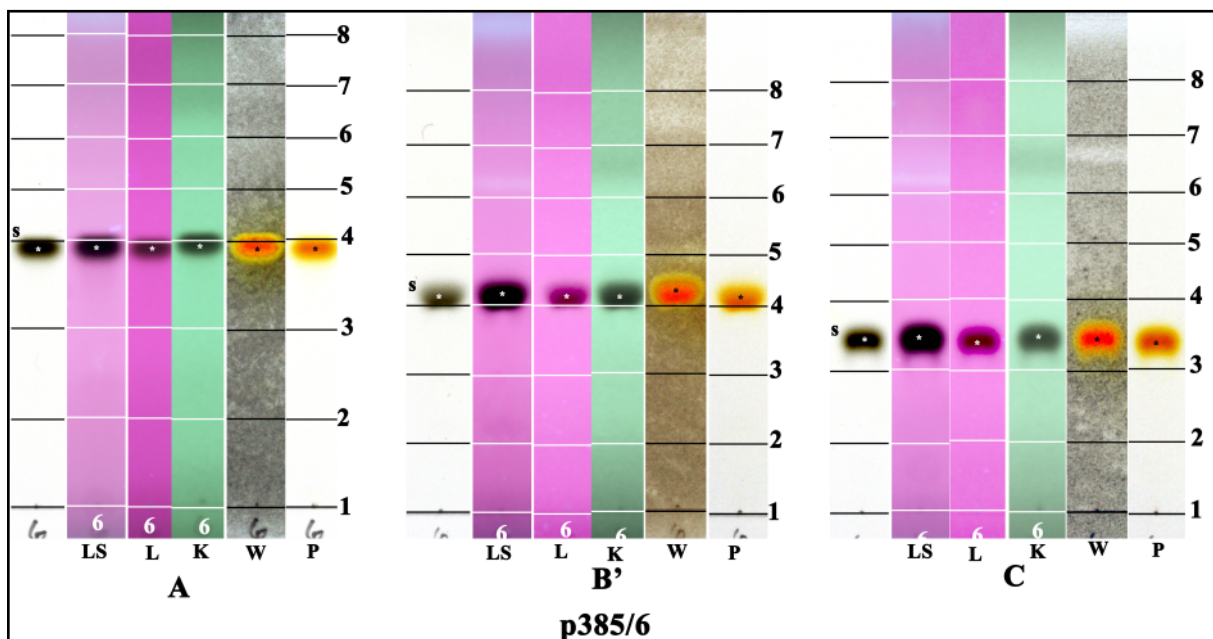


*F. Schumm*

# Atlas of Images of Thin Layer Chromatograms of Lichen Substances. Supplement

## Bilderatlas von Dünnschicht- chromatogrammen von Flechten-Inhaltsstoffen. Ergänzungsband



*F. Schumm*

**Atlas of Images of Thin Layer Chromatograms of  
Lichen Substances. Supplement**

**Bilderatlas von Dünnschichtchromatogrammen von  
Flechten-Inhaltsstoffen. Ergänzungsband**

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1. Auflage 2016

Alle Rechte beim Autor

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Herstellung und Verlag: Books on Demand GmbH, Norderstedt

ISBN:

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## **Preface**

A short time after „F. Schumm & J.A. Elix (2015): Atlas of Images of Thin Layer Chromatograms of Lichen Substances“ was published, I kindly received from Klaus Kalb further purified lichen substances on loan. Most of them came from S. Huneck. This collection contains some rare substances that have not been represented in the 2015 edition of the atlas. These substances are added here. In addition, many substances of Kalb's collection, that were already treated in the 2015 edition of the atlas, are again included here, now based on purified material. I believe it to be of advantage to have the possibility to compare more than one chromatogram of a given substance.

The methods and abbreviations are the same as in the 2015 edition of the atlas and therefore the first pages of that edition are repeated here. As a consequence this supplement can be used without the first edition of 2015.

## **Vorwort**

Kurz nach dem Erscheinen unserer Tafelsammlung „F. Schumm & J.A. Elix (2015): Bilderatlas von Dünnschichtchromatogrammen von Flechten-Inhaltsstoffen“ erhielt ich freundlicher Weise von Klaus Kalb aus seiner reichhaltigen Sammlung leihweise weitere gereinigte Inhaltsstoffe. Die meisten stammen von S. Huneck. In dieser Stoffsammlung befinden sich auch teils recht seltene Inhaltsstoffe, von denen 2015 keine Chromatogramme abgebildet werden konnten. Dies soll hier nachgetragen werden.

Viele Substanzen in der Sammlung von K. Kalb sind schon 2015 abgebildet worden, doch oftmals in Kombination mit anderen, wie es bei Flechtenextrakten vorkommt.

Da in der Sammlung von K. Kalb die Flechtensäuren in gereinigter Form vorlagen, habe ich nochmals alle Inhaltsstoffe abgebildet, auch wenn es zu Wiederholungen kommt, da sich die Tafeln so ergänzen. Selbst halte ich es jedenfalls für hilfreich, von einem Inhaltsstoff nicht nur ein Chromatogramm zum Vergleich heranziehen zu können.

Die Untersuchungsweise und Abkürzungen wurden unverändert beibehalten, wie sie im Atlas 2015 beschrieben worden sind. Damit dieser Ergänzungsband unabhängig vom 1. Band verwendet werden kann, werden die einleitenden Seiten zur Methodik hier ohne Änderung wiederholt.

## **Introduction**

The determination of lichens it is often facilitated by a knowledge of the lichen substances present in the specimens. Thin layer chromatography (TLC) has greatly improved the speed and certainty of recognition of lichen substances by means that are simple to use and relatively inexpensive. Standardized methodology and further refinements of analytical TLC procedures for detecting and comparing lichen metabolites have been reported by C.F. Culberson (1970). For the identification of the TLC spots observed one can compare the relative Rf values (Elix, 2014). Unfortunately these Rf values often vary by up to 5 % for various reasons (in particular relative humidity) and a definite identification requires experience and is often more difficult than indicated in the literature. Therefore we believe that the collection of HPTLC images presented here will assist in the identification of the spots, especially since we show the HPTLC plates under various UV-light before and after applying sulfuric acid and heat, and in water.

In our book *Images from Lichenes Australasici Exsiccati and of other characteristic Australasian Lichens* published in 2014, many of the specimens were accompanied by images of such HPTLC plates as an aid to their identification. Subsequently we decided to expand the number of plates to present the images produced by as many lichen substances as possible. We thank Dr Harrie Sipman (Berlin) for supplying us with many purified compounds from the Huneck collection of lichen substances.

In some cases we have intentionally included more than one plate for a particular lichen substance in order to demonstrate the variability observed in the Rf values, colour of the spots etc.

Here we used small 5 x 5 cm HPTLC plates. Although the resolution of the spots is not as definitive as with professional 20 x 20 cm plates, usually the majority of substances are separated. These plates have the advantage of being relatively inexpensive, of needing only 1-2 cm<sup>3</sup> of solvents per run and can be used at home by amateurs with a limited budget. The images show what can be achieved with these small plates. The method for using these plates is described below.

## **How to use the plates**

Of course it is an advantage to know what substances are expected for a particular lichen so that it is possible to compare the one's observed

results with selected plates in this book. In other cases more extensive searches and comparisons with published Rf values cannot be avoided. A search tool for unknown spots can be obtained from fschumm@online.de

### Remarks on the Rf values

In most Rf tables (Elix 2014) or in the Wintabolites program the following relative positions are used:

Elix:  $0 \leq Y \leq 100$

solvent A: start = 0, norstictic acid = 40, atranorin = 75

solvent B: start = 0, norstictic acid = 29, atranorin = 78

solvent B': start = 0, norstictic acid = 32, atranorin = 73

solvent C: start = 0, norstictic acid = 30, atranorin = 79

We use another system here for determining the relative positions of the spots which is more convenient when the 5 x 5 cm HPTLC plates are used. It can be seen at the sides of the plates in the published images. This „1-7“ position system was previously introduced by Schumm (2002).

Here  $1 \leq X \leq 7$

solvent A,B'/B, C: 1 = start position, 4 = position of norstictic acid, 7 = position of atranorin. For better comparisons we further drew additional lines 2, 3 between the section 1 to 4 and 5, 6 between the section 4 to 7.

A conversion from the 0-100 Rf values for 20 x 20 cm TLC plates to the 1-7 system for 5 x 5 HPTLC plates is only approximate. The following linear interpolation formula may aid in this.

Conversion of Rf values here (1.. x ..7) to Rf values in Elix (2014), (0.. y ..100)

solvent A

$$\text{if } x \leq 4: \quad y = (x - 1) \cdot \frac{40}{3}$$

$$\text{if } x > 4: \quad y = (x - 4) \frac{35}{3} + 40$$

solvent B'

$$\text{if } x \leq 4: y = (x - 1) \cdot \frac{32}{3}$$

$$\text{if } x > 4: y = (x - 4) \cdot \frac{41}{3} + 32$$

solvent C

$$\text{if } x \leq 4: y = (x - 1) \cdot 10$$

$$\text{if } x > 4: y = (x - 4) \cdot \frac{49}{3} + 30$$

Conversion of Rf values (0.. y ..100) in Elix (2014) in the relative Rf values here (1.. x ..7): I think that the examples would help

solvent A

$$\text{if } y \leq 40: x = 1 + \frac{(3 \cdot y)}{40}$$

$$\text{if } y > 40: x = 4 + 3 \cdot \frac{(y - 40)}{(75 - 40)}$$

solvent B'

$$\text{if } y \leq 32: x = 1 + 3 \cdot \frac{y}{32}$$

$$\text{if } y > 32: x = 4 + 3 \cdot \frac{(y - 32)}{(78 - 32)}$$

solvent C

$$\text{if } y \leq 30: x = 1 + 3 \cdot \frac{y}{30}$$

$$\text{if } x > 30: x = 4 + 3 \cdot \frac{(y - 30)}{(79 - 30)}$$

Example 1: In our plate we find in A a spot at position  $x = 3,6$ . Then the wintabulites Rf should be

$$y = (x - 1) \cdot \frac{40}{3} = (3,6 - 1) \cdot \frac{40}{3} = 34,7$$

Example 2: The wintabulites R<sub>f</sub> in A is y = 60,5.  
Then the spot is expected on our plate in position

$$x = 4 + 3 \cdot \frac{(y-40)}{(75-40)} = 4 + 3 \cdot \frac{(60,5-40)}{35} = 5,76$$

### **The presentation of the plates and abbreviations used:**

Each plate contains 3 mounted groups of HPTLC for the solvents A, B/B', C:

**A** = Toluene : Dioxane : Glacial acetic acid = 39.13 : 9.78 : 1.09 ml

**B** = n-Hexane : Diethyl Ether : Formic acid = 26.00 : 20.00 : 4.00 ml

**B'** = n-Hexane : Methyl tert-butyl ether : Formic acid = 30.43 : 15.65 : 3.91 ml [note methyl tert-butyl ether is a potent allergen]

**C** = Toluene : Glacial acetic acid = 42.39 : 7.61 ml

Each plate shows the results for

- = In daylight - after spraying with 10% sulphuric acid and drying at 90-100°C for 20-30 min.

**LS** = longwave UV-light (366 nm) after acid/heat treatment

**L** = longwave UV-light (366 nm) before acid/heat treatment

**K** = shortwave UV-light (254 nm) before acid/heat treatment

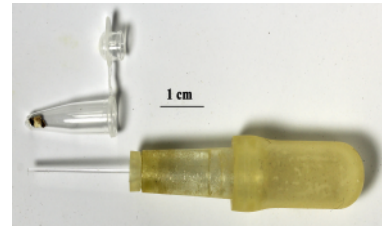
**P** = daylight without acid treatment for detecting pigments

Each plate is labelled with the herbarium number [...] (F. Schumm) and the plate number p.. The plates are stored in Wangen. The origin of the lichen specimens analysed are noted, albeit it in an abbreviated form when published previously in Schumm & Elix (2014). If a purified substance from the Huneck collection was used, then the substance number is given.

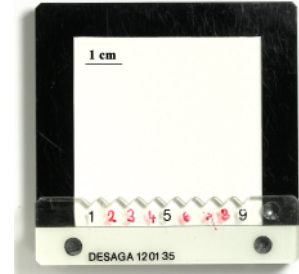
For the images a Canon EOS 40D and a Canon EOS 600D camera was used. Although the same adjustments were used the images for L have a more reddish background with the EOS 600D camera and a more bluish background with the EOS 40D camera.

## Brief instructions

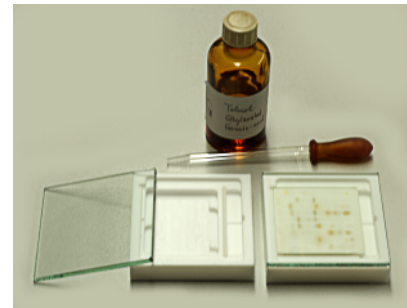
a) Extraction of 1-2 apothecia for example, in 0.2 ml PCR-tubes with 1-3 drops acetone.



b) Apply the extracts with a 0.5 µl microcapillary and a stencil for 9 positions (spots) on a 5 x 5 cm HPTLC-plate (Merck HPTLC Kieselgel 60 F254, no. 1.05635.0001). The 3rd row is always reserved for an extract of *Cladonia symphylicarpa* with norstictic acid and atranorin s reference standards.



c) Develop the plates in the horizontal chamber following Ljubomir Kraus (1994) in the three solvents A, B' and C, stored in 50 ml bottles

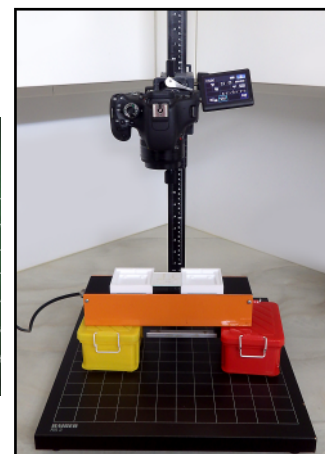
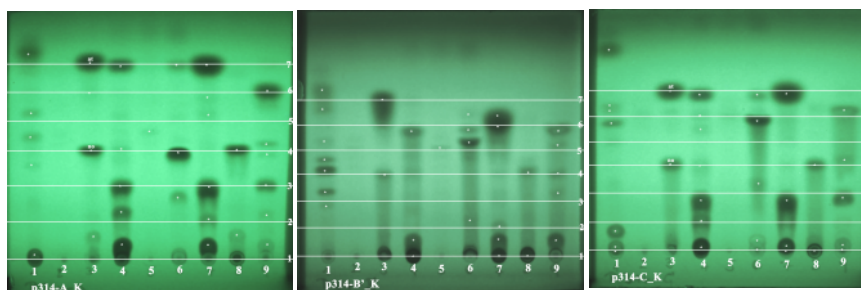


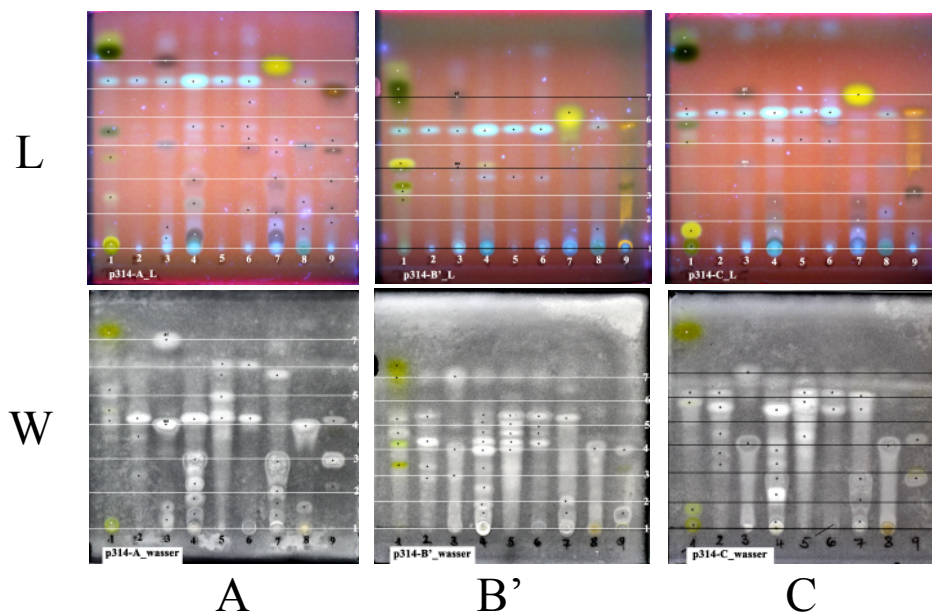
A = Toluene : Dioxane : Glacial acetic acid = 39.13 : 9.78 : 1.09 ml

B' = n-Hexane : Methyl tert-butyl ether : Formic acid = 30.43 : 15.65 : 3.91 ml [note methyl tert-butyl ether is a potent allergen]

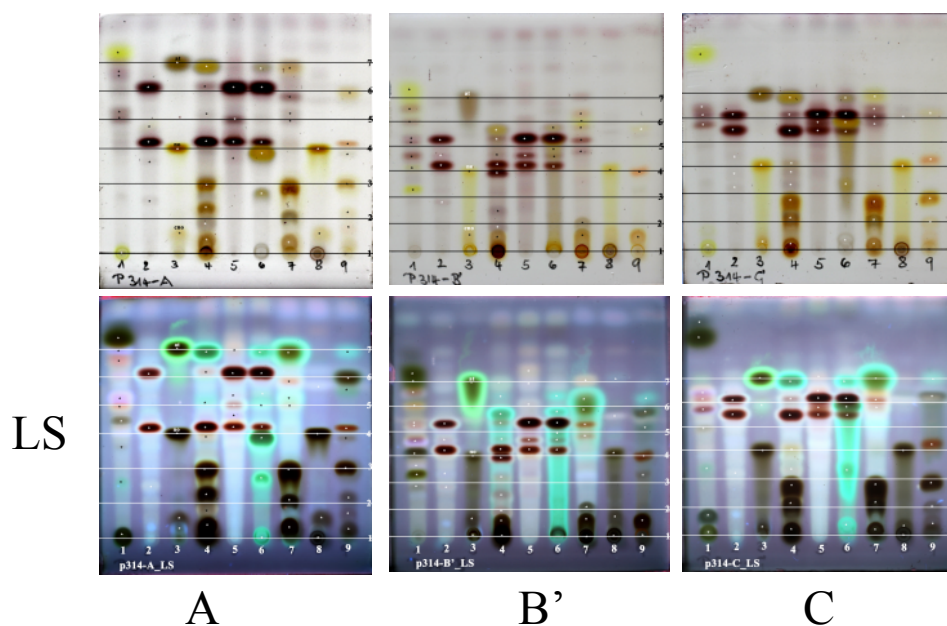
C = Toluene : Glacial acetic acid = 42.39 : 7.61 ml

d) Dry the plates. Images of the plates in longwave (366 nm, = L) and shortwave (254 nm = K) UV-light and after spraying with water (= W). For pigments are also recorded dry in daylight (= P). For the UV-photographs we use a small UV lamp and the UV in transmission mode.





e) Spray with 10% sulphuric acid and dry at 90-100°C for 20-30 min in a oven [beware fumes]. Images then recorded in daylight and longwave UV-light (=LS).



For better comparisons of the resultant spots we divided the plates in two sections by drawing the three horizontal lines. 1= origin, 4= position of norstictic acid, 7= position of atranorin. Further we drew additional lines 2, 3 and 5,6 in the two segments. For the images of the plates illustrated in the book, we collected the relevant rows for a particular specimen. Each plate is labelled with the herbarium number [.] (F.Schumm) and the plate number p..

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## Einführung

Die Bestimmung von Flechten wird häufig erleichtert, wenn man die Flechten-Inhaltsstoffe der zu bestimmenden Proben kennt. Die Dünnschichtchromatographie (TLC) hat die Geschwindigkeit und Sicherheit der Erkennung von Inhaltsstoffen sehr verbessert und sie ist einfach anzuwenden und relativ preiswert. C.F. Culberson (1970) veröffentlichte eine standardisierte Methode und weitere Verbesserungen des TLC Verfahrens, um Flechteninhaltsstoffe zu entdecken und zu vergleichen. Um erhaltene TLC Flecke zu bestimmen kann man sie mit den relativen Rf-Werten (Elix, 2014) vergleichen. Leider variieren diese Rf-Werte aus verschiedensten Gründen (besonders wegen unterschiedlicher Feuchtigkeit) um etwa 5 %. Eine endgültige Bestimmung erfordert Erfahrung und ist schwieriger als es aus der Literatur hervorgeht. Daher glauben wir, dass die hier gezeigte Sammlung von HPTLC Bildern bei der Bestimmung der erhaltenen Flecke eine gute Hilfe ist, insbesondere weil wir die HPTLC Platten auch unter verschiedenem UV-Licht vor und nach der Behandlung mit Schwefelsäure und in Wasser zeigen.

In unserem Buch *Images from Lichenes Australasici Exsiccati and of other characteristic Australasian Lichens*, 2014 veröffentlicht, sind viele Arten mit solchen HPTLC Bildern versehen, die als Bestimmungshilfe dienen sollen. Es lag daher nahe, die Zahl der Platten durch möglichst viele Flechtenstoffe zu erweitern und gesondert zu veröffentlichen. Wir bedanken wir uns bei H. Sipman (Berlin), der uns aus der Sammlung von S. Huneck viele gereinigte Substanzen zur Untersuchung geschickt hat.

Bei einer Reihe von Inhaltsstoffen wurden ganz bewusst mehrere Chromatogramme abgebildet, um die Schwankungen in den Rf-Werten, Farben der Flecke zu zeigen.

Wir verwenden hier 5 x 5 cm kleine HPTLC Platten. Sie haben zwar nicht das hohe Auflösungsvermögen wie 20 x 20 cm große TLC Platten, zeigen aber meistens die Inhaltsstoffe genügend getrennt. Ihr Vorteil ist der geringere Preis und der sehr geringe Verbrauch an Laufmitteln, so dass sie auch vom Amateur zu Hause benutzt werden können. Dieser Atlas zeigt, was man mit diesen Platten erreichen kann und wo ihre Grenzen liegen. Eine knappe bebilderte Anleitung, wie die HPTLCs hier entstanden sind, geben wir weiter unten.

### **Anwendung der Tafeln:**

Es ist natürlich von Vorteil, wenn man schon die zu erwartenden Inhaltsstoffe seiner speziellen Probe kennt und die eigenen Resultate gezielt in diesem Atlas nachschlagen kann. Sonst ist ein u.U. recht langwieriges Suchen und ein Vergleichen mit publizierten Rf-Werten nicht vermeidbar. Ein Suchtool für unbekannte Flecke kann man von fschumm@online.de erhalten.

### **Bemerkungen zu den Rf-Werten:**

In den meisten Rf-Tabellen (Elix 2014) oder in dem PC-Programm Wintabulites werden folgende relativen Positionsangaben verwendet:

Elix:  $0 \leq Y \leq 100$

Laufmittel A: 0 = Startlinie, 40 = Norstictinsäure, 75 = Atranorin

Laufmittel B: 0 = Startlinie, 29 = Norstictinsäure, 78 = Atranorin

Laufmittel B': 0 = Startlinie, 32 = Norstictinsäure, 73 = Atranorin

Laufmittel C: 0 = Startlinie, 30 = Norstictinsäure, 79 = Atranorin

Wir verwenden hier ein anderes System, um die relativen Positionen anzugeben, das für die kleinen 5x5 cm HPTLCs bequemer ist. Dies kann an den Seiten der hier publizierten Bilder gesehen werden. Dieses „1-7“ Positionssystem wurde früher von Schumm (2002) eingeführt.

Hier  $1 \leq X \leq 7$

Laufmittel A,B',C: 1 = Startlinie, 4 = Position von Norstictinsäure, 7 = Position von Atranorin. Zur besseren Orientierung ziehen wir zusätzliche äquidistante Teilungslinien 2,3 bzw. 5,6 in die jeweiligen Bereiche 1 bis 4 bzw. 4 bis 7 ein.

Eine Umrechnung der 0-100 Rf-Werte für 20 x 20 TLC Platen in das 1-7 System für 5 x 5 Platten ist nur angenähert möglich. Die folgenden linear interpolierenden Formeln mögen dazu eine Hilfe sein.

Umrechnung von Rf-Werten hier (1.. x ..7) in Rf-Werte bei Elix (2014), (0.. y ..100)

Laufmittel A

$$\text{für } x \leq 4: y = (x - 1) \cdot \frac{40}{3}$$

$$\text{für } x > 4: y = (x - 4) \frac{35}{3} + 40$$

Laufmittel B'

$$\text{für } x \leq 4: y = (x - 1) \cdot \frac{32}{3}$$

$$\text{für } x > 4: y = (x - 4) \cdot \frac{41}{3} + 32$$

Laufmittel C

$$\text{für } x \leq 4: y = (x - 1) \cdot 10$$

$$\text{für } x > 4: y = (x - 4) \cdot \frac{49}{3} + 30$$

Umrechnung von Rf-Werten (0.. y ..100) bei Elix(2014) in die hier verwendeten relativen Rf-Werte (1.. x ..7):

Laufmittel A

$$\text{für } y \leq 40: x = 1 + \frac{(3 \cdot y)}{40}$$

$$\text{für } y > 40: x = 4 + 3 \cdot \frac{(y - 40)}{(75 - 40)}$$

Laufmittel B'

$$\text{für } y \leq 32: x = 1 + 3 \cdot \frac{y}{32}$$

$$\text{für } y > 32: x = 4 + 3 \cdot \frac{(y - 32)}{(78 - 32)}$$

Laufmittel C

$$\text{für } y \leq 30: x = 1 + 3 \cdot \frac{y}{30}$$

$$\text{für } x > 30: x = 4 + 3 \cdot \frac{(y - 30)}{(79 - 30)}$$

Beispiel 1: In A lesen wir auf unseren Platten bei einem Fleck  $x=3,6$  ab. Der Wintabulites Rf-Wert ist dann:

$$y = (x - 1) \cdot \frac{40}{3} = (3,6 - 1) \cdot \frac{40}{3} = 34,7$$

Beispiel 2: Der Wintabulites Rf-Wert in A ist  $y=60,5$ . Auf unseren Platten sollte der Fleck dann bei folgender Position zu finden sein:

$$x = 4 + 3 \cdot \frac{(y-40)}{(75-40)} = 4 + 3 \cdot \frac{(60,5-40)}{35} = 5,76$$

### **Aufbau der Tafeln und verwendete Abkürzungen:**

Jede Tafel enthält 3 montierte Gruppen von HPTLCs für die Laufmittel A, B'/B und C:

**A** = Toluol : Dioxan : Eisessig = 39.13 : 9.78 : 1.09 ml

**B** = Hexan : Ether : Ameisensäure = 26.00 : 20.00 : 4.00 ml

**B'** = Hexan : Methyl-tert-Butylether : Ameisensäure = 30.43 : 15.65 : 3.91 ml

**C** = Toluol : Eisessig = 42.39 : 7.61 ml

In jeder Gruppe sind abgebildet die Ergebnisse für

- Tageslicht nach Besprühen mit 10% Schwefelsäure und Trocknen bei 90-100°C für 20-30 min

**LS** = langwelliges (366 nm) UV-Licht nach Säure- und Hitzebehandlung

**L** = langwelliges (366 nm) UV-Licht vor Säure- und Hitzebehandlung

**K** = kurzwelliges (254 nm) UV-Licht vor Säure- und Hitzebehandlung

**P** = Tageslicht ohne Säurebehandlung bei Pigmenten

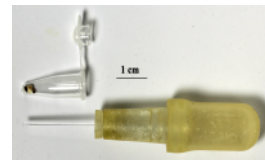
Jede Tafel ist beschriftet mit der Herbarnummer [...] (F. Schumm) und der HPTLC Nummer. Die Platten werden in Wangen aufbewahrt. Die Herkunft der analysierten Flechtenarten ist notiert, allerdings abgekürzt wenn sie zuvor schon in Schumm & Elix (2012) veröffentlicht wurden. Wenn eine gereinigte Substanz aus der Sammlung S. Huneck benutzt wurde, dann wird die Substanznummer angegeben.

Die Bilder wurden mit einer EOS 40D und einer EOS 600D Kamera aufgenommen, wobei eigentümlicher Weise die L-Streifen bei völlig gleichen Bedingungen und Kameraeinstellungen bei der EOS 600D einen rotvioletten, bei der EOS 40D einen mehr blauen Hintergrund aufweisen.

## Kurzanleitung zur Herstellung der 5x5 cm HPTLC-Platten

Ausführliche Anleitungen zur TLC findet man z.B. bei Elix (2014), Orange et al. (2001) und Huneck et al. (1996). Hier soll nur kurz beschrieben werden, wie die kleinen HPTLC-Platten für dieses Buch hergestellt wurden.

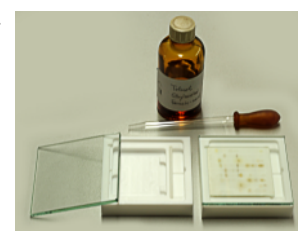
a) Extraktion von z.B. 1-2 Apothecien in 0.2 ml PCR-Gefäßen in 1-3 Tropfen Aceton.



b) Auftragen der Extrakte mit einer 0.5 µl Mikrokapillare und einer Schablone für 9 Positionen auf einer 5 x 5 cm großen HPLC-Platte (Merck HPTLC Kieselgel 60 F254, 1.05635.0001). Die 3. Bahn ist immer für *Cladonia symphylicarpa* zur Eichung mit Norstictinsäure und Atranorin reserviert.



c) Entwicklung in der horizontalen Trennkammer nach Ljubomir Kraus (H-Trennkammer, Glasfrittenstäbchen, Glasscheibe) in den drei Laufmitteln A, B' und C, welche im 50 ml Fläschen vorrätig gehalten werden. Fig 3.



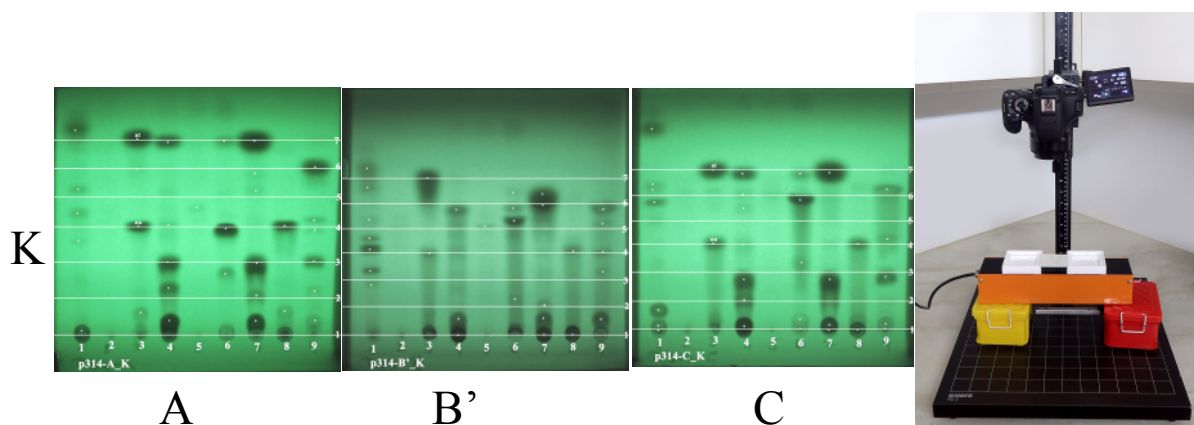
A = Toluol : Dioxan : Eisessig = 39.13 : 9.78 : 1.09 ml

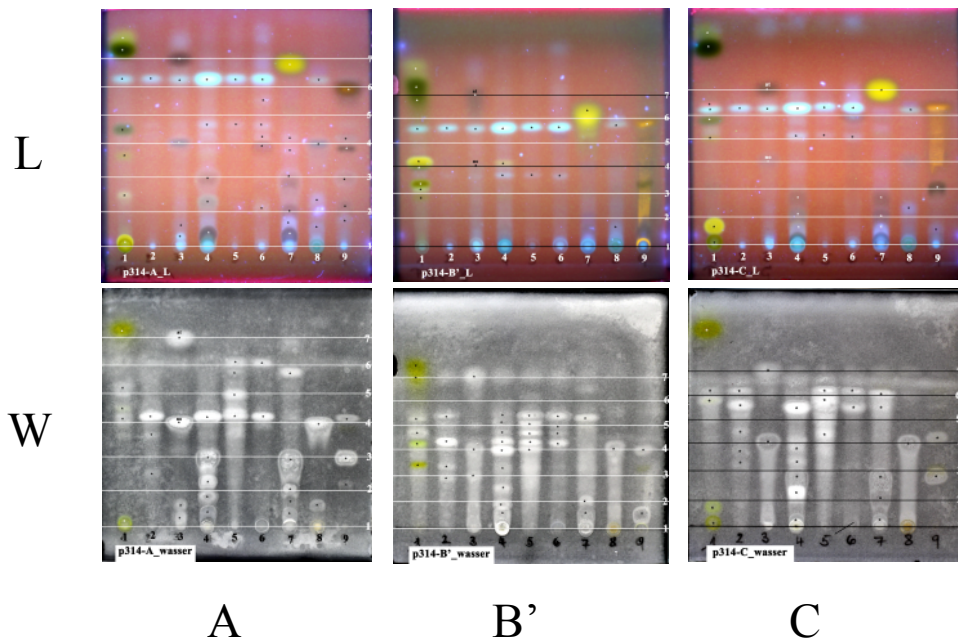
B = Hexan : Ether : Ameisensäure = 26.00 : 20.00 : 4.00 ml

B' = Hexan : Methyl-tert-Butylether : Ameisensäure = 30.43 : 15.65 : 3.91 ml

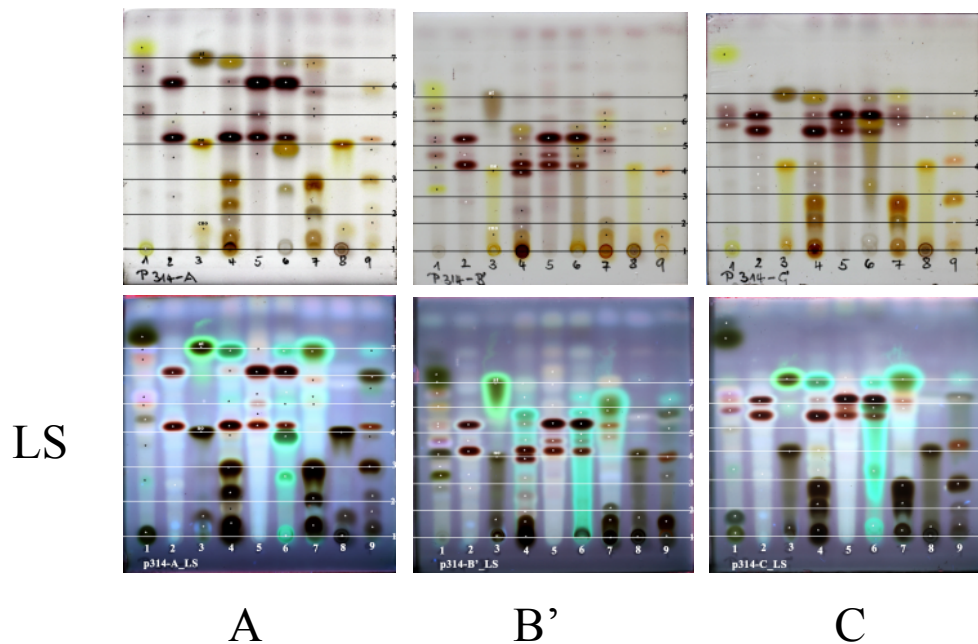
C = Toluol : Eisessig = 42.39 : 7.61 ml

d) Trocknen. Fotos in langwelligem (366 nm, =L) und kurzwelligem (254 nm, =K) UV-Licht und nach Besprühen mit Wasser (=W). Ggf bei Pigmenten auch trocken im Tageslicht (=P).





e) Besprühen mit 10% Schwefelsäure und Trocknen bei 90-100 °C für 20-30 min im Wärmeschrank. Fotos bei Tageslicht und langwelligem UV Licht (=LS).

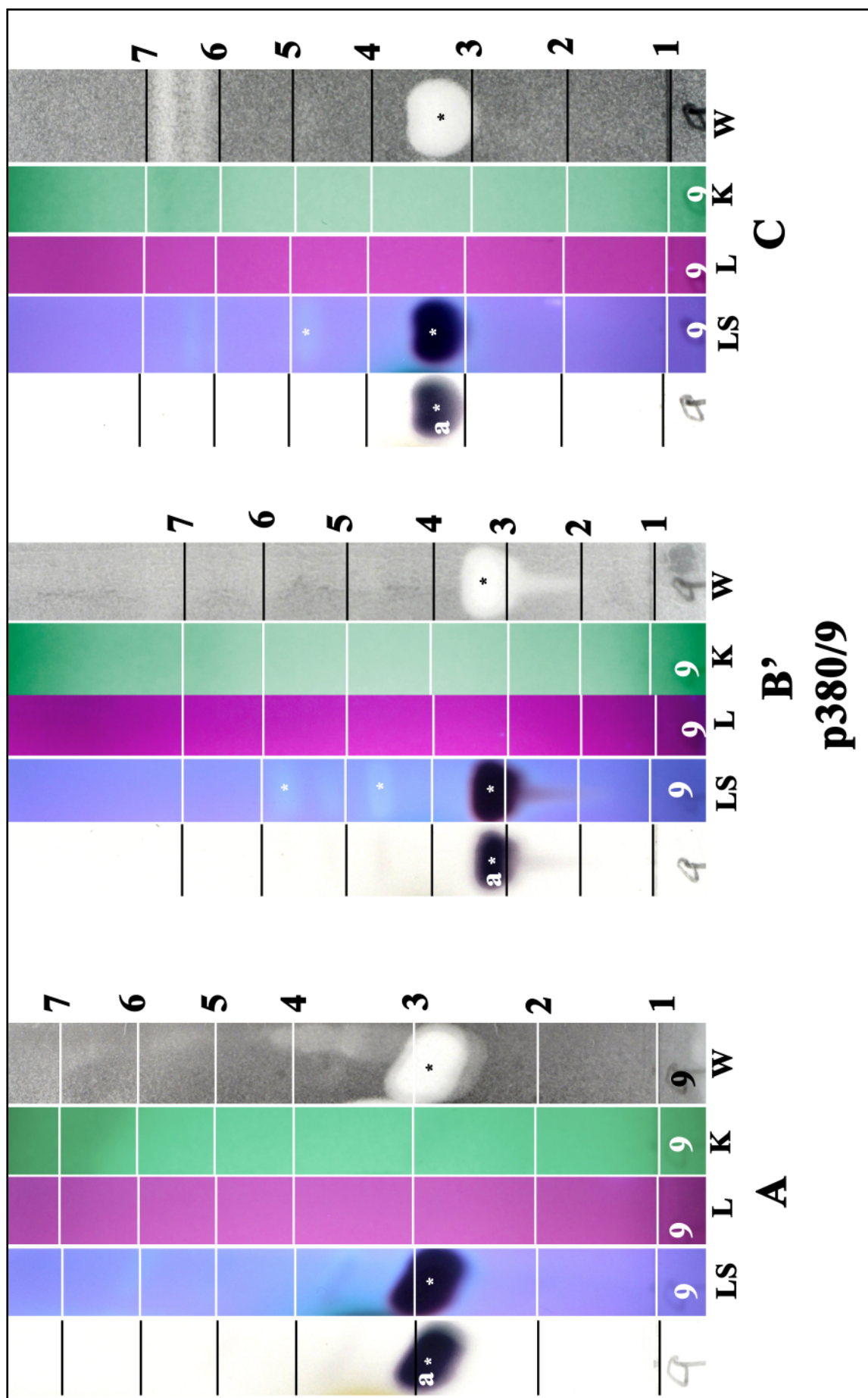


Zur besseren Orientierung ziehen wir horizontale Hilfslinien. 1 = Startlinie, 4 = Position der Norstictinsäure, 7 = Position des Atranorins und zusätzliche Teilungslinien 2,3 bzw. 5,6 in die jeweiligen Bereiche. Für die jeweiligen Arten haben wir die passenden Spalten zusammenmontiert und unten die Herbarnummer [...] und die Plattennummer (p..) festgehalten. Die Platten werden in Wangen aufbewahrt.

