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# Improved Retting Of Jute and Mesta with Microbial Formulation

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# Preface

Technology mission on jute (MM 1.0) was introduced in the year 2007 by the financial assistance from Ministry of Textiles, Govt. of India through Indian Council of Agricultural Research. Central Research Institute for Jute and Allied Fibres (CRIJAF) is the sole research institute shouldering the responsibility of agricultural research on jute and allied fibres production in India. ICAR gave the responsibility of nodal institute to CRIJAF for handling the technology mission on jute (MM 1.0). One of the important components of MM 1.0 was retting and the project MM 1.7 entitled "Improvement of fibre quality through microbial, enzymatic and chemical retting in jute" was assigned to the Crop Production Division of the institute. The targets of the project was identification of efficient retting microbes, quality improvement through strength and colour, reduction of retting period by 6-7 days and relationship between soil quality and jute productivity.

Excellent work was done to fulfill the targets of the project at CRIJAF and in other co-operating centres of the project. CRIJAF has come out with a very efficient microbial consortium consisting of th*ree pectinolytic* bacteria (Bacillus pumilus) after a series of screening and testing in laboratory and field condition. A patent application has also been filed in 2011 in the name of "A Microbial Consortium Used in Faster Retting of Jute and Mesta" (vide application No. 418/KOL/2011, dated 30.03.2011). Later on, a user-friendly microbial formulation of the microbial consortium was developed and tested successfully in various agro-climatic conditions under AINP project on J&AF. Large scale demonstrations of microbial formulation mediated retting technology in jute and mesta growing districts of West Bengal, Uttar Pradesh and Andhra Pradesh benefited farming community over traditional method of retting.

The encouraging findings of the project has enthused us to document the findings in the form of a research bulletin. This research bulletin based on the findings of the project MM 1.7 will definitely serve as an excellent resource material to all the stakeholders working in the field of jute and allied fibres. Valuable suggestions, critical comments and constructive criticism from the readers are welcome for further improvement.

B. Majumdar
Principal Investigator, *MM* 1.7

## 1. Introduction

Jute, universally known as the golden fibre is the multi-cellular and viscoelastic bast fibre and a unique crop of major economic importance of eastern India and most particularly of West Bengal. Retting is the most important post-harvest operation for quality jute fibre production. The process of separation and extraction of fibres from non-fibrous tissues and woody part of the stem through dissolution and decomposition of pectins, gums and other mucilaginous substances is called retting (Dasgupta et al., 1976; Majumdar and Day, 1977). Jute fibre quality depends to a large extent on the bio-chemical process of retting. The fate of a good jute and mesta crop in the field for quality fibre production depends fully on the proper retting carried out in good quality water. If retting is properly carried out, the extracted fibre should exhibit genetic quality of the variety. Improper retting may lead to inferior quality of fibre in spite of good crop which ultimately may face lower price in the market and lower net return to the farmers.

The retting process of jute and mesta plant involves various biochemical, chemical and enzymatic reactions. Retting process utilizes a complex microbial community for dissolution process after immersion of jute plants in water, releasing soluble constituents like sugar, glucosides and nitrogenous compounds (Ahmed and Akhter, 2001). Retting microbes present in plant and water continue to build up their population by utilizing these soluble compounds. As these easily soluble compounds are exhausted, the retting microbes start to utilize free sugars, pectins, hemicellulose and proteins of the plants as essential nutrients for their development and multiplic*ation under the favourable condition (Majumdar and Day, 1977). Jute consists of cellulose cemented by non-cellulosic materials such as pectin, hemicelluloses, etc. These so-called cementing agents are removed by the enzymes produced by microbes in the process of retting. The decomposition of free sugar present in jute and mesta plants takes place at early stage of retting followed by pectins during middle stage, and hemicellulose, sugars and nitrogenous compounds (mainly proteins) at later stage of retting (Kundu, 1964; Ali et al*., 1976). The jute stem vascular system is cemented by three types of pectins/pectic substances which are hydrolyzed by the enzymes namely pectisinase, pectase and pectinase and ultimately broken down to glutamic acid. The retting water becomes acidic at later stage of retting due

