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Jute retting water

A potential source of essential plant nutrients

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Jute retting is an important biochemical process for the production of quality jute fibre. The retting water receives the degraded products during jute retting. A systematic study on the properties of pre and post-retting water in four intensively jute growing districts of West Bengal was carried out. The post-retting water was found to be an important source of various essential plant nutrients.

Keywords: Jute, Plant nutrients, Retting water

JUTE (*Corchorus olitorius* L.) is an environmentally friendly crop and its produces are fully biodegradable in nature. A jute crop absorbs about 14.7 tonnes of carbon dioxide/ha (CO_2/ha) from air during its four months life cycle besides leaving approximately 11 tonnes O_2/ha (oxygen/ha) in the air and indirectly helps in lowering pollution level from the environment. Jute crop sheds about 15 tonnes of green leaves /ha during its four month life cycle. It absorbs a good amount of nutrients during crop growth and a considerable portion of it returned to the soil as leaf fall, which not only helps to maintain fertility of soil but also adds organic carbon to the soil. After the harvest, green stems of jute plants are immersed in the water of retting tank to get the golden jute fibre by the process called "retting". Retting is a biochemical process carried out by the enzymatic action of various retting microbes naturally present in the water and thereafter, extraction of fibres done from retted jute and mesta plants. The total green biomass production is about 50-60 tonnes/ha of jute crop (Fig. 1). These huge quantities of biomass are kept for retting in water (Fig. 2). The economic part of jute plants i.e. jute fibre is about 6 to 6.5% of this green biomass. After proper retting, jute sticks are also obtained at the time of extraction of fibre, that constitutes the major portion of this green biomass. During the retting of jute plants, lots of biodegradable materials are released in the retting water. The controlled decomposition of pectins, hemicelluloses, gums and mucilaginous substances present in the jute plants helps in separation and extraction of fibre from non-fibre tissues resulting addition of degraded products in the retting water. The materials released during retting of jute are bio-degradable and non-toxic to nature.

Fig. 1. Jute plants after harvest kept for leaf shedding.

In the study, the retting water samples were collected from conventional retting sites of four intensive jute growing districts of West Bengal under farmers' field condition. Retting tanks were identified, in each location and water samples were taken in triplicates from the same retting tanks before after completion of retting. Conventional retting is followed universally in stagnant water by 90 % of jute growers of the country in absence of free-flowing water. A retting pond of 30 × 25 × 5 feet is sufficient for retting the harvest from 0.13 ha area (1 bigha). The ratio of jute plants and water is maintained in a ratio of 1:5. The green jute plants after harvesting at the age of 110-120 days are kept in the jute field for 3-4 days for defoliation of jute leaves. The weight of jute plants from 0.13 ha is about 60 to 70 quintals and about 50,000 litres of water is needed for completion of retting. The defoliated bundles of jute plants are then arranged in the retting pond in layers (2-3) and then, weight in the form of soil or mud keeping in old cement bags or fertilizer bags are kept over the jute bundles for its complete immersion. Farmers also use water hyacinth as weighing material over the jute bundles depending on the availability. The retting process is completed by the enzymatic actions of retting microbes generally present in soil and water in 18-21 days. On average, farmers generally get about 4-5 quintals of dry jute fibre from 0.13 ha area i.e. 30-35 q/ha. Under conventional retting of jute, no chemicals and microbes are used externally for completion of retting.

The collected retting water samples were analyzed for different physico-chemical and chemical properties in laboratory following standard procedure. The pH and EC of retting water sample was determined by pH cum conductivity benchtop (Thermo Scientific) as per standard protocol. The retting water samples were neutralized first at pH 7.0 and then BOD was estimated by titrating with sodium thiosulphate solution as per the standard procedure and for chemical oxygen demand (COD), the closed refluxed method had been used. To determinate the concentration of Ca2+ and Mg2+ in retting water samples, the Versenate titration method had been used. The total N (nitrogen) present in retting water samples was determined by the Kjeldahl method. Nitrates and nitrites were reduced to ammonium with Devarda's alloy and measured by spectrophotometer. The total P (phosphorus) in retting water was measured by using the ascorbic acid method. The K content in retting water was determined by using Flame photometer following the standard procedure. The micronutrients (Fe, Mn, Zn and Cu) in retting water samples were analysed by using an atomic absorption spectrophotometer.

Table 1. Effect of jute retting on physico-chemical and chemical properties of post-retting water

Retting water properties	Pre-retting water		Post-retting water	
	Range	Mean	Range	Mean
pH	6.63-7.44	7.21	6.22-7.08	6.70
Electrical conductivity (ds/m)	0.194- 0.330	0.240	0.509-0.850	0.675
Bicarbonate content (me/l)	1.30-3.15	2.26	2.72-6.81	4.67
Total nitrogen (mg/l)	1.62-16.90	6.47	5.35-26.25	16.10
Total phosphorus (mg/l)	0.69-1.70	1.15	1.20-4.04	2.53
Total potassium (mg/l)	1.85-13.20	5.20	10.80-30.50	18.50
Total Ca+ Mg (ppm)	24.15-36.60	30.51	61.30-103.67	85.50
Total bicarbonate (me/l)	1.30-3.15	2.25	3.15-6.87	4.70
Total iron (ppm)	0.13-0.32	0.22	0.30-0.45	0.38
Total manganese (ppm)	0.009-0.1	0.019	0.018-0.122	0.029
Total zinc (ppm)	0.032-0.31	0.09	0.051-0.60	0.14
Total copper (ppm)	0.06-0.33	0.13	0.11-0.49	0.24
Biological oxygen demand (mg/l)	4.02-9.05	6.34	41.92-97.25	61.54
Chemical oxygen demand (mg/l)	27.60-80.85	49.12	133.72-402.95	232.32

The pH of post-retting water is reduced (Table 1) compared with pre-retting water as a result of release of organic acids in the retting water from the decomposition of jute plants. On the other hand, the electric conductivity (EC) of post-retting water is increased by more than two times compared with pre-retting water because of the addition of calcium, magnesium, iron salts released from the jute plants during retting process (Table 1).