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Australia

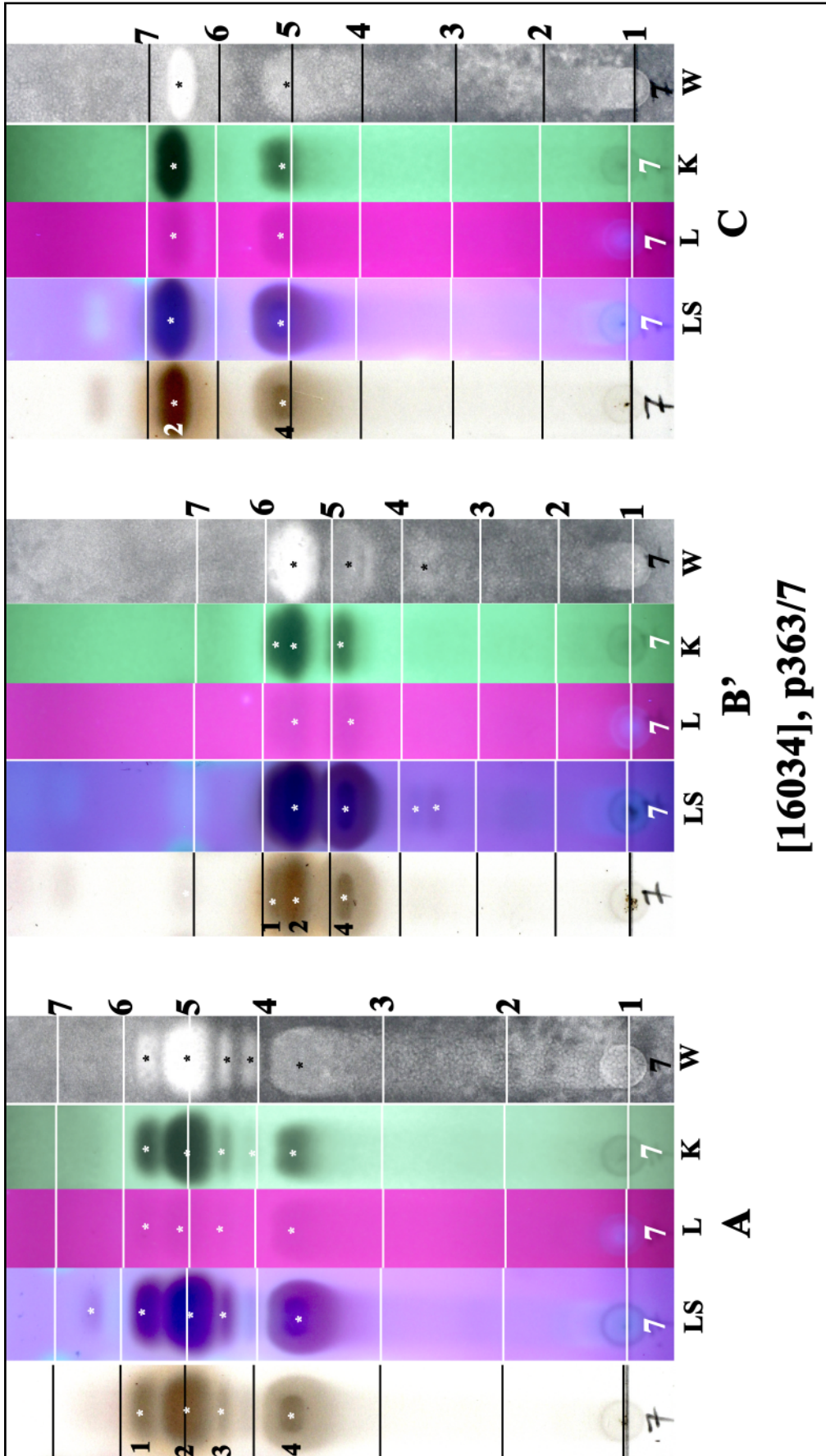
# 1 $\alpha$ 3 $\beta$ ,22-hopantriol



a: 1 $\alpha$ 3 $\beta$ ,22-hopantriol

Purified lichen substance received from K. Kalb; origin S. Huneck.

2,4-di-*O*-methylnorsekikaic acid

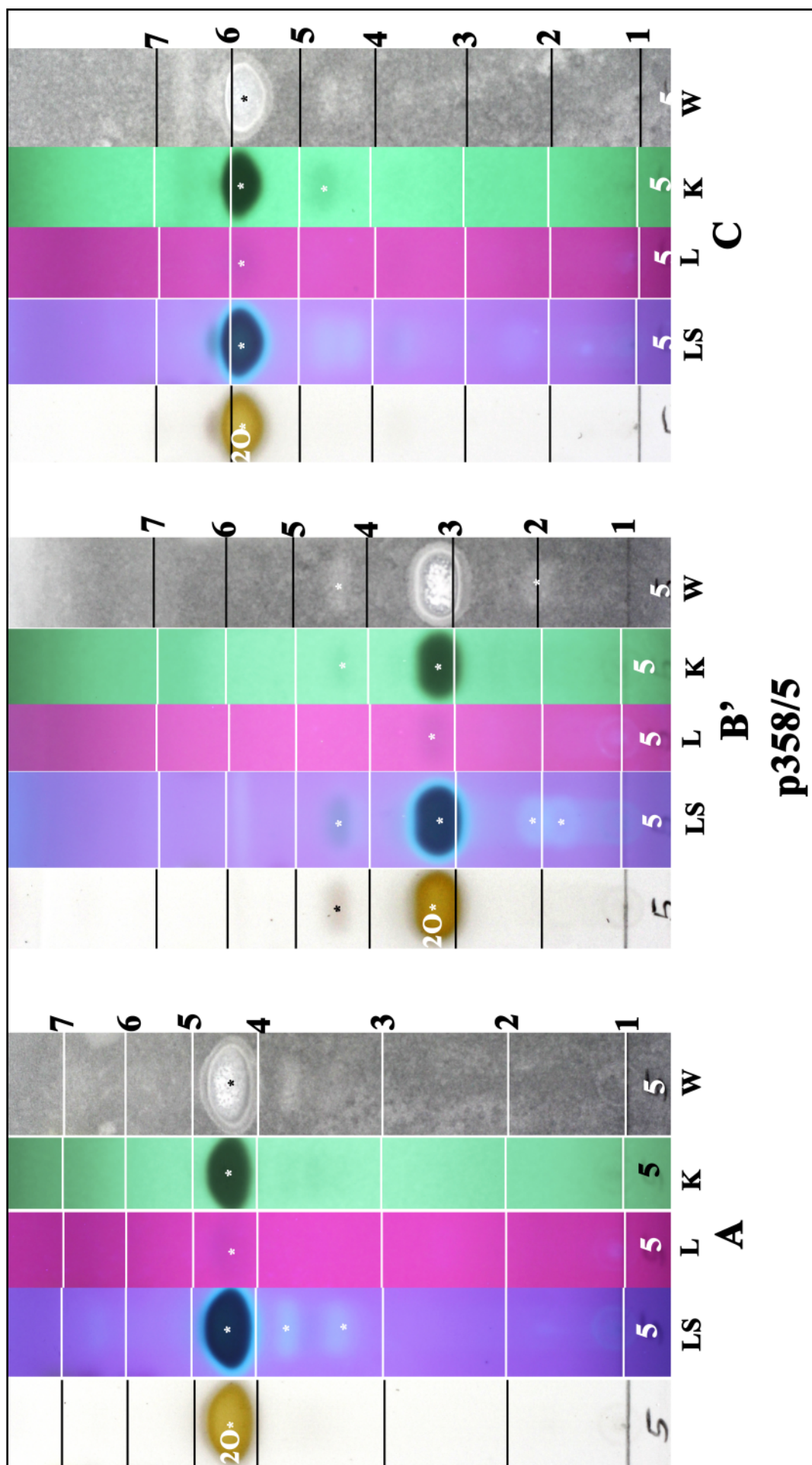


[16034], p363/7

- 1: 4-*O*-methylerythrochlorophaeic acid, 2: merochlorophaeic acid,
- 4: erythrochlorophaeic acid, 3: 2,4-di-*O*-methylnorsekikaic acid; conf. J.A. Elix.

*Cladonia merochlorophaea* Asahina, [16034], Australia, Australian Capital Territory, Canberra, Black Mountain Reserve, 35.27591° S, 149.09386° E, 760 m. Leg. J.A. Elix, F. Schumm & E. Stocker-Wörgötter, 07.11.2009, det. J.A. Elix.

# 2-O-methylconfluent acid

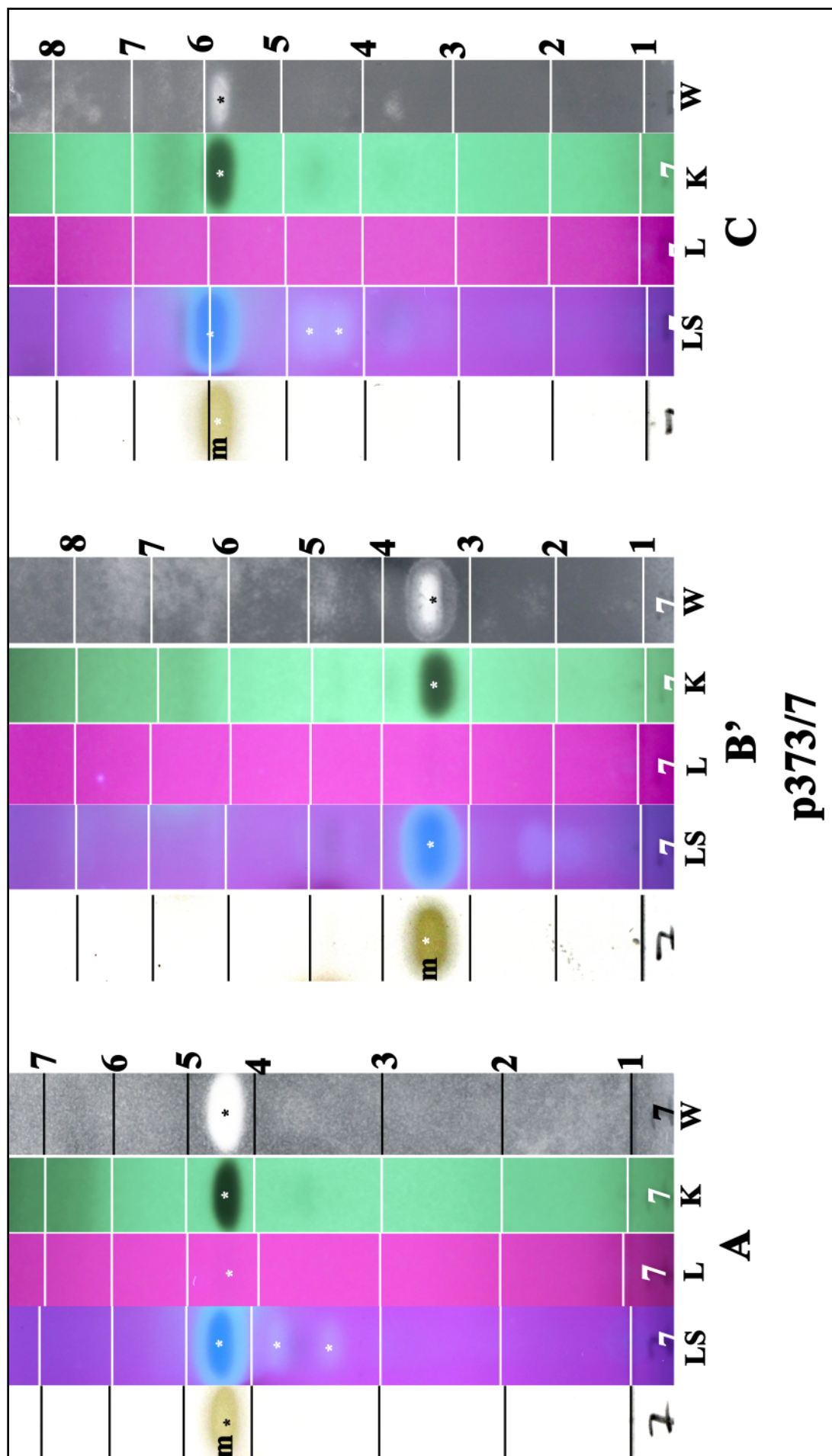


p358/5

20: 2-O-methylconfluent acid

Purified lichensubstance received from K. Kalb; origin S. Huneck.

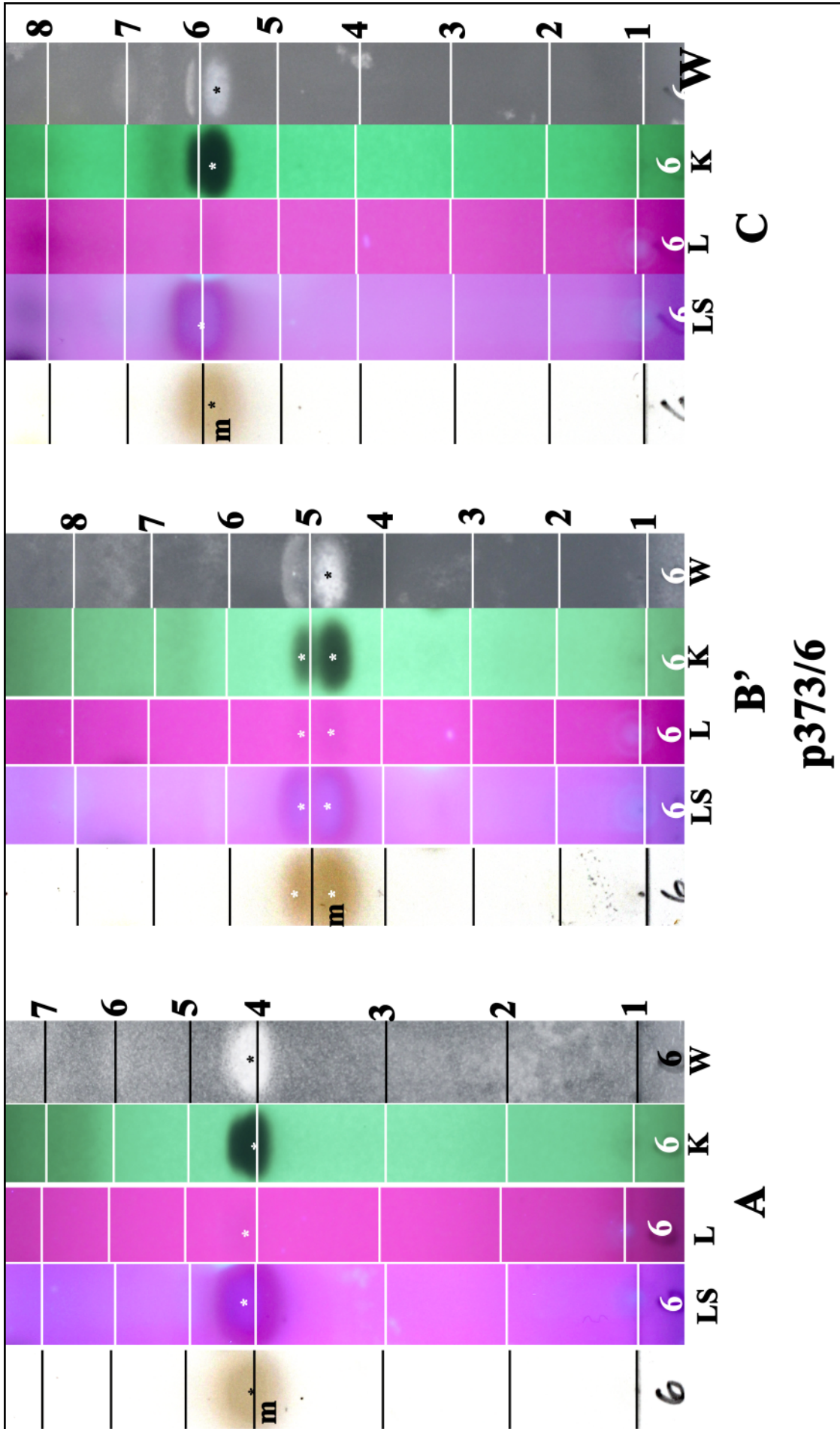
# 2-O-methylconfluent acid



m: 2-O-methylconfluent acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

2-O-methylsekikaic acid

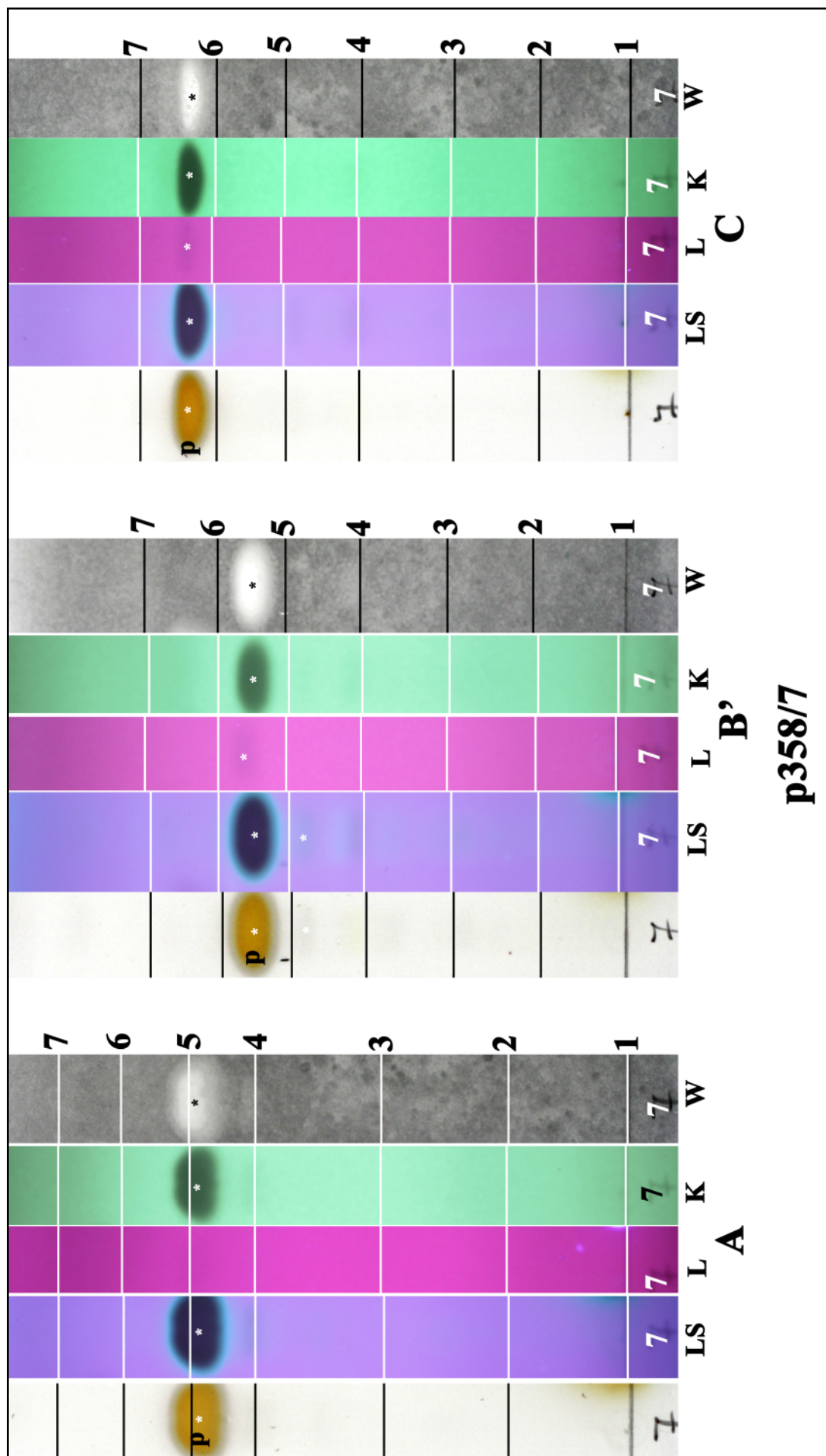


p373/6

m: 2-O-methylsekikaic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

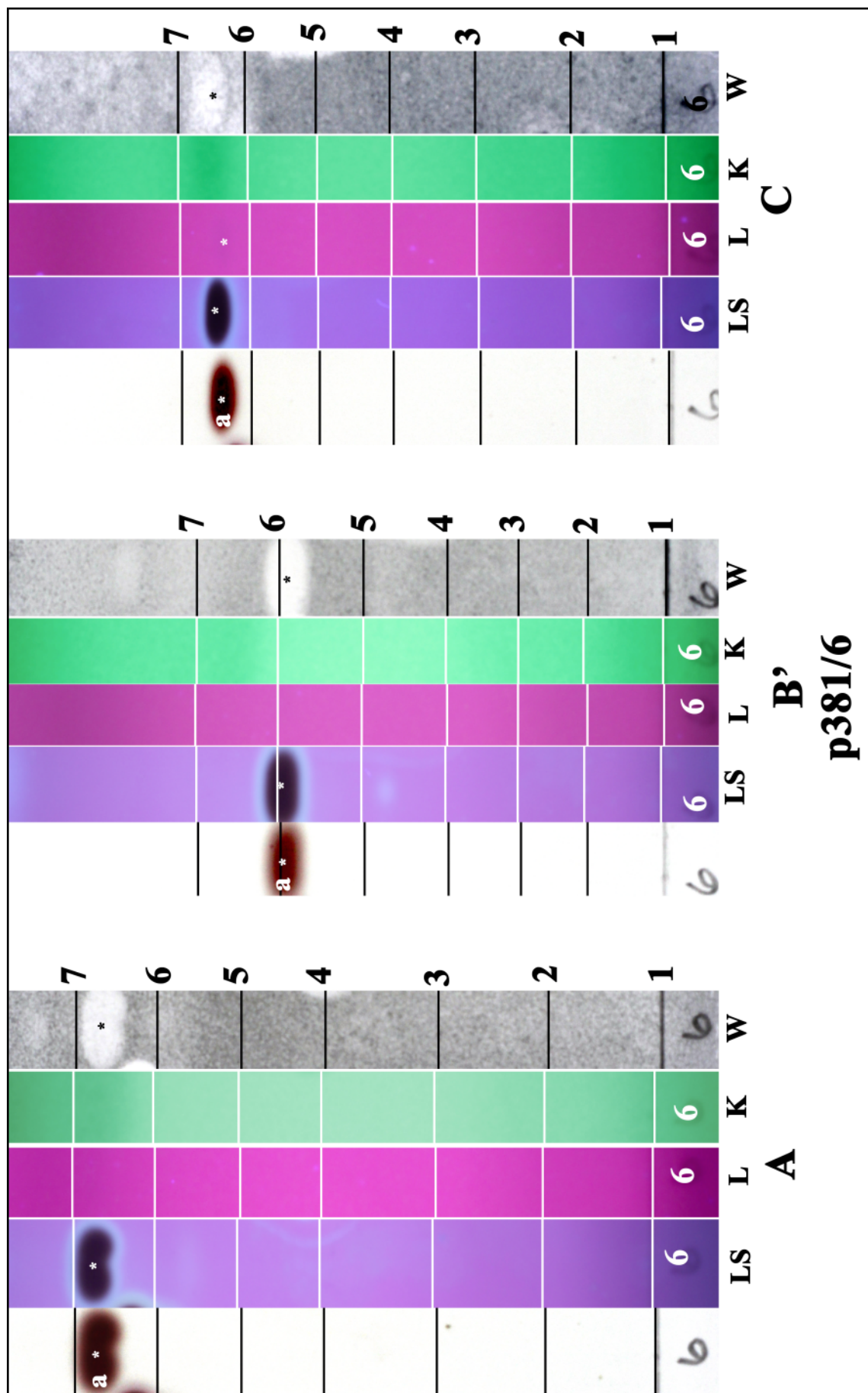
# 2'-O-methylperlatolic acid



p: 2'-O-methylperlatolic acid

Purified lichensubstance received from K. Kalb; origin S. Huneck.

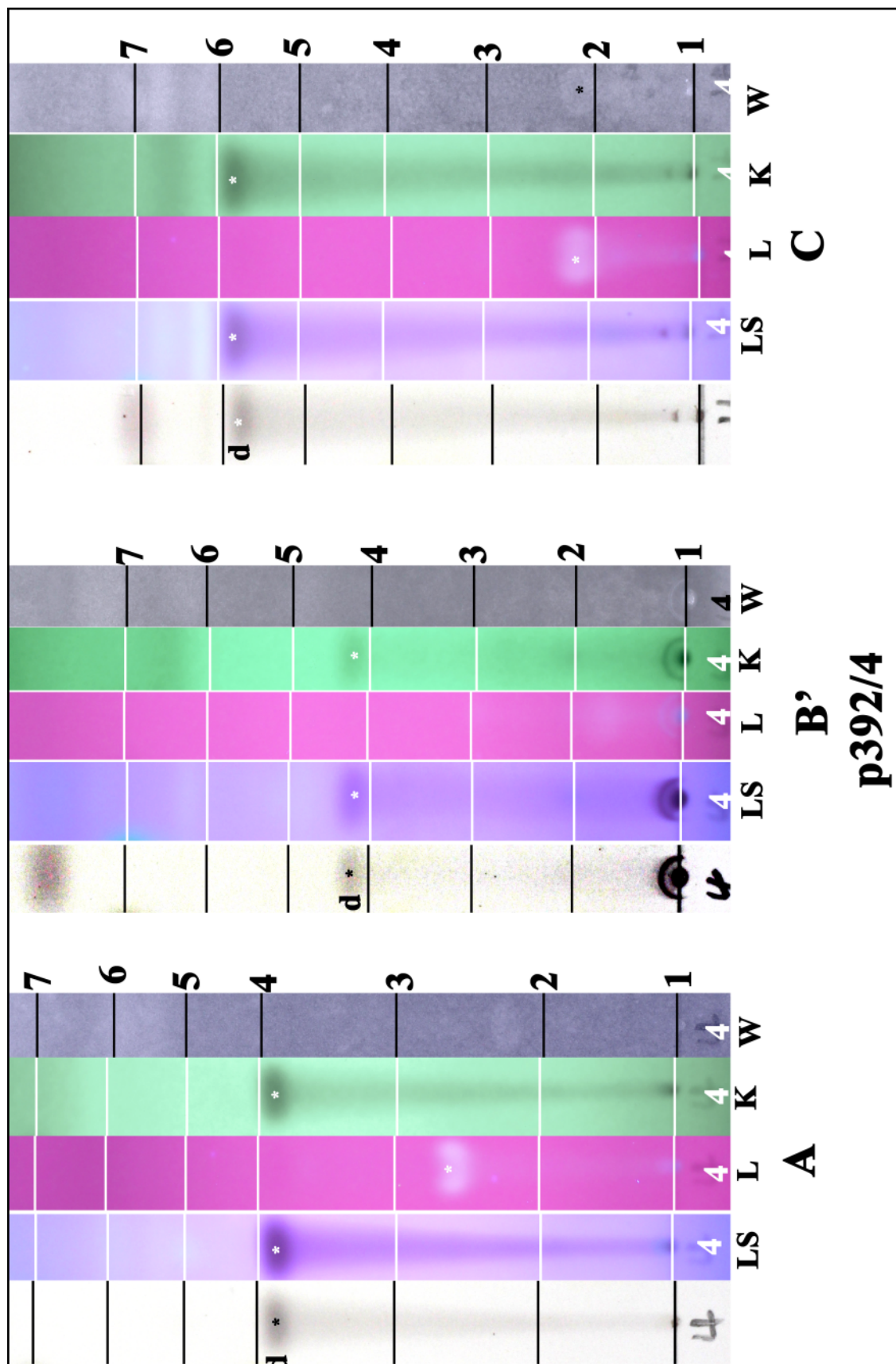
**2 $\alpha$ ,3 $\beta$ ,22 $\alpha$ -triacetoxystictane**



**a: 2 $\alpha$ ,3 $\beta$ ,22 $\alpha$ -triacetoxystictane**

Purified lichen substance received from K. Kalb; origin S. Huneck.

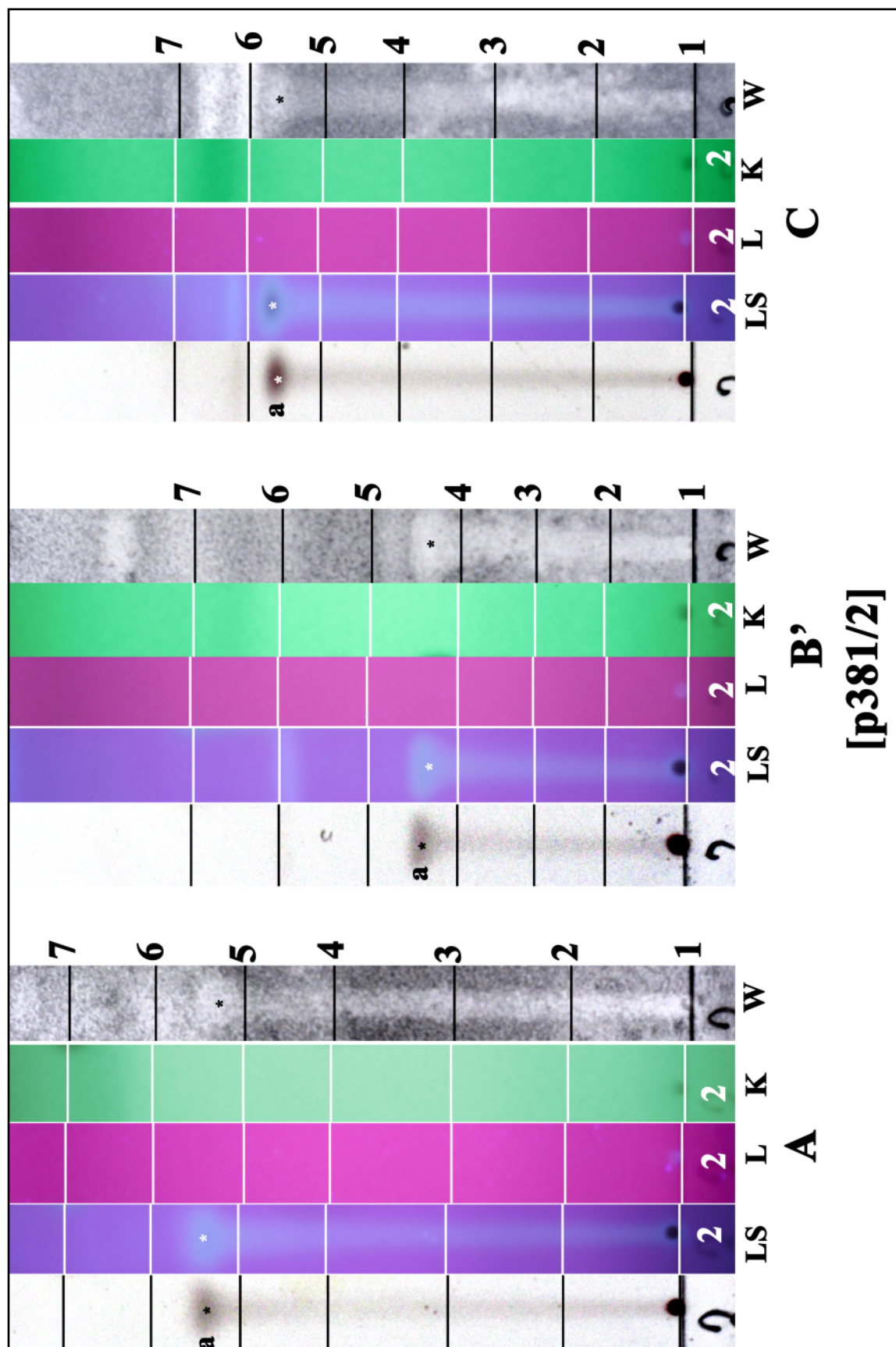
# 3-*O*-demethylschizopeltic acid



d: 3-*O*-demethylschizopeltic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

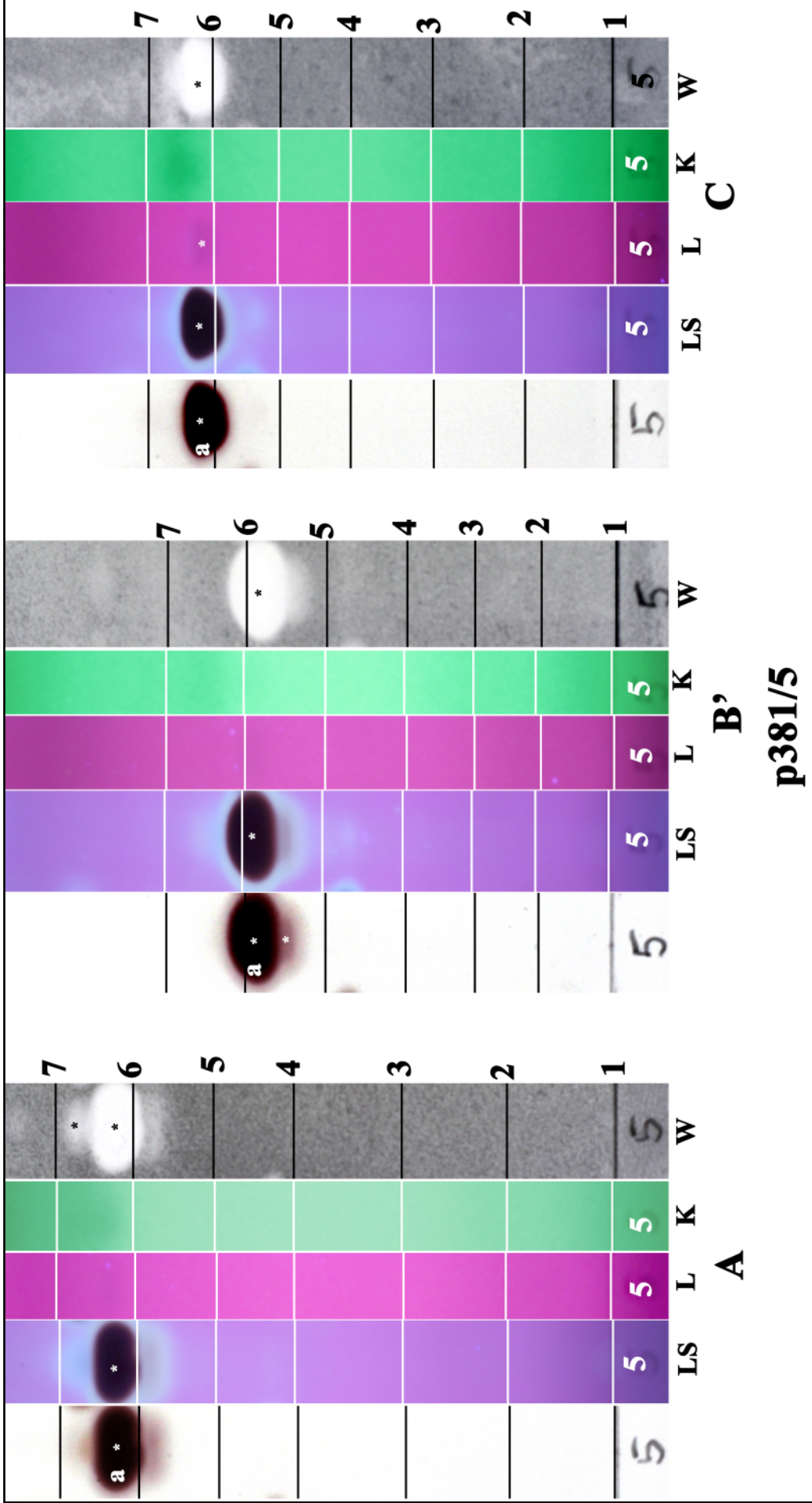
# 3 $\beta$ -acetoxyhopane-1 $\beta$ ,22-diol



a: 3 $\beta$ -acetoxyhopane-1 $\beta$ ,22-diol

Purified lichen substance received from K. Kalb; origin S. Huneck.

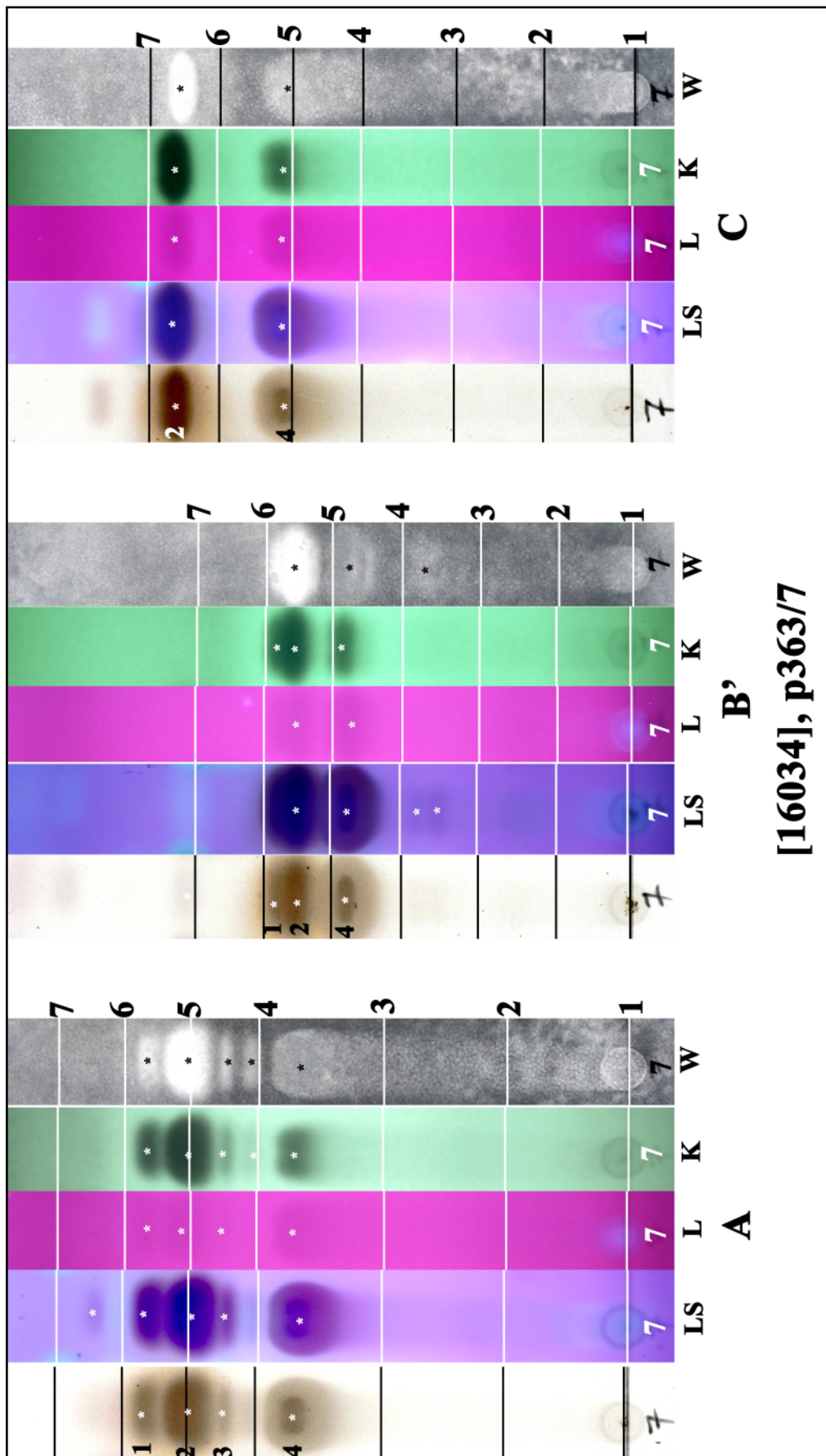
**3β-hydroxy-25-acetoxy-20(S),24(R)epoxydammarane**



**a: 3β-hydroxy-25-acetoxy-20(S),24(R)epoxydammarane**

Purified lichen substance received from K. Kalb; origin S. Huneck.

## 4-*O*-methylcryptochlorophaeic acid

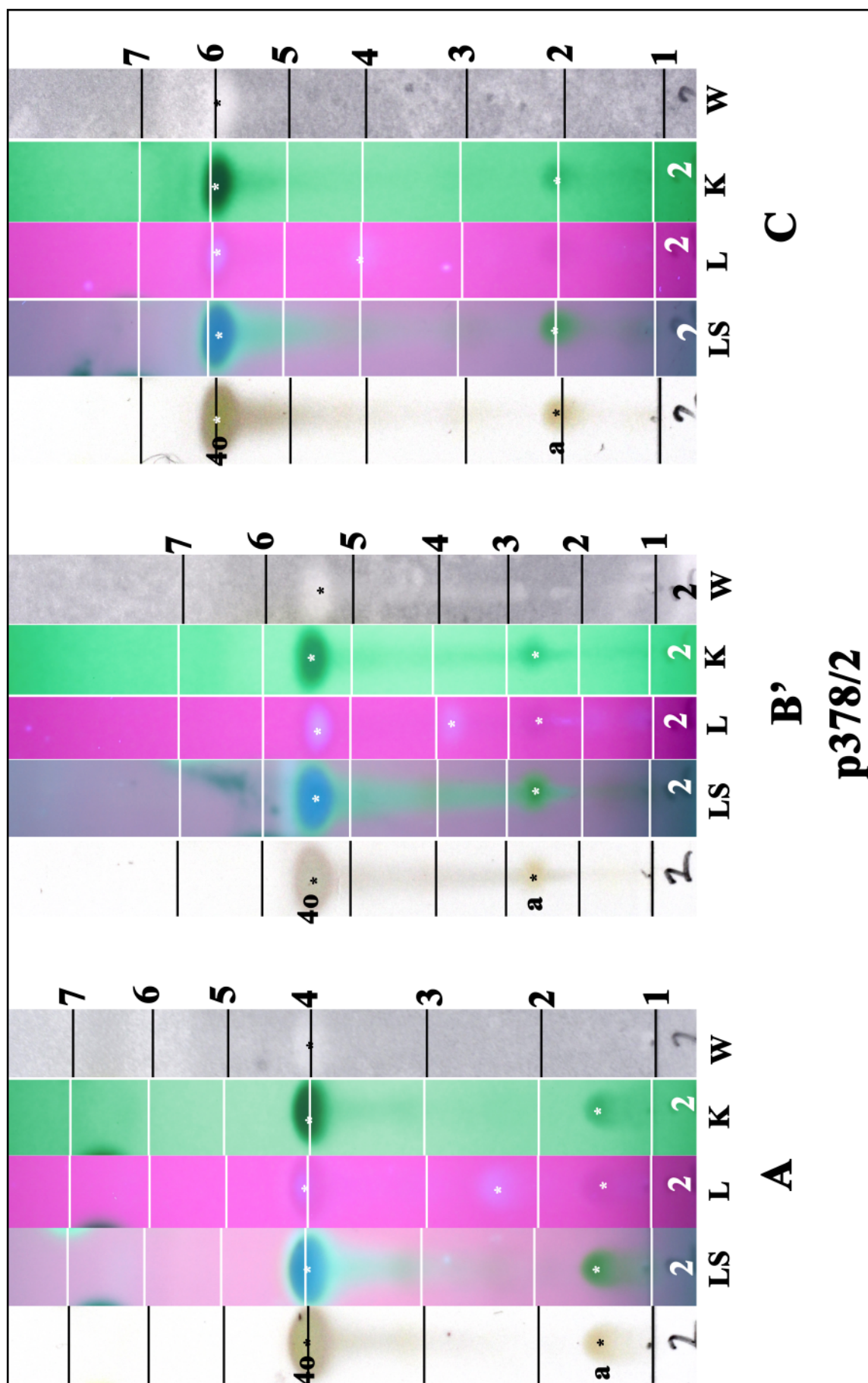


[16034], p363/7

- 1: 4-*O*-methylcryptochlorophaeic acid, 2: merochlorophaeic acid,  
4: 2,4-di-*O*-methylnorsekikaic acid; conf. J.A. Elix.

