INTRODUCTION

Jute is the world's foremost bast fibre crop and next to cotton it is the most important fibre plant in India. The fibre is obtained from the bark of the two cultivated species of the genus Corchorus, viz., C. capsularis L. and C. olitorius L., belonging to the family Tiliaceae. Approximately two million tons of jute fibres are produced annually in India and Pakistan, both the countries together meeting nearly 98 per cent of the world requirement of jute. This crop occupies a key place in Indian economy as it earns a good amount of foreign exchange and supports a flourishing industry.

Jute was a monopoly crop of India until 1947, but with the partition of the country major portion of the area under jute cultivation fell in Pakistan, thus creating a new problem of shortage in jute production in India. This situation has since improved gradually largely due to the extension of acreage under jute cultivation rather than due to an actual increase in yield per acre. The two important considerations in jute research are the quality and quantity of the fibre. The present situation of India does not allow any more extension in jute acreage without affecting the food production. The twin problems in jute agriculture, therefore, continue to be (i) increasing the average yield per acre and (ii) improving the quality simultaneously.
Increase in yield has been obtained by the application of manures and fertilizers. Thus, Choudhury (1942, 1946) has obtained an increase in fibre yield on application of ammonium sulphate and sodium nitrate. Again, it has been found that potassium chloride and superphosphate alone or in mixture have not increased fibre yield while ammonium sulphate in combination with the above fertilizers has proved to be effective (Choudhury, 1951).

From the reports of several manurial trials conducted by the Jute Agricultural Research Institute it is evident that nitrogen in whatever form it is made available is beneficial for fibre growth. (Ann. Rep., J.A.R.I., 1952-57). It has been further reported that foliar application of nitrogen in the form of urea and other sources also increased the fibre yield (Ann. Rep., J.A.R.I.; 1957-58).

Sen Gupta (1953) has observed that ammonium nitrogen is better than nitrate nitrogen and according to Das & Dua (1955) ammonium sulphate has proved to be the best source of nitrogen. In their studies on the effects of different levels of N, P and K on jute, Sen and Banerjee (1960) have observed that growth is proportional to the level of nitrogen and an increase in phosphorus or potassium without corresponding increase in nitrogen level has very little effect. The effects of sodium, potassium and calcium in association with nitrate nitrogen in the formation of fibres has also been worked out in Jute Agricultural Research Institute. The results have brought into prominence the role of cations in the formation of fibre cells (Kar, 1959).
Nitrogen decreases the number of fibre bundles in a fibre wedge although it increases the diameter and height of the plants. This increase in basal diameter as well as in height causes an overall increase in the total number of fibre bundles and average yield of fibre. Application of superphosphate results in an increase in the number of fibre bundles in a fibre wedge, but the total number of fibre bundles decrease because of absence of any increase in basal diameter (Kundu, 1959).

As regards the effect of manurial treatments on the formation of periderm it has been found that manures do not have any important role, though potash seems to have some effect in reducing the periderm height in stem. (Ann. Rep., J.A.R.I., 1944 - 45).

It is thus clear from the above citations of works on jute nutrition that the extent of growth and yield of fibre in this crop depend upon the three major elements viz., N, P and K and that application of manures in jute fields is an assuredly practical method for enhancing its production level. However, scanty attention appears to have been paid towards augmenting the qualitative status of jute in relation to the quantitative output. It is of vital importance for the industry that quantity and equality should proceed together.

The effect of nitrogen regarding the above point is worth considering since it increases fibre yield. It has been reported that the quality of jute bears a negative correlation with its nitrogen content (Sarkar et al, 1944). Pal et al. (1957) have shown that nitrogen content of fibre increases with an
increased supply of nitrogen to the plants and thus affects the quality of fibres. Nitrogen increases the fibre yield but the quality of fibre deteriorates under all sources of nitrogen (Das, 1958).

The commercially used fibres are the secondary phloem or phloic fibres developed by the activity of the cambium. Fibre development has been reported to occur in two stages, the primary wall phase and the cell wall thickening phase. The secondary wall is deposited in fibres where further growth and enlargement have ceased (Kundu, 1942, 1954; Ghosh, Rao and Patel, 1944).

In a mature stem fibre layout consists of certain unit structures viz., phloem pyramids, fibre layers, fibre bundles and ultimate-fibre cells (Kundu, 1943). The fibre bundles vary greatly in shape and size and the number of ultimate fibre cells as well as of fibre bundles are affected by different elements as mentioned earlier. It has been found that other factors remaining constant the quality of fibre increases with the increase in number of ultimate fibre cells per fibre bundle (Kundu, 1959).

