

VARIATIONS IN THE MEDULLARY BUNDLES OF *ACHYRANTHES ASPERA* L. AND THE ORIGINAL HOME OF THE SPECIES

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(With 2 figures in the text)

THE stem of a number of species of *Achyranthes* (*A. aspera* L.¹, *A. crispa*², *A. argentea* Lamk.² and *A. bidentata* Blume³) has been shown to possess a pair of collateral medullary bundles inside the normal primary vascular ring. These bundles in an internode lie opposite to each other, in a line with the pair of leaves just below, and in most of the species, namely, *A. bidentata*, *A. argentea* and *A. crispa*, they run in the same lines throughout the length of an internode, quite freely and without touching each other. In every adjacent internode in these species, as in *A. aspera* also, they change their position to a different plane perpendicular to their first position. The disposition of the two medullary bundles in the internodes of *A. aspera*, however, varies a great deal in material collected from different places, though it agrees quite exactly with the other species in the ground plan. These variations further have been found to show a very regular sequence, and as they seem to throw some light on the original home of the species, it has been thought worth while to report the following observations.

The material used in the investigation has come from the following four places:

Place	Longitude	Latitude
1. Lahore	74° 26' E.	31° 27' N.
2. Bombay	72° 54' E.	18° 55' N.
3. Calcutta	88° 30' E.	22° 30' N.
4. Benares	83° 00' E.	25° 15' N.

The material of Bombay plants was sent to the writer by Professor R. H. Dastur. It was preserved in formalin and was examined by cutting hand sections. The material from other places was examined by the writer on the spot in the fresh condition by cutting it with a safety razor blade. This latter method is possible owing to the fact that the medullary bundles can be quite clearly seen even on cutting

¹ Dastur(1) and Joshi(2).

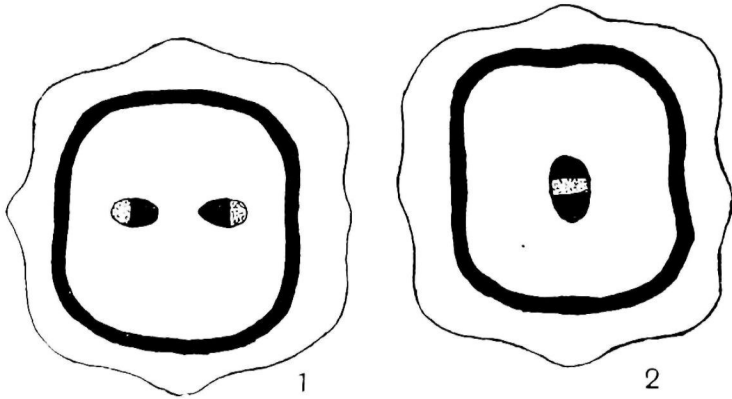
² Schmid(3).

³ This has been seen by the writer though the observations are not yet published.

an internode with a sharp knife. They appear as green structures in the white pith, and in this manner it is possible to examine a large number of plants completely within a short time. A microscope is needed only when the detailed structure of the bundles is to be seen.

OBSERVATIONS

(a) *Lahore plants*. The structure of the Lahore plants has been fully described by the writer elsewhere (2), and here it will be sufficient to give just a brief summary of the results obtained. The two free medullary bundles (Fig. 1), such as were described by Dastur (1) to be



Figs. 1 and 2. *Achyranthes aspera*. Transverse sections of the stem: 1, just below a node, showing two free medullary bundles; 2, through the middle of an internode, showing the medullary bundles fused and forming one amphyxyl bundle. The outer normal ring of bundles is shown in black. In the medullary bundles xylem is shown in black and phloem by dots. There is always a cambium in between the xylem and the phloem but this is not represented. Magnified about 20 times.

of universal occurrence in all the internodes of the Bombay plants, are found only in a few internodes in Lahore plants. They are mostly restricted to only two or three internodes of the stem (both of the main stem and the branches) just below the various flowering spikes. In every plant examined—and no less than 50 were studied completely—it was found that, in an overwhelming majority of the internodes, the two medullary bundles are free only for a short distance just above or below a node. Through their greater length, they are found to run together and unite with each other to form a single strand in the centre of the pith which could be described either as a double bundle or as a single bundle of an amphyxyl type (Fig. 2). The various changes that lead to the formation of this type of bundle are also described in the paper mentioned above.