*Cladonia merochlorophaea* Asahina, [16034], Australia, Australian Capital Territory, Canberra, Black Mountain Reserve, 35.27591° S, 149.09386° E, 760 m. Leg. J.A. Elix, F. Schumm & E. Stocker-Wörgötter, 07.11.2009, det. J.A. Elix.

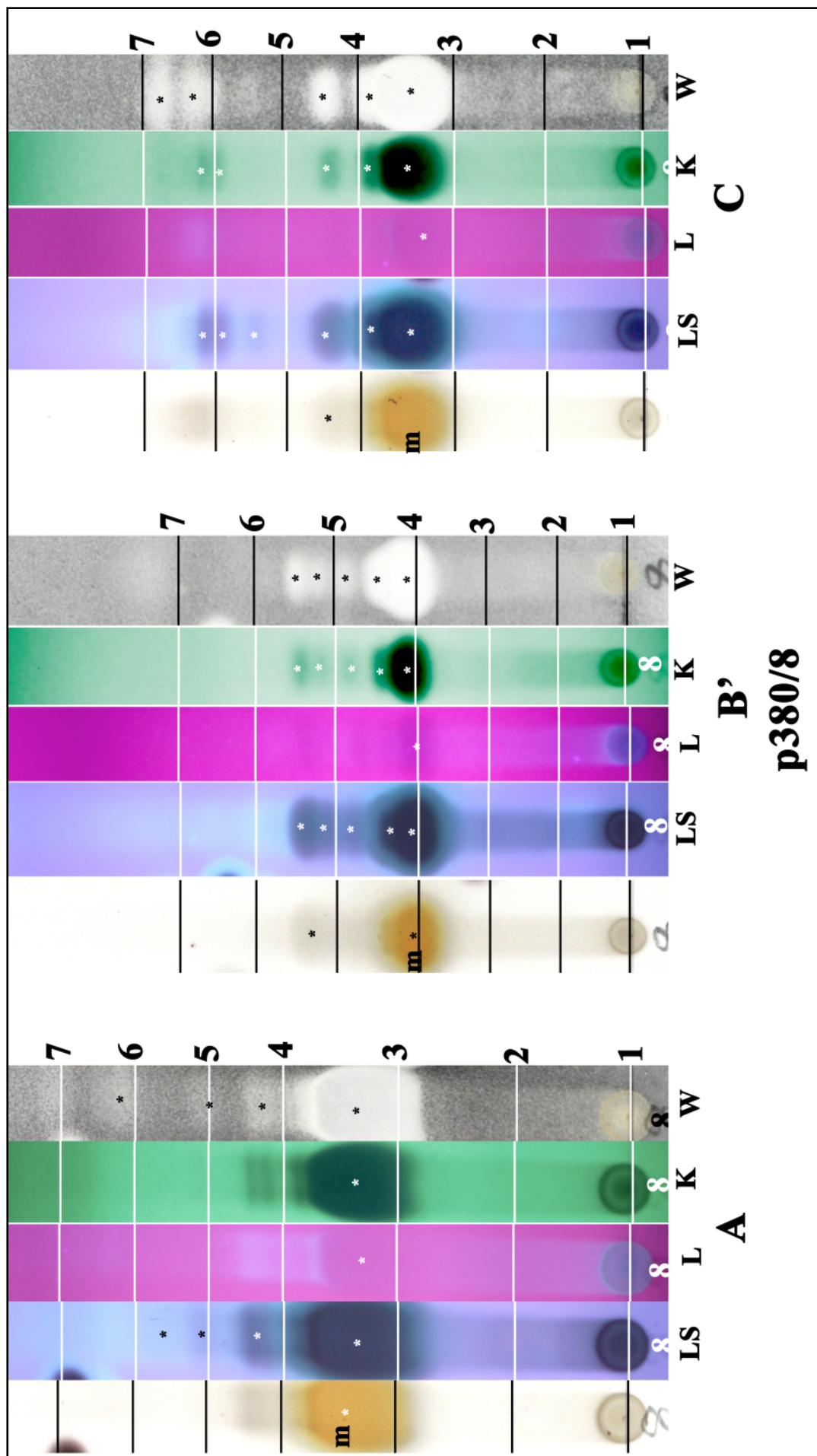
# 4-*O*-methylhypoprotocetraric acid



40: 4-*O*-methylhypoprotocetraric acid, a: ?

Purified lichen substance received from K. Kalb; origin S. Huneck.

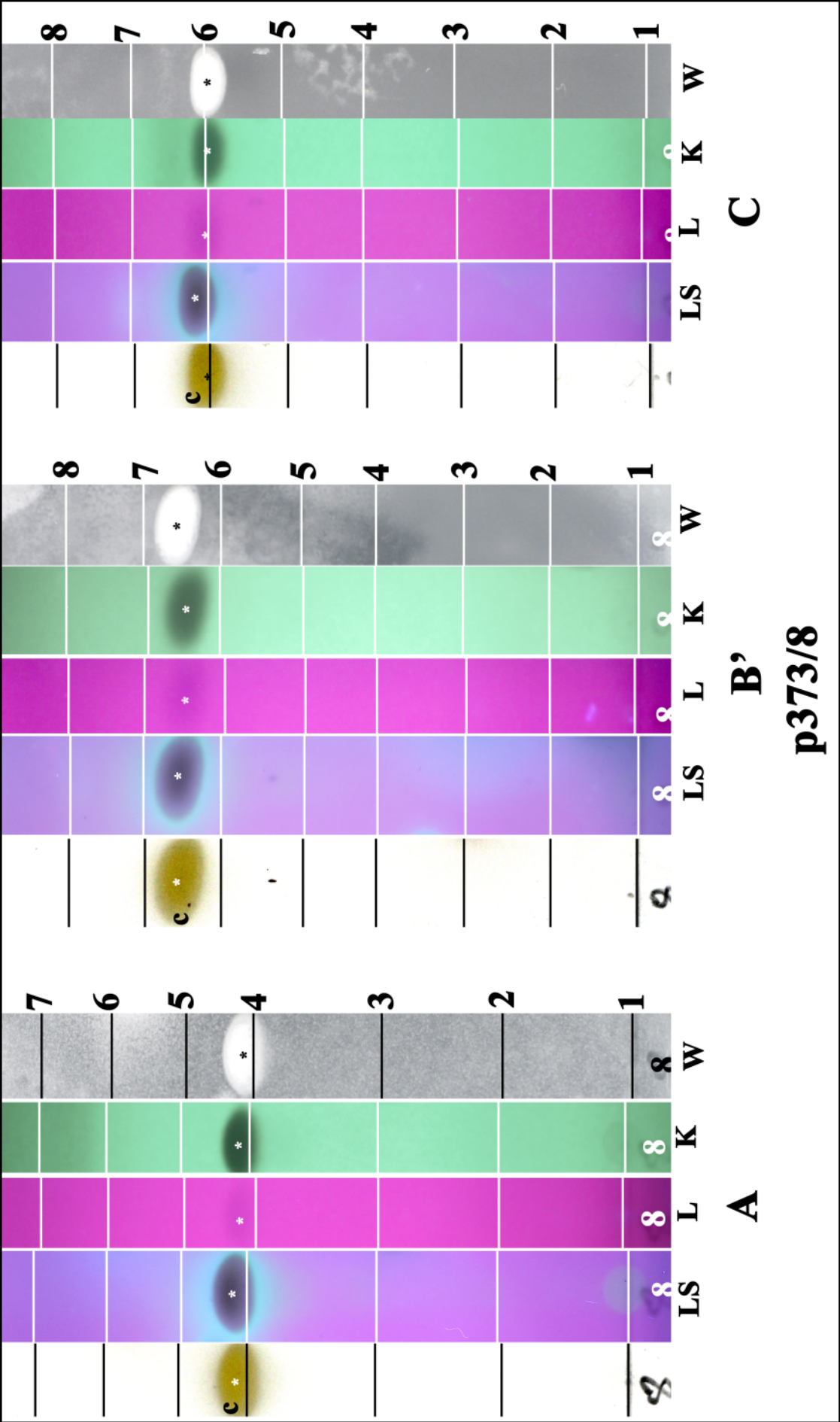
# 4'-*O*-methylpaludosic acid



m: 4'-*O*-methylpaludosic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

5-chloro-4-O-demethylbarbatic acid

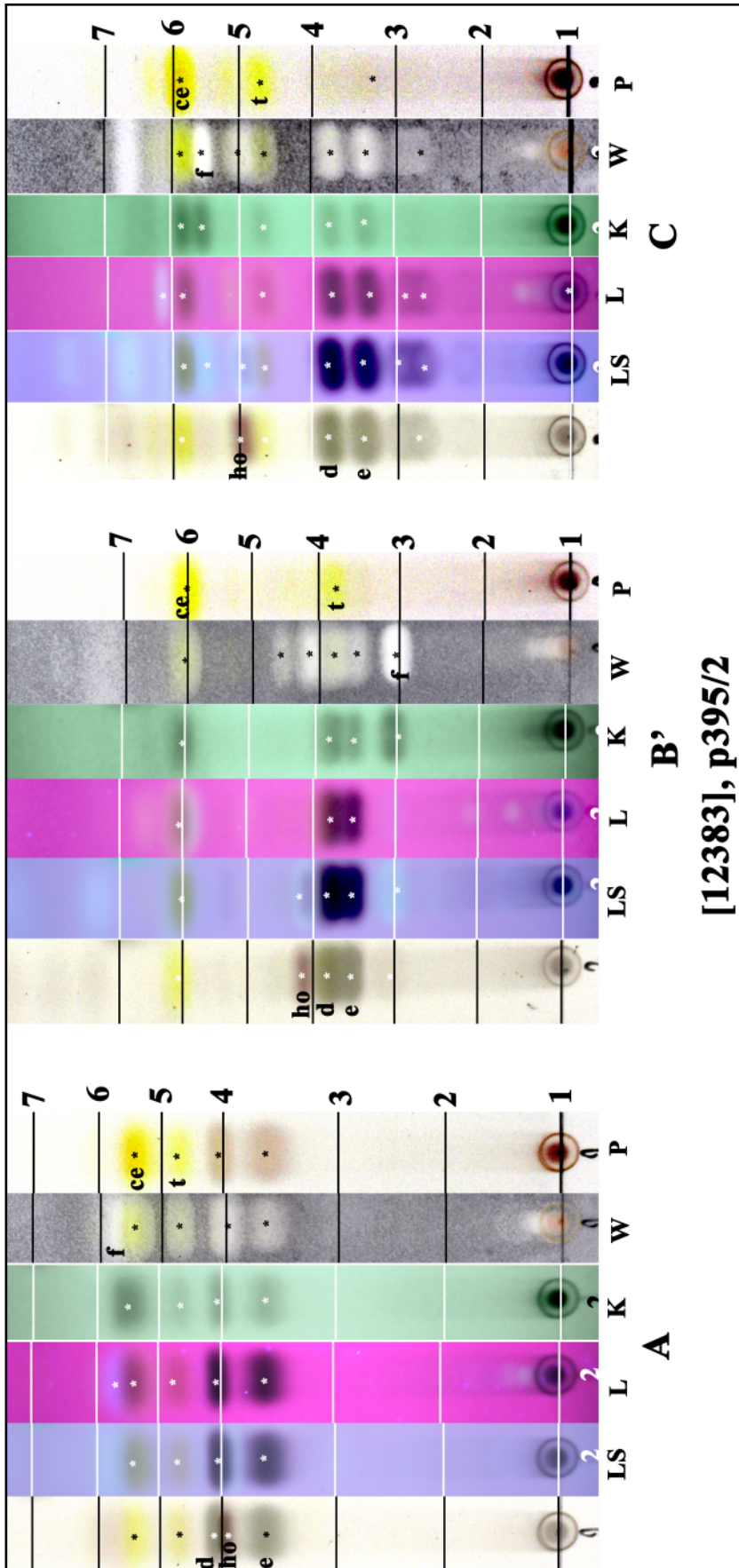


c: 5-chloro-4-O-demethylbarbatic acid

p373/8

Purified lichen substance received from K. Kalb; origin S. Huneck.

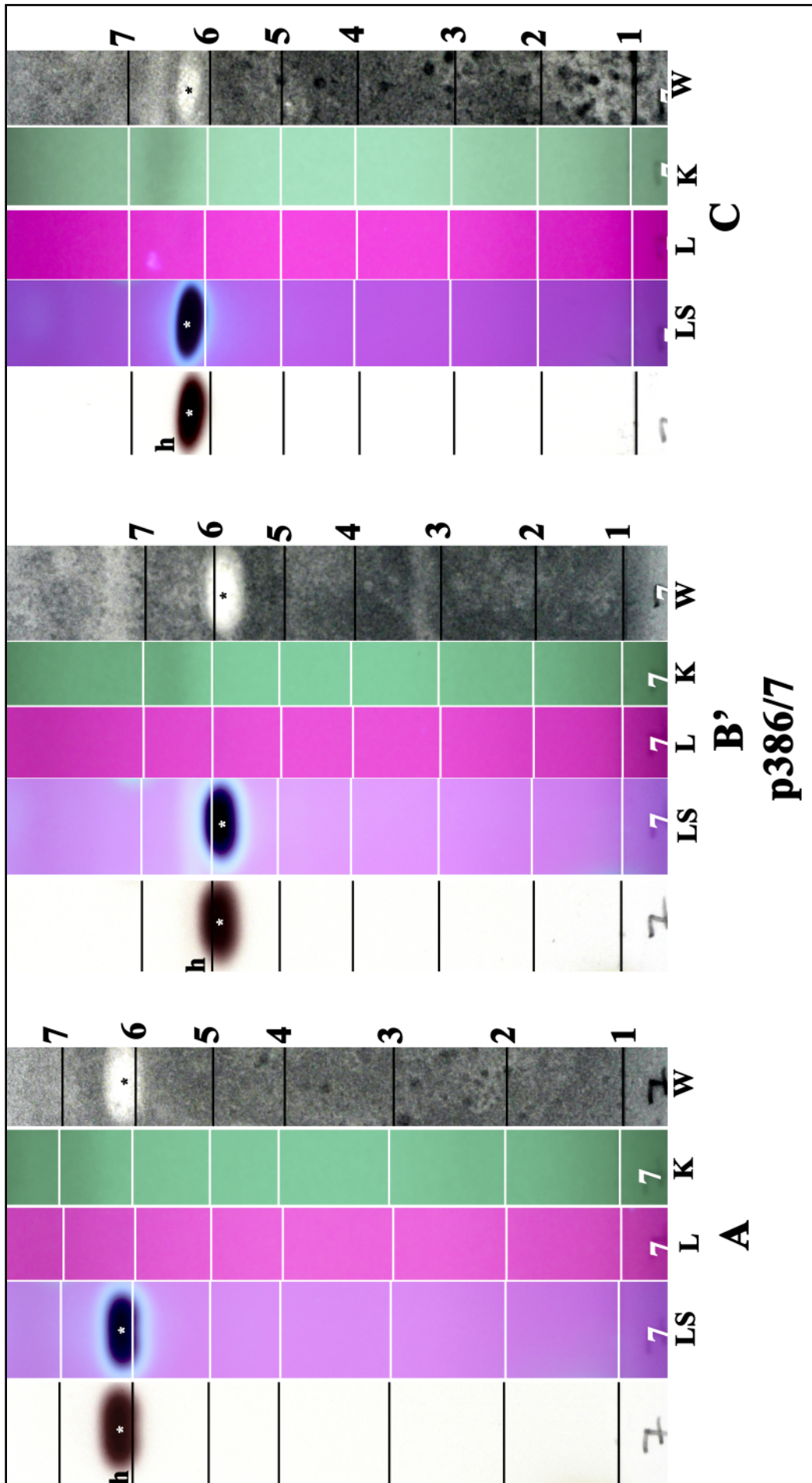
# 7-chloroemodin



ho: hopane-6 $\alpha$ ,7 $\beta$ ,22-triol, 7-chloroemodin, t: teloschistin, d,e,f: unknowns

*Nephroma laevigatum* Ach., [12383], Griechenland, N-Samos, südlich Avlakia an der Straße oberhalb Vourliotes nördlich des Bergmassivs Lazarou, 37°48' N, 26°51' E, ca. 840 m. Leg. Düll, Maier, Schumm 03.05.2006, det. F. Schumm.

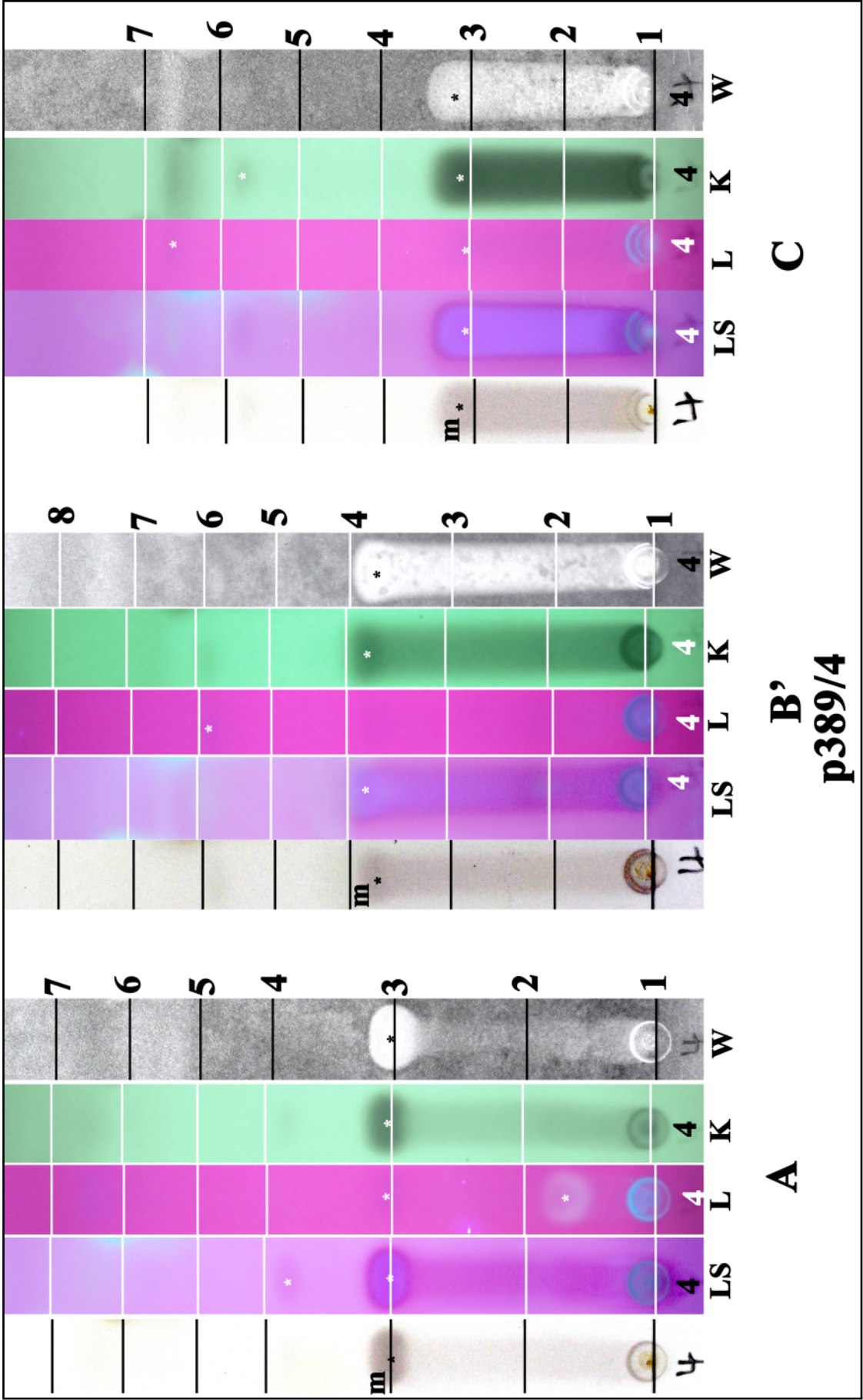
**7 $\beta$ -acetoxy-22-hydroxyhopan**



**h: 7 $\beta$ -acetoxy-22-hydroxyhopan**

Purified lichen substance received from K. Kalb; origin S. Huneck.

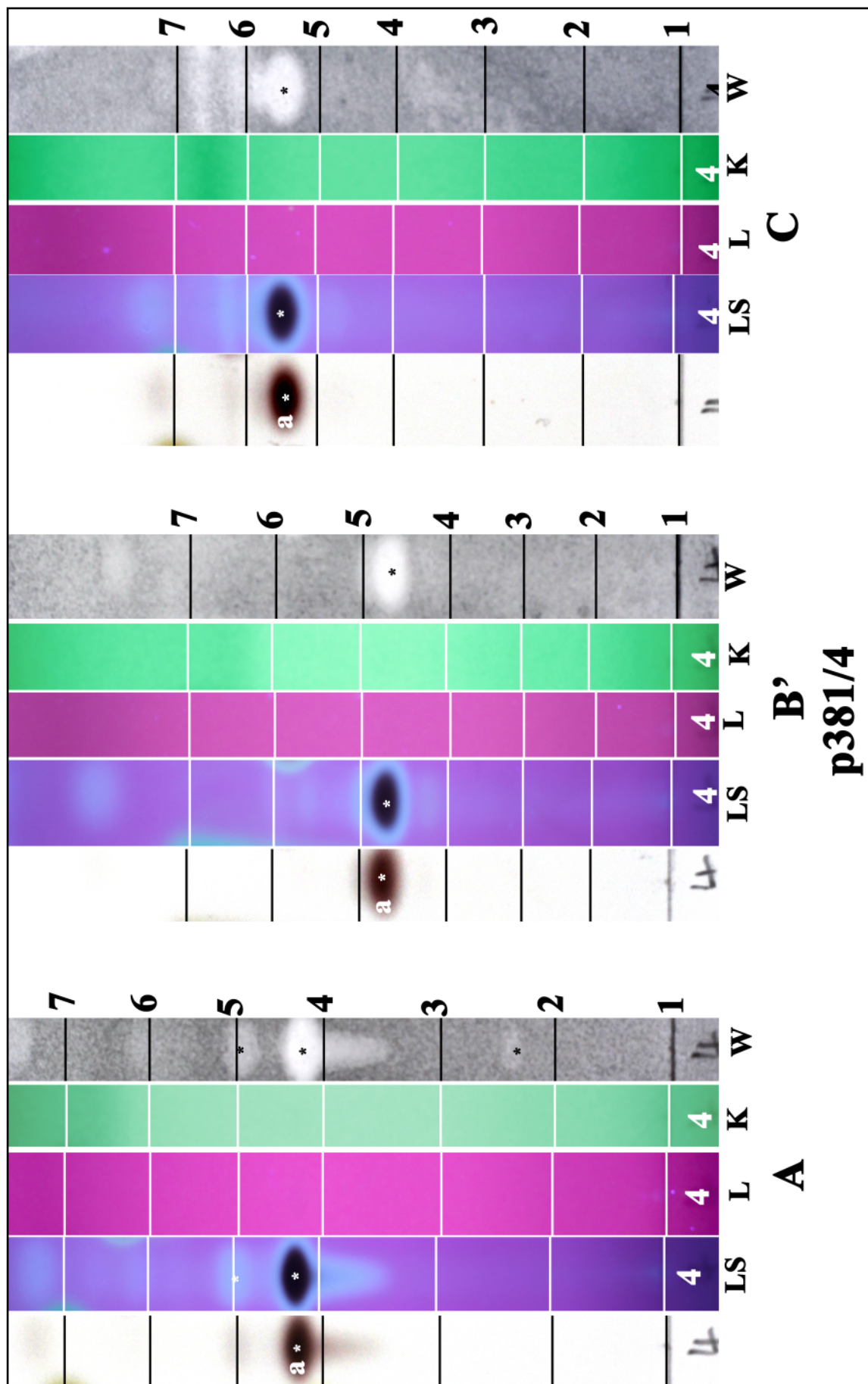
9-methyl pannarate



m: 9-methyl pannarate

Purified lichen substance received from K. Kalb; origin S. Huneck.

# 15 $\alpha$ ,22-dihydroxyhopane

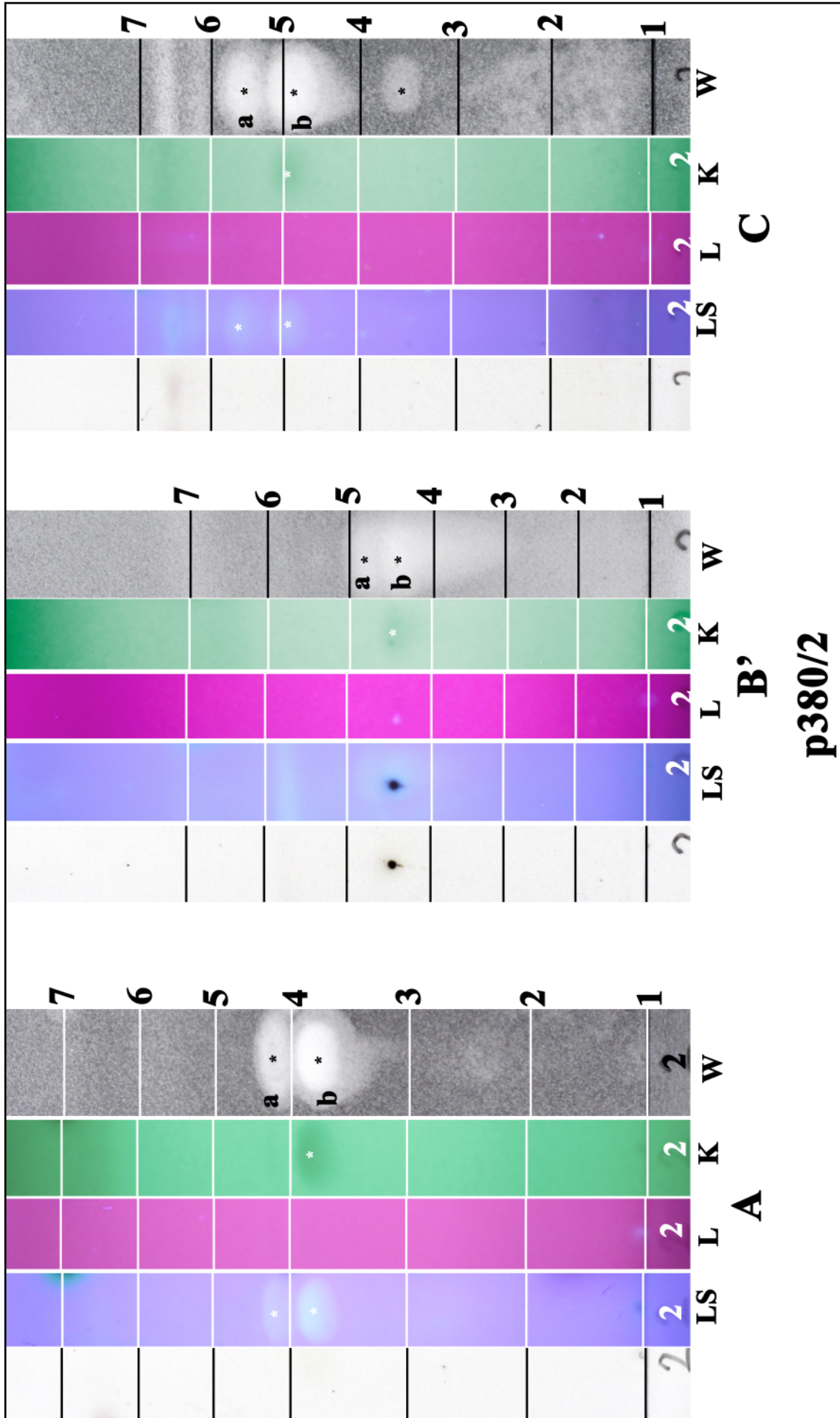


a: 15 $\alpha$ ,22-dihydroxyhopane

Purified lichen substance received from K. Kalb; origin S. Huneck.



acaranoic acid & acarenoic acid

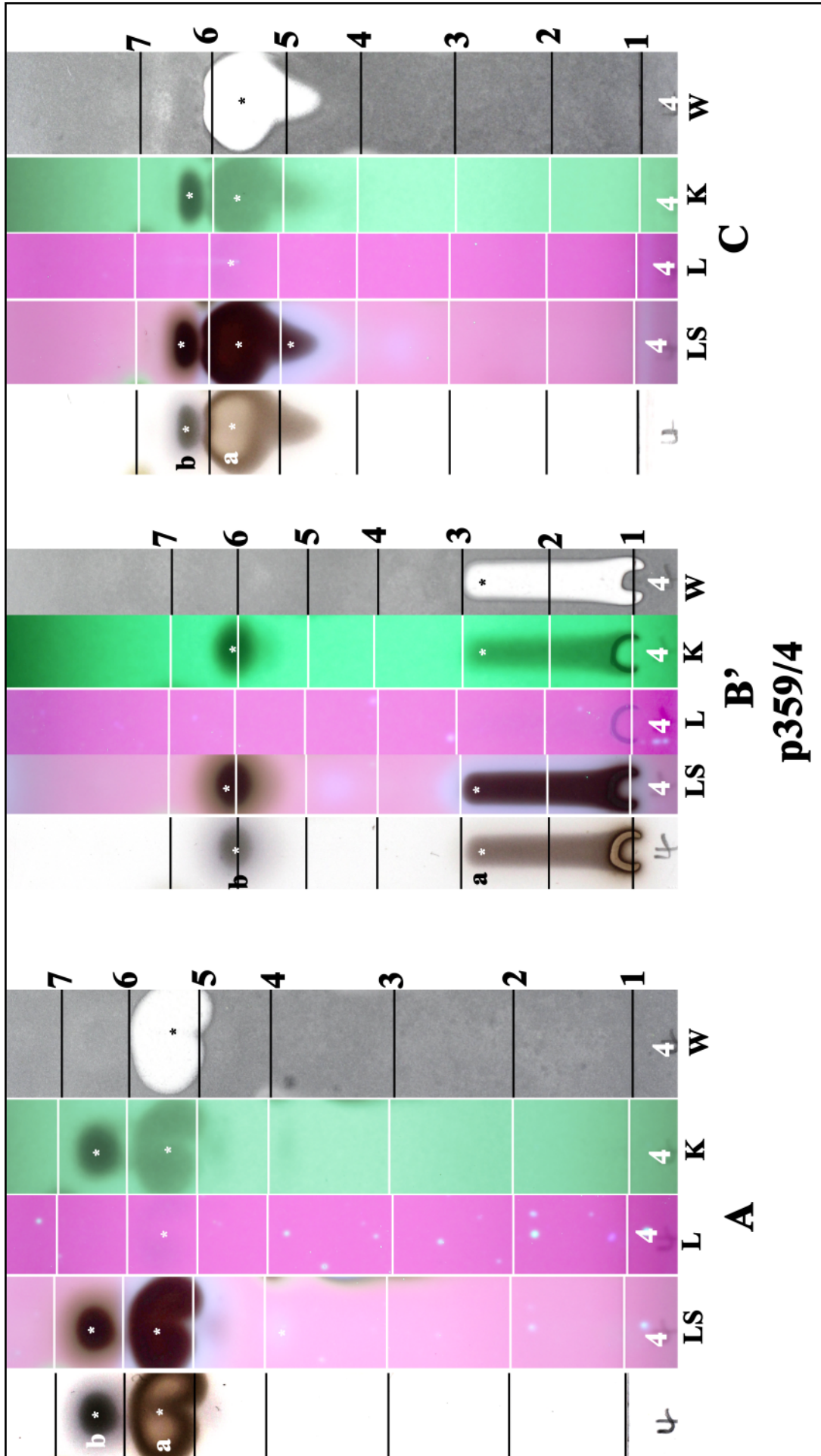


p380/2

a: acaranoic acid, b: acarenoic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

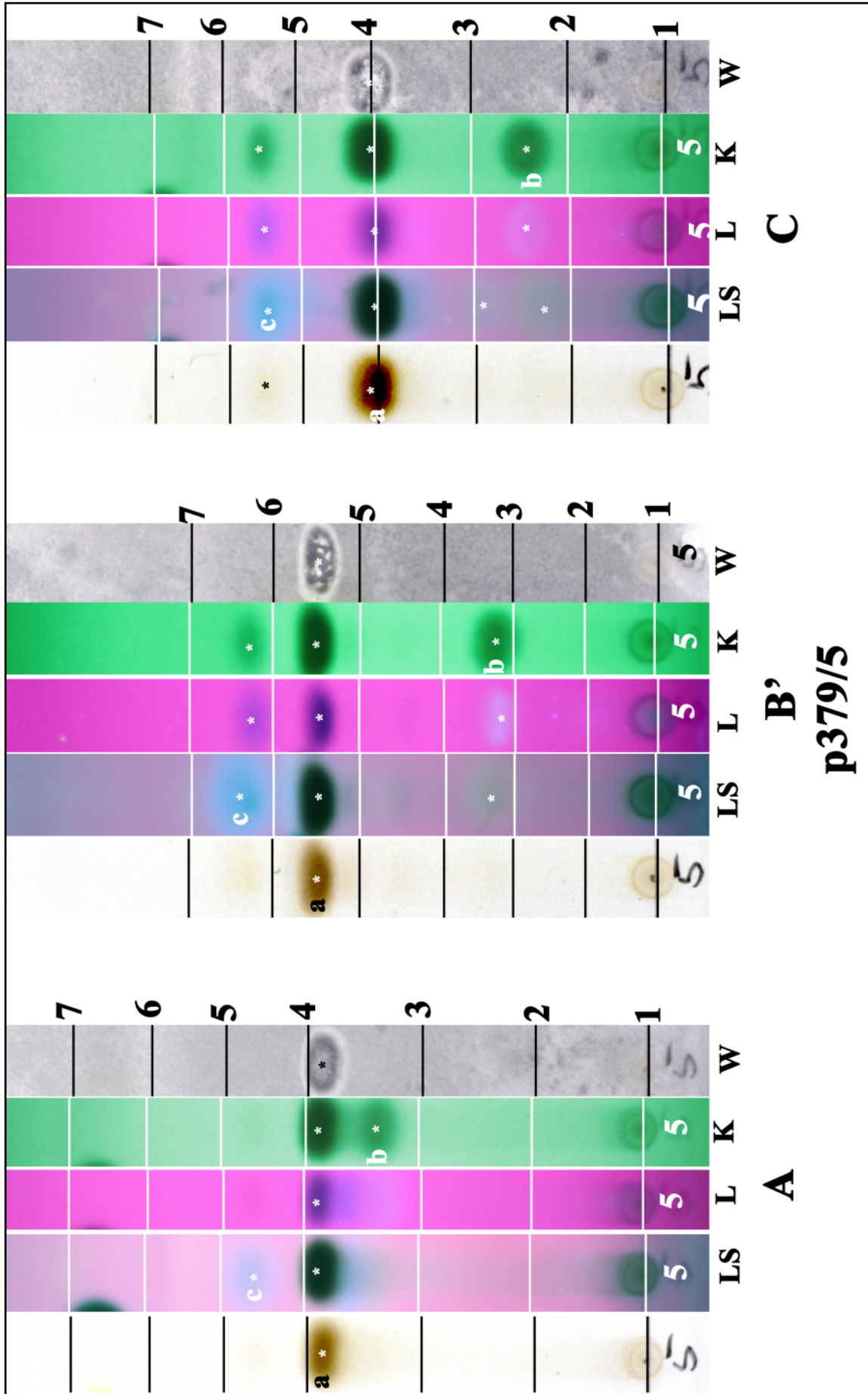
acetylportentol



a: acetylportentol, b: unknown

Purified lichensubstance received from K. Kalb; origin S. Huneck.

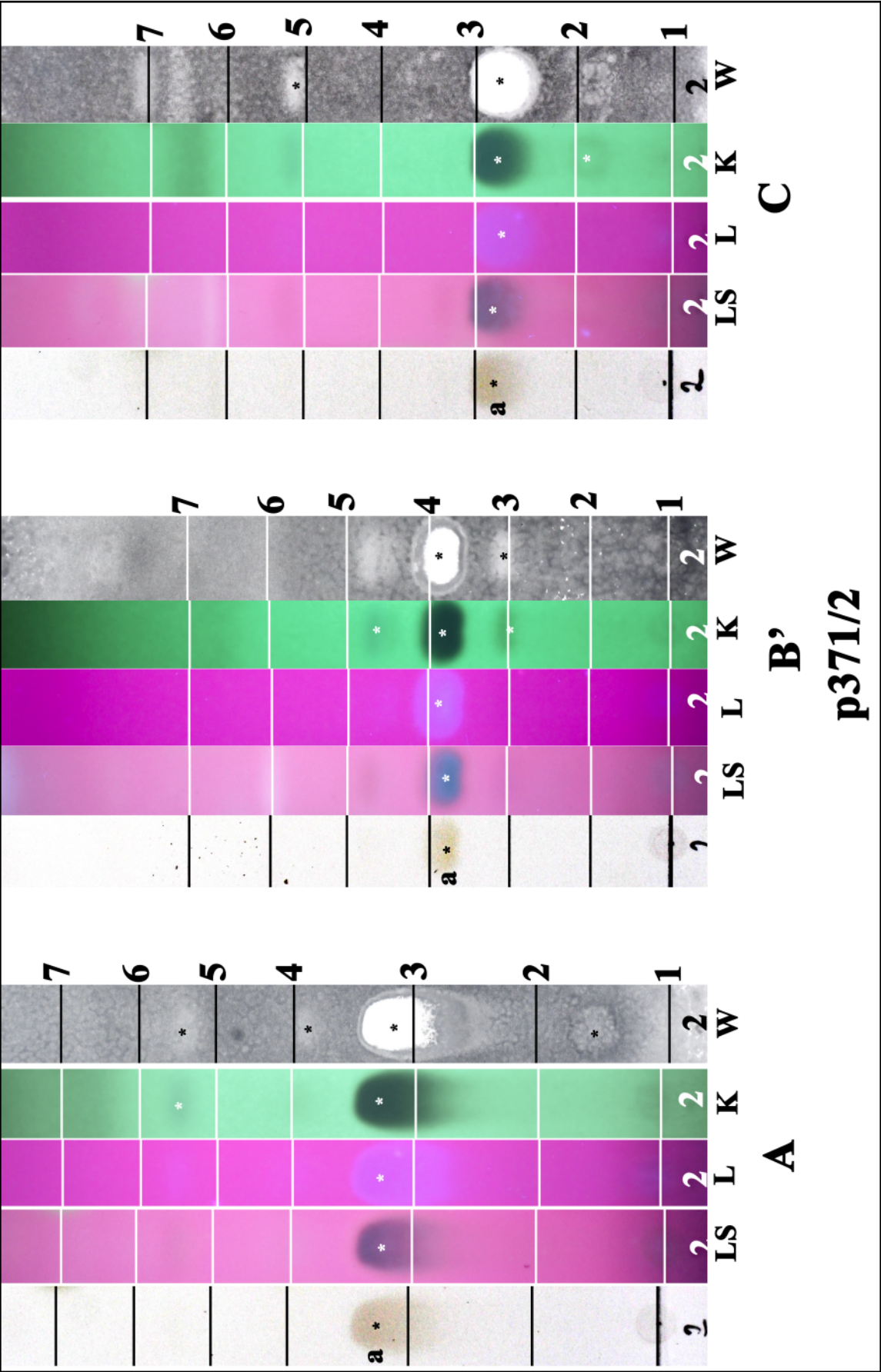
**alctorialic acid**



**a: alctorialic acid, b,c: ?**

Purified lichen substance received from K. Kalb; origin S. Huneck.

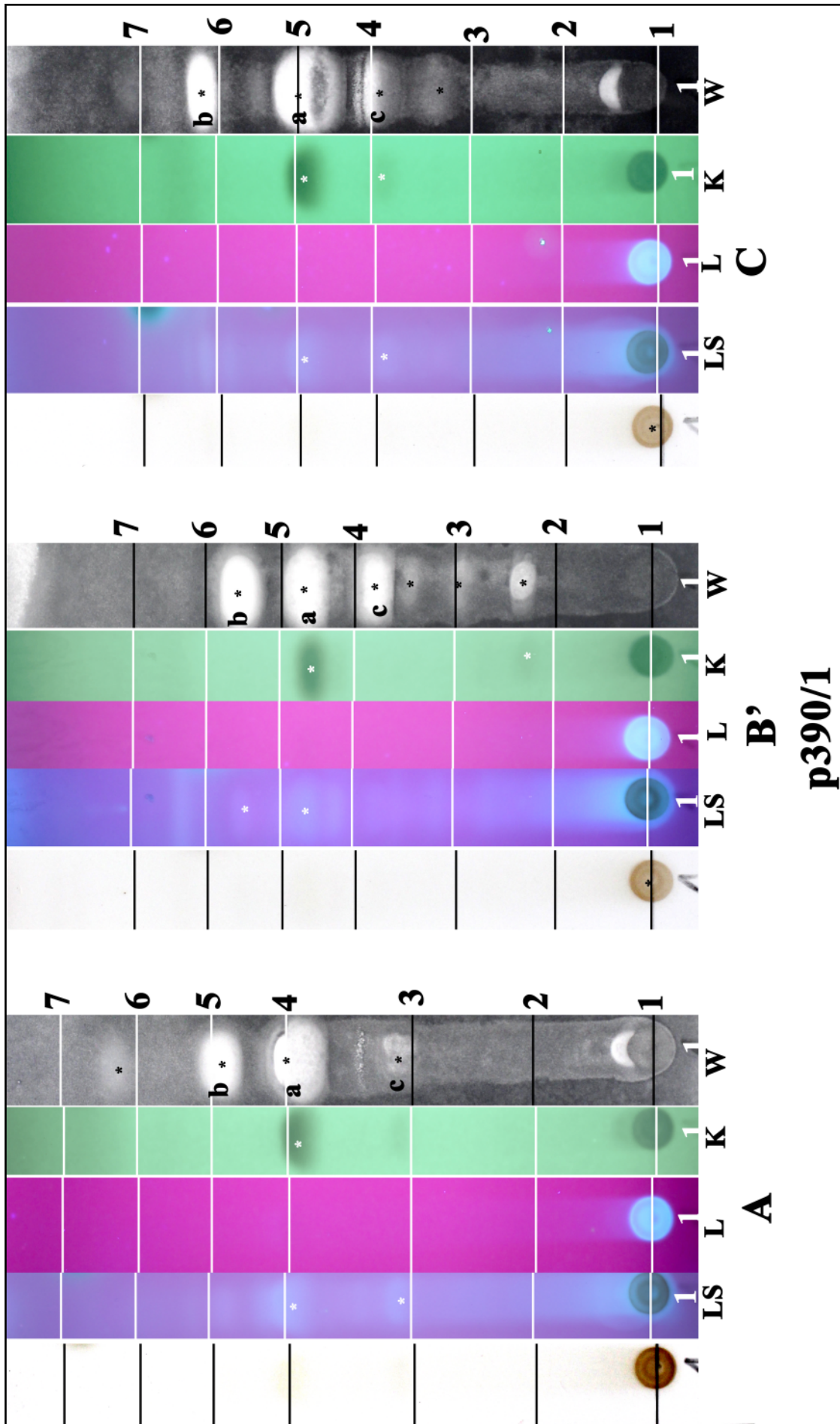
**alectoronic acid**



**a: alectoronic acid**

Purified lichen substance received from K. Kalb; origin S. Huneck.