The total nitrogen, phosphorus and potassium contents in the post retting water samples of four jute growing districts namely North 24 Parganas, Hooghly, Nadia and South Dinajpur of West Bengal recorded were 1.6-3.7, 1.78-2.84 and 1.75-4.00 times higher respectively, compared with the corresponding pre-retting water samples. Jute plants absorb a considerable amount of nitrogen, phosphorus and potassium along with other nutrients during its four months crop cycle from the applied fertilizer and soil reserve. The increase in N, P and K contents in post-retting water might be because of release of these nutrients during biochemical degradation of organism in jute plants. The total nitrogen, phosphorus and potassium ranged between 5.35-26.25, 1.20-4.04 and 10.8-30.5 mg/l respectively, in post-retting water samples of four intensively jute growing districts of West Bengal.

The post-retting water samples were very rich in secondary nutrients like calcium (Ca) and magnesium (Mg) compared with the pre-retting water samples. The Ca+ Mg content in the post-retting water ranged between 61.30 and 103.67 ppm which was higher by more than two times than the corresponding pre-retting water samples of four jute growing districts of West Bengal. The higher Ca + Mg content in the post-retting water was because of their addition in the retting water during the jute retting process of jute plants containing higher polyuronides and pectins present in the form of their metallic salts. Among the studied districts of West Bengal, the higher Ca + Mg content was recorded in the post-retting water samples of North 24 Parganas (79-103.67 ppm) followed by South Dinajpur (80.3-98.3 ppm), Hooghly (67.2-96.87 ppm) and Nadia (61.3-86.48 ppm) districts. The bicarbonate content in

Fig. 2. Typical "Jak" of jute plants kept for retting,

post-retting samples of four jute growing districts of West Bengal increased and ranged from 2.72-6.81 me/l compared with pre-retting water samples, where it ranged between 1.30 and 3.15 me/l. Bicarbonate content in retting water creates temporary hardness of water, but the bicarbonate content in post-retting water samples of West Bengal was not alarming because of their lower concentration.

The post-retting water samples were very rich in total micronutrients like iron (Fe), manganese (Mn), zinc (Zn) and copper (Cu) (Table 1). The total Zn, Cu, Fe and Mn contents in post-retting water samples were increased by 1.40-1.93, 1.50-2.55, 1.40-2.47 and 1.78-2.27 times respectively compared with their respective contents in pre-retting water samples collected from the jute growing districts of West Bengal. The mean total Zn, Cu and Fe contents in post-retting water samples were less than 0.5 ppm and that of total Mn was less than 0.1 ppm which was far below the toxic level for these micronutrients.

Jute retting is a biochemical process carried out by the microbes present in the retting water hence it directly affects the biological oxygen demand (BOD) and chemical oxygen demand (COD) of retting water. The BOD and COD contents in the post-retting water samples of four jute growing districts of West Bengal increased many folds compared with the pre-retting water samples. The higher BOD in retting water indicates very high microbial growth, which is expected as retting is a microbial process and depleted oxygen level because of consumption of dissolved oxygen of retting water by the microbial community resulting in higher BOD of post retting water. The higher COD in post-retting water indicates the presence of suspended and colloidal organic matter in the water. The COD in the post-retting water ranged between 133.72 and 402.95 mg/l in the concerned districts of West Bengal, which was within the permissible limit under environmental control. The higher BOD and COD in the post-retting water is a temporary phenomenon, the addition of fresh water in the form of rainfall reduces the BOD and COD of post retting water in due course.

SUMMARY

The biochemical process of jute retting involves biodegradation of very high amount of plant biomass (50-60 tonnes/ha) by the enzymatic action of retting microbes present in the retting water resulting in the extraction of jute fibre. During this process of jute retting, the BOD and COD contents in the post-retting water increased many folds because of higher microbial growth, depleted oxygen level and higher suspended organic matter content in post-retting water, although the BOD and COD values were within the safe limit of environmental pollution. The pH of the post-retting water decreased while electrical conductivity increased respectively because of secretion of organic acids from the decomposition of jute and addition of salts like Ca, Mg, iron etc. released from jute plants during retting. Post retting water samples were very rich in primary, secondary and important micronutrients like Fe, Mn, Zn and Cu released from the jute plants during retting. Post-retting water quality parameters to be used for irrigation purposes were found to be within the permissible limits (pH 6.22-7.08, EC 0.509-0.85 ds/m, total N 5.35-26.25 mg/l, P 1.20-4.04 mg/l, K 10.80-30.50 mg/l, Zn- 0.051-0.6 ppm, Cu-0.11-0.49 ppm, Mn 0.019-0.22 ppm and Fe 0.30-0.45 ppm).

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