(b) *Bombay plants.* The material of Bombay plants sent by Professor R. H. Dastur consisted of 49 pieces of stem, each varying in length from 4 to 6 in. These provided 124 internodes. In 40 pieces, comprising 94 internodes, the medullary bundles were found to remain perfectly free from each other throughout their length. In nine pieces alone out of 49, amphixylic-fused medullary bundles were seen. These nine pieces comprised 30 internodes, and out of these 22 showed the above condition. In this way out of a total of 124 internodes examined, in 102 free medullary bundles were found, while in less than 20 per cent., in 22 only, these bundles were found to run through a smaller or longer length of the internode in the fused condition. From their thickness, hardness, amount of secondary growth, and in three cases from the presence of the root, it was concluded that the pieces showing fused bundles had come from near the base of the plant.

Thus in Bombay plants, the fused medullary bundles are not so conspicuous as in the Punjab plants. In fact Dastur (1), who was the first person to describe the medullary bundles of *Achyranthes aspera* and whose material also came from Bombay Presidency, failed to observe this condition. It may be then that in some plants this condition may be altogether absent. This is very probable from what I have seen of Calcutta and Benares plants. The fair representation of the fused condition in the material that I received from the same place may just be by chance. Even in this, however, the condition is of no such regular occurrence as in the Punjab plants. Besides being confined only to the base of the plant, it was often seen that the medullary bundles while they were fused in an upper internode were free in one just below. In the Punjab plants it is never so. The free medullary bundles are found only in a few internodes just below the inflorescence, and then lower down in all the internodes without any irregularity the fused condition is seen.

(c) *Calcutta plants.* About 25 plants were examined by the writer from the side of a road in the Royal Botanic Gardens, Sibpur. In all of these, with the exception of one, the medullary bundles were found to remain free in all the internodes of the plant. In the one plant in which conditions were different, it was only in one internode that the fused medullary bundles were seen. This internode came from near the base of the plant.

(d) *Benares plants.* At Benares about 50 complete plants were studied. These were taken from every type of situation where these plants grow. No differences connected with situation were found,

but in taking all the plants together it was noticed that in about half of them, as in the great majority of Calcutta plants, the medullary bundles remained quite free in all the internodes of the plant. In the other half, fused amphixylic bundles were seen here and there, as in the Punjab plants, but their occurrence was found to be very irregular. In one branch the sixth internode, in another the fourth, and in another the fifth internode from the inflorescence were found to show the fused condition of the medullary bundles, but all the internodes below these were found to possess two quite free medullary bundles throughout their length. In another branch three internodes consecutively, the third, fourth and fifth, showed the fused condition of the medullary bundles, but the internode below the fifth one, i.e. the sixth internode below the inflorescence, was found to show the free condition of the medullary bundles throughout its length. In another branch, the fourth and the sixth internodes below the inflorescence were found to show the fused condition of the medullary bundles, while the first, second, third and fifth internodes showed free bundles. In still another branch, it was the seventh internode below the inflorescence which showed the fusion of the medullary bundles. In this manner every branch was seen to possess a different condition from the others and the variations in the different branches exhibited no order, so the Benares plants in the structure of their medullary bundles are intermediate between the Calcutta and the Punjab plants.

DISCUSSION

From the presence of free collateral medullary bundles in the stem of all the investigated species of *Achyranthes* except *A. aspera*, preponderance of this condition in the Calcutta and Bombay plants of *A. aspera* and its presence even in the Punjab plants of the latter species (where the fused bundles are best seen) in a few internodes below every inflorescence and the highly specialised character of the fused bundles, it is quite clear that the occurrence of two free medullary bundles throughout the length of an internode is a primitive condition, and their fusion in the middle of an internode to form a single strand is a later and a derived condition. From this it follows that the Calcutta and Bombay plants, where the fusion of the medullary bundles is either completely absent or occurs only rarely and irregularly, are primitive, and the Punjab plants where the fused condition of the medullary bundles is dominant are more recent. Naturally, therefore, the first plants are to be regarded as near the

original home of the species, and the Punjab plants to be away from the original home. This would mean that in India the original home of the species was in the south in the tropics, and from there it has spread out northwards towards the sub-tropical parts.

The structure of Benares plants fully supports such a conclusion. This is a station intermediate in situation between Calcutta and Punjab, and the plants growing here also show a structure intermediate between that of Calcutta and Punjab plants.

The fact that the family Amarantaceae is mostly tropical in distribution also conforms with this hypothesis.

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