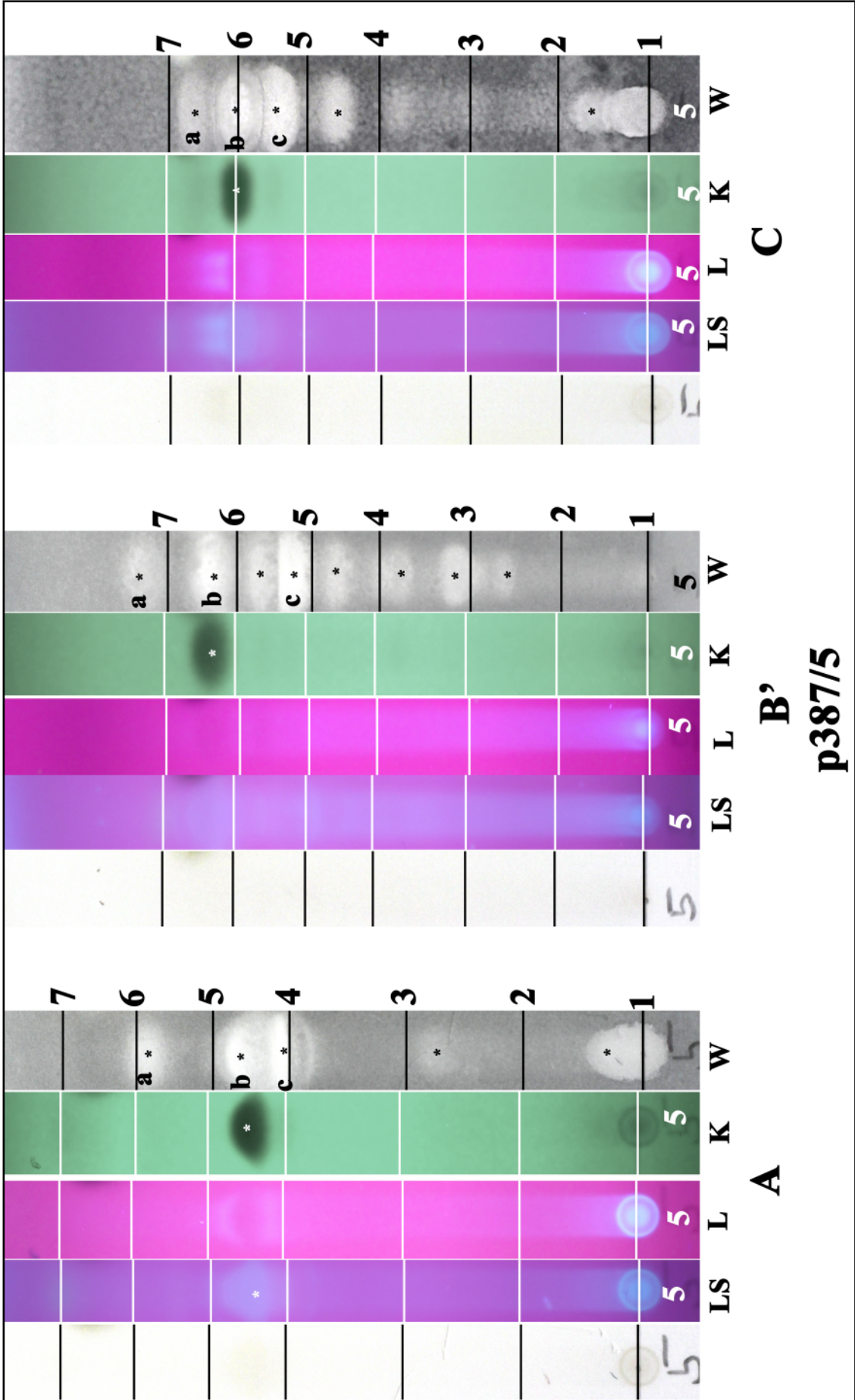
allo-pertusaric acid



a: allopertusaric acid, b,c: unknown

Purified lichen substance received from K. Kalb; origin S. Huneck.

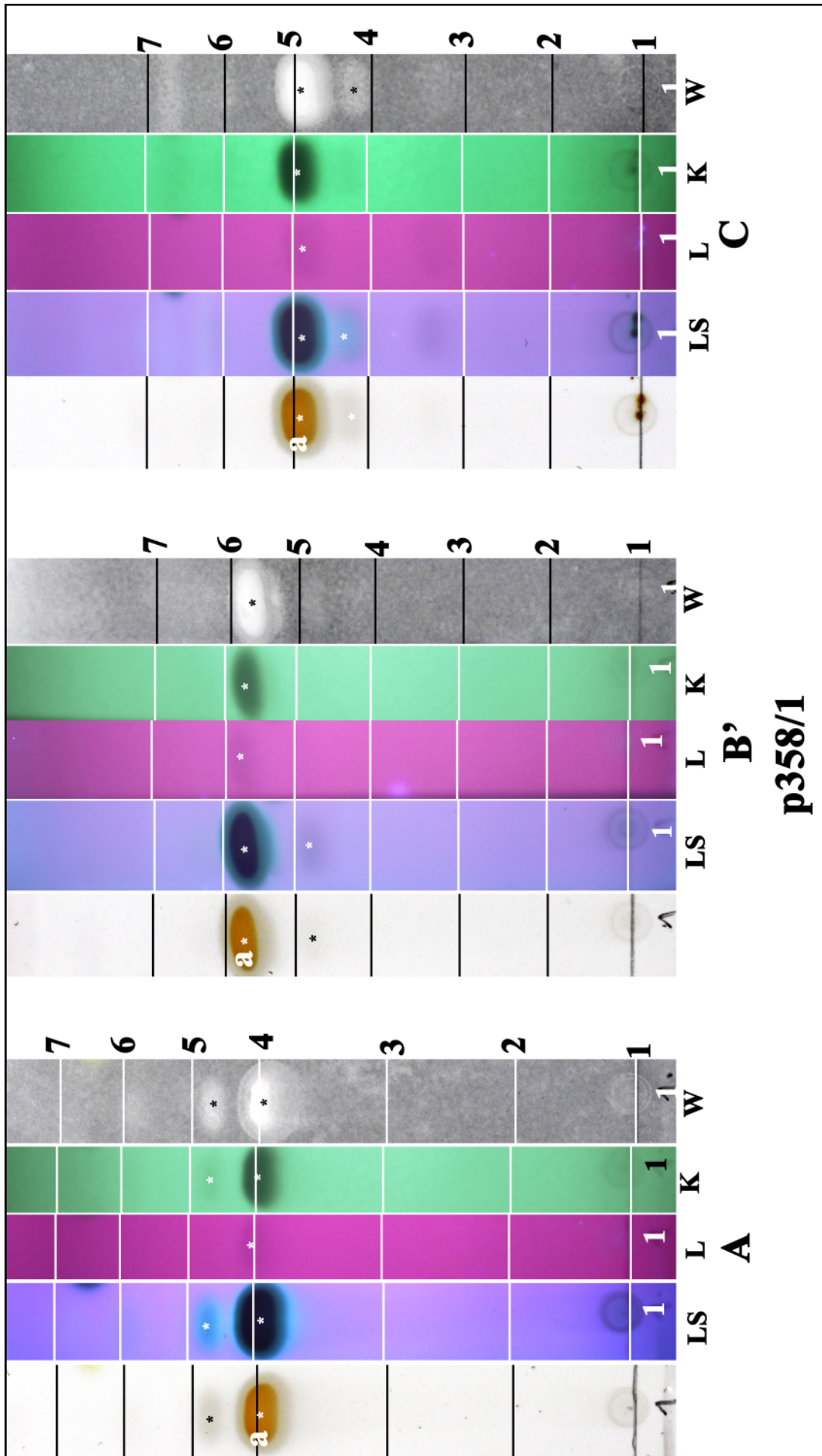
allo-protolichesterinic acid



c(?): allo-protolichesterinic acid, a,b:?

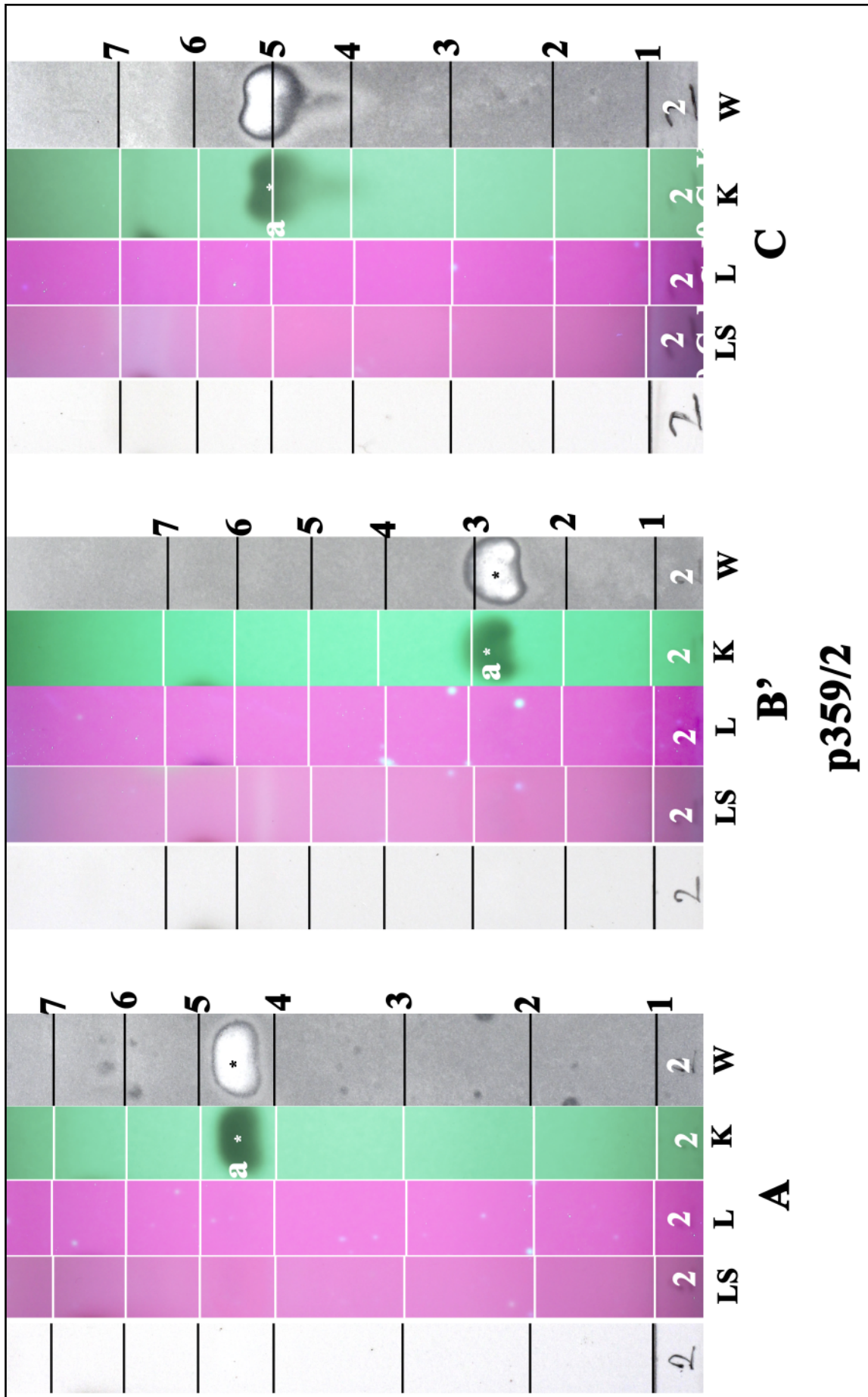
Purified lichen substance received from K. Kalb; origin S. Huneck.

anziaic acid



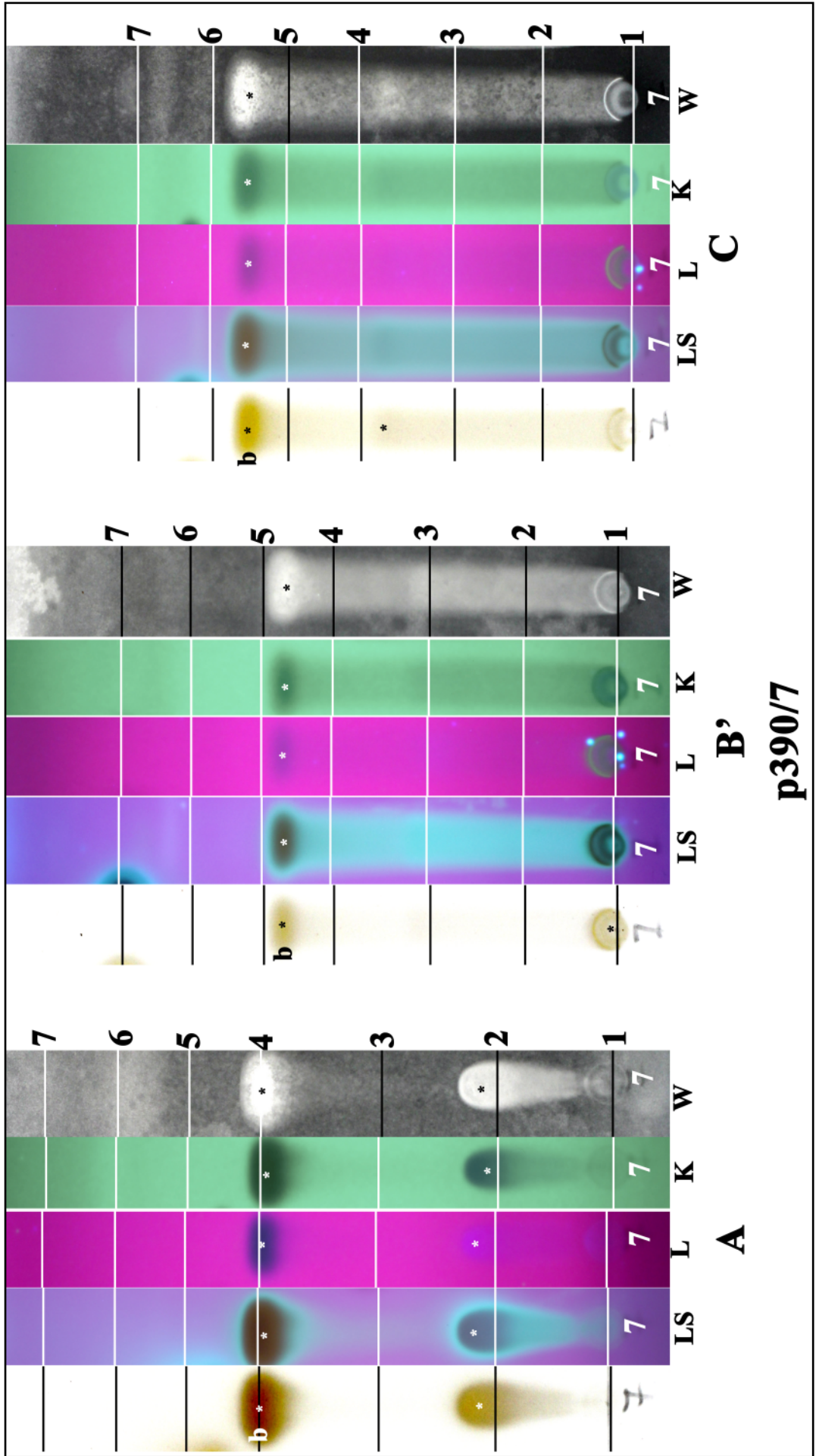
Purified lichen substance received from K. Kalb; origin S. Huneck.

arthonin



Purified lichen substance received from K. Kalb; origin S. Huneck.

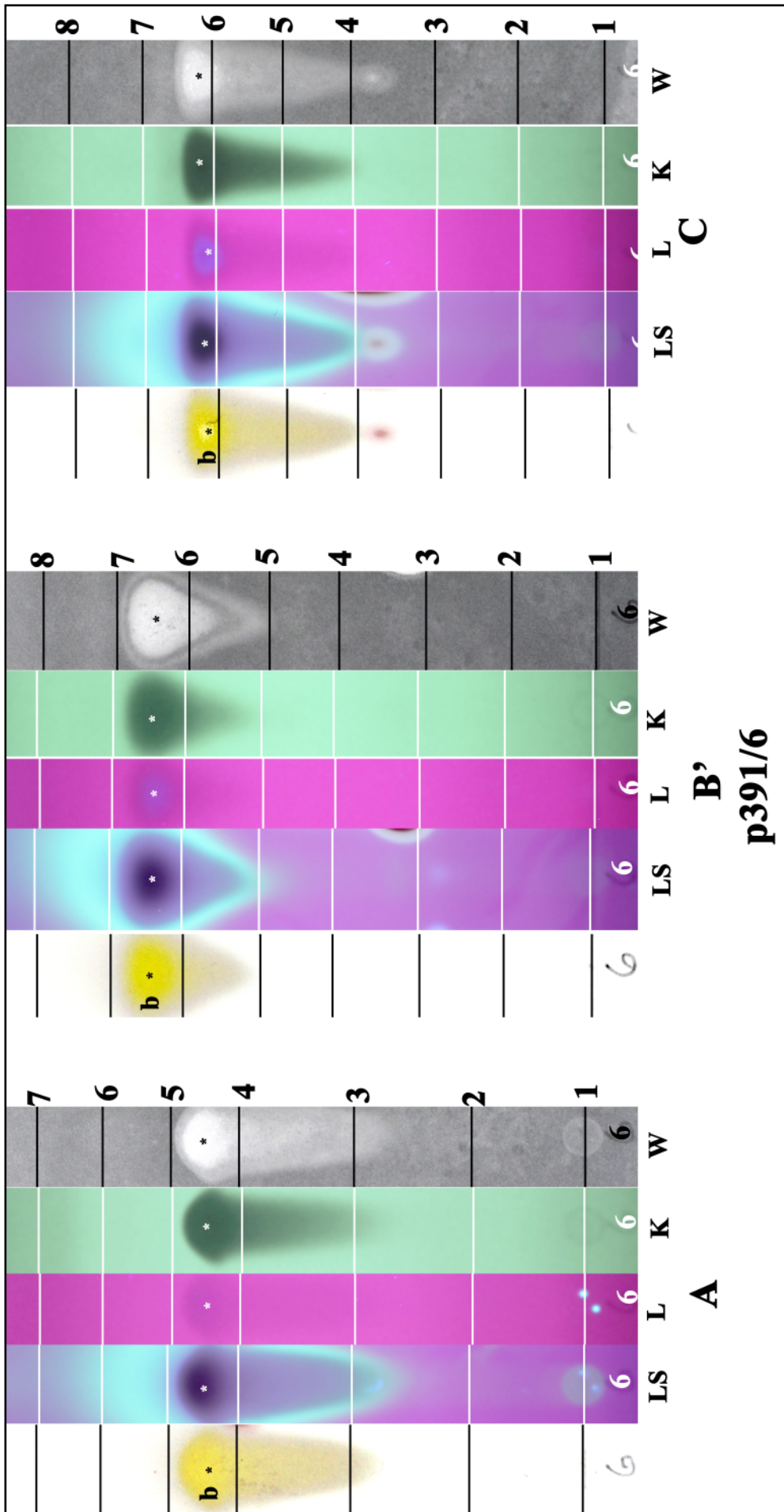
**baeomycesic acid**



**b: baeomycesic acid**

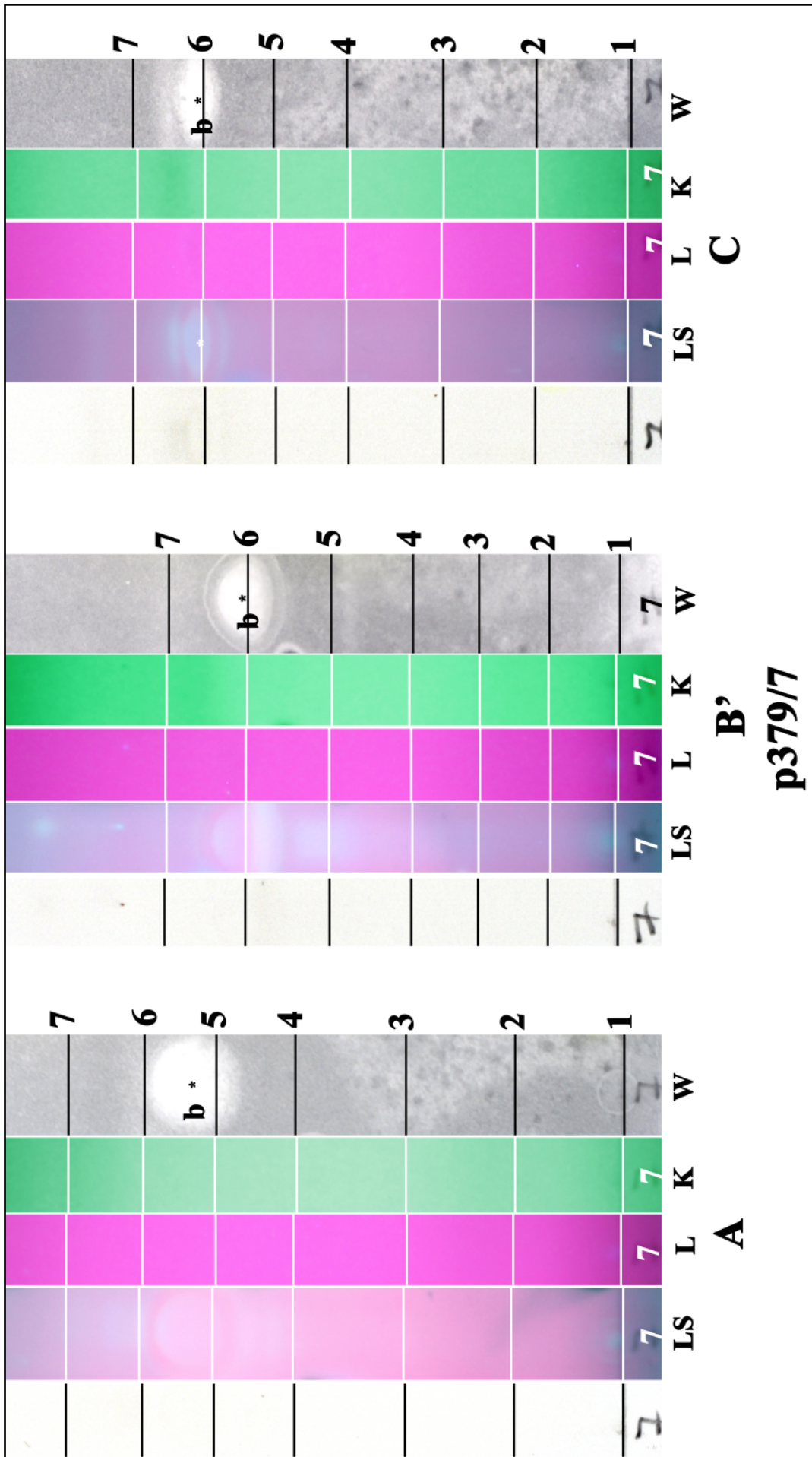
Purified lichen substance received from K. Kalb; origin S. Huneck.

barbatic acid



Purified lichen substance received from K. Kalb; origin S. Huneck.

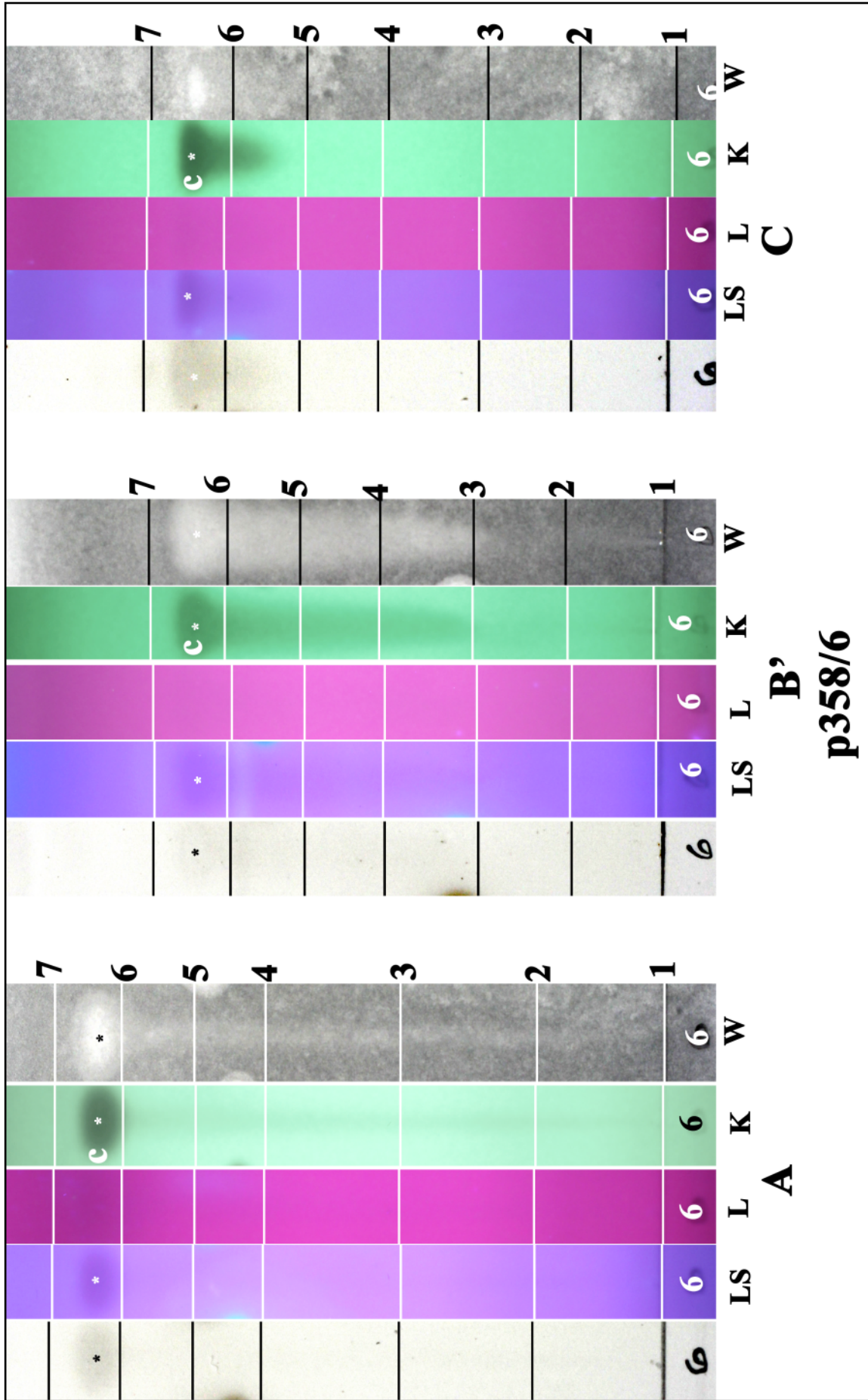
**bourgeanic acid**



**b: bourgeanic acid**

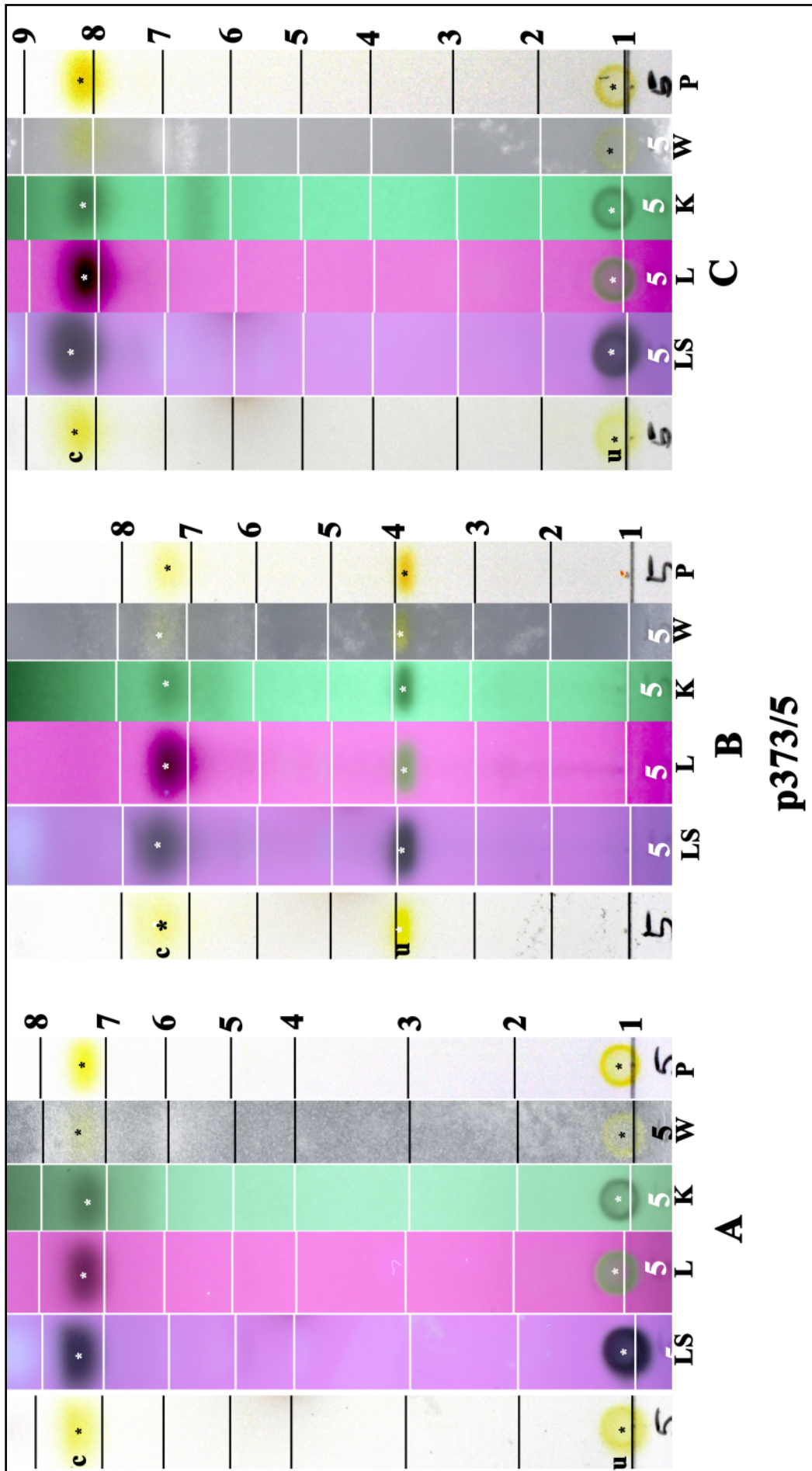
Purified lichen substance received from K. Kalb; origin S. Huneck.

caloploicin



Purified lichen substance received from K. Kalb; origin S. Huneck.

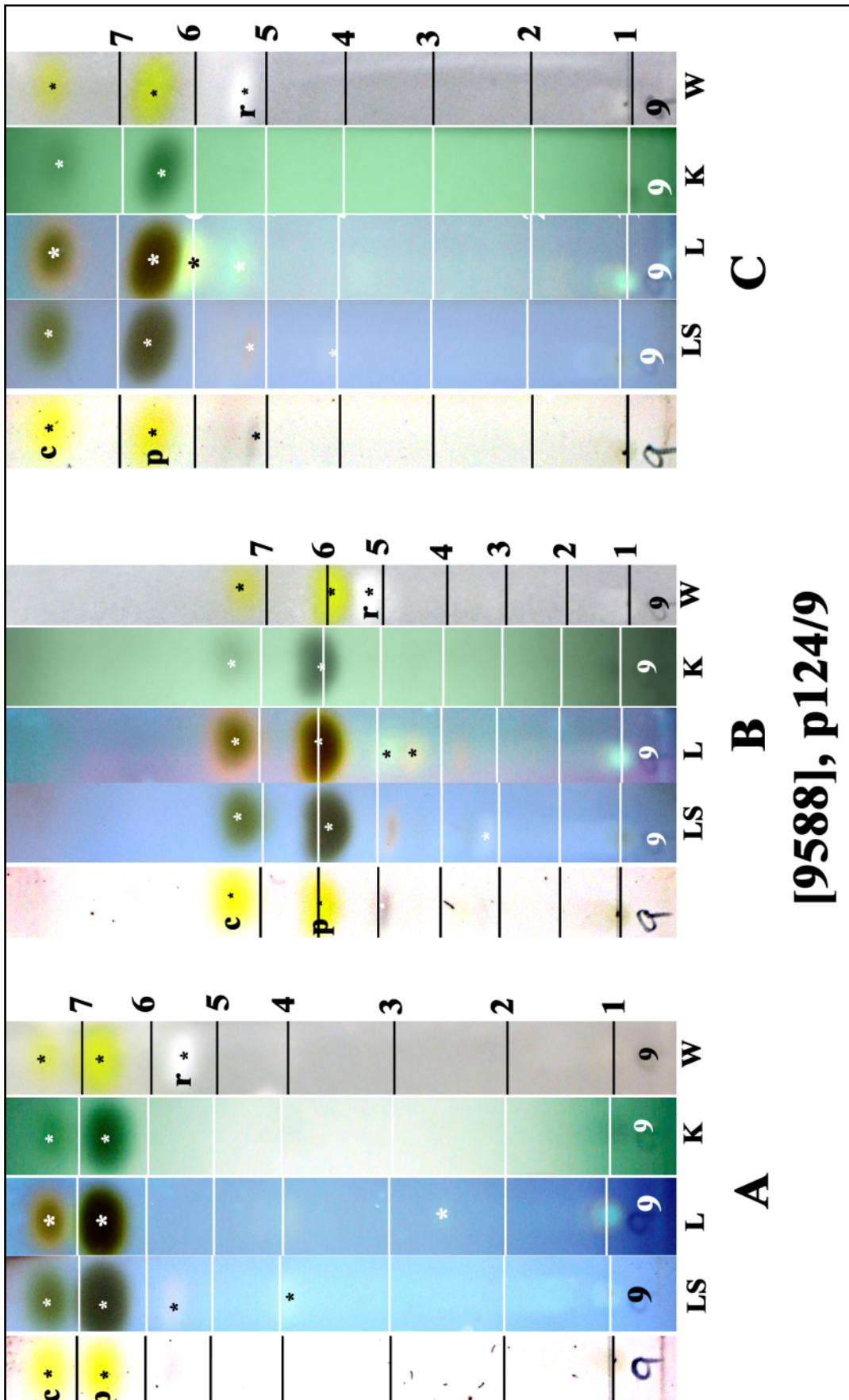
calycin



c: calycin, u: unknown

Purified lichen substance received from K. Kalb; origin S. Huneck.

calycin

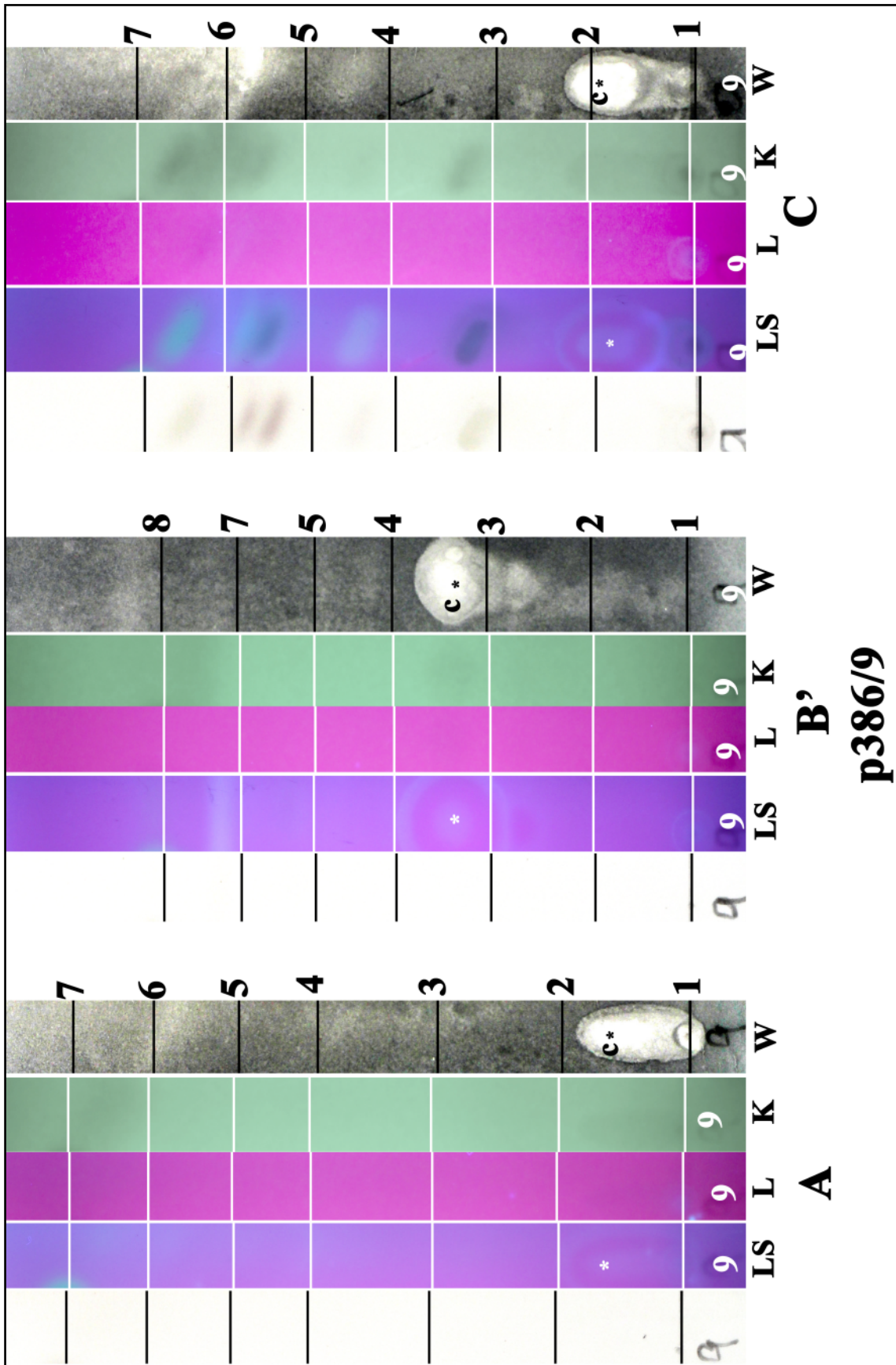


[9588], p124/9

c: calycin, p: pinastric acid, r: roccellic acid ?

*Chrysothrix candelaris*, [9588], Germany, Baden-Württemberg, Kreis Schramberg, westliche Talseite im Schiltachtal, 3 km südlich Schramberg, auf Kiefernrinde, 550 m, TK: 7716/SW. Leg. V. Wirth & U. Schwarz 21.11.1992, det. V. Wirth 1992.