Unlike the cereal crops vegetative growth is the most important factor in jute, since the extent of fibre production depends primarily upon the length of activity of the vegetative phase. The growth characteristics of jute has been discussed by Ear (1954). The formation of fibre begins very early in the life of the plant and the fibre is laid down along the stem by the activity of the apical meristem and cambium. The apical meristem is responsible for growth in length while the cambial activity
regulates growth in width and responsible for the major part (70-80%) of the fibre produced by the plant. The fibre formation as a result of initial meristematic activity in the apical region is very meagre in comparison to the fibres formed by the successive layers of cambium in the same region. The amount of fibre produced is essentially correlated to the formation of bark (Kar and De Sarkar, 1954, 1957).

Considering the nature of growth and pattern of fibre development during the life cycle of the plant, it is not unusual to find fibre cells of different ages with variations in their dimensions and cell wall thickening in a particular jute sample. In jute the unit which is processed in the mills is not a single individual fibre cell as in cotton, but a fibre strand consisting of numerous fibre cells cemented together. The quality of fibre depends on various characters and there is no single criterion on which the quality can be assessed. The quality depends on the physical and chemical properties of the individual fibre cells, these properties again depend upon the dimensions of the plants (Bandyopadhyay and Sarkar, 1952). Other characters which determine the quality of fibre are colour, lustre and softness along with the physical properties such as tensile strength, rigidity, elasticity etc. The relation between the physical properties and the chemical characteristics of jute fibre has been studied by Bandyopadhyay and Makhopadhaya (1955) and the relation between chemical characters of fibre and spinning quality has been investigated by Sarkar et al (1944) and Chatterjee (1950). Spinning quality in general decreases with increasing nitrogen, lignin, fat and wax content. For good quality yarns the ultimate fibres should be long and slender with a high length-breadth ratio (Rao...
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and Saha, 1961). The physical and chemical characters of the fibres depend upon the nature of growth and thickening of the fibre cells during the various phases of plant growth. Thickening as well as lignification of the fibre cells differ according to the stages of maturity (Macmillan et al., 1955) as well as along the length of the stem (Rao and Kundu, 1955). It has also been found that fibres obtained from the top portion of stem are of better quality than those from bottom regions due to the difference in lignification (Sen, 1955) and dimension of the ultimate fibre cells (Rao and Saha, 1961).

Another important character which determines the quality of jute is the process of retting. Jute is usually harvested at the bud stage, at a late stage periderm formation starts and decreases the quality of fibre (Patel and Ghosh, 1944) by increasing the nitrogen, fat and wax content (Chatterjee, 1950). Ghose and Patel (1945) have shown that the yield of fibre is correlated to the height and basal diameter of the plants. Jute plants generally require a fairly long vegetative period in order to attain good height and stem thickening (Kundu, 1946), but late stage harvesting though shows a comparatively higher yield degrades the quality.

With such divergent considerations as yield and quality an improvement in one direction may mean deterioration in the other, hence a comprehensive understanding of the metabolism of jute plant and its relation with the physiology of fibre development is a prerequisite for initiation of attempts at improving its quantity and quality. The two major metabolic activities which govern the growth behaviour of plants are the carbohydrate and nitrogen metabolism, physico-chemical characters of the fibres also being thus affected during the growth process.
The present study entitled "Studies on the carbohydrate and nitrogen metabolism in relation to growth and fibre formation in jute" was undertaken with the view to correlating the different aspects of the physiology of jute plant. The terms carbohydrate and nitrogen metabolism have been used here in the widest sense to present an overall pattern of the growth process. Growth is a dynamic process which essentially incorporates all the metabolic activities of an organism into one integrated mechanism; hence, the general terms carbohydrate and nitrogen metabolism serve an useful purpose.

Studies on the carbohydrate metabolism of cotton plant at different growth periods and its relation to fruitfulness have been studied by Ergle, (1936), Eaton and Joham (1944), Eaton and Riglér, (1945). It is clear from the works done on carbohydrate metabolism in cotton plants from different aspects that there is no definite relation between carbohydrate supply and fruitfulness. It would be interesting to study this aspect in jute plants.

Periodical changes in the various carbohydrate and nitrogen fractions in wood and bark from the different portions of the plants under differential treatments and the relationship that these changes bear to the quantitative variation in formation of fibre have been reported here. An acquaintance with the metabolic activity of the plants during the different stages of growth may lead to some conclusion towards the betterment of fibre production.
According to Kar (1959) "It will be an interesting and profitable aspect of research to find out the effect of manural combination like nitrogen, phosphate and potash or of micronutrients on the production of quality fibre". Studies were, therefore, undertaken on the effect of different levels of N, P and K on the carbohydrate and nitrogen metabolism with the view to elucidating their role in the formation of fibre at different growth stages of the jute plant. The present study though not dealing with the quality or other technological aspects of the fibre constitutes an initial attempt which may contribute a necessary step towards improving the quantity and quality of fibre.