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Effect of Colchicine and Morphactin on the Cotyledonary Venation of *Lycopersicon esculentum* var. *angurlata*

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With 1 Plate (9 Figures)

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Abstract

The venation pattern in the treated and untreated cotyledons of *Lycopersicon esculentum* Mill. var. *angurlata* conforms to the pinnate camptodromous type. The number and size of tracheids varies in different treatments. The average size of areoles is not significantly variable. Tracheids occur either solitary or in clusters at the free vein endings. Isolated tracheids are also present. Marginal multiseriate fimbriate vein is observed. Loop formation is common in larger areoles. The noteworthy point is the density of tracheids which is maximum in 25 ppm colchicine treatment. The increased concentration of both morphactin and colchicine inhibits the size of tracheids as well as their number per areole.

Zusammenfassung

Die Wirkung von Colchicin und Morphactin auf die Nervatur der Keimblätter von *Lycopersicon esculentum*

Die Nervatur der unbehandelten und behandelten Keimblätter entspricht dem pinnaten camptodromen Typ (n. Hickey 1973, ein Mittelnerv mit seitlichen, am Rande nicht frei endenden Seitennerven). Die durchschnittliche Größe der Leitbündelmaschen zeigt keine deutlichen Veränderungen. Die Tracheiden an den Nervenendigungen liegen entweder einzeln oder in Gruppen, auch isolierte Tracheiden kommen vor. Am Blattrand ist eine vielreihige, durch Verschmelzung von Nerven höherer Ordnung entstandene, entlang des Blattrandes verlaufende Blattader zu beobachten. In den größeren Leitbündelmaschen sind Schleifen häufig. Bemerkenswert ist, daß die Tracheiden ihre größte Dichte in 25 ppm Colchicin erreichen; höhere Konzentrationen von Colchicin wie von

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Morphactin verringern Zahl wie Größe der Tracheiden pro Leitbündelmasche. (Übersetzt und ergänzt vom Editor.)

Introduction

HICKEY (1973) classified the architecture of dicotyledonous leaves and DILCHER (1974) reviewed the literature on the venation pattern. COLEMAN & GREYSON (1976) studied the leaf ontogeny of tomato with reference to the development of venation. The effect of growth regulators has been studied on stomatal structure and ontogeny but not on venation pattern of cotyledons (see INAMDAR 1970). Therefore the present work has been undertaken to study the effect of colchicine and morphactin on the venation pattern of cotyledons of *Lycopersicon esculentum*.

Material and Methods

Seeds for the present investigation were obtained from the Institute of Agriculture, Anand. The seeds were surface sterilised in 5 volume hydrogen peroxide for 5 minutes and washed twice in glass distilled water. Then they were transferred to sterilised petridishes lined with filter papers. Colchicine and Morphactin in three concentrations: 25, 50, and 100 ppm were used. For control the seeds were cultured in distilled water. Filter papers and substrates were renewed at the interval of 24 hours. Germination started after four days and seedlings were collected and fixed in FAA after 15 days.

The cotyledons were cleared in 2.5% NaOH solution for about 24 hours followed by sodium hypochlorite for about 4 hours. The cleared cotyledons were washed thoroughly in tap water and stained in safranin and mounted in glycerine jelly. Microphotographs were taken with the help of a Zeiss photomicroscope using blue and yellow filters. Mean values of ten observations showing the size of areoles, number of tracheids per areoles and size of tracheids are compiled in the following table.

S. NO.	Treatment	Number of tracheids per areole	Size of tracheids (μm) L	B	Average size of areoles (mm^2)
1.	D. W.	3	28	9	.09
2.	COL 25 ppm	10	36	10	.06
3.	COL 50 ppm	5	29	9	.07
4.	COL 100 ppm	3	22	11	.09
5.	MOR 25 ppm	6	38	9	.07
6.	MOR 50 ppm	6	34	10	.06
7.	MOR 100 ppm	2	32	10	.07