to the presence of organic acids (acetic, lactic, butyric, ketoglutaris), acetone, ethyl alcohol, butyl alcohol and various gases (Ali *et al*., 1968; Debsharma, 1976), resulting in the reduction of growth of retting bacteria compared to higher growth observed at initial and middle stage of retting. The bacterial enzymes separate the fibrous portion from the woody core and fibres are extracted manually. Jute fibre is chemically ligno-cellulose in nature. Besides the 60 to 70% of pure cellulose, the other accessory components of the cell wall of jute fibre mainly consists of lignin, hemicellulose, uronic acid, pectin, including a small amount of fat, resin, wax, etc. (Ahmed *et al.*, 2003). Besides the manufacture of hessian and sacking, jute fibre is nowadays used for making high valued diversified products like carpet, yarn for textile use, handicrafts, ornaments, etc. The production of diversified jute products needs high quality jute fibre and the demand for quality fibre by jute mills is getting momentum. Production of quality jute fibre depends on the proper retting in presence of good quality water. In India, the production of quality jute fibre is confined to some belts of North Bengal because of availability of free flowing soft water. On the other hand, our neighboring country Bangladesh is in advantageous position because of availability of good quality retting water and the country is producing very high quality jute fibre suitable for making diversified products and the Indian jute mills are importing quality fibre from Bangladesh. So, there is an opportunity for quality fibre production by Indian jute growers by adopting improved retting practices.

## 2. Conventional whole plant retting

The traditional whole plant retting method of jute and mesta is universally practiced since the initiation of jute cultivation. After the harvesting of jute and mesta, the plants are kept in the field for defoliation/leaf shedding for a duration of 3 to 4 days. During the period of leaf shedding, the living cells of jute and mesta plants start to die and this is the initiation of retting process. The defoliated jute bundles are then transported to the nearby retting facilities, immersed in clean or stagnant water according to the availability in natural retting tank, road-side ditches, sometimes in river with locally available jak materials. Most of the farmers use mud/soil and banana logs as jak materials for immersion of jute/mesta bundles in water (Plate 1 to 4). The retting of jute is completed in 18-21 days in this method. The fibre is then extracted manually

by "beat-break-jerk" or single plant extraction method which varies from place to place. The farmers using or selling jute stick as fencing or roof materials prefer single plant extraction method, whereas, farmers using jute sticks for fuel

**Place 1. A typical "Jak" of jute bundles retting**

**Plate 2. Mud and banana plant as for covering material**

purpose prefer beat-break-jerk method of extraction. After extraction, fibre is sun dried, tied and transported to market for sale. Use of mud/soil and banana plants for retting purpose helped in the production of ferrous tanin which imperts black colour to the fibre, known as 'Shyamla". The conventional whole plant retting of jute and mesta has certain demerits.

- Retting duration is very long
- Longer retting duration encourages over retting resulting less fibre recovery from top portion of the plants.
- The fibre is black in colour with poor lusture.
- The strength of fibre is very poor.
- Because of lower fibre quality, farmers get low price for their fibre in the market
- Most of the fibre produced by this method is unsuitable for production of high valued diversified products.

Plate 3. Fibre extraction and washing

Plate 4. Drying of extracted fibre

## 3. Need for improved method of retting

The traditional method of retting requires a large volume of water (1:20:: Plant:water) for proper retting. There is a sharp decline in the permanent water bodies in jute growing areas during last 3 to 4 decades because of urbanization, siltation and creation of modern facilities and industrialization. The reduction in permanent water bodies reduced the scope of retting in good quality water with efficient retting microbes. Besides the decline in permanent water bodies, the irregular rainfall pattern during retting period aggravated the situation. The less rainfall during retting period for last few years in various jute growing areas of the country and West Bengal in particular has affected the jute farming. Under such a water scarce situation, retting following traditional method becomes a risky and non-profitable business. Sometimes farmers are compelled to ret their harvest in very low volume of muddy water resulting in very poor quality fibre and low net income.

Use of underground water for retting on payment basis needs extra investment without any extra return. Generally three to four times watering is needed for completion of one time retting because of quick percolation and evaporation loss of water under prolonged summer. The repeated retting of jute and mesta in the same stagnant water of natural retting tank, artificially prepared polythene lined or cemented retting tank also led to the production of inferior quality fibre if addition of fresh water either from rainfall or ground water resources are not met after each retting. Moreover, retting of jute and mesta in artificial retting tank utilizing uplifted ground water prolongs retting period than required in the conventional retting because of very low population of retting microbes. Addition of efficient retting microbes in artificial retting tank may enhance the

pace of retting process. So, there was an urgent need for the search of efficient retting microbes as well as development of improved retting methods requiring less water and completion of retting in short period of time using efficient retting microbes with quality fibre production.