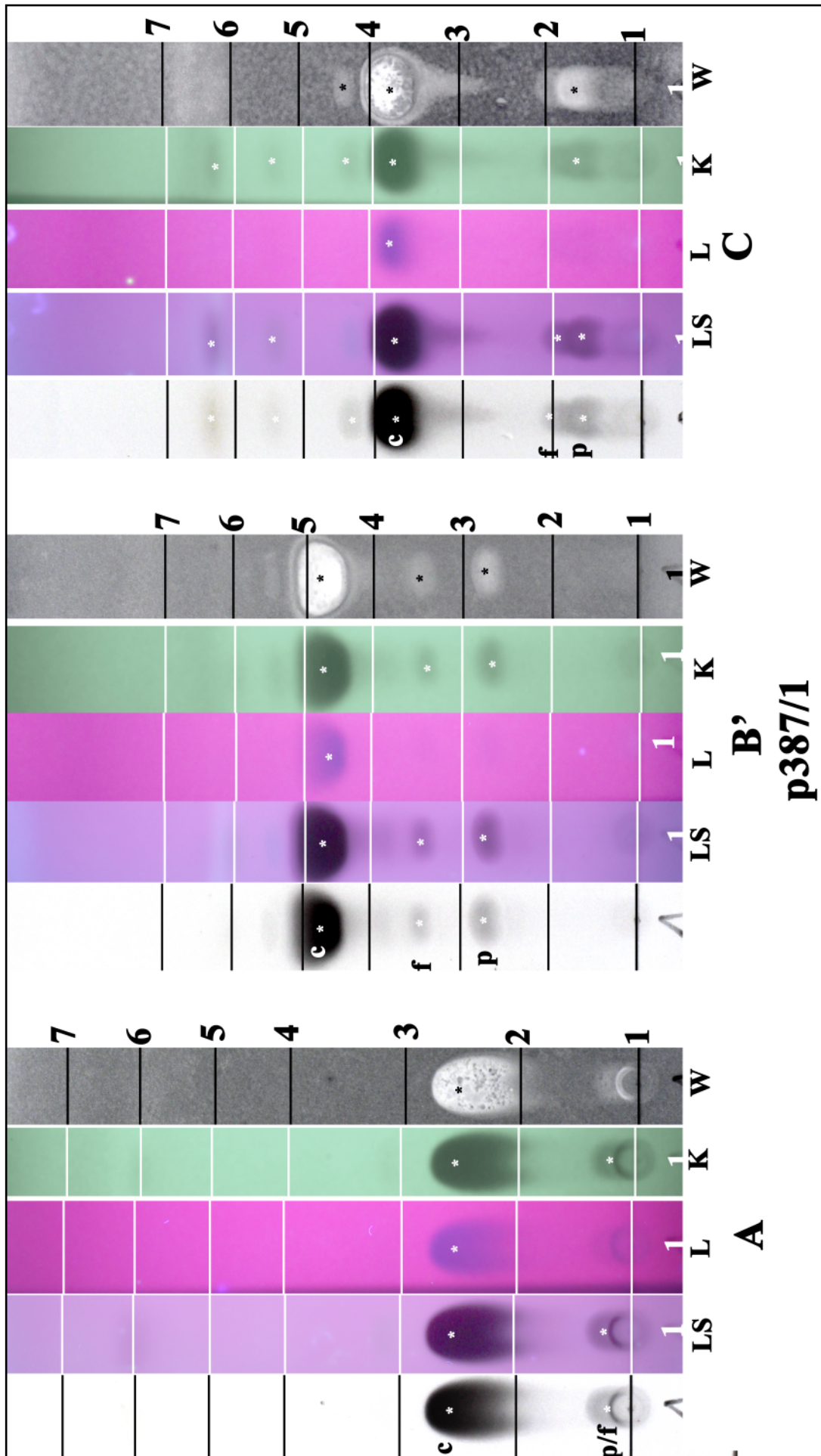
**caperic acid**



c: caperic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

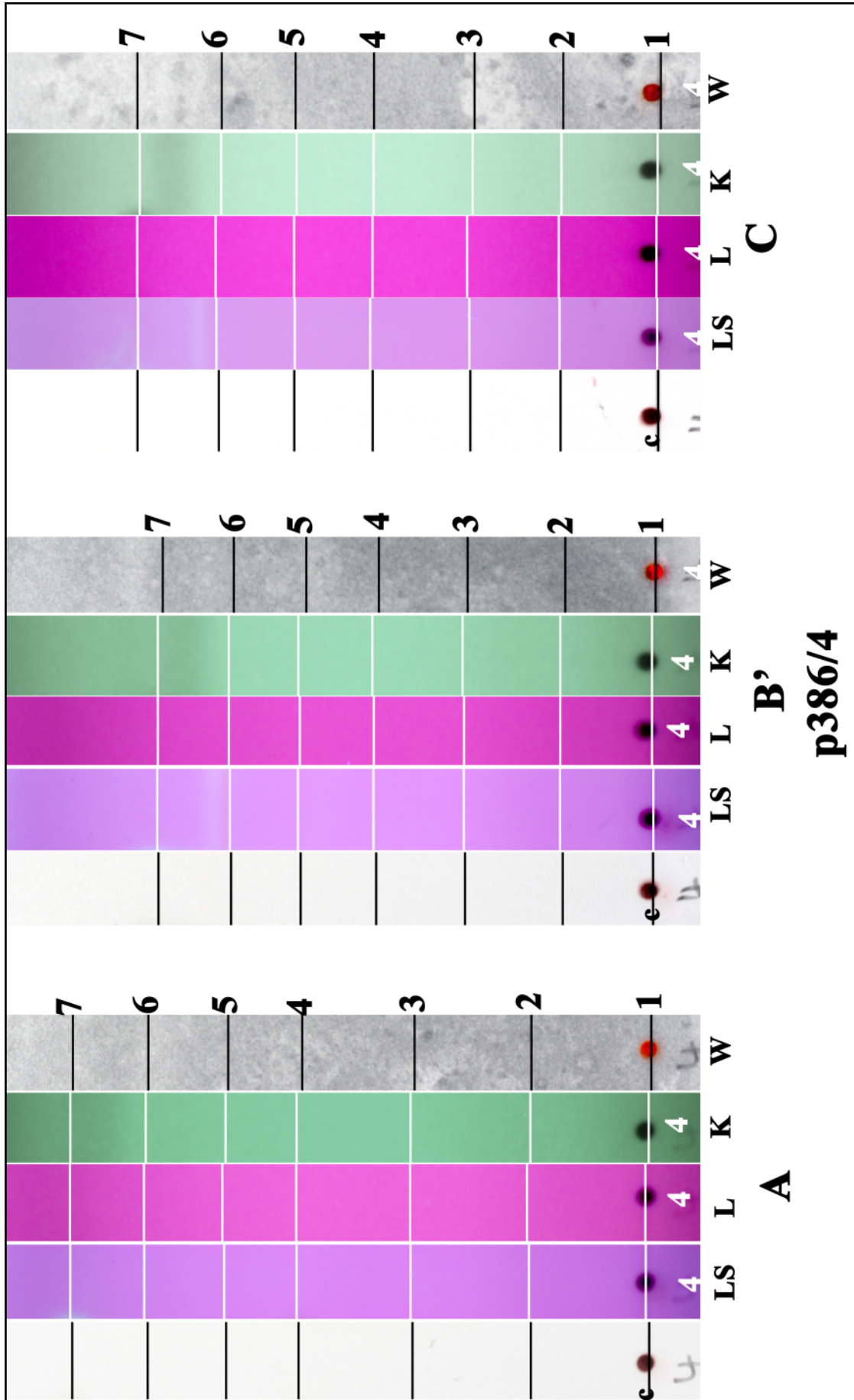
**cetraric acid**, not found in lichens



c: cetraric acid, p: protocetraric acid, f: fumarprotocetraric acid

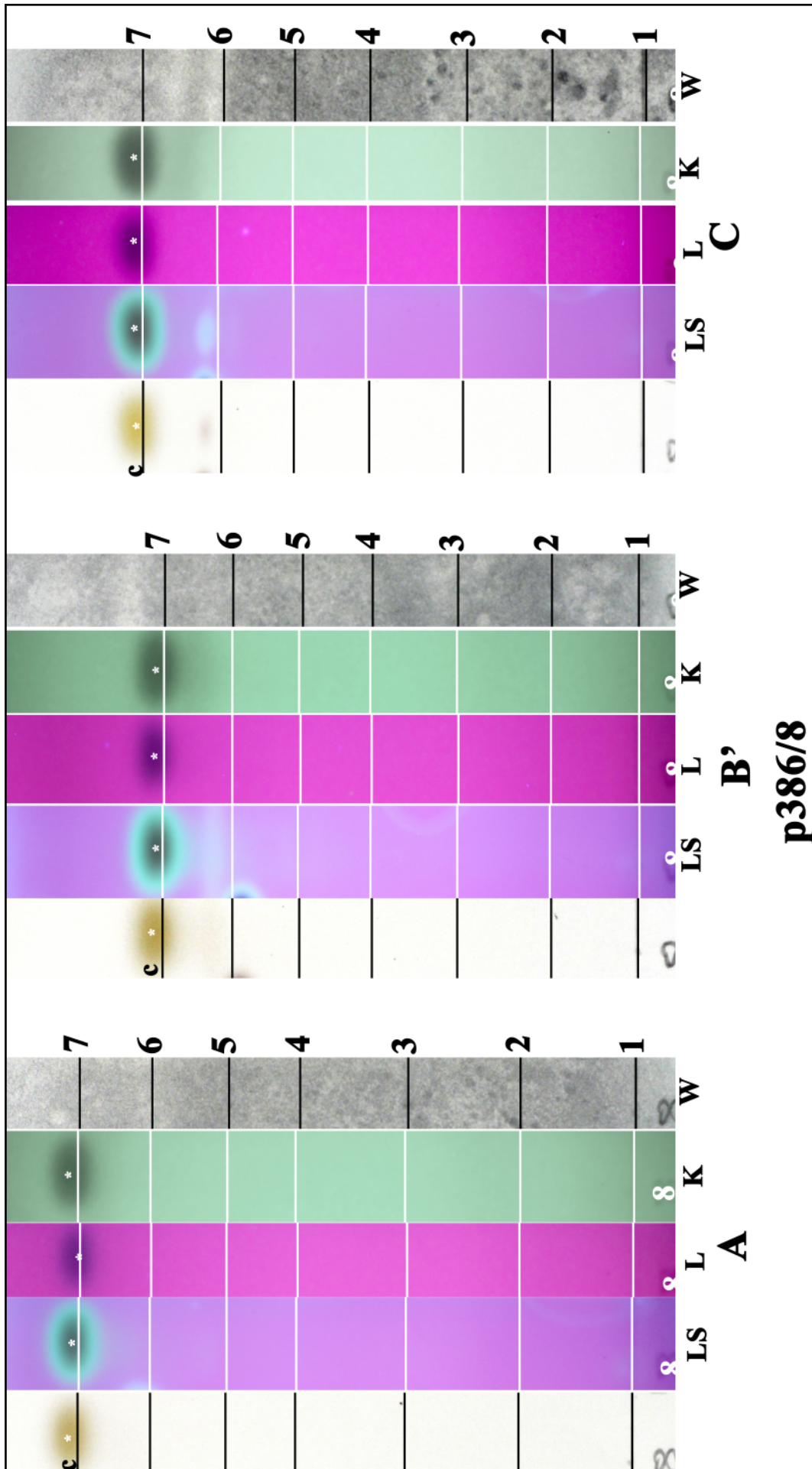
Purified lichen substance received from K. Kalb; origin S. Huneck.

**chiodectonic acid**



Purified lichen substance received from K. Kalb; origin S. Huneck.

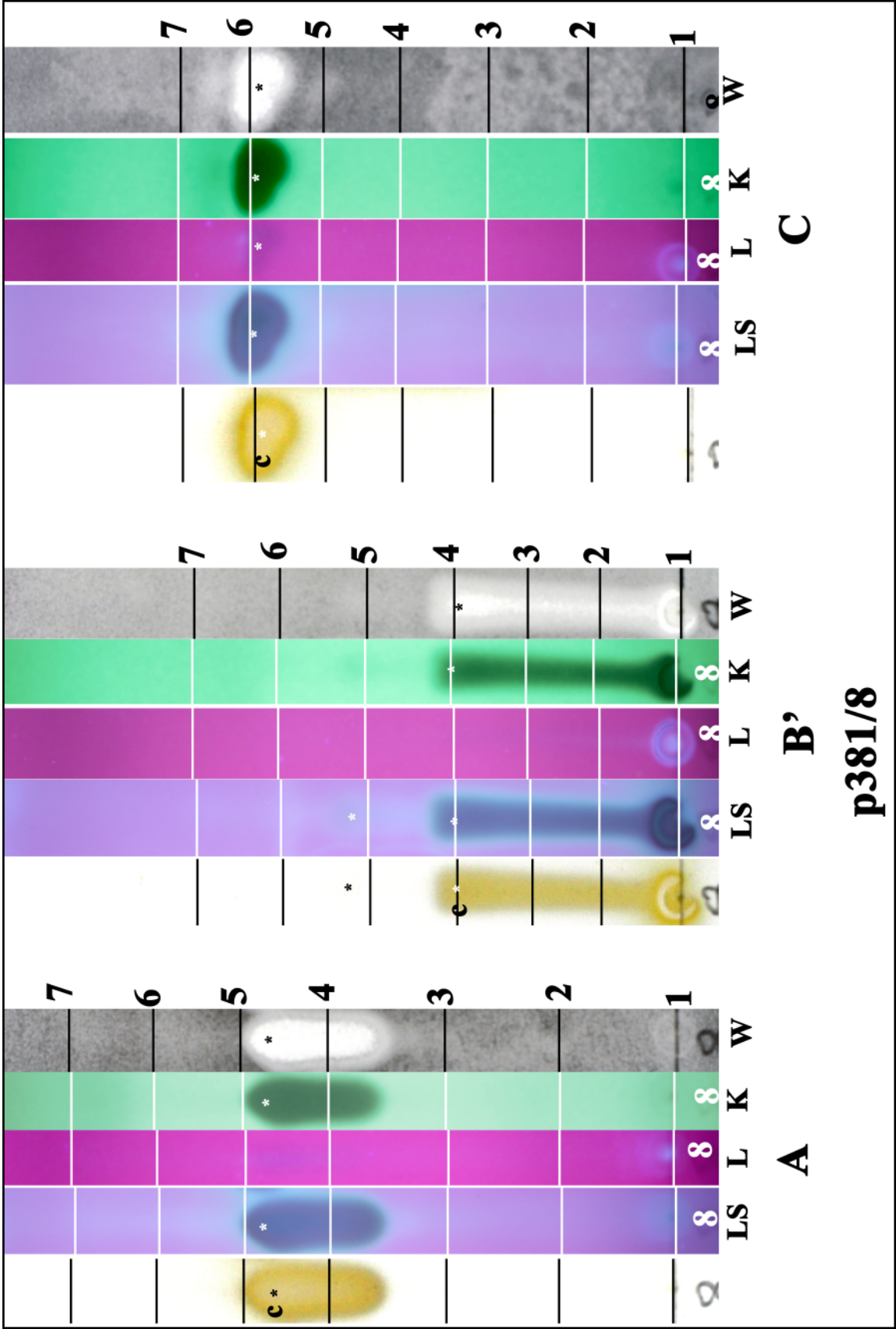
**chloroatranorin**



**c: chloroatranorin**

Purified lichen substance received from K. Kalb; origin S. Huneck.

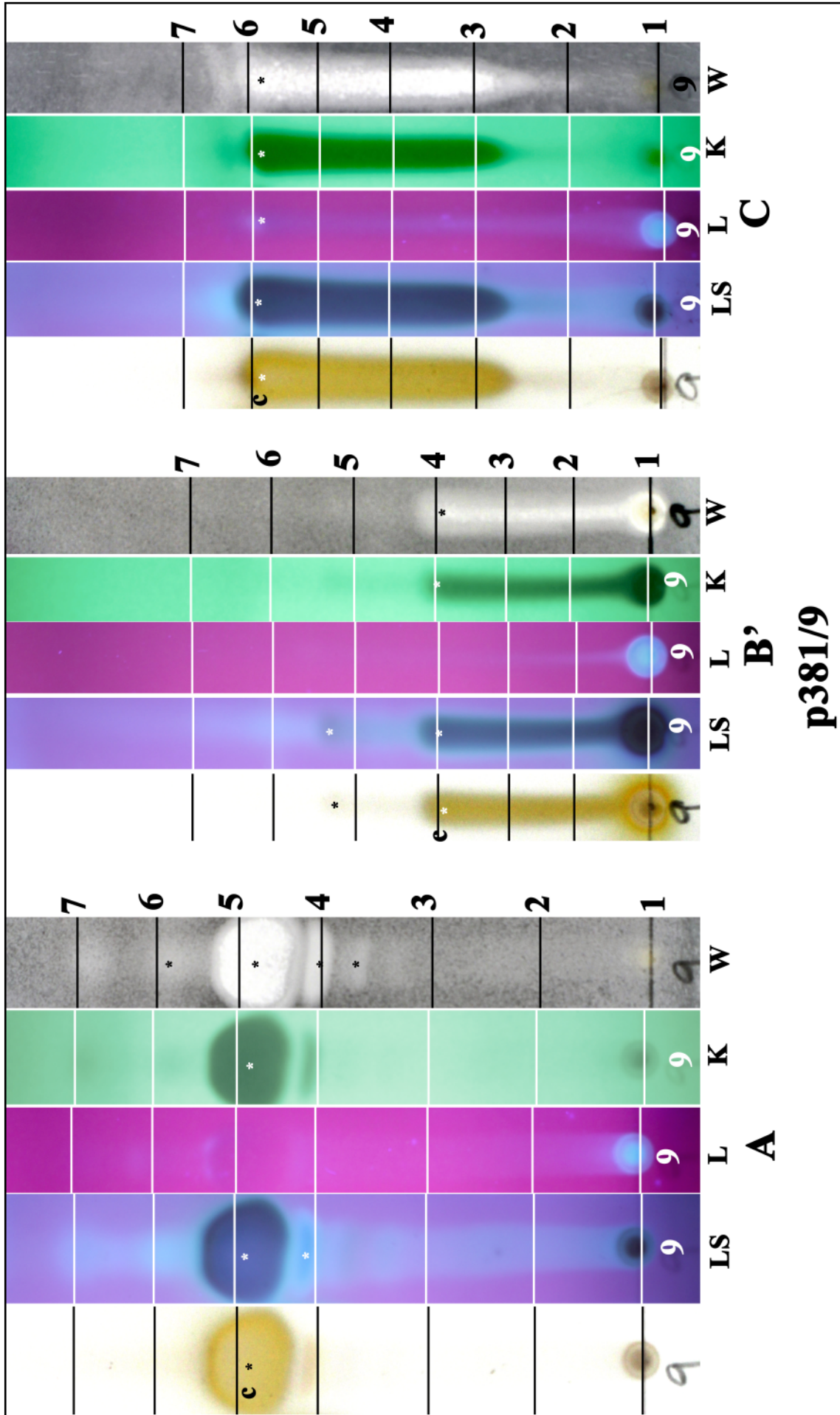
confluent acid



c: confluent acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

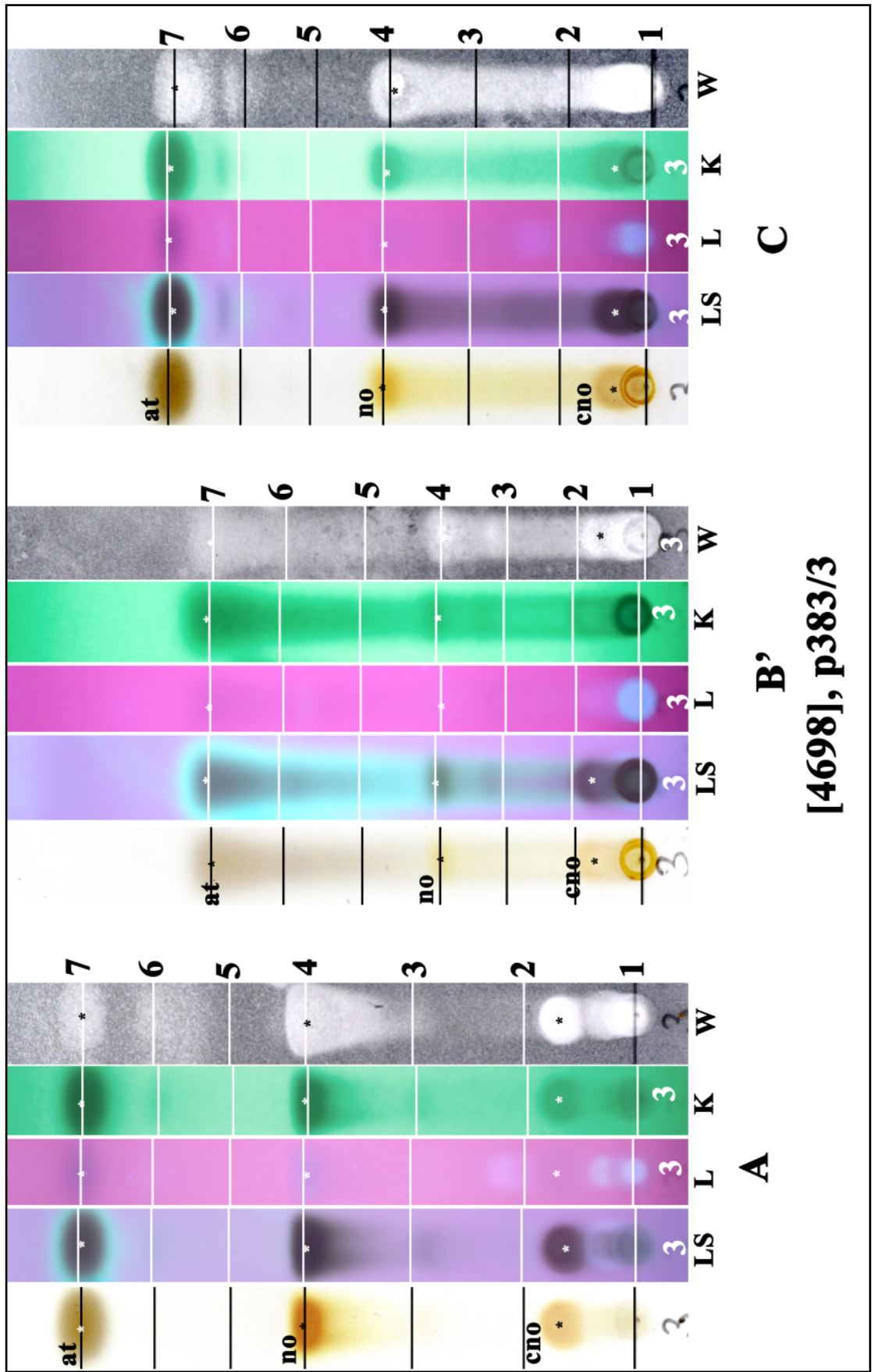
confluent acid



c: confluent acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

connorstictic acid

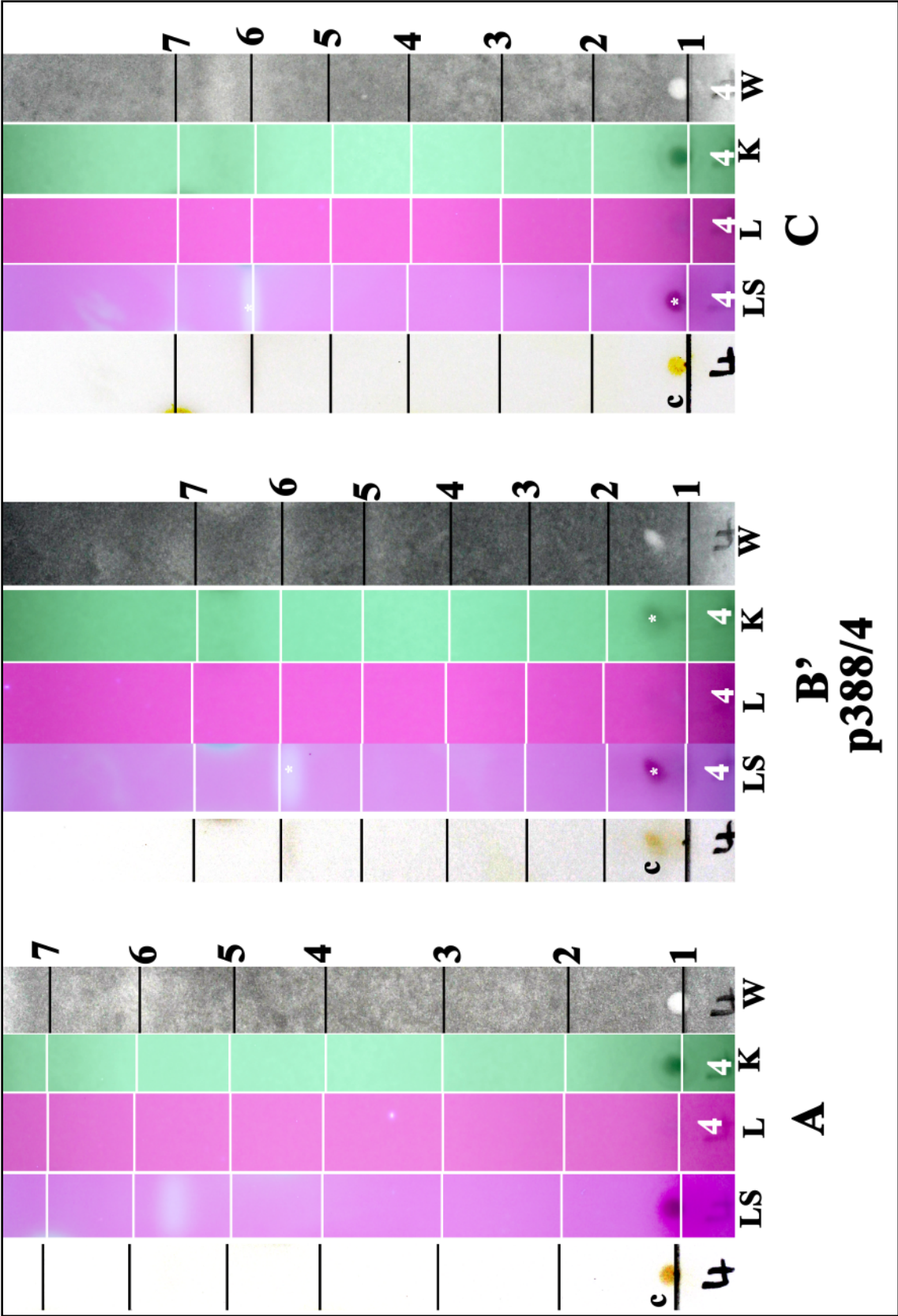


[4698], p383/3

at: atranorin, no: norstictic acid, cno: connorstictic acid

*Cladonia symphycarpa* (Ach.) Fr., [4698], Germany, Baden-Württemberg, Schwäbische Alb, Laichingen, Kalkblöcke in Steppenheide nahe der Laichinger Tiefenhöhle, ca. 755 m, TK 7524. Leg. et det. F. Schumm 08.1978.

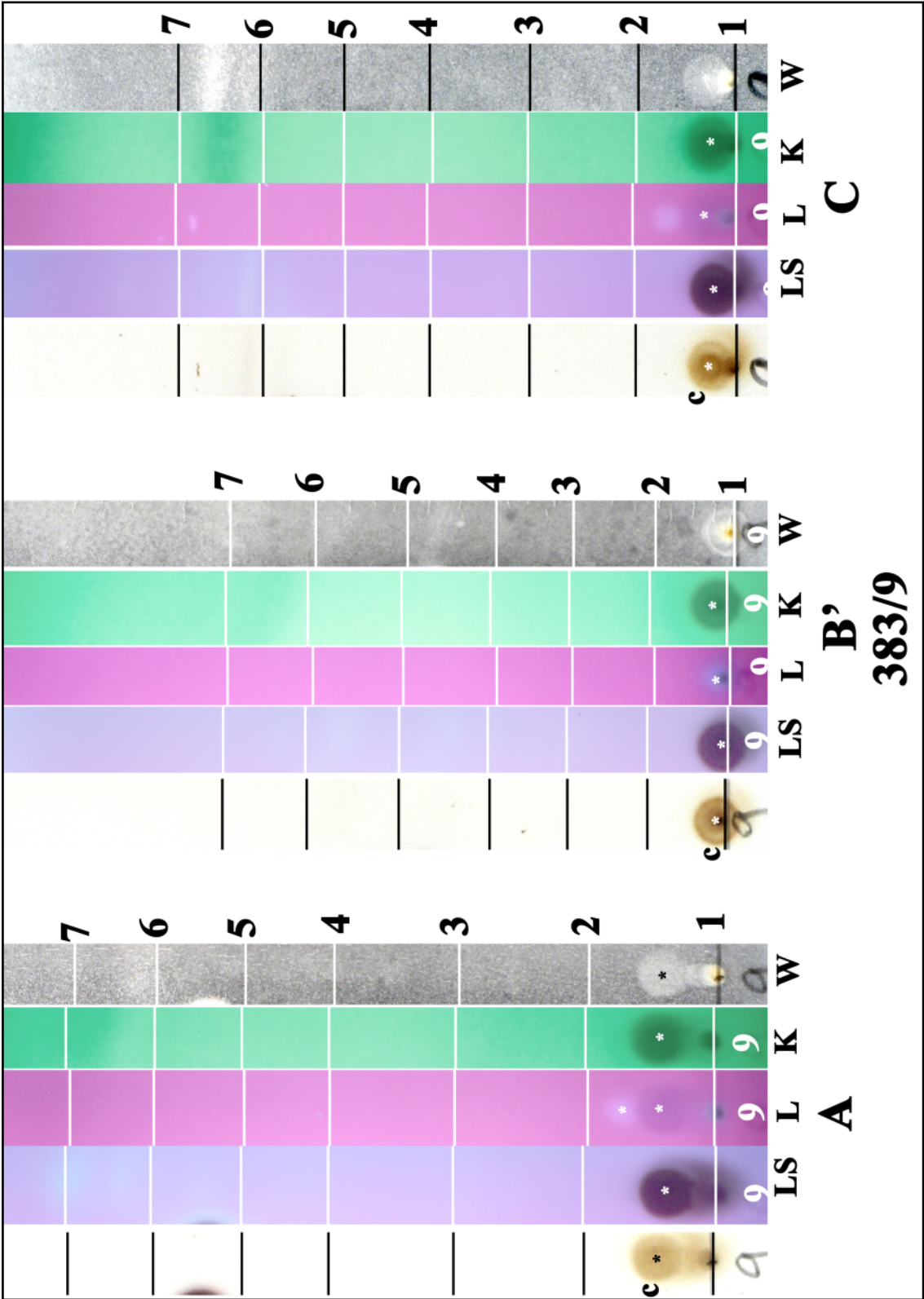
conprotocetraric acid



c: conprotocetraric acid

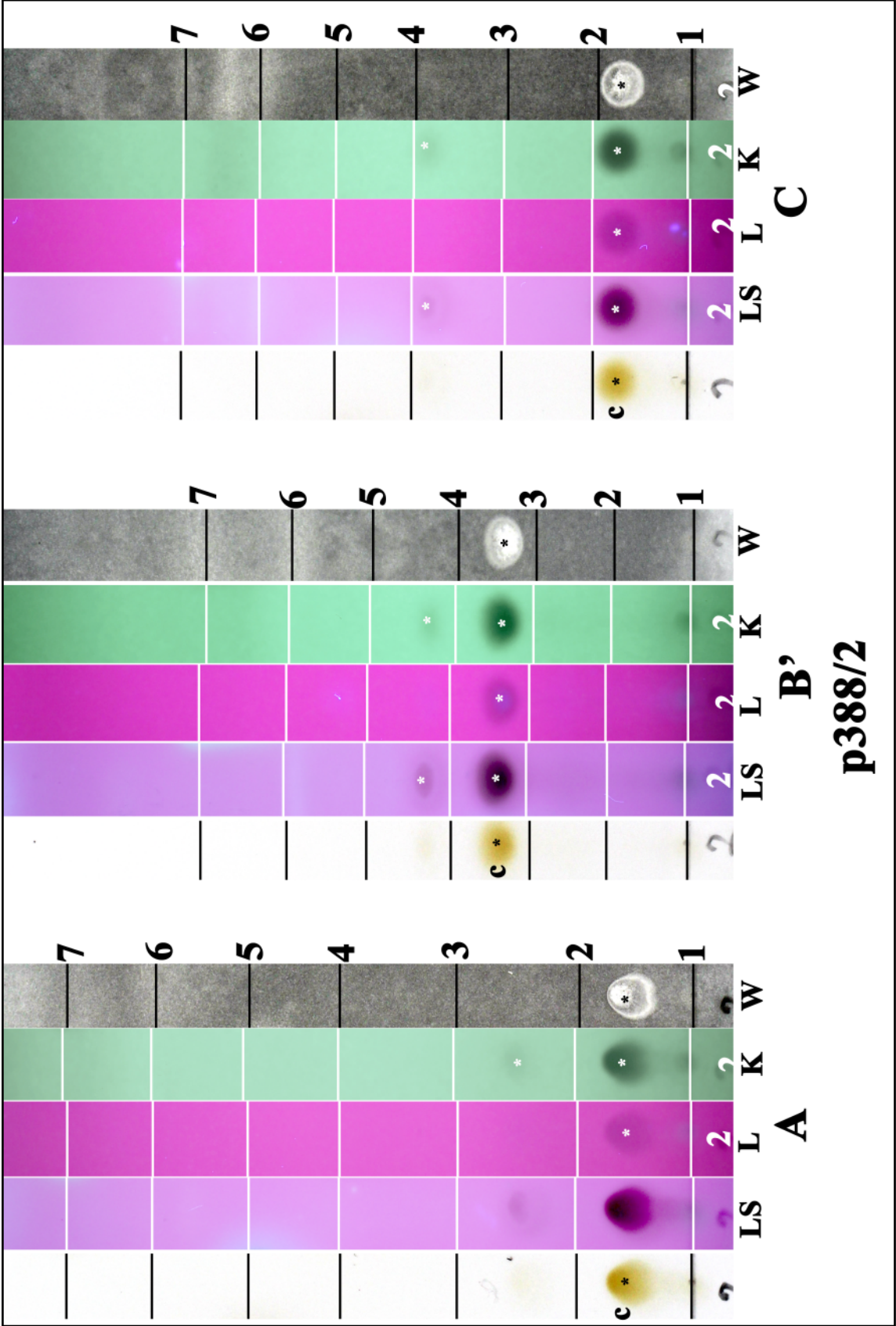
Purified lichen substance received from K. Kalb; origin J.A. Elix.

constictic acid



Purified lichen substance received from K. Kalb; origin J.A. Elix.

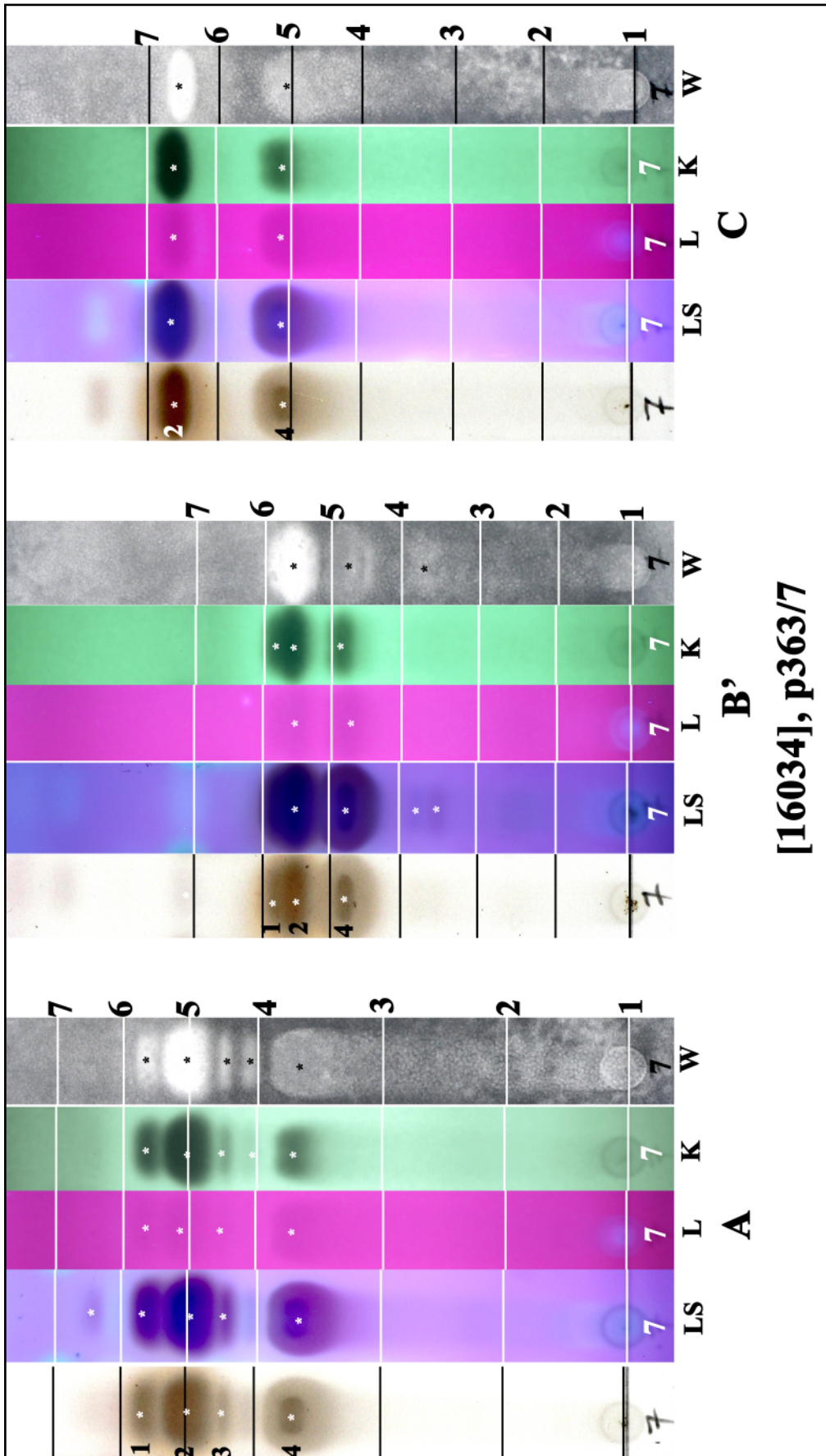
convirensic acid



c: convirensic acid

Purified lichen substance received from K. Kalb; origin J.A. Elix.

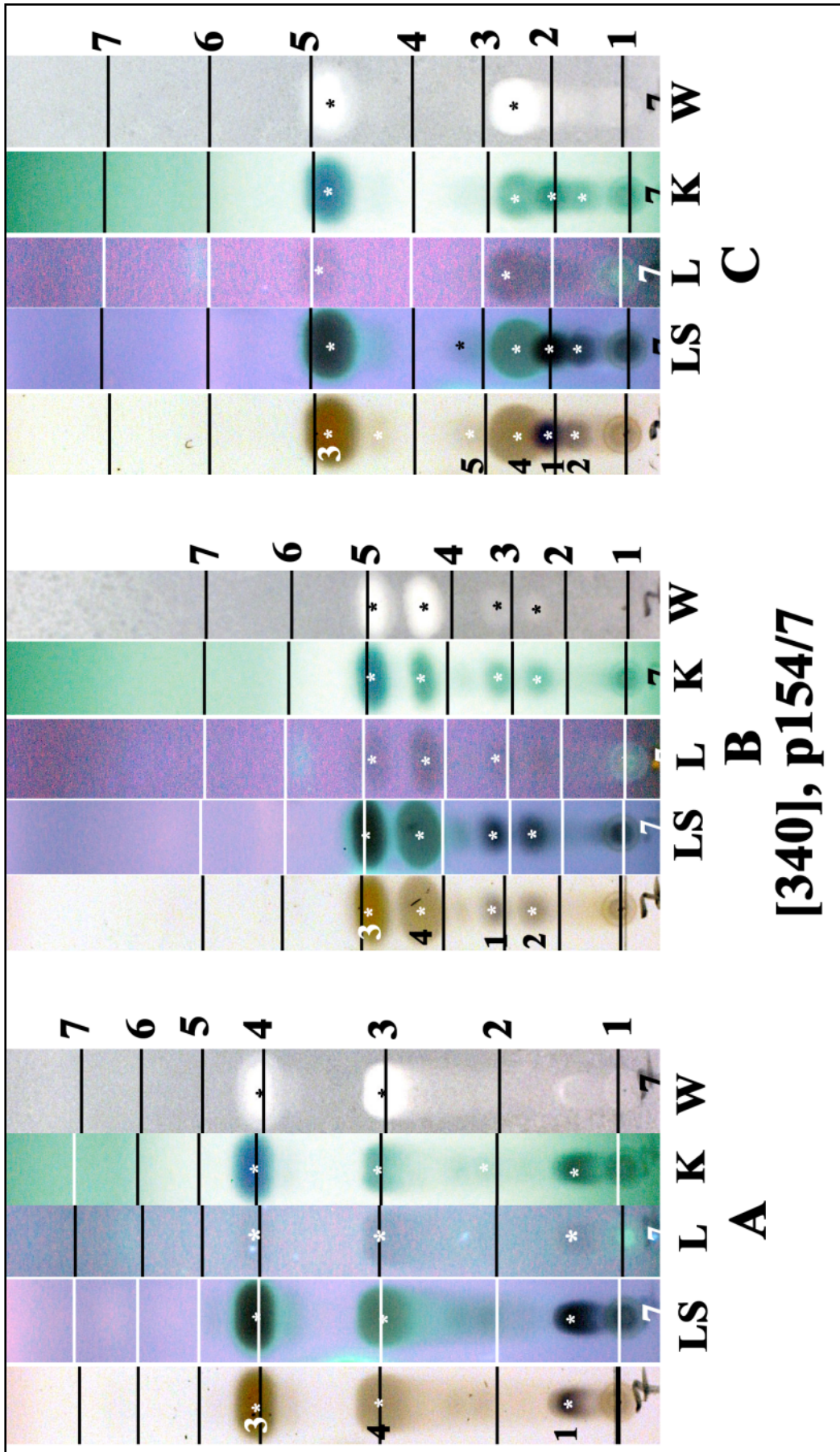
cryptochlorophaeic acid



- 1: 4-*O*-methylcryptochlorophaeic acid, 2: merochlorophaeic acid,
- 4: cryptochlorophaeic acid, 3: 2,4-di-*O*-methylnorsekikaic acid; conf. J.A. Elix.

*Cladonia merochlorophaea* Asahina, [16034], Australia, Australian Capital Territory, Canberra, Black Mountain Reserve, 35.27591° S, 149.09386° E, 760 m. Leg. J.A. Elix, F. Schumm & E. Stocker-Wörgötter, 07.11.2009, det. J.A. Elix.