D. W. — Distilled water, COL — Colchicine, MOR — Morphactin, L — Length, B — Breadth.

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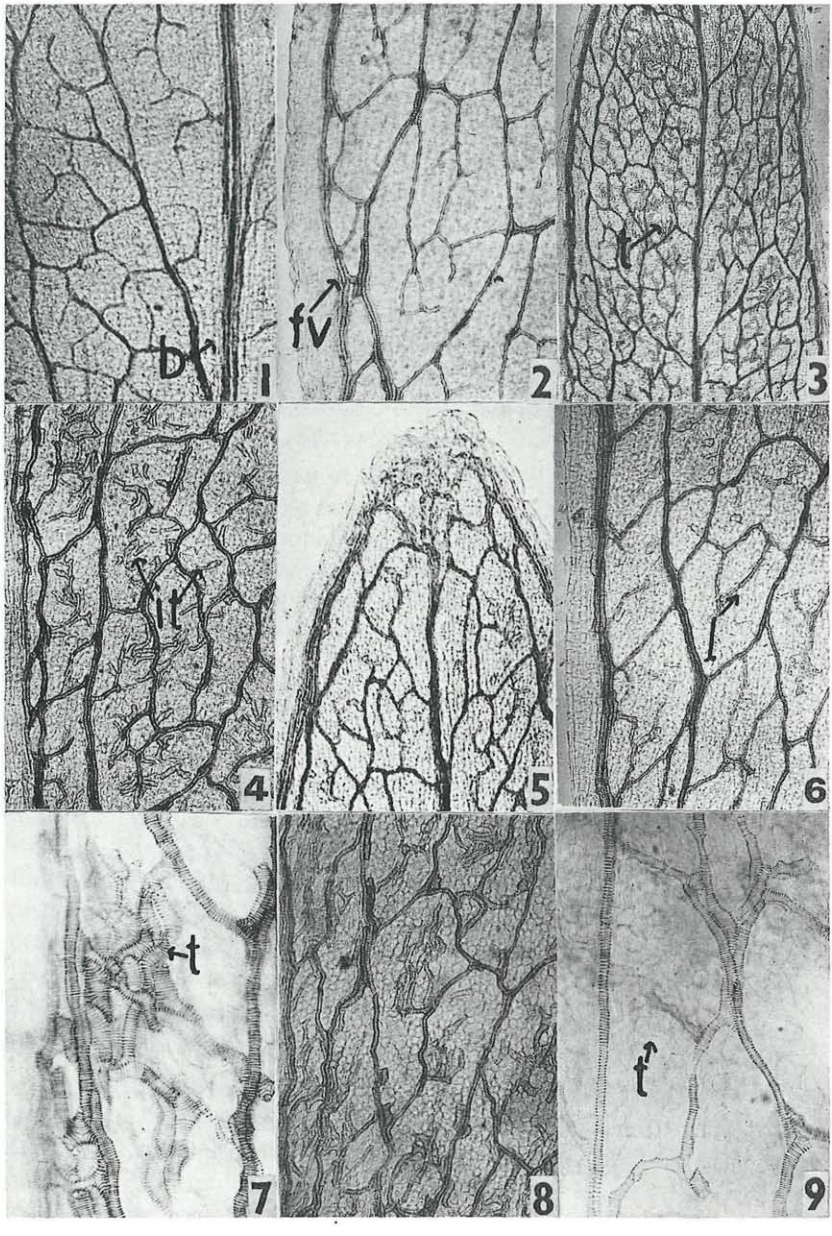

Explanation to plate I figures 1—9. Cotyledonary venation in control (distilled water): Fig. 1, 2; colchicine 25 ppm: Fig. 3, 4; colchicine 50 ppm: Fig. 5, 6; morphactin 25 ppm: Fig. 7; morphactin 50 ppm: Fig. 8; morphactin 100 ppm: Fig. 9. b = bundle sheath, fv = fimbriate vein, t = tracheids, it = isolated tracheids, l = loop. Figs. 1, 3, 5 ×51, figs. 2, 4, 6, 8 ×112, figs. 7, 9 ×315)

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Observations

I. Control (D. W.) (Figs. 1, 2):

The venation pattern is of pinnate camptodromous type. The nature of primary vein is stout, straight with parenchymatous bundle sheath (Fig. 1—b). The secondary veins are alternate and subopposite on both sides of the primary vein. The angle of divergence of secondary veins on the primary vein is more or less uniform throughout. The secondary veins like the primary vein are also covered by parenchymatous bundlesheath. The relative thickness of secondaries are moderate. The secondaries at the basal region are connected with the adjacent ones forming an arc (Fig. 1). The secondaries near the cotyledonary apex lose their identity beyond their departure from the primary vein. Intersecondary veins are absent. Areoles of different sizes are formed by all types of veins.