## 4. Search for efficient retting microbes

Cellulose is the principal constituent of fibre that constitutes the framework of the cell wall structure. Pectin and hemicelluloses (22-25%) are the main binder and are rich in the primary wall and middle lamella. The predominant task for extraction of fibre is to remove non-cellulosic substances in the bast without causing damage to the fibre cellulose. So, our search for efficient retting microbes was confined to those microbes which can degrade pectin and hemicellulose primarily xylan without any cellulose degrading activity. Hence, those retting microbes which have pectinololytic and xylanolytic activity without any cellulolytic activities were our main targets. To achieve this target, a large number of retting water samples were collected from the quality jute fibre producing districts of West Bengal and efficient pectinolytic bacterial isolates were screened on the basis of high polygalacturonase and pectin lyase activity using various substrates of pectin (Majumdar *et al.*, 2008; Majumdar *et al.*, 2009a). These pectinolytic bacterial isolates were then screened for their xylanase and cellulose activities. Finally six very efficient bacterial isolates were identified on the basis of their very high polygalacturonase (5.1 -6.0 IU/ml), pectin lyase (162.5 – 203.7 U/ml) and xylanase (12.2-16.2 IU/ml) activity without any cellulose activity.

### 4.1. Development of a promising microbial consortium for retting

It was clear from the work of various researchers involved in retting, that number of bacteria (aerobic and anaerobic) and fungi in cumulative mode are responsible for the completion of microbial retting. Banik *et al.* (2003) reported that not a single bacteria or fungi but a mixture of microbes secreting different enzymes are more effective for retting of jute plants. So, there was a need for the evaluation of a microbial consortium having efficient retting microbes.

The six efficient bacterial isolates were further screened for antagonism by using standard method and one isolate showing antagonism with other isolates were discarded. The remaining five isolates screened out for making efficient

retting consortium which produced cellulose free- pectinase, xylanase and found compatible with each other. Finally the isolates were applied in all probable combination and tested for pectin degrading capability. Out of all isolates, a combination of three isolates of PJRB1, PJRB2 and PJRB3 in the form of a microbial consortium was found to be very effective for jute retting purpose and a microbial consortium was prepared consisting of these three isolates (Majumdar *et al*. 2009b). These three isolates were later identified as three different strains of *Bacillus pumilus*. This microbial consortium was found highly effective in jute retting and can be used for jute and mesta retting with improvement in fibre quality during drought condition utilizing very little amount of ground water in artificial polythene lined or cemented retting tank. The consortium can also be used for quality fibre production in stagnant water of natural retting tank under traditional method of retting. A patent application on "A microbial consortium used in faster retting of jute and mesta" has been filed to the patent office, Kolkata on 30/3/2011 (Application no. 418/KOL/2011).

### 4.2. Development of user friendly talc based formulation of microbial consortium

The liquid form of microbial consortium developed by CRIJAF had viability for limited period of time under normal condition, which was not suitable for field application purposes besides problem in handling and application of liquid form. To overcome this, search for suitable carrier materials which can be used for the development of powdery formulation of microbial consortium with increase viability was carried out. Several carrier materials like charcoal, jute leaf manure, and talc were tested to find out the suitable one for powdery formulation of microbial consortium.

**Plate 5. CRIJAF microbial formulation**

Finally, locally available commercial grade talc was used as carrier material to see the possibility of using it for making powdery formulation of microbial consortium. Talc based formulation maintained viability up to 120 days in the range of $10^8$ to $10^9$/g of wet weight of powder compared to initial cfu of $10^{10}$. This talc based powdery formulation was found to ret jute in 13 - 15 days with fibre strength of 27.8-29.9 g/tex in field trials. This easy to handle talc based

powdery formulation (Plate. 5) can be stored in room temperature for four months and can be used for retting of jute and mesta as and when it is required (Majumdar *et al*. 2011). By developing this formulation, the problems regarding transportation and application at field level was eliminated.