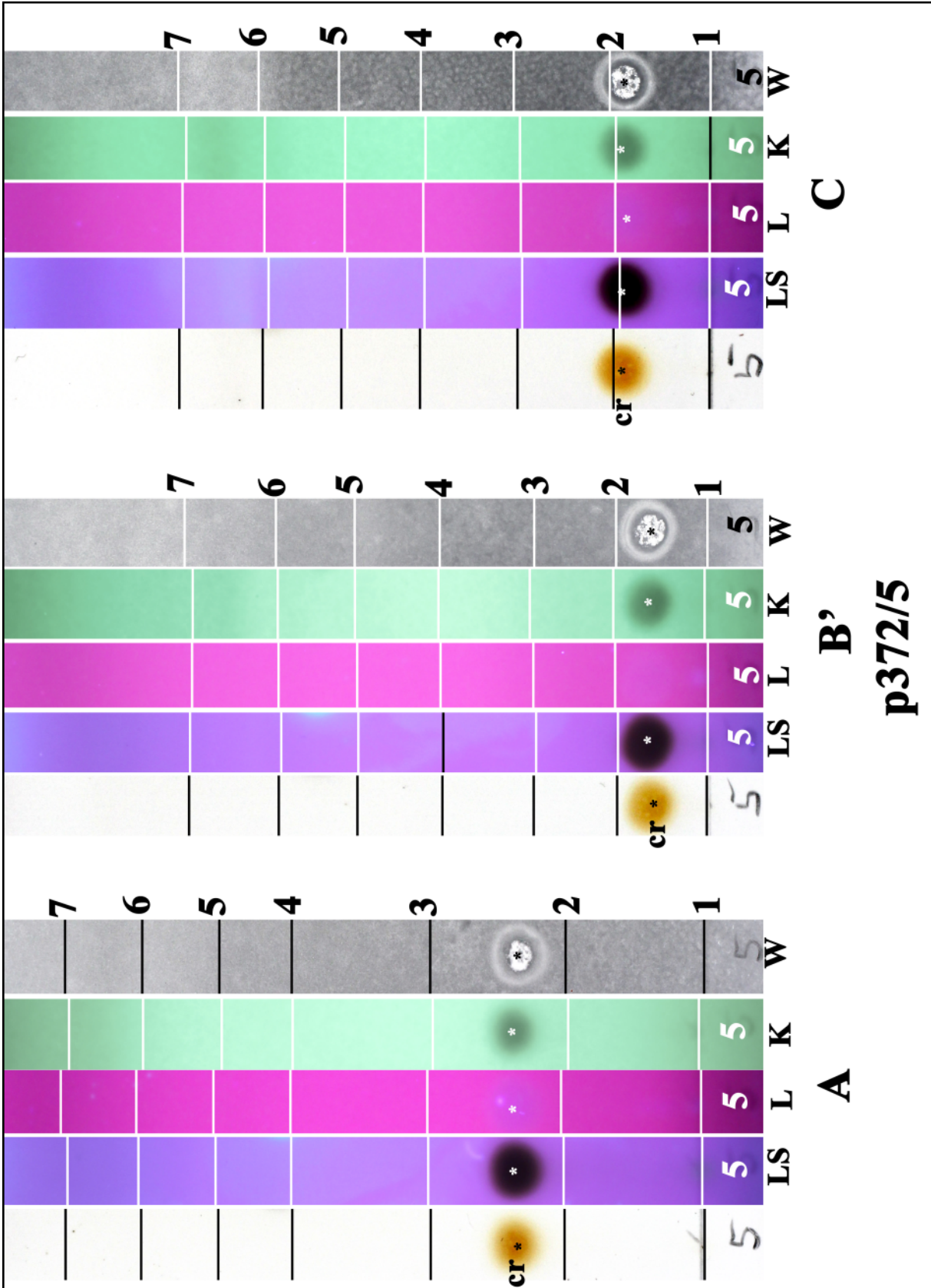
cryptochlorophaeic acid



1: fumarprotocetraric acid, 2: protocetraric acid, 3: cryptochlorophaeic acid,  
 4: paludosic acid, 5: unknown, conf. J.A. Elix

*Cladonia cryptochlorophaea* Asahina, [340], Germany, Baden-Württemberg, Schwarzwald, Mitteltal, auf einem Laubbaum über Moosen. Leg. Eisele 17.03.1947.

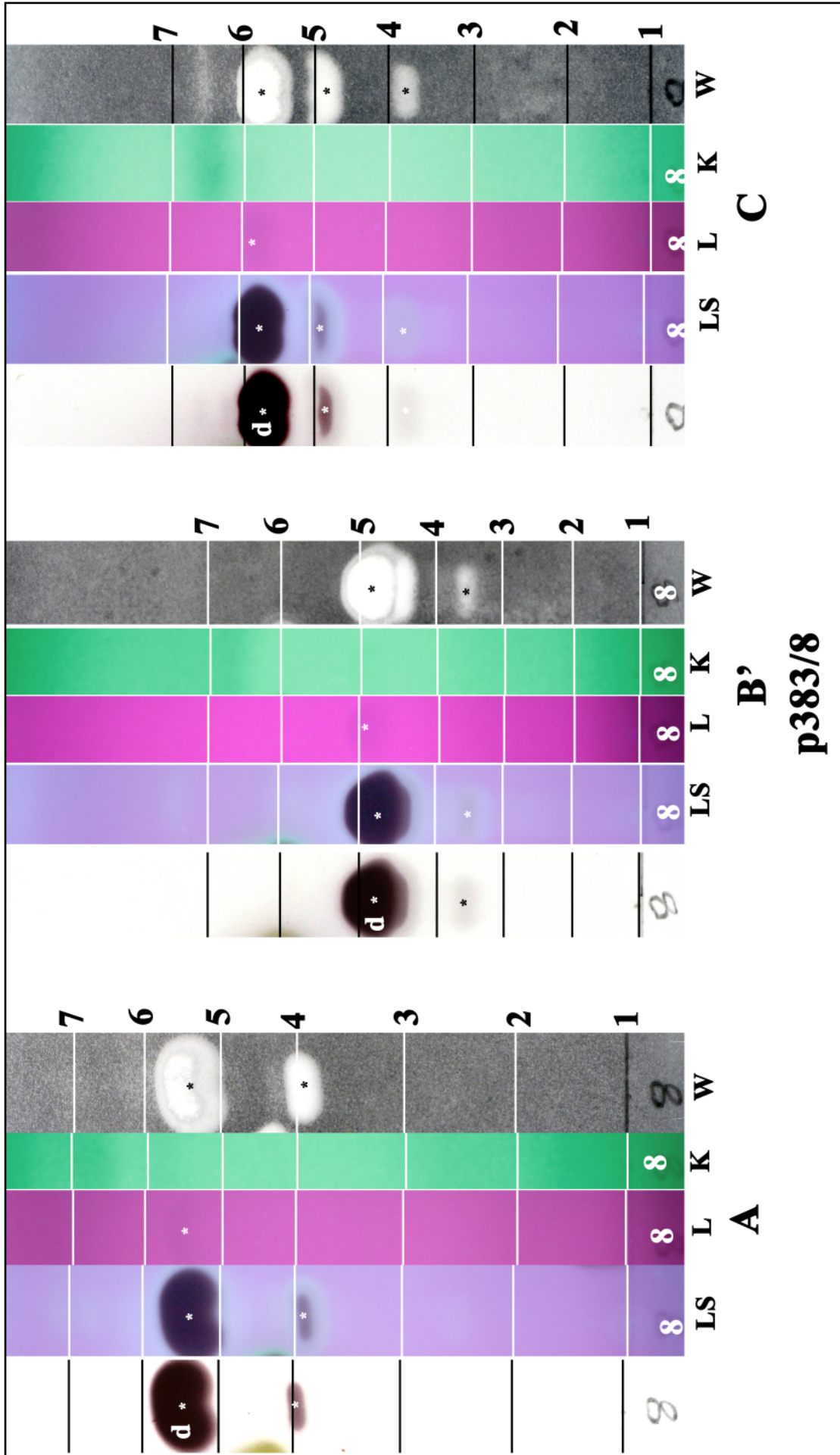
cryptostictic acid



cr: cryptostictic acid

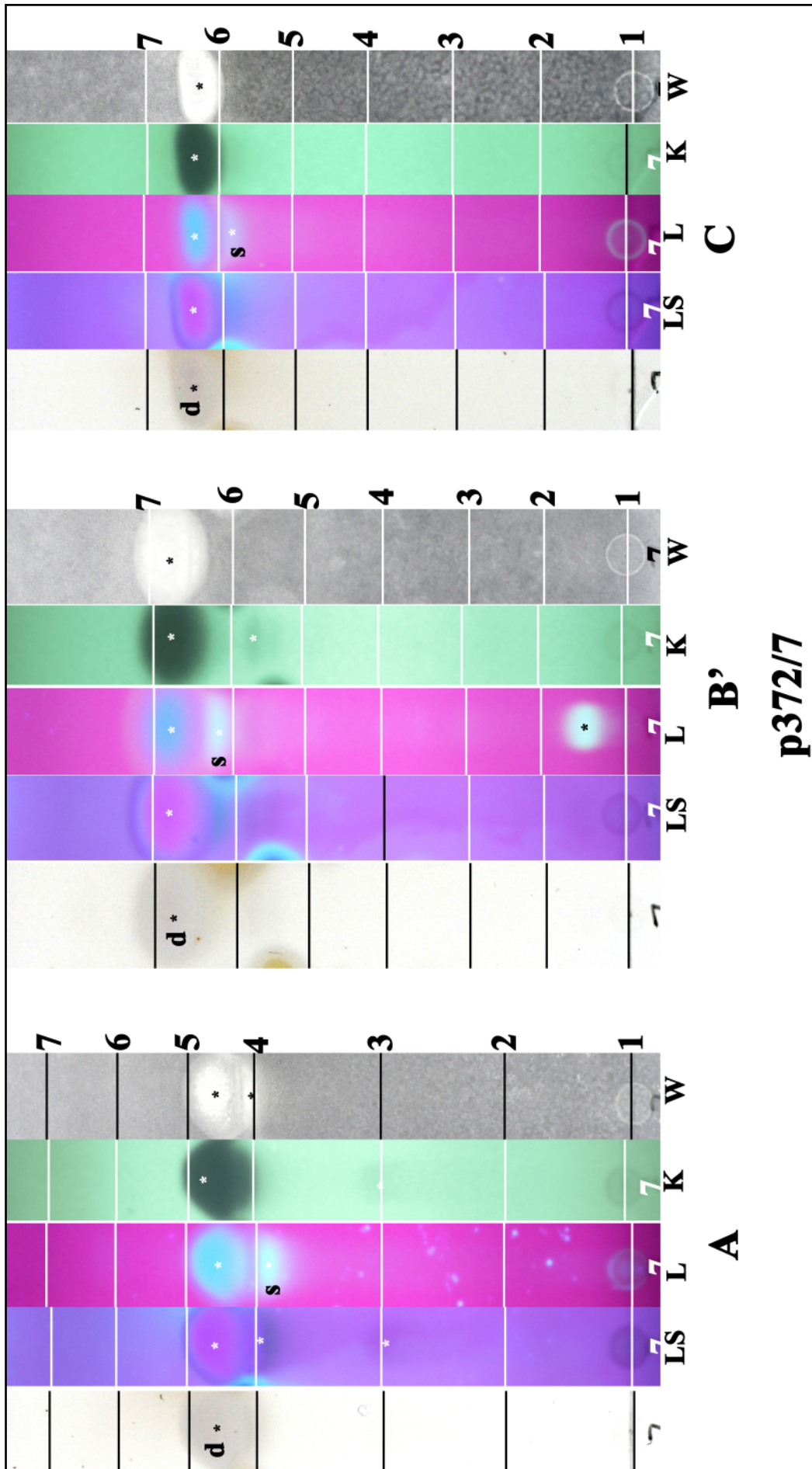
Purified lichen substance received from K. Kalb; origin J.A. Elix.

**diacetylleucotylin**



Purified lichen substance received from K. Kalb; origin S. Huneck.

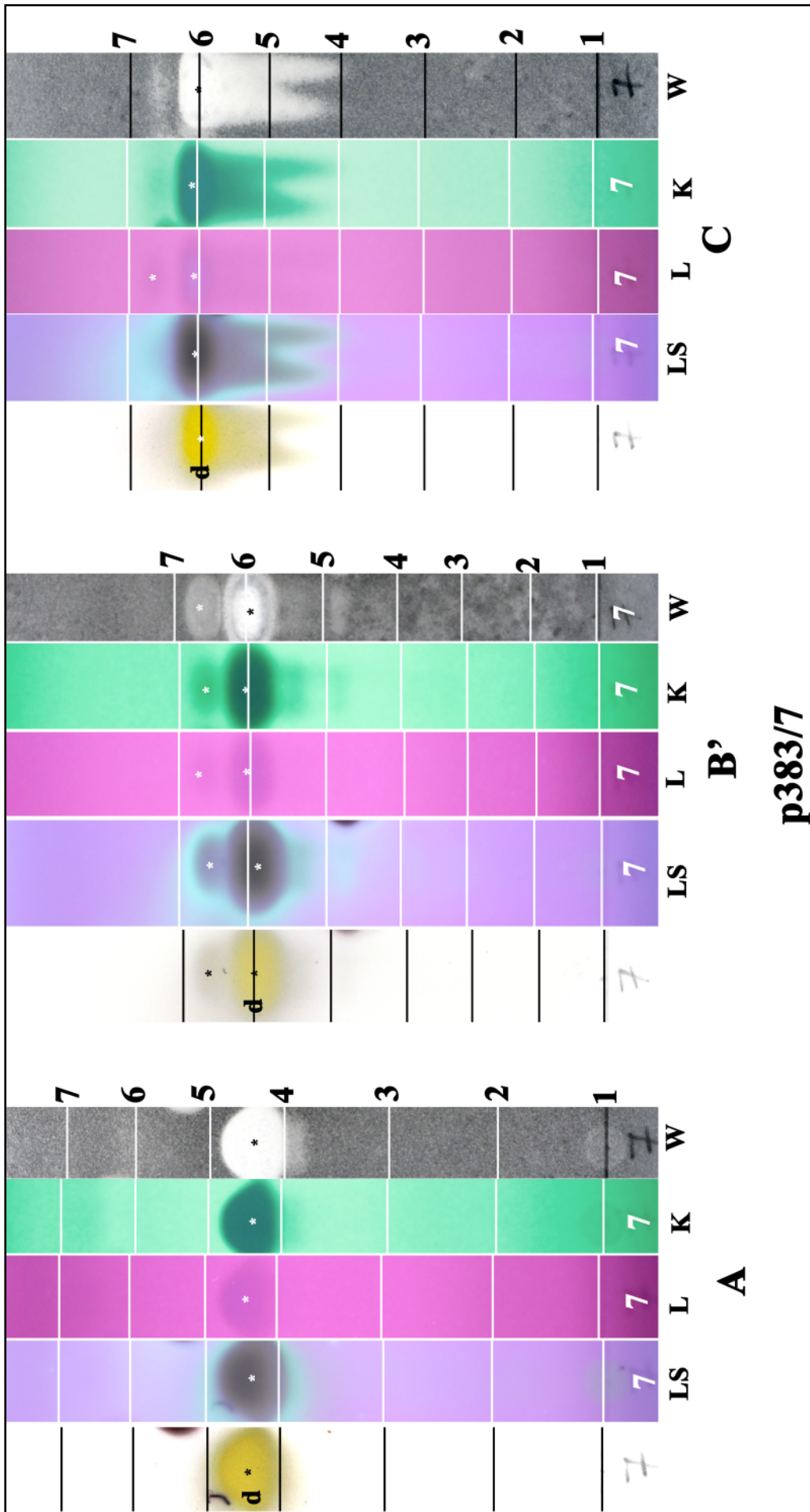
didymic acid



d: didymic acid, s: subdidymic acid

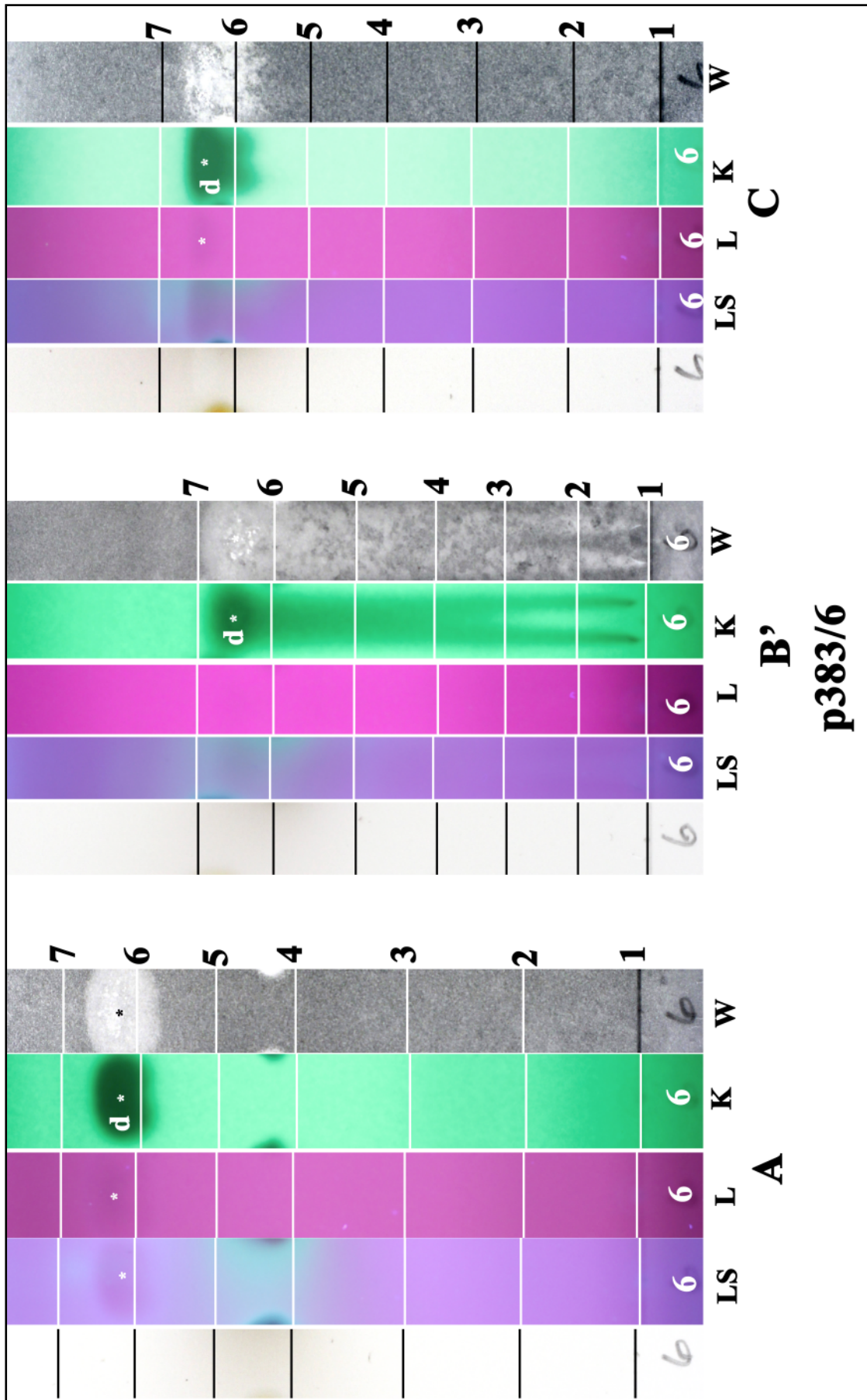
Purified lichen substance received from K. Kalb; origin S. Huneck.

**diffraitaic acid**



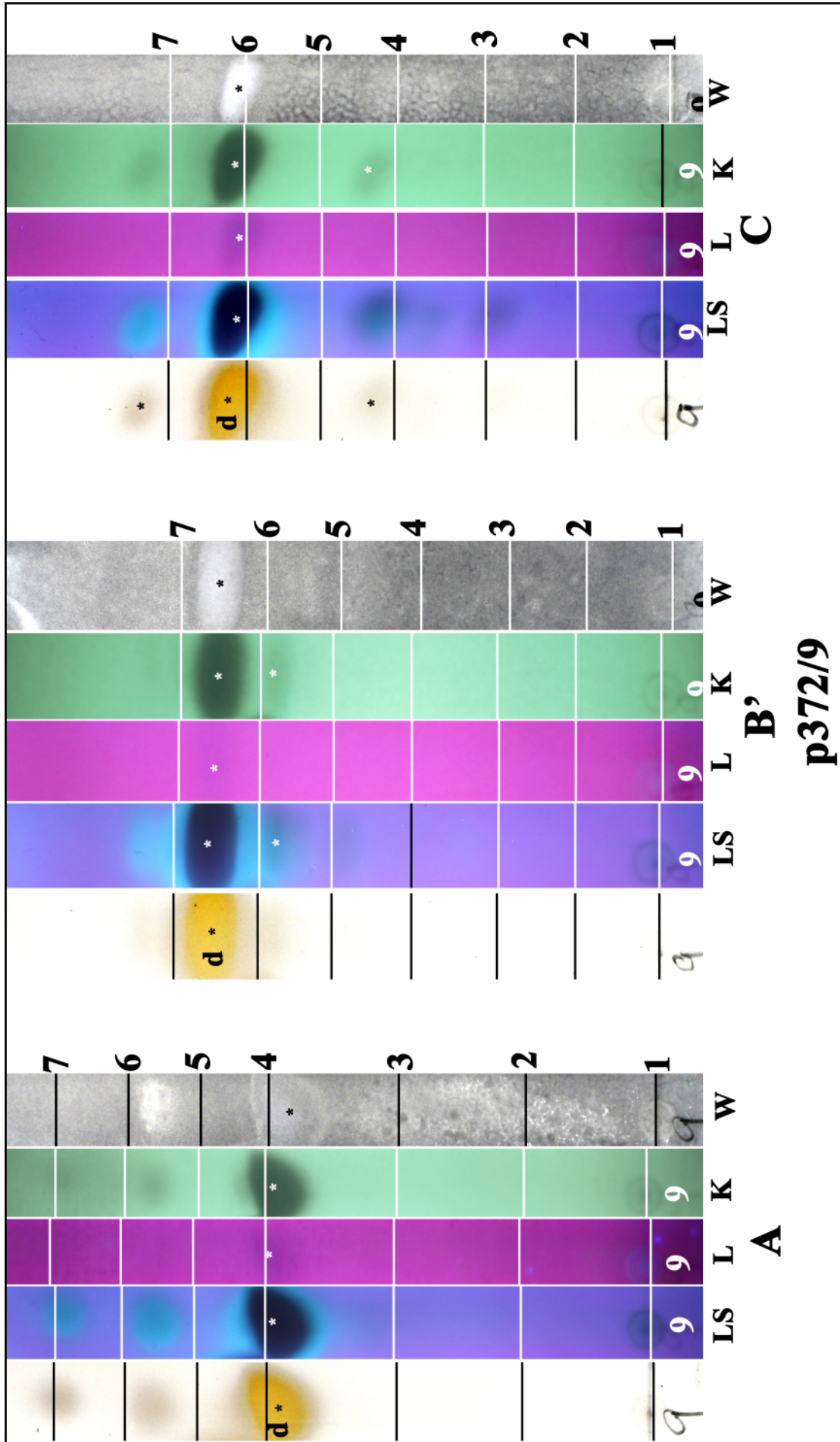
Purified lichen substance received from K. Kalb; origin S. Huneck.

**diploicin**



Purified lichen substance received from K. Kalb; origin S. Huneck.

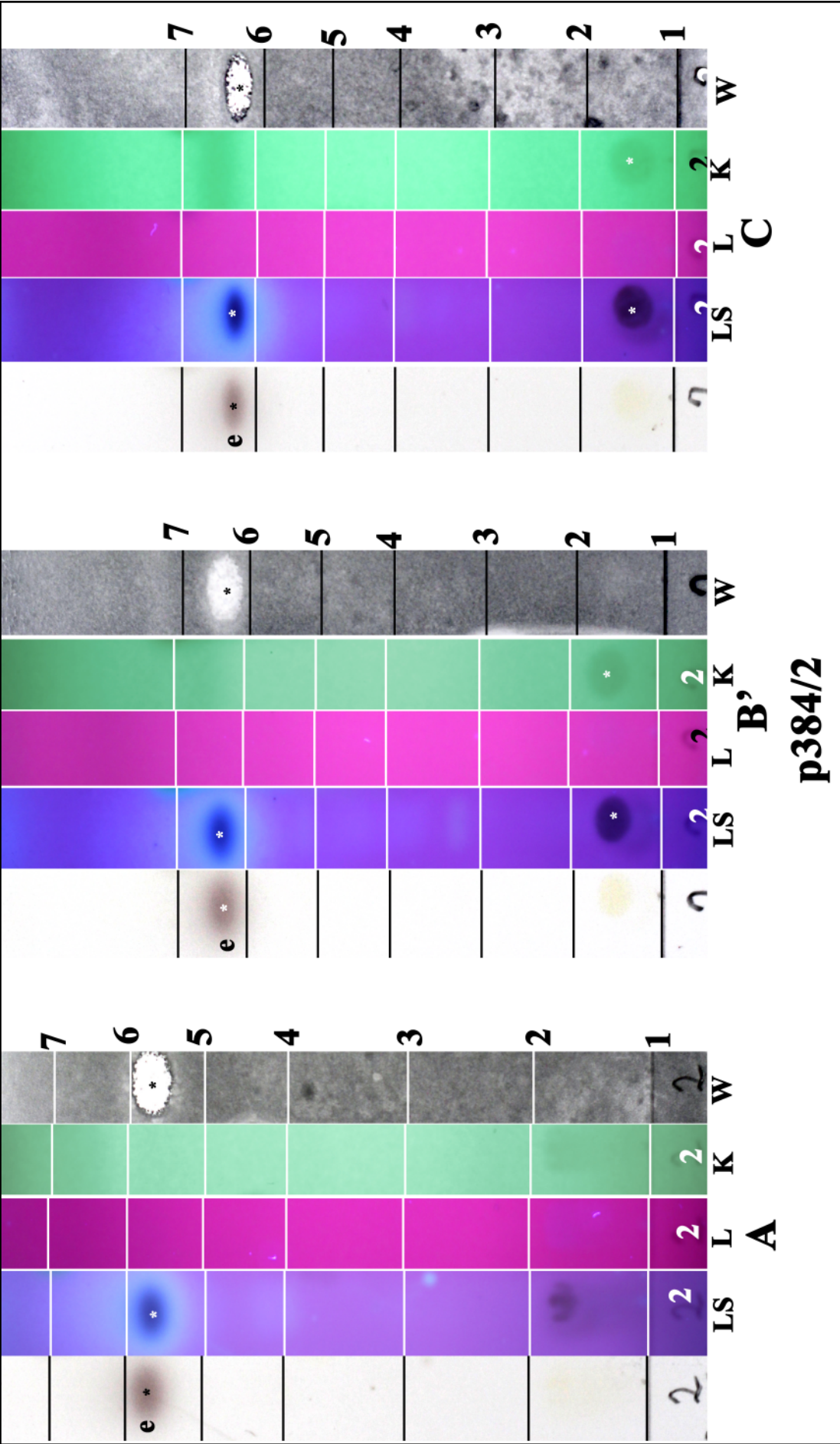
divaricatic acid



d: divaricatic acid

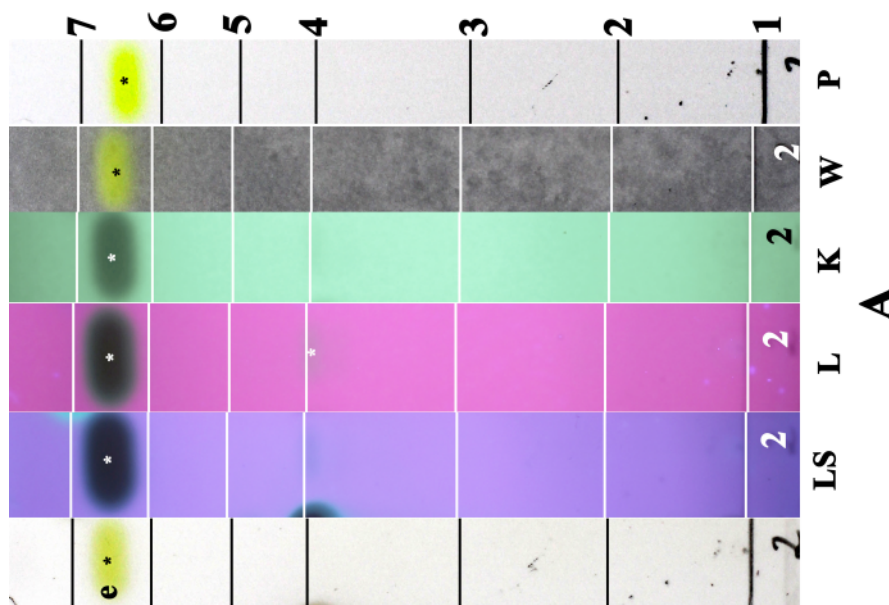
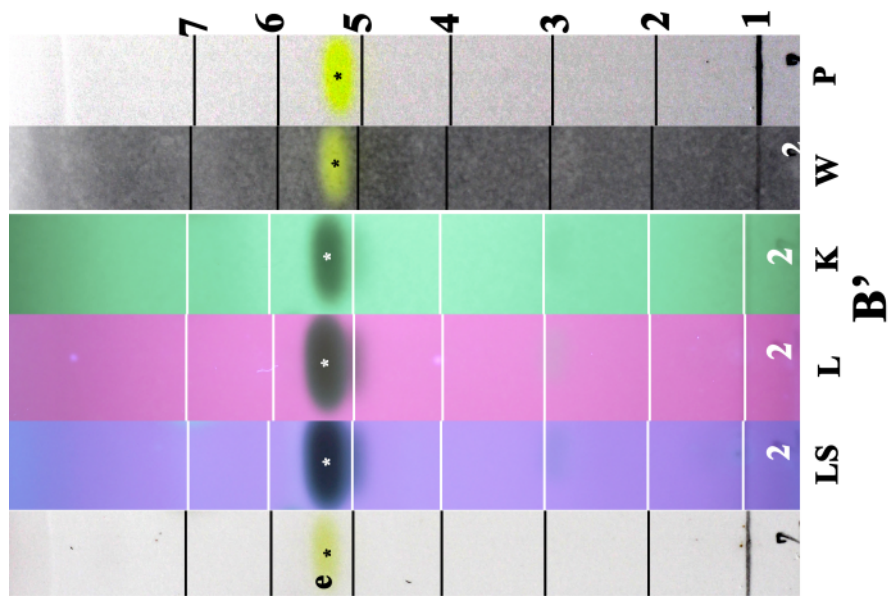
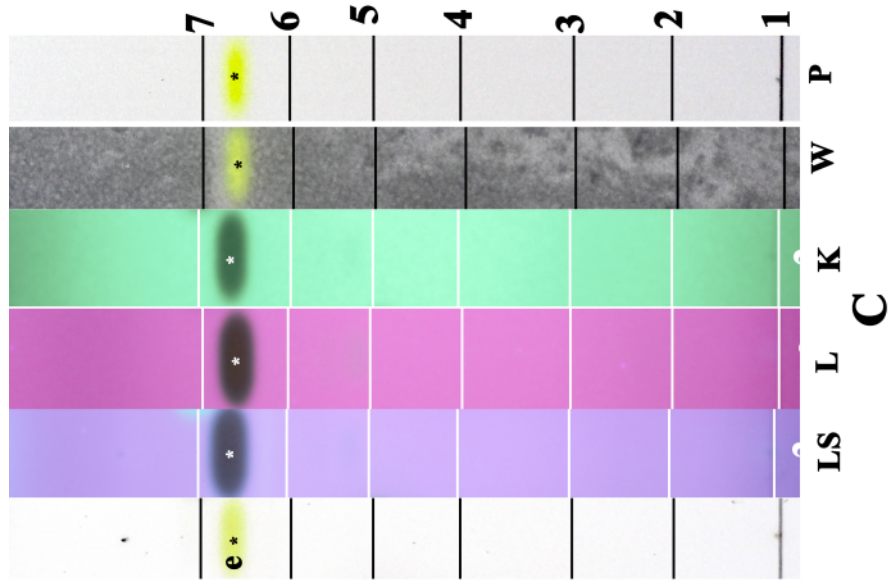
Purified lichen substance received from K. Kalb; origin S. Huneck.

ent-kauran-16 $\alpha$ -ol



Purified lichen substance received from K. Kalb; origin S. Huneck.

**epanorin**

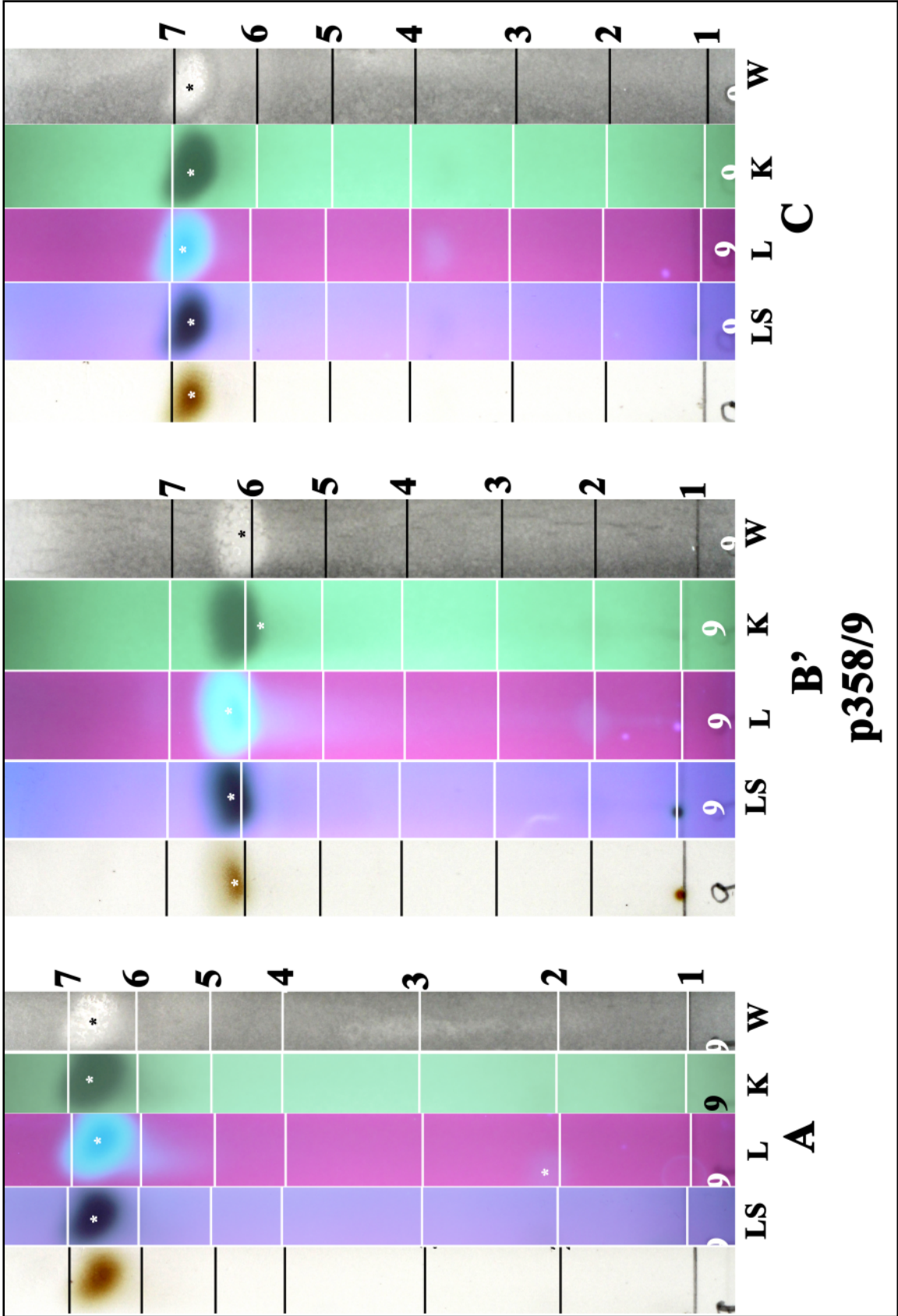


**p358/2**

**e: epanorin**

Purified lichen substance received from K. Kalb; origin S. Huneck.

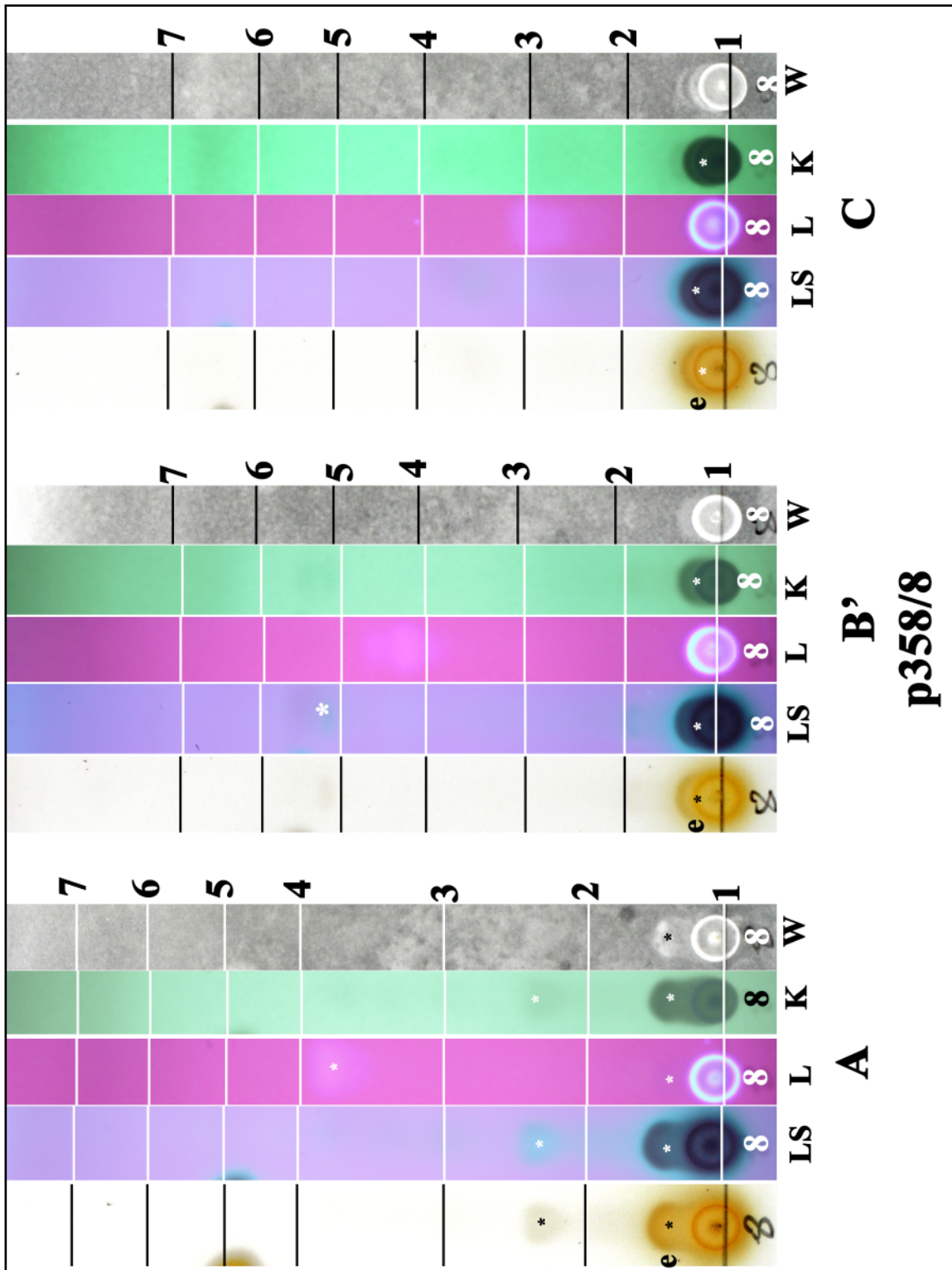
**eriodermin**



eriodermin

Purified lichen substance received from K. Kalb; origin S. Huneck.