The vein endings may be simple or branched. Simple vein endings may be linear and curved, the latter are more common. Both arms of branched vein endings may be equal or unequal. Here the longer arms are facing towards the minor veins, while the shorter ones are facing towards the major veins. In case of equal branched vein endings both the arms are facing towards the secondary vein. There is no relation between the size of an areole and the number of vein endings, as even the neighbouring areoles although equal in size show variations in number of vein endings. Moreover the larger areoles may have few vein endings or none where a loop like areole is present, while the smaller ones have more of them. The vein endings in some cases are terminated by uniseriate tracheids. They are also found over the veins except the primary vein. Sometimes they occur isolated. They may be solitary or in groups with lesser density. The marginal fimbriate vein (Fig. 2 — fv) is present which is markedly thinner than the primary vein. The average size of areole is 0.09 mm^2, number of tracheids per areole are 3 and their length and breadth 28 and 9 μm respectively.

Treated Cotyledons:

II. Colchicine (COL) (Figs. 3—6):

(i) 25 ppm (Figs. 3, 4): The density of veins as well as tracheids increase enormously. Distribution of tracheids seems to be uniform with greater density at the apical region on either side of the midrib rather than the basal one. The number of free vein endings is very less. Secondaries and tertiaries are more or less equally thickened, therefore there is no clear demarcation between them as compared to the control. The marginal fimbriate vein is thickened as compared to the control and interconnected with the minor venation system as in control. The vein endings may be with or without uniseriate elongated tracheids and occur solitary or in clusters. Isolated tracheids may be solitary or in clusters of 2 to 4 in the areoles. As in control the tracheids are present on all types of veins except

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the primary vein. Sometimes tracheids are arranged in a helical fashion at the vein endings.

(ii) 50 ppm (Figs. 5, 6): As compared to COL. 25 ppm venation and tracheids are less formed. The tracheids are more distributed towards the extreme tip of the cotyledons although they were randomly present throughout the surface. The tracheids are mostly small and isodiametric. Isolated tracheids are also present in the areoles. Vein endings may be with or without tracheids. Loop formation is observed which may have been formed due to the attraction and union of vein endings (Fig. 6 — L).

(iii) 100 ppm: The density of veins is greater as compared to the tracheids. The tracheids are distributed only at the tip region, while they are totaly absent in the basal region. Here the free vein endings are more frequent as compared to COL. 25 and 50 ppm. The free vein endings whether simple or branched may or may not terminate with tracheids. Isolated tracheids are also seen.

The increased concentration of colchicine inhibits both the number and size of tracheids per areole.

III. Morphactin (MOR) (Figs. 7—9):

(i) 25 ppm. (Fig. 7): There is an apparent change in the venation pattern as well as tracheids. The tracheids may be solitary or in clusters. The tracheids are present in the basal region of the cotyledons. The elongated tracheids are more numerous compared to the isodiametric ones.

(ii) 50 ppm (Fig. 8): The tracheids are evenly distributed throughout the surface of the cotyledons as compared to MOR. 25 ppm. Their density is greater towards the marginal region than in the midrib region. Majority of the tracheids are elongated with isodiametric ones here and there. The tracheids may be solitary or clustered. Clustered tracheids occur only on one side of the free vein endings. They are present on all types of veins except the primary veins. Isolated tracheids may be solitary or clustered.

(iii) 100 ppm (Fig. 9): Here the density of the veins is greater than that of the tracheids. The areoles are of definite shape as compared to MOR. 25 and 50 ppm. The tracheids present in the areoles may be isolated or at the tips of vein endings. Free vein endings are more frequent.

The increased concentration of morphactin inhibits both the size of the tracheids and their number per areole.

Discussion

The foliar venation has been studied by many authors but not the cotyledonary venation pattern (see Hickey 1973). The effect of growth regulators on the cotyledonary venation pattern has been studied for the first time in tomato. The venation patterns conforms to the pinnate camptodromous type of Hickey (1973). The increased concentration of colchicine

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and morphactin affects the average size of areole per mm^2, as well as the number and distribution of tracheids per areole and size of tracheids. Formation of tracheids is more frequent in COL. 25 and MOR. 25 ppm compared to with the control. The primary and secondary veins are enveloped by parenchymatous bundle sheath. The vein endings may be simple or branched. Uniseriate tracheids may occur solitary or in clusters at the vein endings as well as over other veins. Loop formation is seen in big areoles. Isolated tracheids also are present which may be solitary or clustered. Isolated veins were reported by KASAPLIGIL (1951) and disjunct foliar veins in Hawaiian Euphorbias by HERBEST (1971) and "storage" or "water tracheids" in *Euphorbia* and *Pongonophora* by VINDT (1960) and FOSTER (1956). Marginal fimbriate vein is present in both treated and untreated cotyledons. This has been reported in the leaves of tomato by COLEMAN & GREYSON (1976).

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