**How to use microbial formulation**

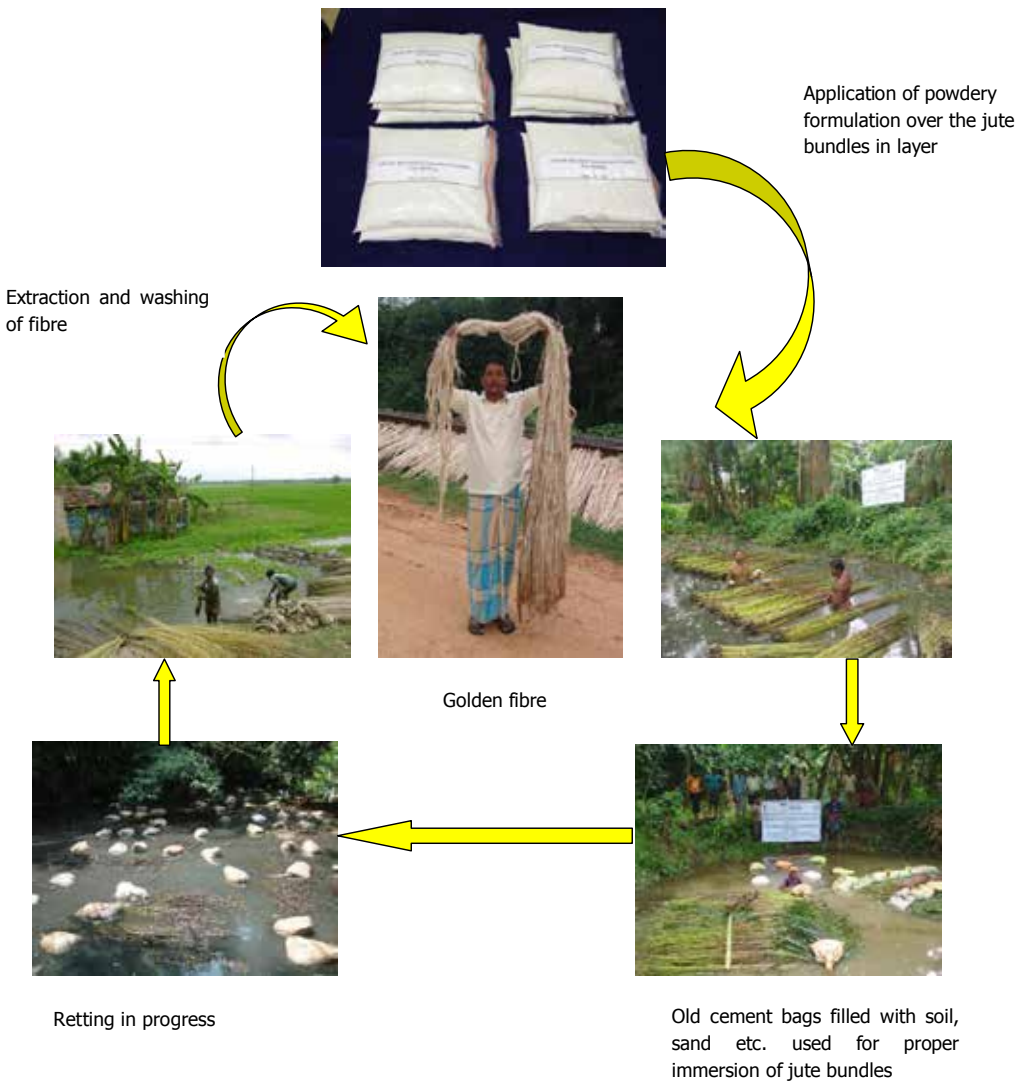


**Plate. 6. Schematic diagram showing the method of using microbial formulation for retting**

## 5. Microbial consortium mediated improved retting methods

Availability of good quality retting water is the main hindrance for carrying out retting of jute and mesta with quality fibre production. Retting of 50 to 60 t of green biomass/ha needs a huge volume of fresh water. By considering this, several new retting methods were developed which required very less water compared to traditional method of retting. These new improved methods of retting in conjunction with microbial formulation developed by CRIJAF were found very promising under farmers' field conditions which are discussed below.

### 5.1. Mechano - microbial retting of jute

Mechano-microbial retting technique was developed with an objective of carrying out efficient retting in very less amount of water by reducing the volume of green jute plants by extracting green ribbons immediately after harvest and retting with the use of microbial consortium/formulation (Saha ***et al.***, 2009; Majumdar ***et al.***, 2009c,d). Availability of good quality retting water during retting period is a great concern; hence improved method of mechano-microbial retting is the most appropriate one under severe water scarcity situation. Mechano-microbial retting of jute consists of two distinct processes, viz. i) mechanical extraction of green ribbons, and ii) retting of green ribbons with CRIJAF microbial retting consortium/fomulation.

#### 5.1.1. Mechanical extraction of green ribbon

Under mechanical extraction, green jute/mesta plants immediately after harvest is utilized for extraction of green ribbons either by a) power operated bast fibre extractor suitable for jute, mesta, sunnhemp and ramie and/or by b) manually operated jute fibre extractor suitable only for jute and mesta ribboning purposes. By extracting the green ribbons, the volume of jute plants is reduced by several times and the total green weight is also reduced by 50 to 55%. Hence, the use of green ribbons for retting reduced the requirement of water significantly. The power operated bast fibre extractor can extract 25 kg dry fibre/hr with broken stick, whereas, the manually operated jute ribboner also can extract about 15-20 kg dry fibre/hr with unbroken sticks (Plate. 7). This jute ribboner machine is light in weight, portable, easier to operate and cheaper too (Annual Report, CRIJAF, 2005-06). The mechano-microbial retting has a great future provided a user friendly power/diesel driven efficient ribboner with higher extraction efficiency is developed.