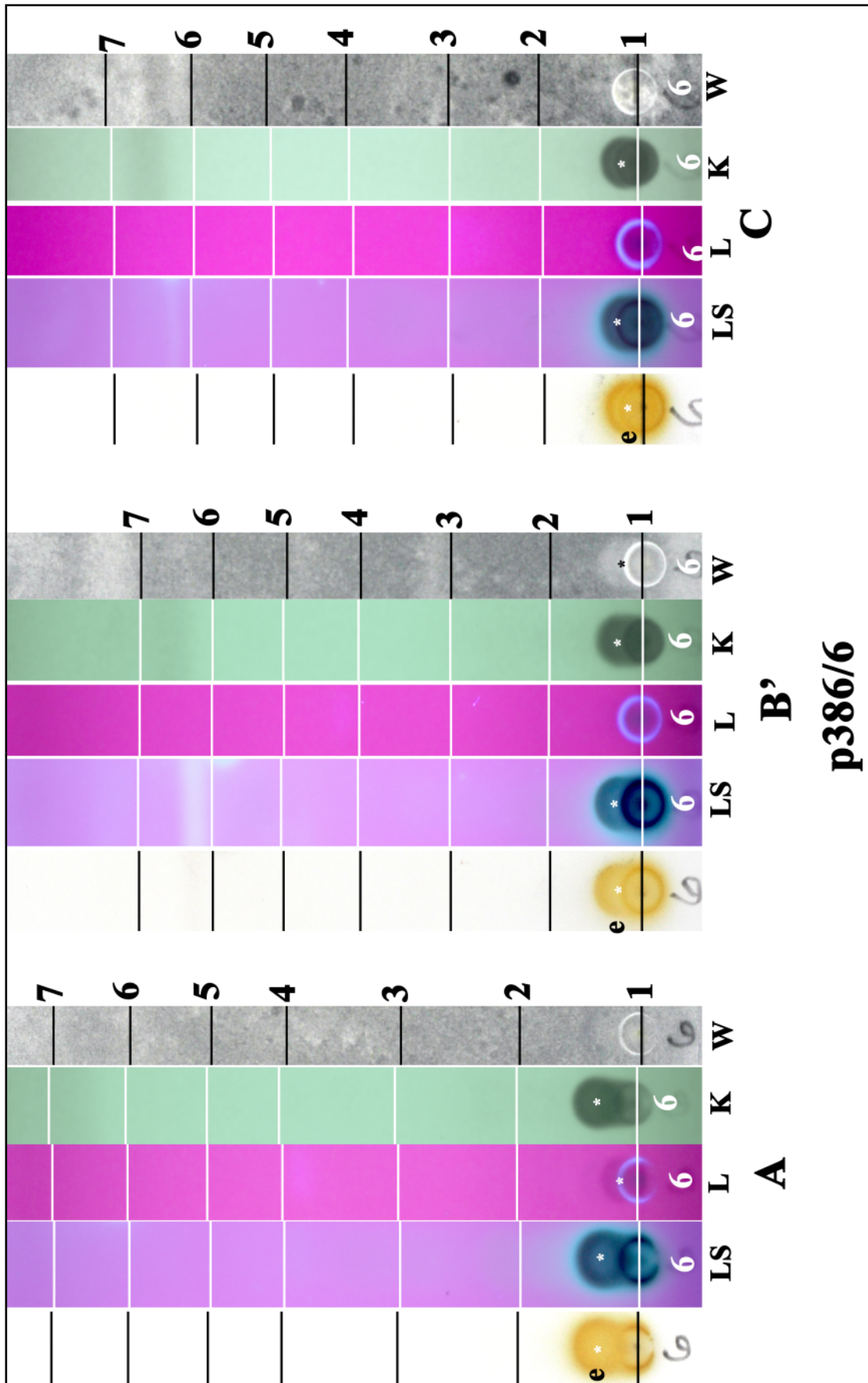
erythrin



e: erythrin

Purified lichen substance received from K. Kalb; origin S. Huneck.

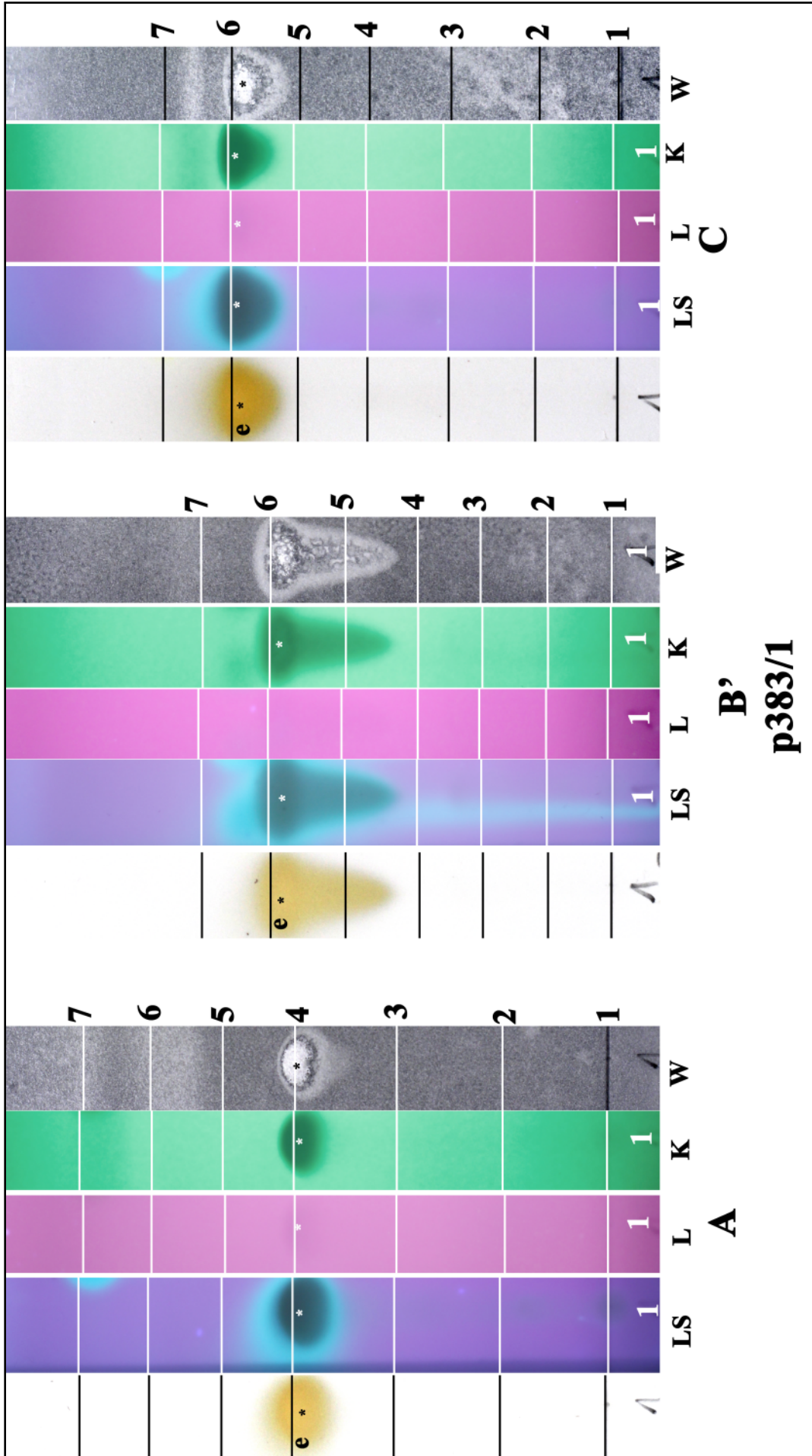
erythrin



e: erythrin

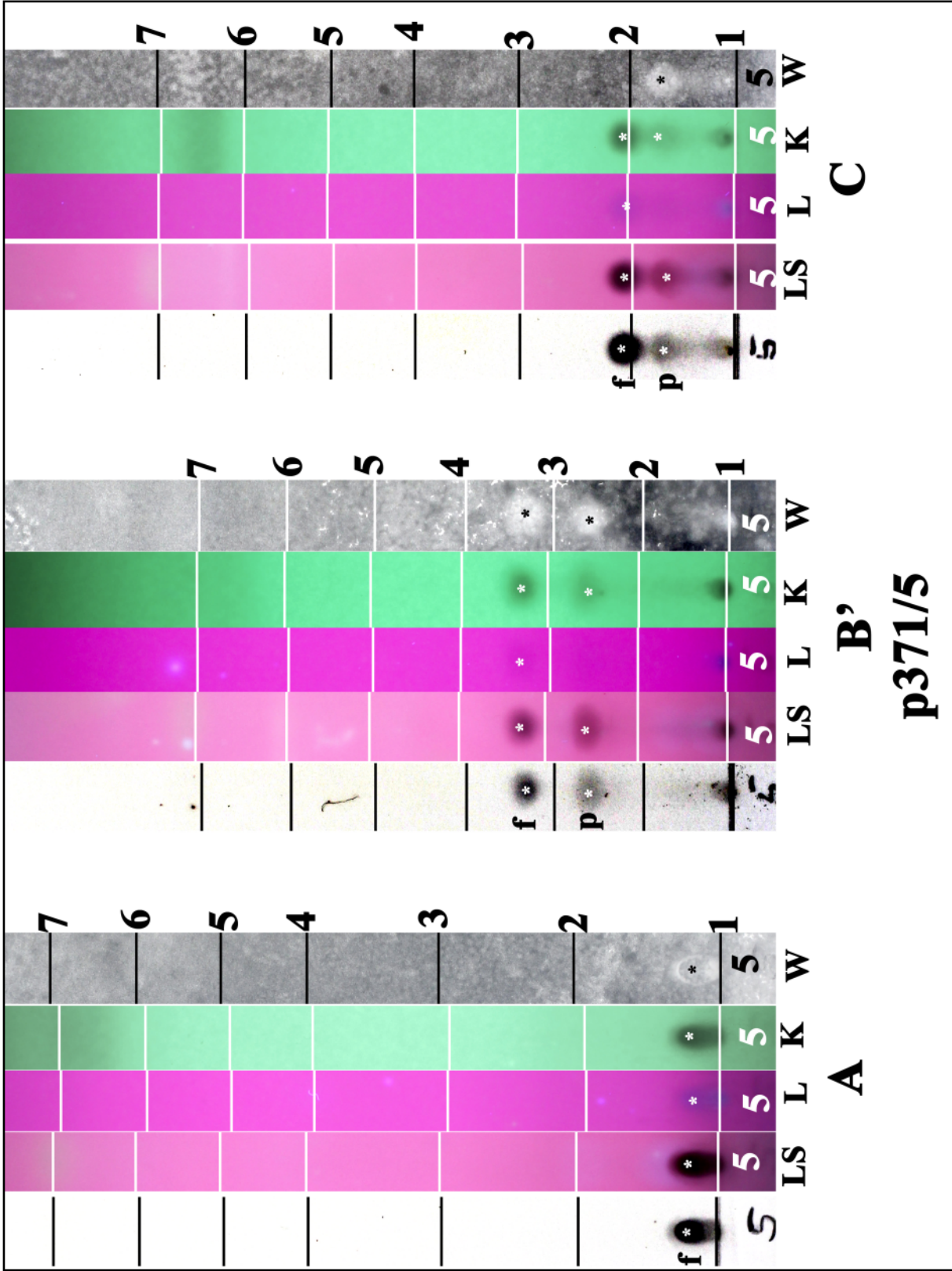
Purified lichen substance received from K. Kalb; origin S. Huneck.

evernic acid



Purified lichen substance received from K. Kalb; origin S. Huneck.

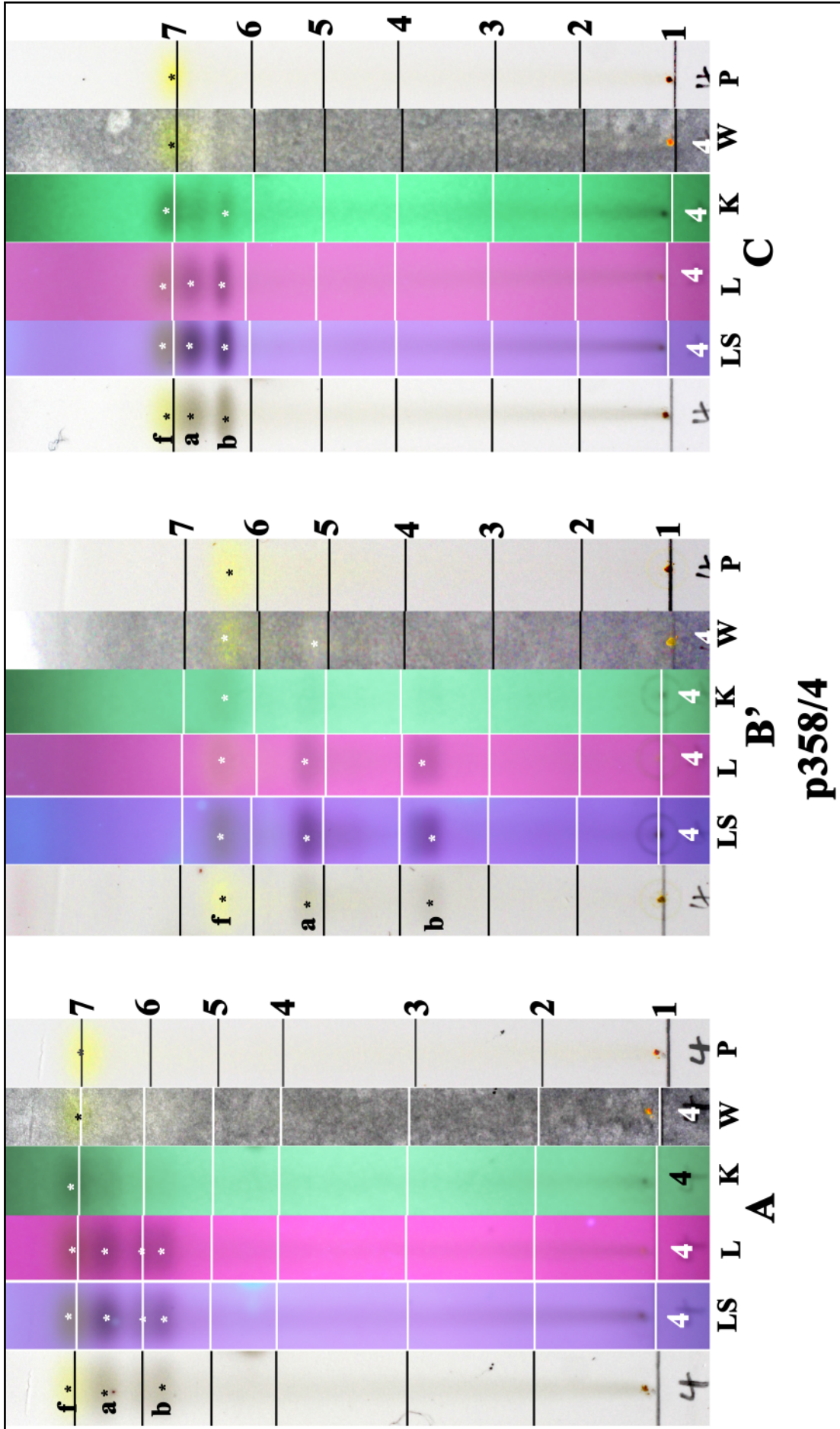
fumarprotocetraric acid



f: fumarprotocetraric acid, p: protocetraric acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

fragilin

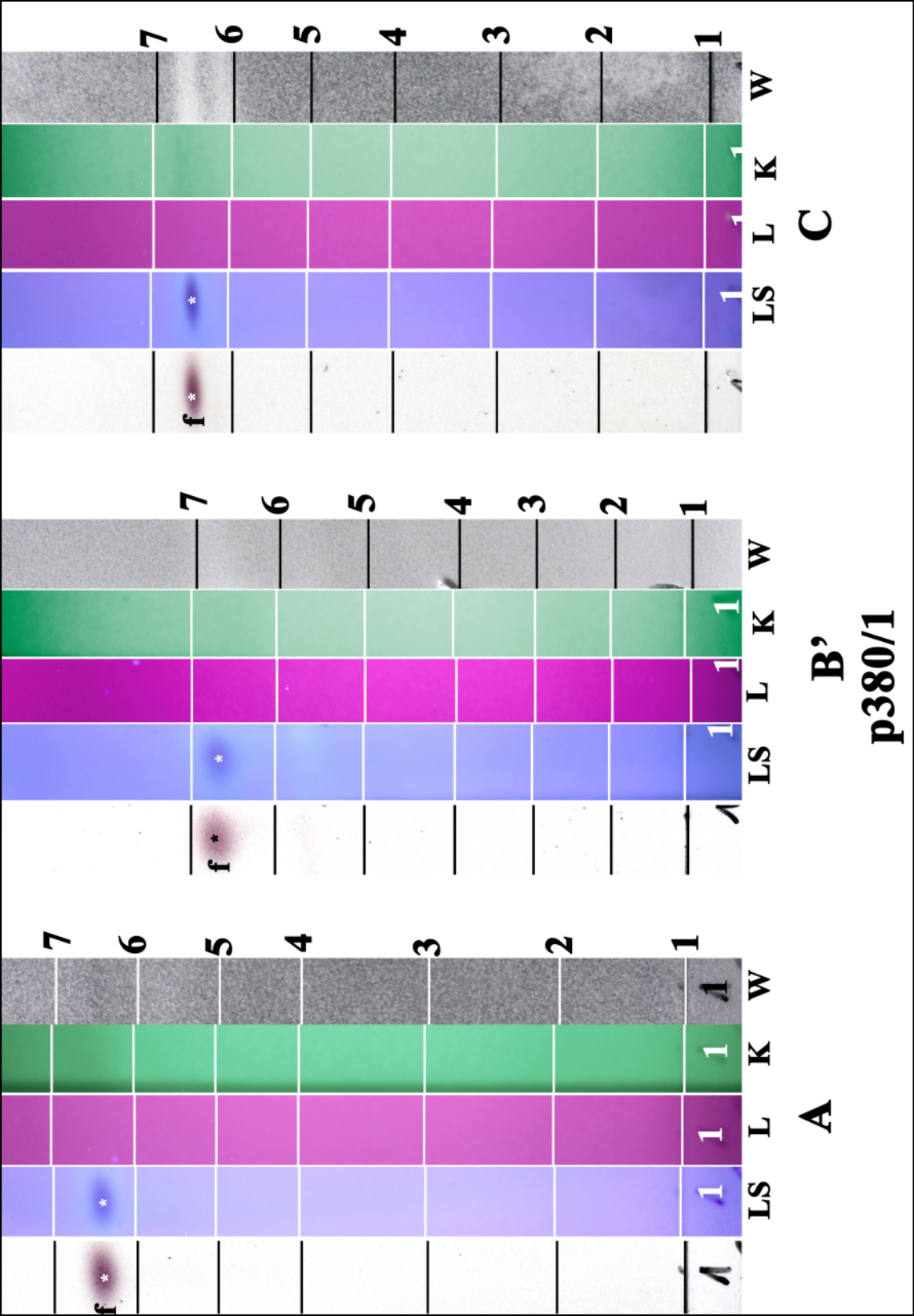


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f: fragilin, a,b: unknown

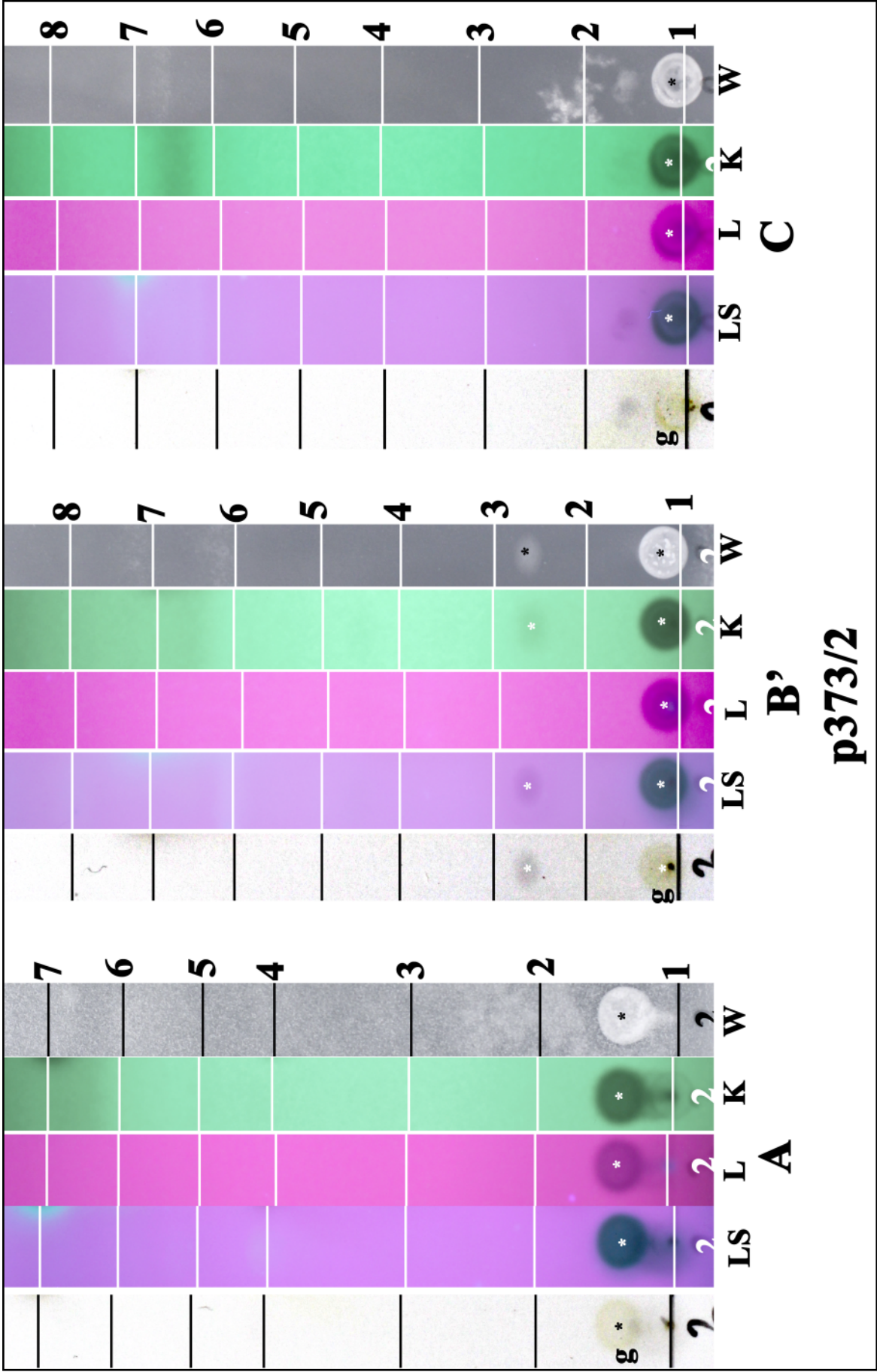
Purified lichen substance received from K. Kalb; origin S. Huneck.

friedelan-3β-ol



Purified lichen substance received from K. Kalb; origin S. Huneck.

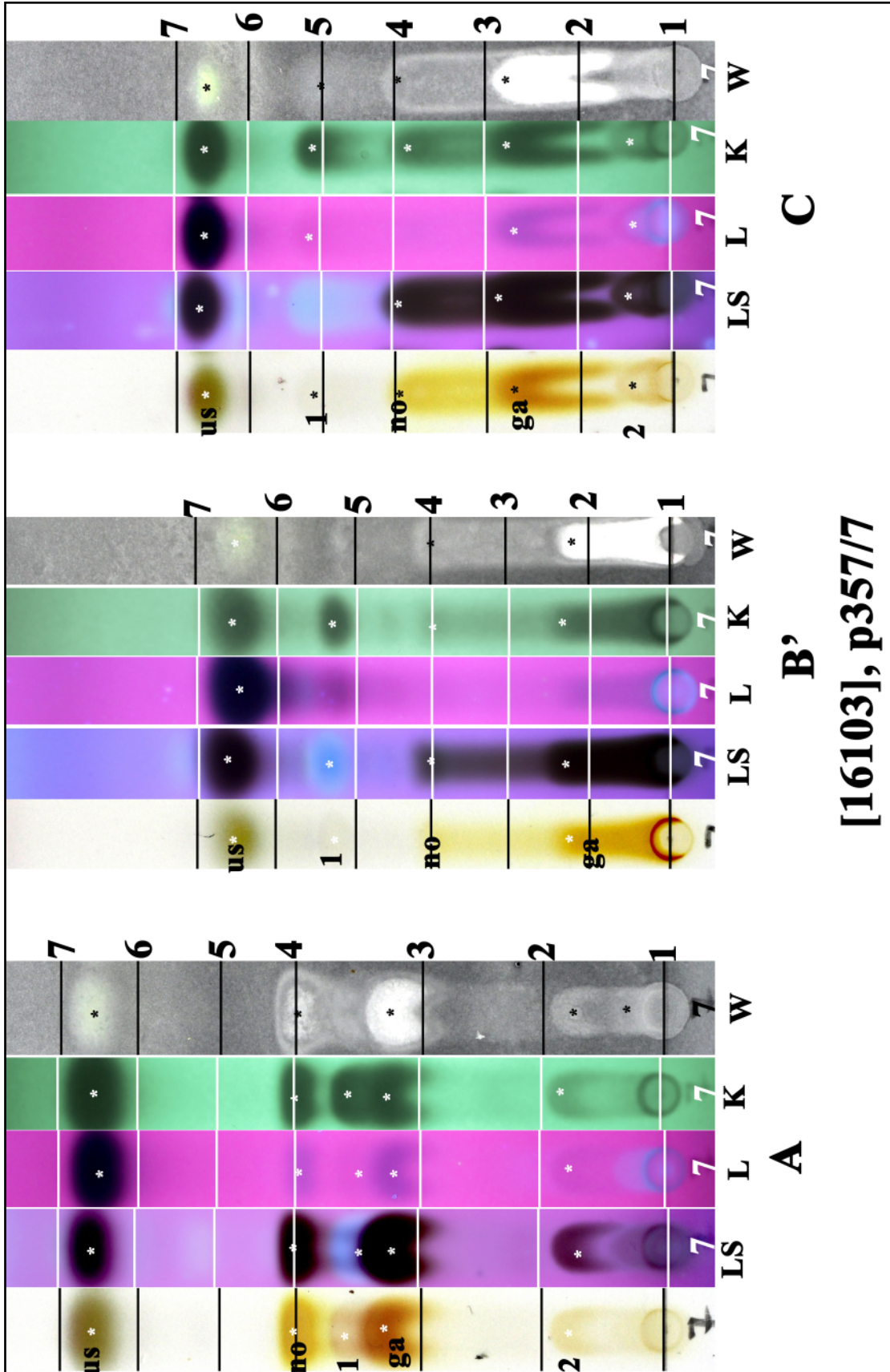
galapagin



g: galapagin

Purified lichen substance received from K. Kalb; origin S. Huneck.

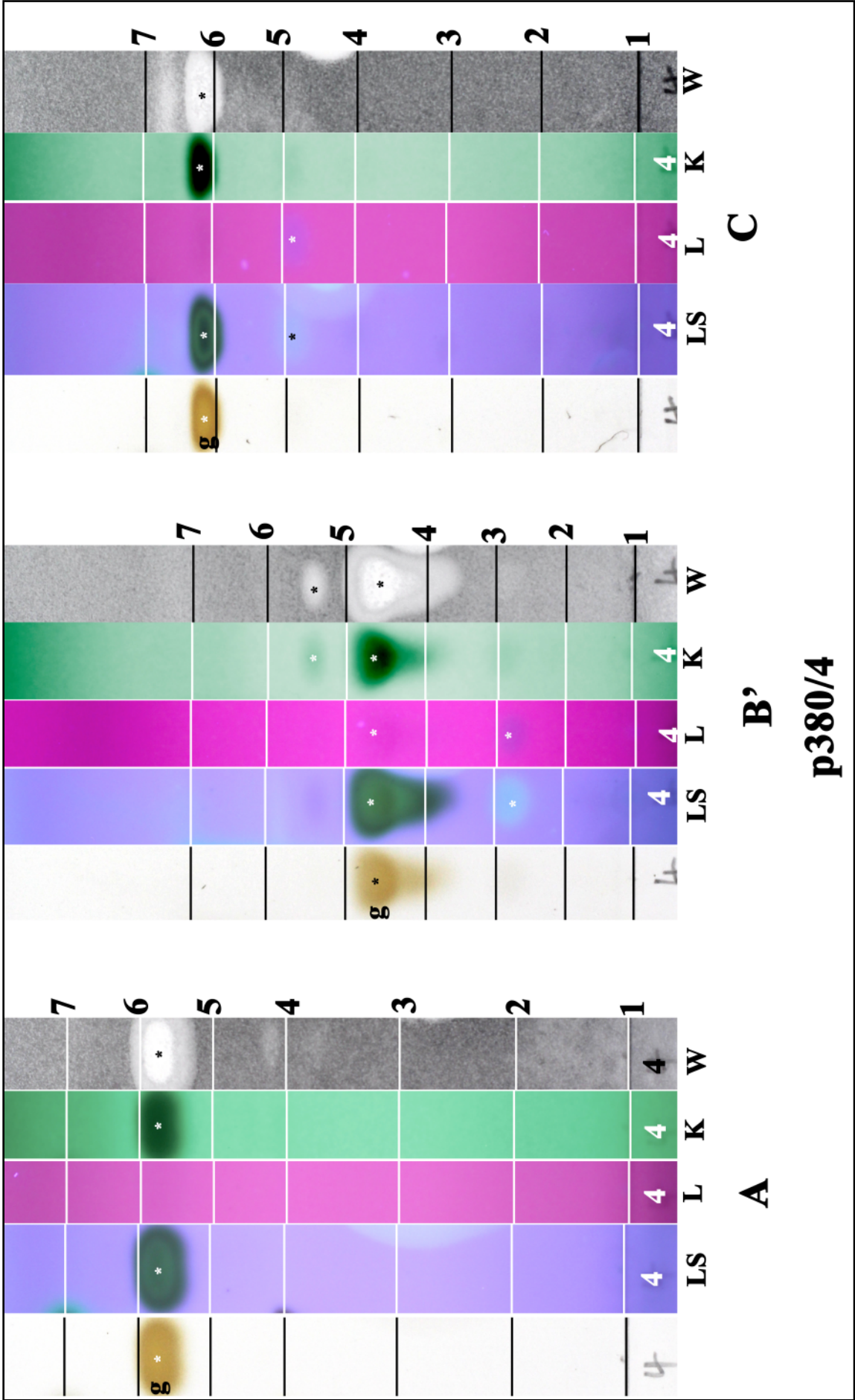
galbinic acid



us: usnic acid, no: norstictic acid, ga: galbinic acid, 2: salazinic acid, 1: unknown, conf. J.A. Elix

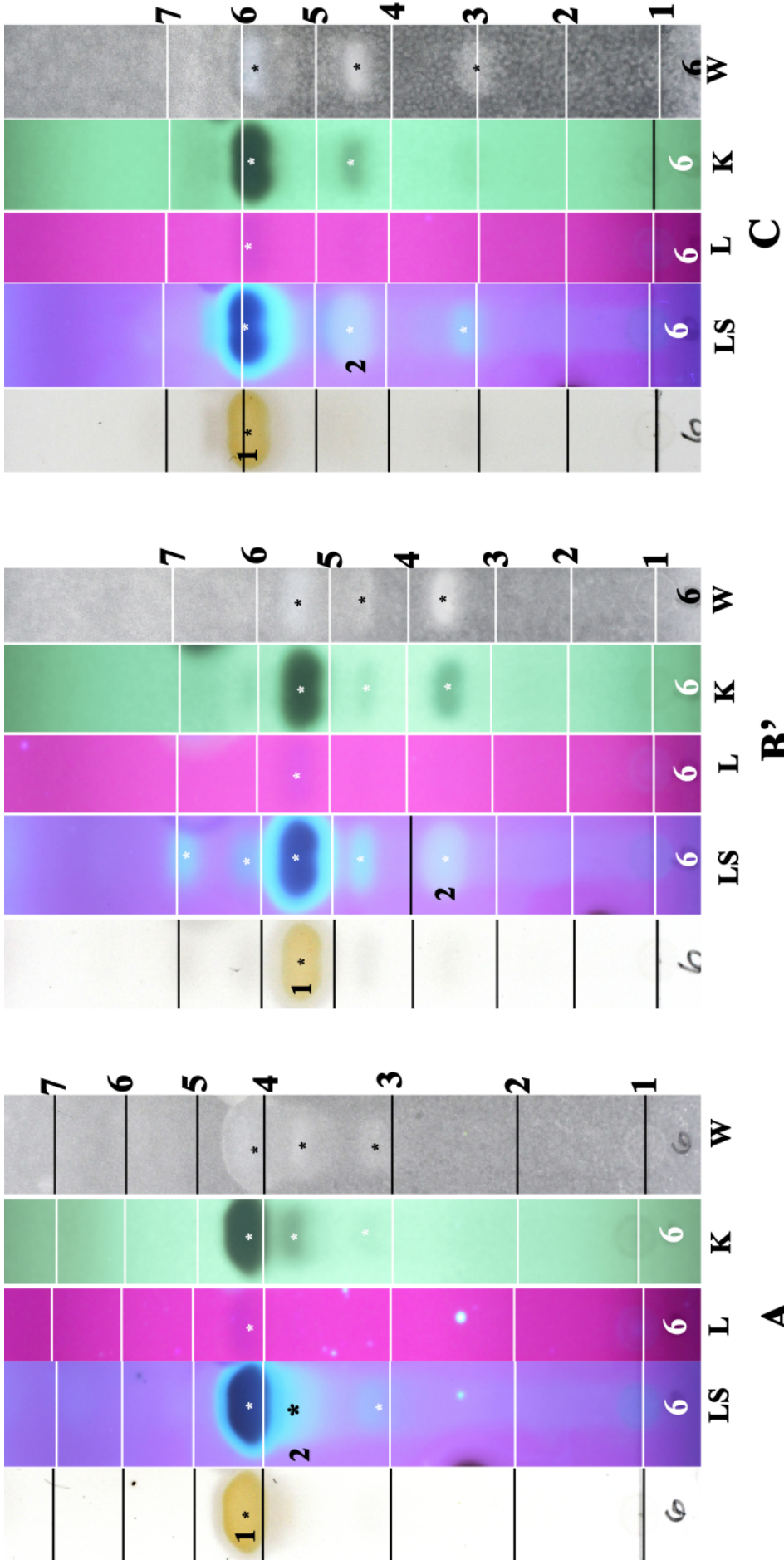
*Usnea dasaea* Stirton, [16103], Australia, New South Wales, north of Batemans Bay, Cullendulla Creek Nature Reserve (Mangrove), 35.70092° S, 150.19882° E, 3 m. Leg. F. Schumm & E. Stocker-Wörögötter, 10.11.2009, det. J.A. Elix.

gangaleoidin



Purified lichen substance received from K. Kalb; origin S. Huneck.

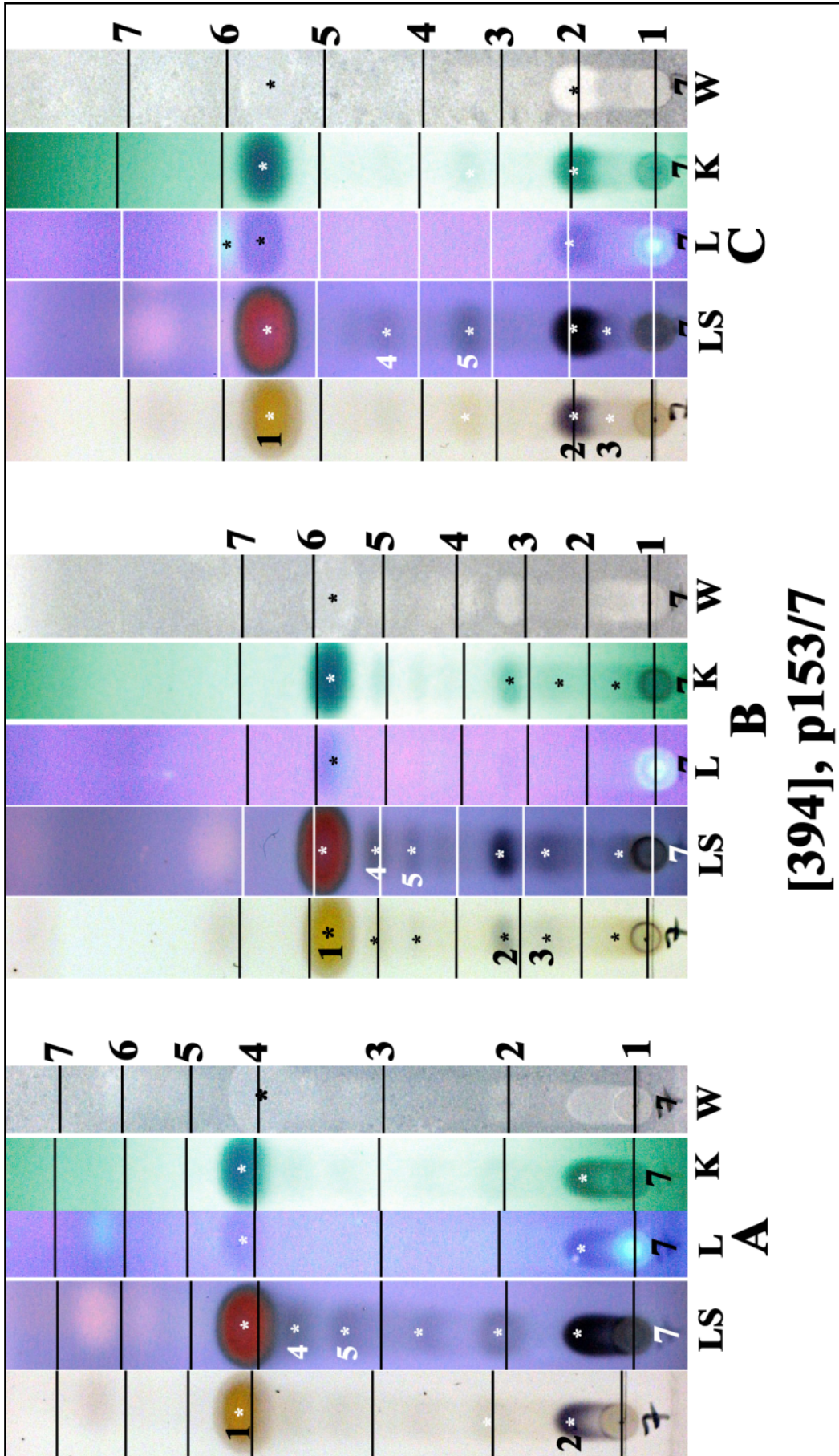
glomelliferic acid



1: glomelliferic acid, 2: glomellic acid

Purified lichen substance received from K. Kalb; origin Zopf.

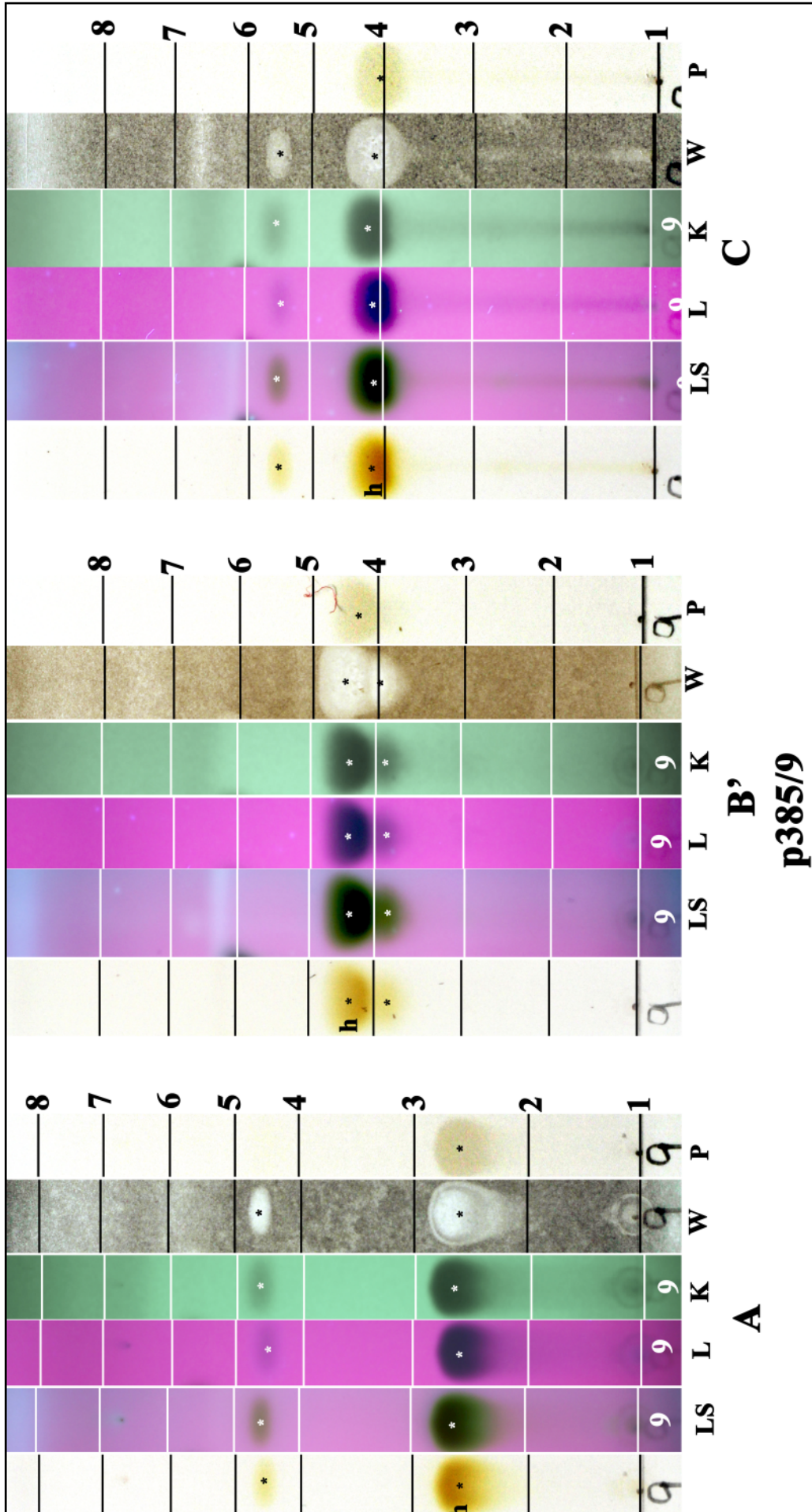
grayanic acid



1: grayanic acid, 2: fumarprotocetraric acid, 3: protocetraric acid,  
4: congrayanic acid, 5: 4-O-demethylgrayanic acid, conf. J.A. Elix

*Cladonia grayi* Meril. ex Sandst. s. str., [394], Germany, Baden-Württemberg, Schwarzwald, Freudenstadt, TK 7516. Leg. F. Schumm, 4.05.1967.

