and Development Working Group to recommend priority projects to Jute Interational. The technical centre envisaged to be established under Jute International would be fed with results from various national and international reserach centres for effective translation as and when necessary. The Research and Development Working Group also stressed the need for viable national research centres to carry out their own research projects which will be valuable to their own national industries.

In the country, the mandate for carrying out technological research has been given to the Bangladesh Jute Research Institute. The Institute consists of an agricultural research wing and a technological research centre. Facilities at the technological research centre are inadequate to carry out any meaningful research and development project. In addition, the centre is understaffed and lacks expertise in all the important areas of jute technology. As the report of the research and development working group for Jute International states, assistance to the Bangladesh Jute Research Institute is urgently needed to improve its own facilities for research and development, irrespective of related technical activities planned for Jute International.

The Government has recognised the significance of technological research on product development, diversification of end-uses for jute fibres and testing quality control services. Through the Ministry of Jute and the Bangladesh Jute Industries Corporation, the Government is proceeding with a re-organisation of the Bangladesh Jute Research Institute with the aim of making it a viable research institution.

APPENDIX II


# বাংলাদেশ জুট রিসার্চ ইন্‌স্টিটিউট (কারিগরী)

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

মানিক মিয়া এ্যভেনিউ, ঢাকা-১৫

তার-বাজরী (Cable : BAJRI)

দূরালাপনী : ৩১০৯৭৫
৩১০১০১-২/১

Bangladesh Jute Research Institute (Technology)
Govt. of the People's Republic of Bangladesh
Manik Mia Avenue, Dacca-15


সম্পর্ক নং _____

তারিখ, ঢাকা July 22, 1985

Dr. B. L. Ghosh
Biology Division
Indian Jute Industries Research Association
17 Taratola Road
Calcutta - 700 088
India

Dear Dr. Ghosh,

I trust you received my Telex informing you that I would be unable to pay you a visit during my present stay in Bangladesh. I very much regret that I have been unable to visit you, but the trip was becoming difficult and time-consuming to arrange for various reasons, and my work programme at BJRI is very full so I felt that I could not really spare the time - 6 weeks passes more quickly than one imagines'.

However, I thought I would take this opportunity to make some of the comments that I would have made had I visited you, and I should say that my background is in Microbiology ( As opposed to Biochemistry) and so my opinion is obviously biased towards this. My comments are attached, and I hope that you find them constructive. If you have any comments on them I would be pleased to receive them at my U.K. address.

I regret it has not been possible to visit you this trip but perhaps we may meet in the future.

Yours sincerely,

John Green

Enclosures

1. What physical measurement do you think gives the best indication of 'softening' of cuttings or do you need to look at a range of measurements? I ask this because although a great deal is talked about softening it seems to me to be difficult to define or measure precisely. In your paper J. Text. Inst. (1980) you applied carding resistance and compressibility to study softening of fibre, but have you applied this to cuttings?

2. In your papers J. Text. Inst. (1980), (1983) you state that the enzymes present in the wheat-bran extract are primarily responsible for softening activity (Although you concede that this is in conjunction with microbiological activity). (Although a microbiologist I would suggest that your process could be effective for two alternative reasons. Firstly the wheat-bran extract may contain nutrients (Intrinsic materials in the bran, and/or materials (such as vitamins produced by fungal growth) which are stimulating microbial activity during piling. This could be tested by using a negative control such as wheat-bran extract alone (that is without fungal growth) or wheat-bran extract which has been heated to inactivate enzymes. Secondly, the wheat-bran extract could contain significant numbers of conidia of the fungus (if it has sporulated within the 2-3 day incubation period) so that the fungal inoculum (i.e. the conidia) in the extract could result in fungal growth (and activity) in the bins. Have you examined the wheat-bran extract for the presence of conidia? A suitable control would be to use an inoculated wheat-bran extract with conidia removed by filtration or centrifugation.

   I appreciate the problem you have in conducting such controls within mills - you commented on this in your papers, and how to conduct meaningful experiments on the laboratory or pilot-scale is a problem we are wrestling with at BJRI. However, without such control the relative effects of enzymes/nutrients/fungal inoculum can only be surmised. For instance, you mention in your 1983 paper (page 91) that one mill blends the residual solid culture with line cuttings to promote softening. Have you measured the levels of residual enzymes in this? I suspect they will be low and that the softening effect results form the application of nutrients (Bran) and/or heavy fungal inoculum. You mention in your 1983 paper (page 115) that did carry out an experiment in the IJIRA pilot mill, so could you not test these theories using pilot-scale facilities? I concede that small-scale experiments with small volumes of cuttings would not reproduce bin conditions or provide a sufficient volume of fibre to conduct spinning trials. However, in your manuscript of Part III (page 2) you mention that preliminary studies had shown that any combination of enzyme without cellulose did not show significant softening. I assume these studies were carried out on a small-scale, so could not this system be used to test controls?

3. I would be interested to know how the cotton activity (Part III) relates to the various cellulolytic enzymes mentioned in Part I - is cotton activity the sum of the activities of these enzymes and does a doubling in one or all of these enzymes' activities lead to a doubling in cotton activity? I ask because in Part III you state that cotton activity is absent unless the specific inbibitor is removed, yet in Part I the activity of the four cellulose - degrading enzymes was detected without removal of the inhibitor.

In conclusion, I feel that you underestimate the role of micro-organisms in your modified piling process and I suspect that it is the nutrient/fungal inoculum input which enhances the softening activity. Perhaps the addition of other nutrients or organisms with other enzyme activities might result in even better softening.