### 5.1.2. Retting of green ribbon with microbial retting formulation

The green ribbons extracted by either of the above mentioned extractors are then kept in polyethylene lined or concrete retting tank for retting (Plate. 8, 9 & 10). The green ribbon: water is kept as 1: 5. The green ribbons: water ratio should be maintained strictly for application of formulation and proper retting. Microbial formulation @ 1 kg/2q of ribbons with a cfu of $10^{10}$ to $10^{12}$/g of formulation is added in the retting water of the tank. After completion of the retting, ribbons are washed in clean water for obtaining good quality fibre. The same retting water can be used for retting again, by removing half of the water and filling it with fresh water. No fresh application of formulation is needed for further retting in the same retting tank. This method has been successfully demonstrated to among jute farmers' of four districts of West Bengal (North 24 Pargana, Hooghly, Nadia and Murshidabad) and Purnia and Katihar districts of Bihar (Annual Report, CRIJAF, 2009-10).

**Plate. 7. Extraction of green ribbons using CRIJAF jute ribboner**

**Plate. 8. Spraying of microbial consortium over the ribbons**

**Plate. 9. Vertical steeping of green ribbons in retting tank**

**Plate. 10. Lustrous fibre obtained formulation**

### 5.1.3. Merits of mechano-microbial retting

- This method requires less volume of water, so it is best suited for water scarce areas.
- Retting is completed within 7-9 days compared to 18-21 days required under conventional whole plant retting.
- Total fibre production is more than traditional whole plant retting, where a substantial portion of fibre is lost during retting and washing.
- The fibre is of golden yellowish colour with very good lusture.
- The fibre quality is improved at least by 2 grades (from TD6 to TD4) in this method as compared to conventional method which often produces dark coloured fibre.
- The net income is increased by Rs. 5000 - 6000/ha than conventional method, because of more productivity and better quality.

### 5.1.4. Demerits of mechano-microbial retting

- Highly skilled labourers are needed to carry out the retting method especially extraction of green ribbons.
- Power connection is necessary in the jute field for extraction of green ribbons through bast fibre extractor.
- The efficiency of manually and power operated bast fibre extractor is low, which will take longer duration for extraction.
- If retting is carried out in polyethylene lined retting tank, there is possibility of damage to the polyethylene sheet by animals etc. leading to the drain out of retting liquor and improper retting.

### 5.2. *In-situ* retting of jute and mesta with microbial formulation

*In-situ* retting of jute and mesta was introduced to eliminate the carrying cost of harvested jute plants to the retting site by carrying out retting in the jute field itself with reduced amount of water than traditional retting. Under water crisis situation, in the absence of normal rainfall during retting season, this method of retting was prescribed by using underground or lifted water in the polyethylene lined retting tank with microbial formulation for quick retting, so that the farmers are not affected by the drought like situation during retting season of jute and mesta. This improved method of retting involves construction of a circular micro-pond of 6.5 m floor diameter, 7.5 m top diameter, and 1 m depth having 1 m wide earthen embankment in the lowest corner of the jute/mesta field, so

that farmers need not carry their harvested jute/mesta to a distant retting site for retting (Ghoral *et al.*, 2009a, b). This retting tank is lined with polyethylene sheet, which is sufficient to ret jute/ mesta harvested from one bigha (0.13 ha) of land with the help of CRIJAF microbial retting formulation in a 1: 1 ratio of jute plants: water within 12- 15 days with 2 to 3 grade improvement in fibre quality (Plate. 11-14). Microbial formulation with a cfu of $10^{10}$ to $10^{12}$/g of formulation is applied in the retting tank over the jute bundles in each layer @ 4 to 6 kg for jute or mesta plants harvested from one bigha (0.13 ha) land.

**Plate. 11. Radial straw arrangement periphery of *in-situ* retting tank**

**Plate. 12. Spraying of microbial along the consortium**

**Plate. 13. Sand-filled bags over the 'jak' to avoid floating**

**Plate. 14. Fibre extraction in the *in-situ* retting tank**

### 5.2.1. Merits of *in-situ* retting

- Retting is completed within 12 to 15 days compared to 18 to 21 days under conventional retting.
- Transport cost of Rs. 3500 to 4000/ha requied under traditional method for carrying harvested jute bundles to the retting spot can be eliminated by this method.

- The quality of fibre can be improved at least by 2 to 3 grade.
- The famer can be benefitted by Rs. 5000 to 6000/ha over traditional method.
- The pond embankment can be utilized for plantation of high value vegetable crops (early cauliflower, cabbage, brinjal, tomato, capsicum, etc.), which will compensate the cost of polyethylene.
- The pond can be used for fish cum paddy culture after retting.

### 5.2.2. Demerits of *in-situ* retting

- Initial cost involvement is higher for digging of ponds and purchase of polyethylene sheet.
- Skilled labourers are needed to carry out the retting under this method especially laying of jute bundles in the retting tank.
- There is possibility of damage to the polyethylene sheet by animals, sharp bottom of jute plants, etc. leading to the drain out of retting liquor and improper retting.
- Farmers have to keep some area of his field for making the retting pond, which is the most important hindrance for the popularization of the method.

## 6. Modified conventional method of retting with microbial formulation

The scarcity of rainfall during retting period in recent years in jute growing areas of eastern India in general and West Bengal in particular hindered the retting process culminated to the production of inferior quality fibre resulting in reduced net income. Repeated retting of jute and mesta in the same stagnant water of natural retting tank led to the production of inferior quality fibre if addition of fresh water either from rainfall or ground water resources are not met after each retting. Moreover, in case of less rainfall retting of jute and mesta utilizing uplifted ground water lengthes retting period and requires repeated watering for retting. Under such situation, use of talc based microbial formulation developed by CRIJAF was found suitable not only for reduction of retting period but also for improvement in fibre quality by at least two or three grade. Here, in this method (Plate. 16-19), instead of using mud and banana plants as 'jak' materials for immersion of jute bundles, old cement bags filled with soil/mud/ sand/bricks etc. are used for immersion purpose. At the time of making the 'jak' of jute bundles, the talc based formulation is applied on the jute bundles in each layer and when the 'jak' is ready, the filled cement bags are kept on the jute bundles for proper immersion in the water. As no banana plants and mud is

used directly for immersion purpose, the retting water in the retting tank does not become dirty, and in the same stagnant water 2 to 3 cycles of retting can be carried out using the same filled old cement bags. Three to four kg microbial formulation is needed for quick retting of jute and mesta plants harvested from 1 bigha (0.13 ha) land. For the second or third retting in the same stagnant water, the need of microbial formulation will be half of the amount required at first retting. By following this method, farmers can get quality fibre with good golden colour, lusture and strength.

## 7. Demonstration of improved retting with microbial formulation

The talc based microbial formulation developed by CRIJAF was extensively demonstrated in various jute growing districts of West Bengal, Bahraich district of Uttar Pradesh and mesta growing district of Andhra Pradesh during the retting season of 2012. By using this talc based formulation in natural retting tank, the retting period was reduced by 6 to 7 days with improvement in fibre quality by

**Plate. 15. Distribution of talc based formulation among the farming community**

2 to 3 grades (Fig. 15- 19). Whole plant retting of jute in cemented retting tank with talc based microbial formulation was completed in 13 days with fibre strength of 29.5 g/tex (Majumdar *et al*. 2013). It has been observed that the ***** mesta was completed in 13 to 15 days with microbial formulation compared to 25 days required under conventional method of retting, thereby reducing the retting period by 10 to 12 days in Srikakulam district of Andhra Pradesh during the month of October & November and the farmers earned additional Rs. 400 /q fibre from the improvement in fibre quality.

Plate. 16 . Application of microbial formulation over the jute bundles in retting tank

Plate 17 . Retting in progress with microbial formulation in stagnant water under farmers field

**Plate 18 . Extraction and washing of fibre after retting**

**Plate 19. Golden and lustrous jute fibre obtained by the farmers with microbial formulation**

## 8. Quality improvement

There was a sharp improvement in fibre quality in terms of colour, lusture and fibre strength with the use of CRIJAF microbial formulation for retting over the traditional method of retting (Table 1). Besides reduction in retting duration, the fibre strength is also improved substantially with the use of this microbial formulation not only in West Bengal but also in eastern Uttar Pradesh and Mesta growing district of Srikakulam, Andhra Pradesh. The retting duration is reduced by 5 to 7 days in most of the places and in mesta growing district of srikakulam, the retting duration is reduced by more than 10 days with the use of microbial formulation for retting. The average fibre strength of the resulted fibre ranged between 24.6 to 26.2 g/tex , which is quite good for jute fibre.

**Table 1. Effect of using microbial formulation on jute and mesta retting duration and fibre strength**

| District & state | No. of demonstrations | Retting duration (days) | Fibre strength (g/tex) | Retting duration under traditional method (days) |
|---|---|---|---|---|
| Hooghly, West Bengal | 44 | 9-14 (11.6)* | 23.1-30.1 (26.2) | 15-19 (18.2) |
| North 24 Parganas, West Bengal | 79 | 10-17 (13.4) | 23.9-28.8 (25.2) | 17-21(19.5) |
| Nadia, West Bengal | 57 | 11-19 (14.6) | 23.3-31.6 (25.7) | 21-23(22) |
| Murshidabad, West Bengal | 05 | 13-14 (13.6) | 24.0-29.0 (25.4) | 16-21(18.6) |
| Malda, West Bengal | 20 | 12-14 (12.7) | 23.5-26.1 (24.6) | 17-22(19.5) |
| Baharaich, Uttar Pradesh | 15 | 09-11 (9.2) | 23.5- 30.8 (25.8) | 15-17(16.3) |
| Srikakulam, Andhra Pradesh | 60 | 13-15 (13.6) | - | 22-25(23.8) |

*The values in parenthesis indicate the mean values.

## 9. Impact of improved retting using microbial formulation

- Production of quality fibre becomes a reality.
- Productivity improved because of reduction in retting period.
- Farmers got higher price for their quality fibre @ Rs.200 to 300/q extra over traditionally produced fibre in West Bengal.
- The farmers of Srikakulam district of Andhra Pradesh got higher price for the quality fibre @ Rs. 400/q extra over traditionally produced fibre.
- The improved method of retting is user friendly and the health hazard problem has been reduced drastically.
- Production of quality fibre in stagnant water has got a new dimension.
- The quality fibre needed for the production of diversified products by the industry may be fulfilled by using the microbial formulation for retting.
- The valuable currency spent to import jute fibre for diversified products may be minimized.

## 10. Dos of retting

- Harvesting of jute plants should be done at proper stage of maturity between 110 to 120 days for quick retting and quality fibre production. Over-aged plants take longer period for retting with deterioration in fibre quality.
- If possible jute plants should be sorted in thick and thin diameter of stems before retting, it will prevent the over retting of thin plants.
- Defoliation prior to retting will reduce transport and handling charges and return organic materials to the soil and reduce the amount of organic load discharged to the retting waters.
- Keeping dhaincha (*Sesbania aculeate*), sunnhemp (*Crotalaria juncea*) plants and *Gliricidia* leaves as covering materials or in between the jak reduced the retting period by 3-5 days.
- Retting should be done in free flowing water. If free flowing water is not available retting should be done in stagnant water and water should be non-saline & clean.
- The volume of water should be enough to allow the jute bundles to float.
- The minimal volume of water used for retting should be such that the *jak* is submerged completely in water and there is 4 inches of water above the upper layer of jak.
- Jute bundles when immersed in water should not touch the bottom or

ground.

- Concrete block, wooden log, old cement bags filled with sand, mud or stone can be used as covering materials for proper immersion of jute bundles in water
- Periodic checking of jute bundles kept in retting tank should be checked for extraction of fibre in proper time and to avoid over retting.
- Extracted fibres should be washed in clean water.
- Fibres should be dried properly under the sun in a bamboo-frame.

## 11. Don'ts of retting

- Do not keep the jute plants in the field beyond 120 days, harvesting of jute plants beyond 120 days of crop age will delay the retting as well as deteriorate the quality of fibre.
- Do not use mud or banana plants to cover the jute bundles/ jak for retting as it will end up giving black color to the jute fibre also known as *Shyamla*.
- Do not use excessive amount of water to submerge the jute plants as it will delay the retting process.
- Do not over - ret jute plants. Over-retting of jute will produce inferior quality of fibre and thus the price of the product will decrease.
- The same retting tank or ditch should not be used for retting when water becomes dirty and addition of fresh water is also not possible, otherwise it will lead to the production of very inferior quality fibre.

## 12. Factors affecting the retting process

The retting efficiency and the production of quality jute fibre depends on several factors like crop age, fertilization of crop, quality of retting water, including pH and temperature, activators, covering materials etc. Some of these factors are easily manageable by farmers with little care while some are dependent on nature. If farmers take care of following factors, they can manage the retting process to some extent for the production of quality jute and mesta fibre.

### Crop age

The retting period is longer for older plants compared to younger plants. The amount of cementing but decomposable materials like pectins and hemicelluloses are more in older plants with modified and more resistant like structures which gives restricted entry of microorganisms resulting in longer time for retting.

The jute pectin is esterified pectin and in older plants, the pectins are highly esterified which require longer time for degradation. Usually, fibre loss is 17.3%, if 75 days old plants are retted and 9.5 % if plants of 120 days old plants are retted (Ahmed and Akhter, 2001). So, the jute and mesta plants should be harvested within 100 to 120 days for quick retting and quality fibre production.

## Fertilization of crop

The application of nitrogenous and phosphatic fertilizers affects the retting process to some extent. Higher application of nitrogenous fertilizers is found to accelerate the retting process and reduce the retting period and vice versa (Mandal and Saha, 1997; Ahmed and Akhter, 2001). On the other hand, higher doses of applied phosphorus were found to decelerate the retting process resulting in increase in the retting period. Addition of organic and inorganic sources of nitrogen like urea, ammonium acetate etc. in retting tank helped the growth and activity of the retting microbes resulting in shortening of the retting period (Mukherjee ***et al.***, 1961). But indiscriminate use of urea etc. as N source to the retting tank affects the quality of jute and mesta fibre.

## Quality of retting water

Under conventional method of retting in stagnant water, there are releases of many decomposable products in higher amount, which can affect the growth and activity of various retting microbes, if not removed and ultimately may lead to the improper retting or fibre quality degradation. Retting is best carried out in slow moving clean & soft water of canal, river, etc. with low salts, iron and calcium content. Whereas, fast moving water not only carries away the decomposed products of retting but also retting microbes with it resulting improper retting. Retting under soft water produces better quality jute fibre than retting under hard water. Maintenance of 15 cm water level over the top layer of plant bundles with a plant - water ratio at 1: 20 is ideal for proper retting under conventional whole plant retting. If the jak is placed more than 60 cm depths from surface, then retting process delayed. Lower level of oxygen at higher depth may affect the activity carried out by aerobic microbes resulting in delay in completion of retting. In case of higher volume of water available for retting, release of lactic acid due to anaerobic condition delays retting (Mandal and Saha, 1997).

## pH and temperature

The pH and temperature of retting water during retting period to a large extent determines the status of retting, retting period and quality of fibre produced. Two optimum pH ranges for retting - one in the acidic range (around pH 5.5) and the other in the neutral or slightly alkaline range were reported by Kundu, (1964). Retting is relatively faster in acidic region compared to alkaline region. The optimum temperature for retting is around $34^0$C. Retting is delayed if temperature fluctuates from $34^0$C on either side. Heavy rainfall during retting time delays the retting process because of sharp fall in the retting water temperature.

## Activators

Retting process is found to accelerate in the presence of several natural and chemical activators in the retting tank. Addition of dhaincha (*Sesbania aculeate*), sunnhemp (*Crotalaria juncea*) plants (Halder and Kundu, 1957; Ali *et al*., 1972) and *Gliricidia* leaves as covering materials or in between the jak reduced the retting period by 3-5 days. These legumes being rich in nitrogen help in the growth and activity of retting microbes by supplying additional nutrients to them. Various chemical activators like 0.05 % magnesium sulphate, ammonium sulphate (Mandal and Saha, 1997, Ahmed and Akhter, 2001), urea, ammonium oxalate, calcium sulphate and magnesium phosphate (CRIJAF Annual Report, 2008-09) were found to reduce the retting period.

## Type of covering materials used for retting

The covering materials used for retting of jute plants also affect the quality of fibre produced. The use of banana plant and mud/soil for covering or immersion of jute jak in retting tank is found to decolourize the golden fibre. It occurs due to the ferrous iron content of soil & retting water and the tannic acid content of plant covering material (Mukherjee *et al.*, 1960). So instead of using the soil/mud directly over the jak of jute bundles, it may be applied by filling in old cement bags to avoid the black colouration of jute fibre. To avoid the discolouration of fibre, seasoned wooden logs, cemented poles, brick bats tied in cement bags can be used as jak materials and covering materials should preferably be water hyacinth or coconut leaves.

## 13. Conclusion

A good crop of jute not necessarily always produces quality fibre. The quality jute fibre production entirely depends upon the process of retting. Slow moving clean water used for rating produces best quality fibre, but such conditions are rarely prevailed in the jute growing areas of India. Scarcity of water or low rainfall retting period compels farmers to ret their jute crop in stagnant water resulting in low quality jute fibre. Under such situation, adoption of modified conventional method of retting, mechano-microbial retting and in-situ retting with microbial formulation developed by CRIJAF nill produce quality fibre. By following these techniques, farmers can ret their jute and mesta crop in lesser time with very less quantity of water along with improvement in fibre quality and get more net income than conventional method of retting.

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