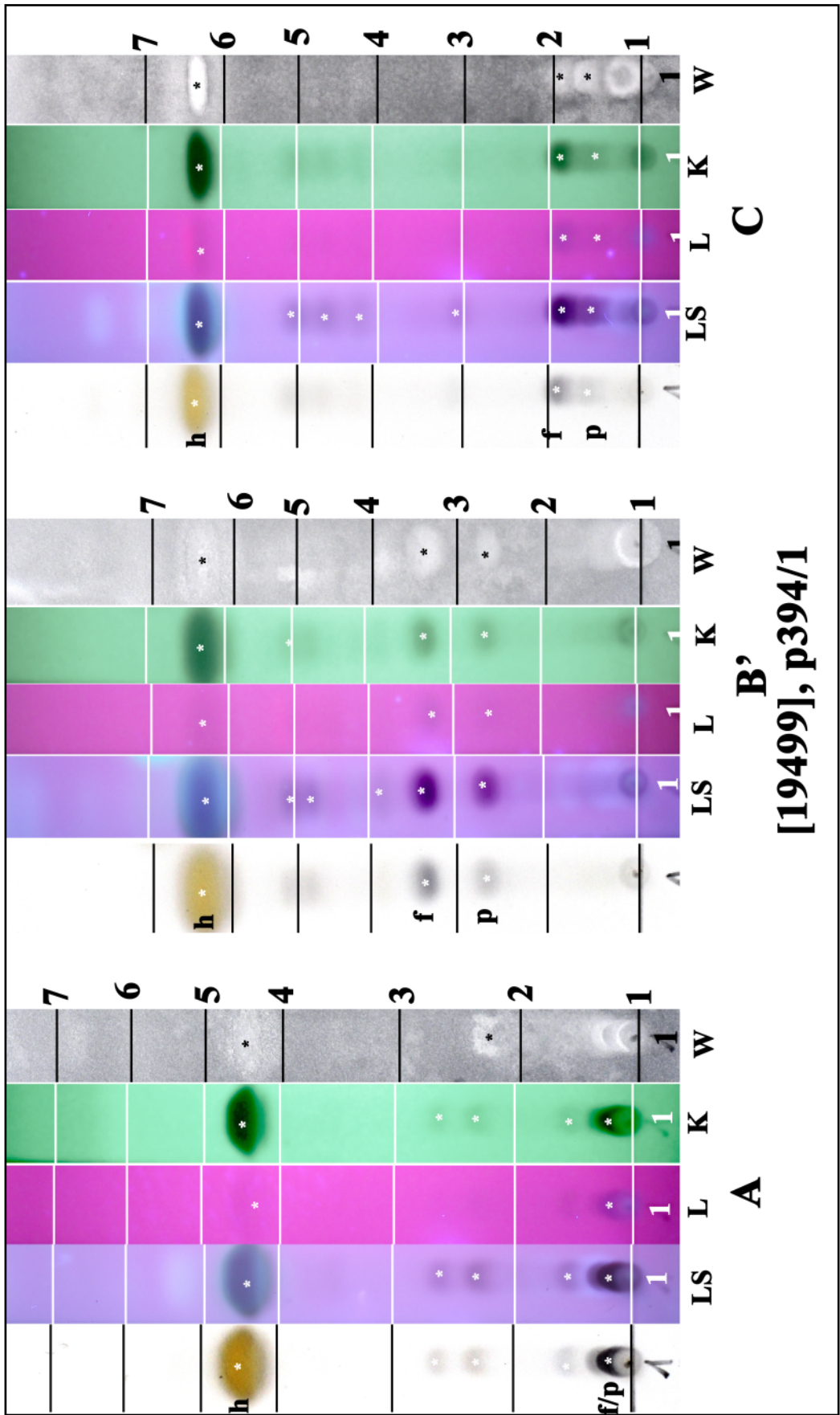
haemathamnolic acid



h: haemathamnolic acid

Purified lichen substance received from K. Kalb; origin Dr. Letcher.

homosekikaic acid

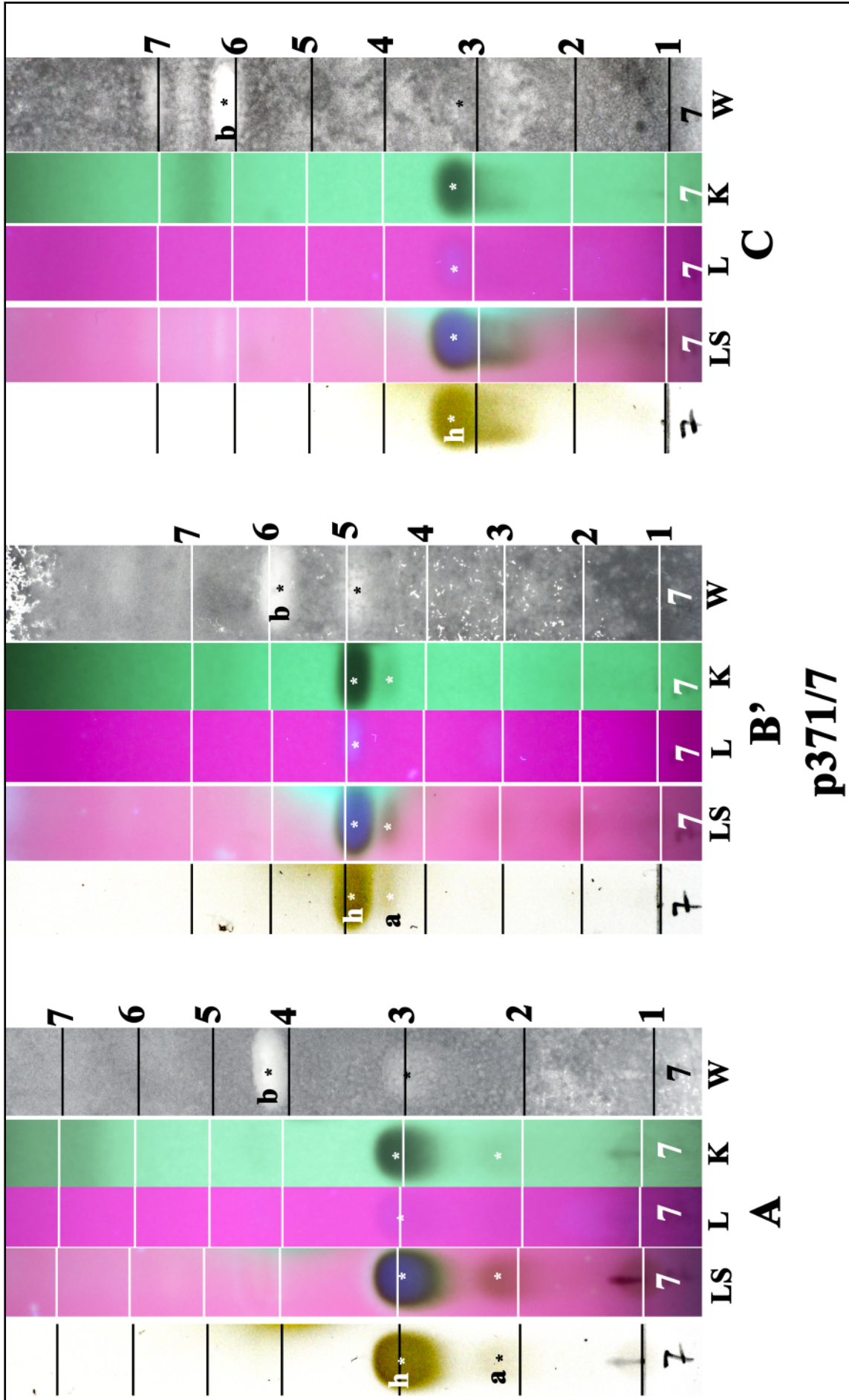


h: homosekikaic acid, f: fumarprotocetraric acid, p: protocetraric acid

*Cladonia rei* Schaer., [19499], Germany, Hessen, Amöneburg bei Marburg, sonnige Basaltblöcke in einer Hangwiese kurz vor dem Ortseingang, 50.7896° N, 8.91995° E, 324 m. Leg. et det. F. Schumm, 01.08.2016.



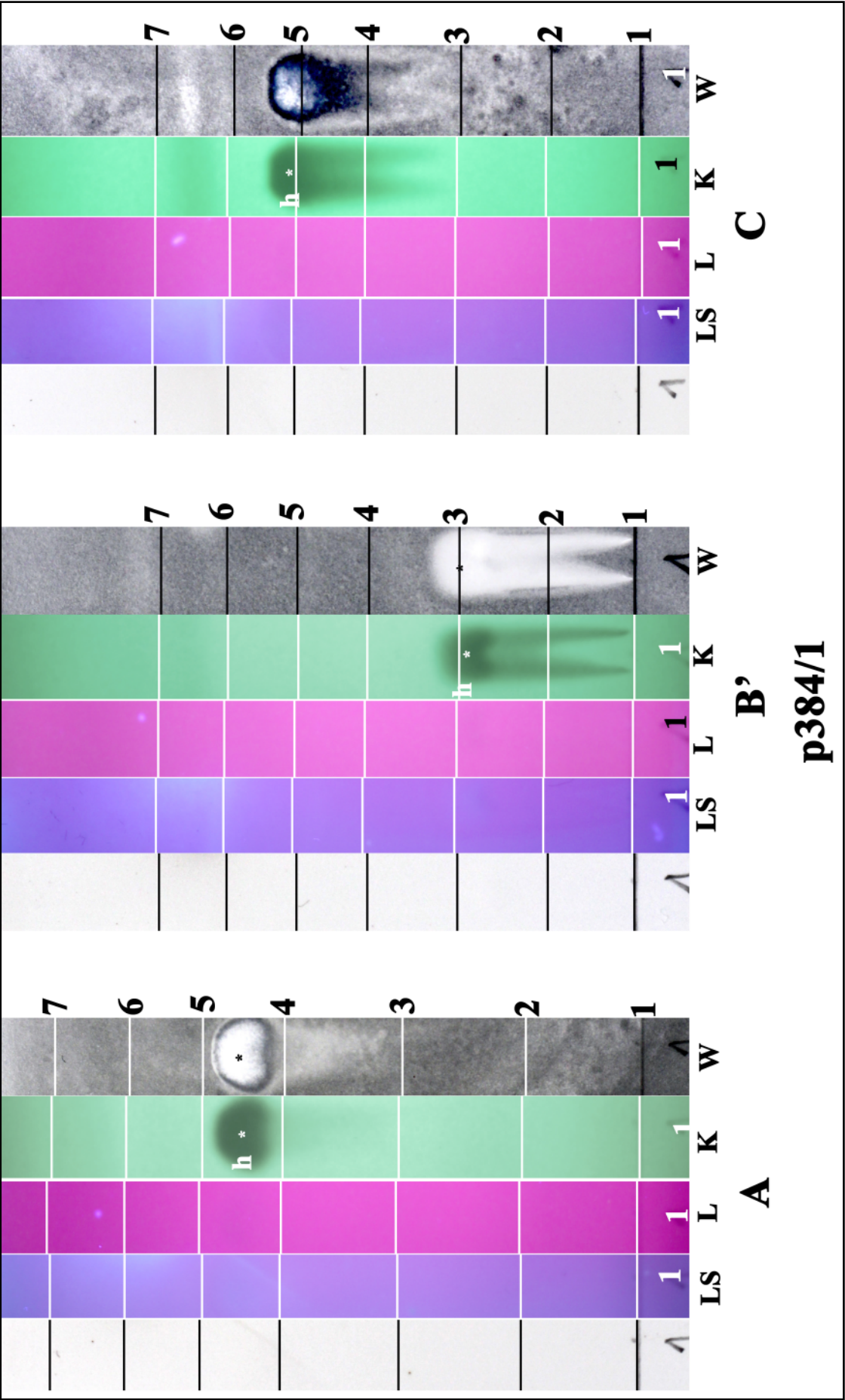
hypoprotocetraric acid



h: hypoprotocetraric acid, a,b: unknown

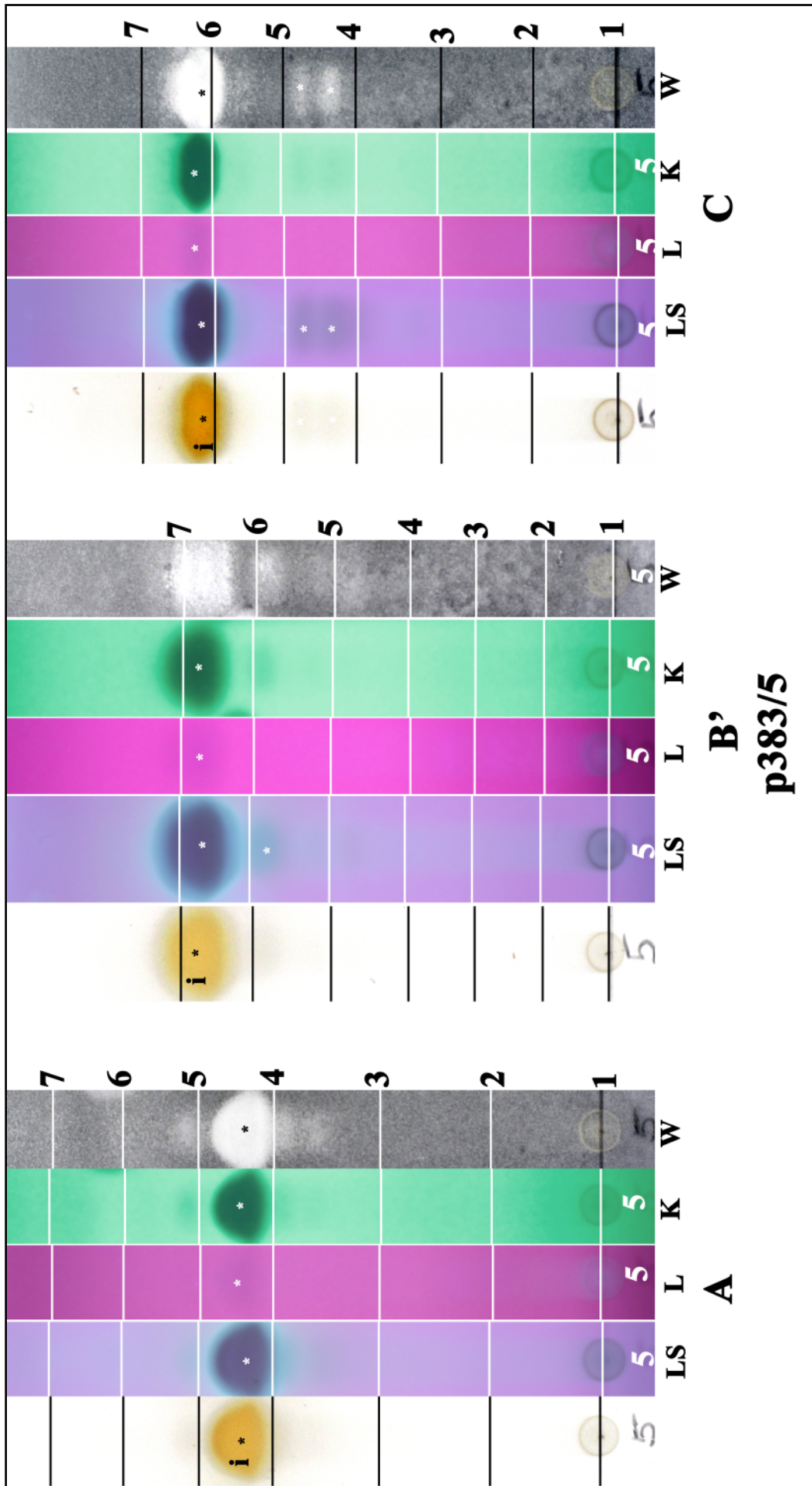
Purified lichen substance received from K. Kalb; origin S. Huneck.

**hypothallin**



Purified lichen substance received from K. Kalb; origin S. Huneck.

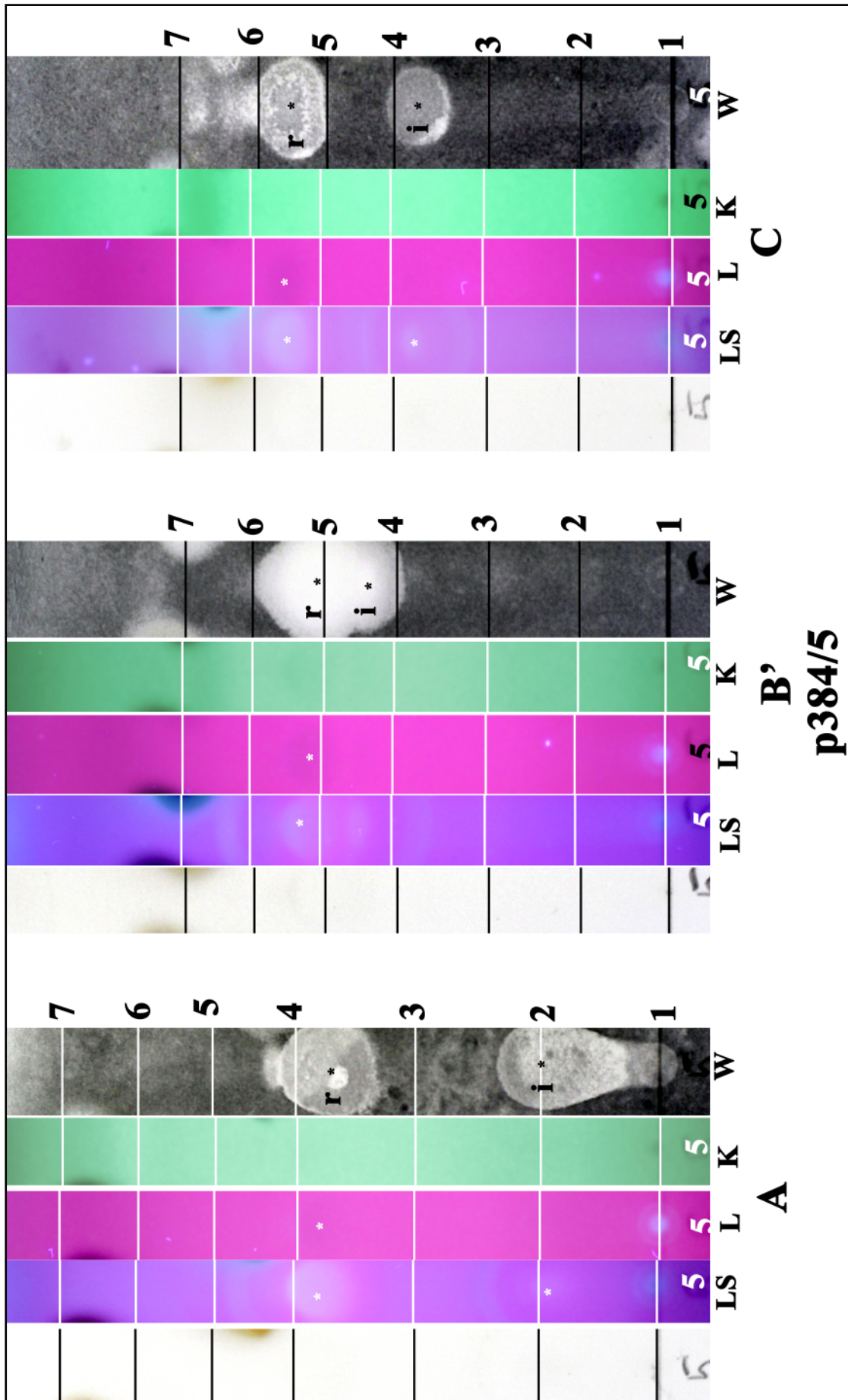
imbricatic acid



i: imbricatic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

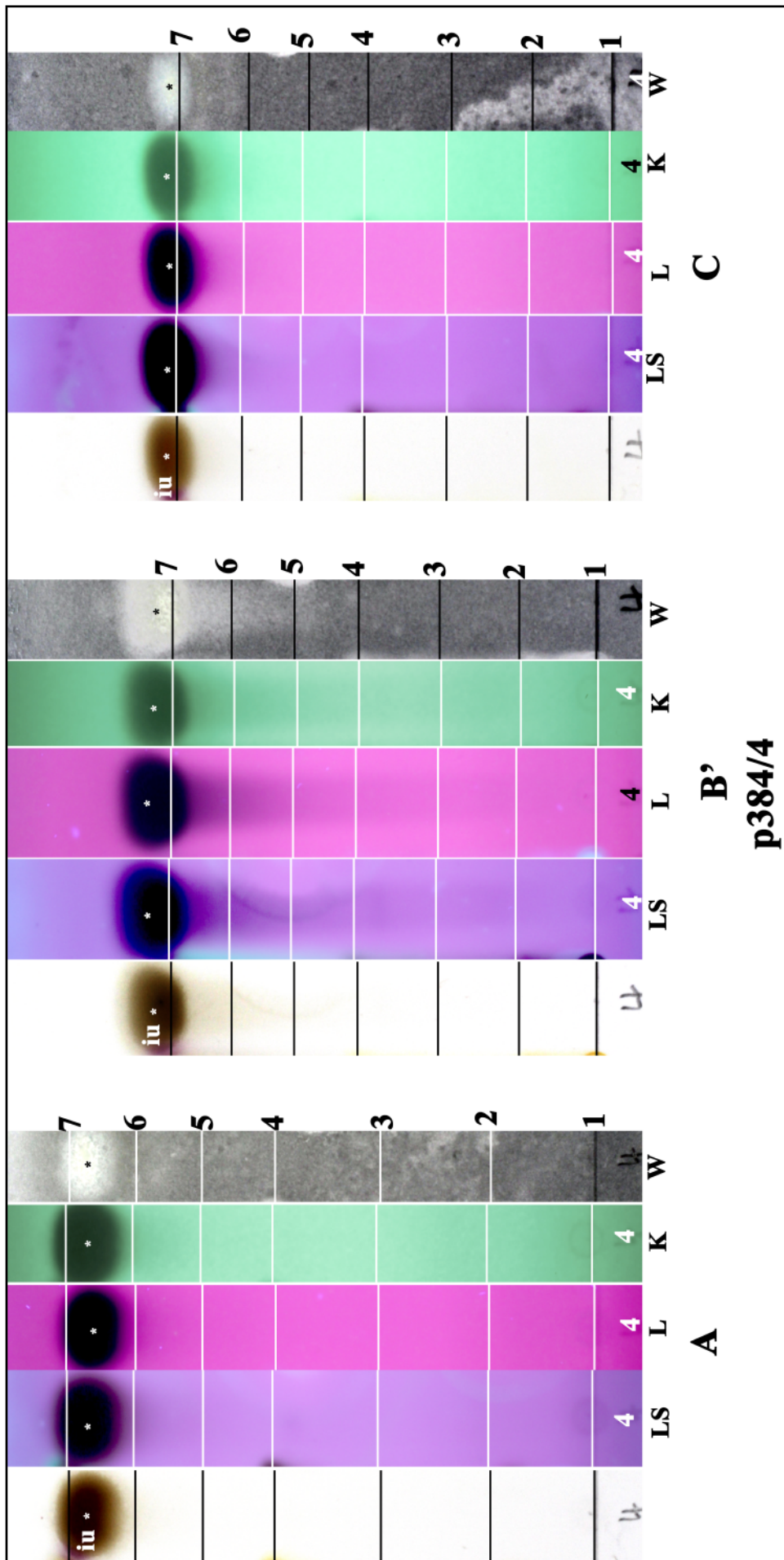
isorangiformic acid



i: isorangiformic acid, r: rangiformic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

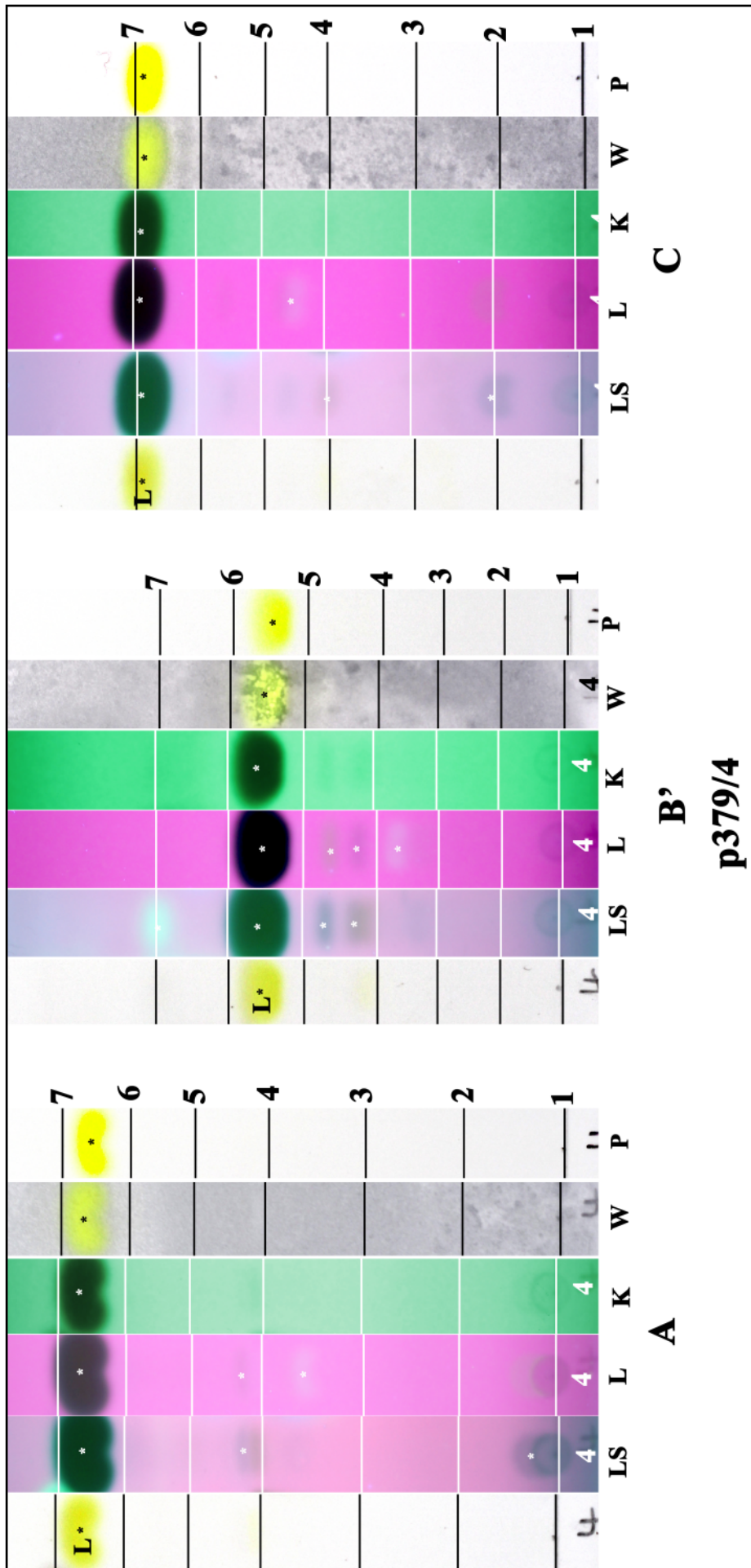
**isousnic acid**



**iu: isousnic acid**

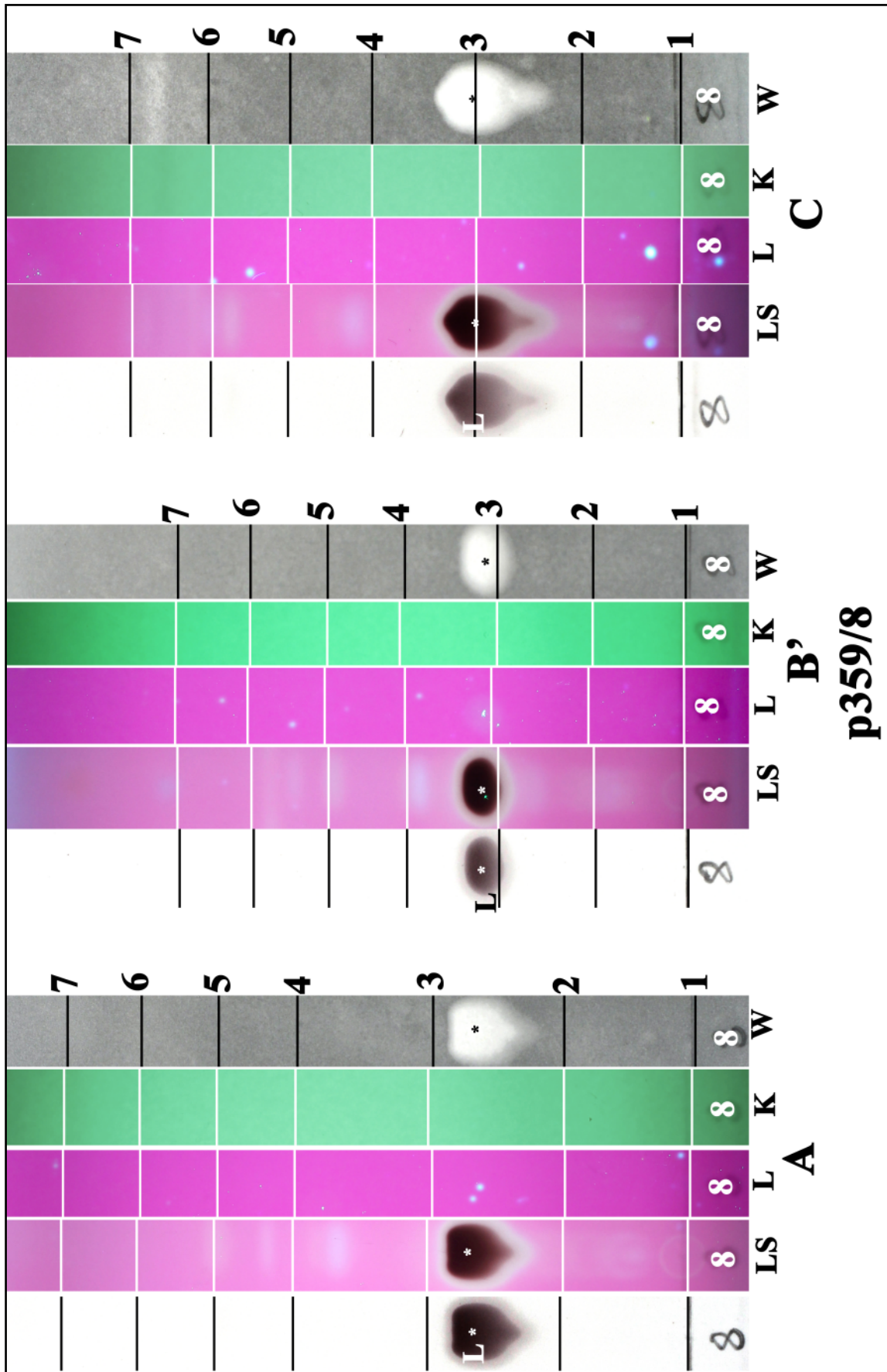
Purified lichen substance received from K. Kalb; origin S. Huneck.

leprapinic acid



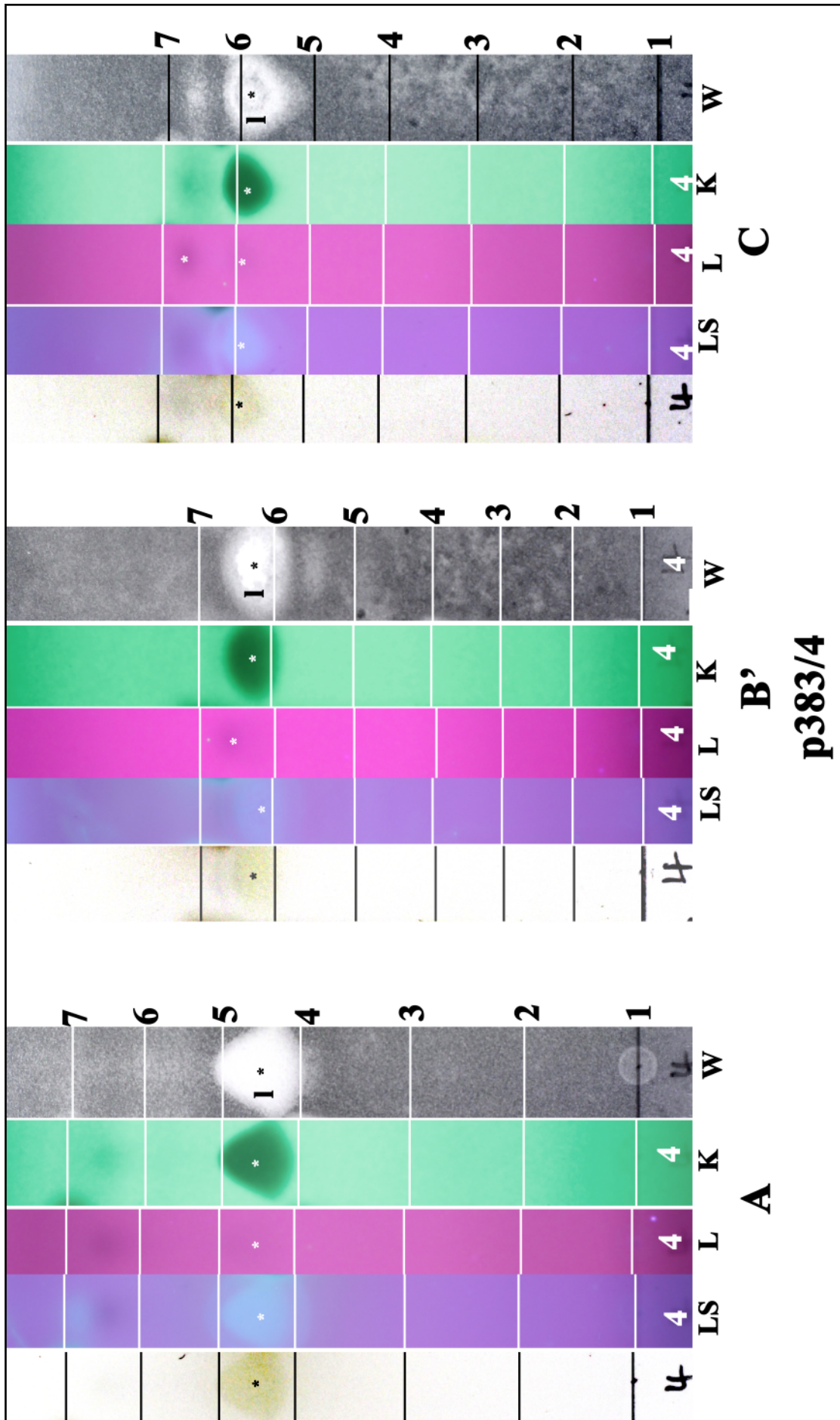
Purified lichen substance received from K. Kalb; origin S. Huneck.

leucotylin



Purified lichen substance received from K. Kalb; origin S. Huneck.

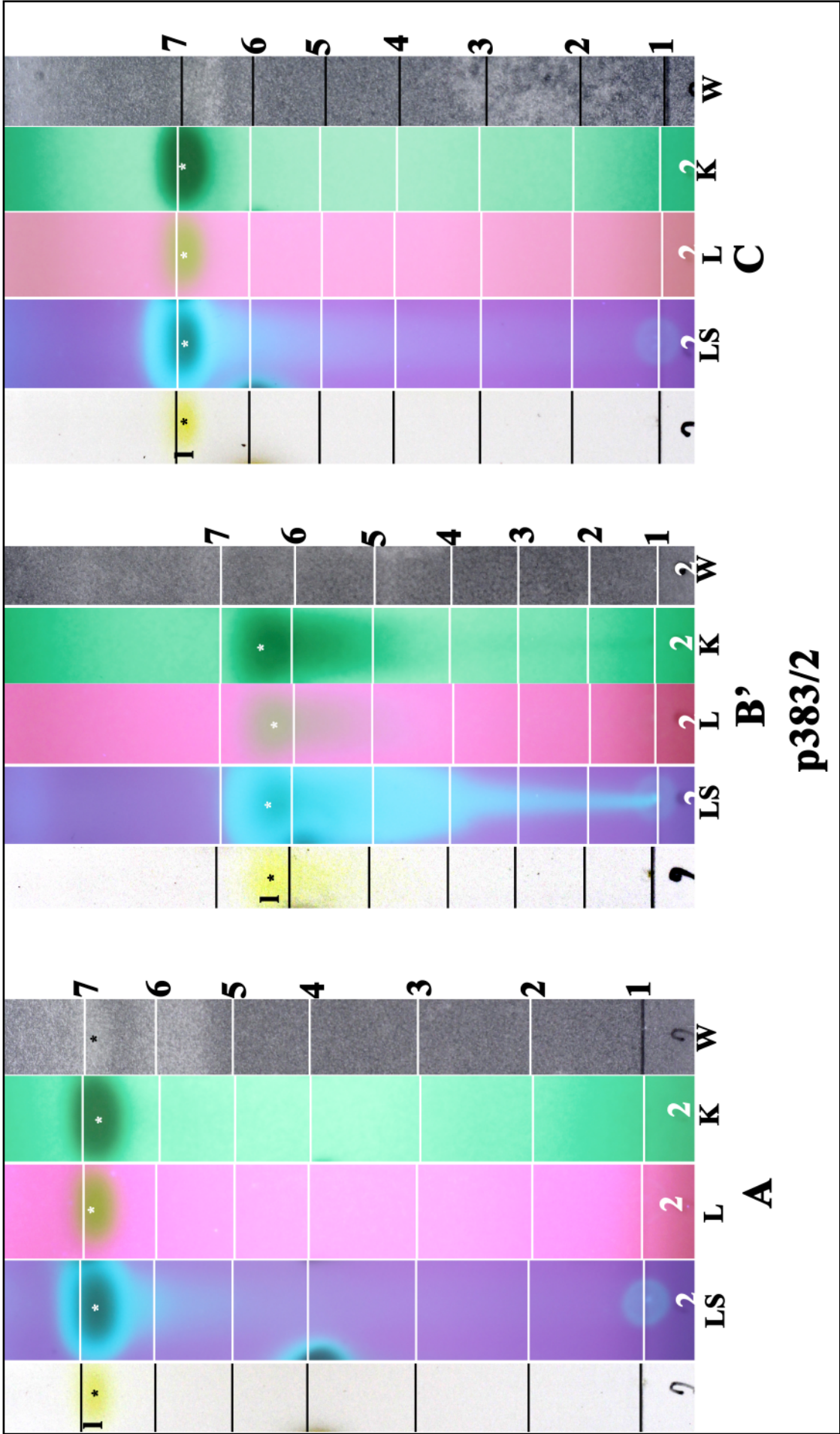
**(-)-lichesterinic acid**



**I: (-)-lichesterinic acid**

Purified lichen substance received from K. Kalb; origin S. Huneck.

lichexanthone

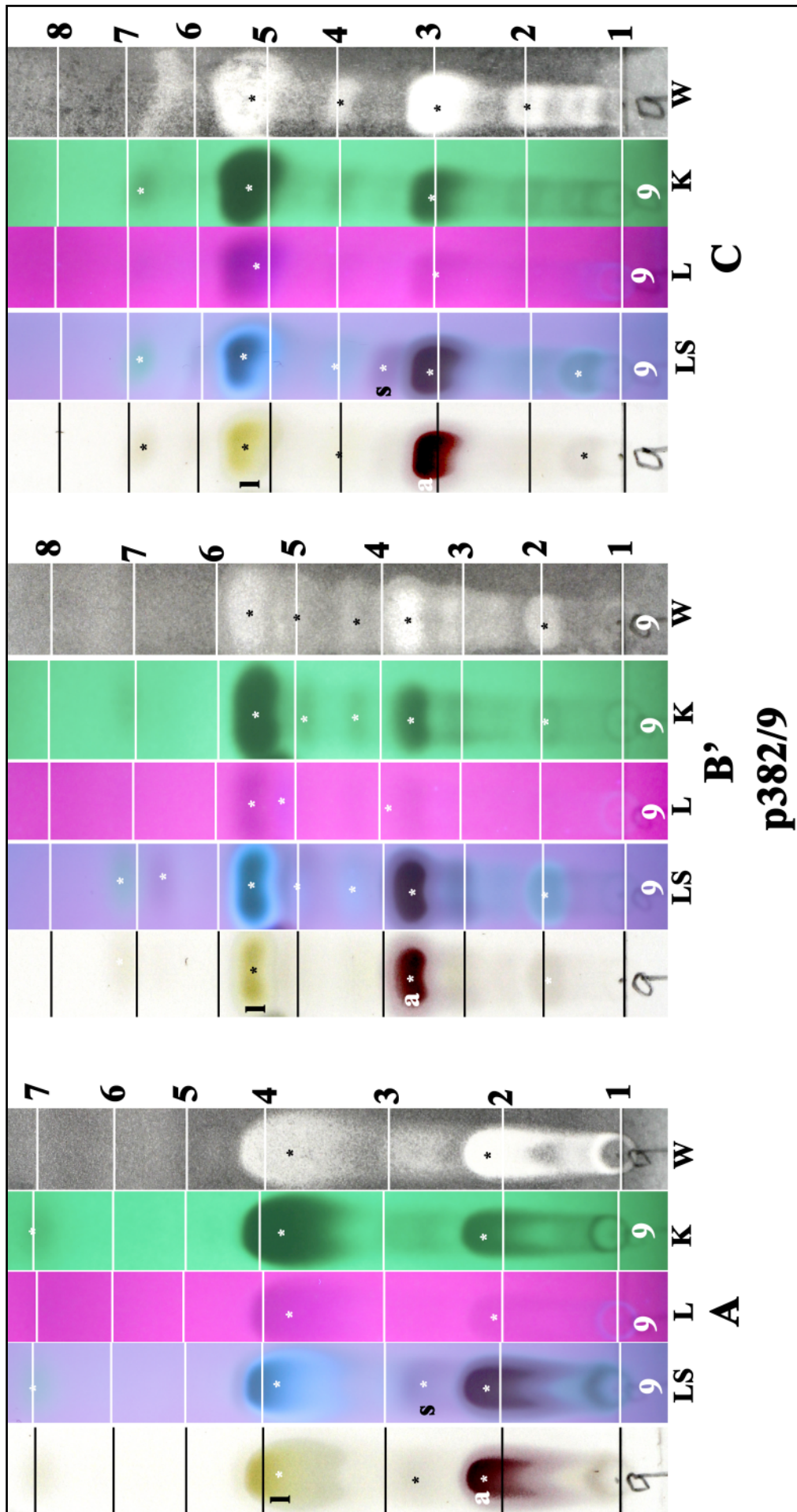


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I: lichexanthone

Purified lichen substance received from K. Kalb; origin S. Huneck.

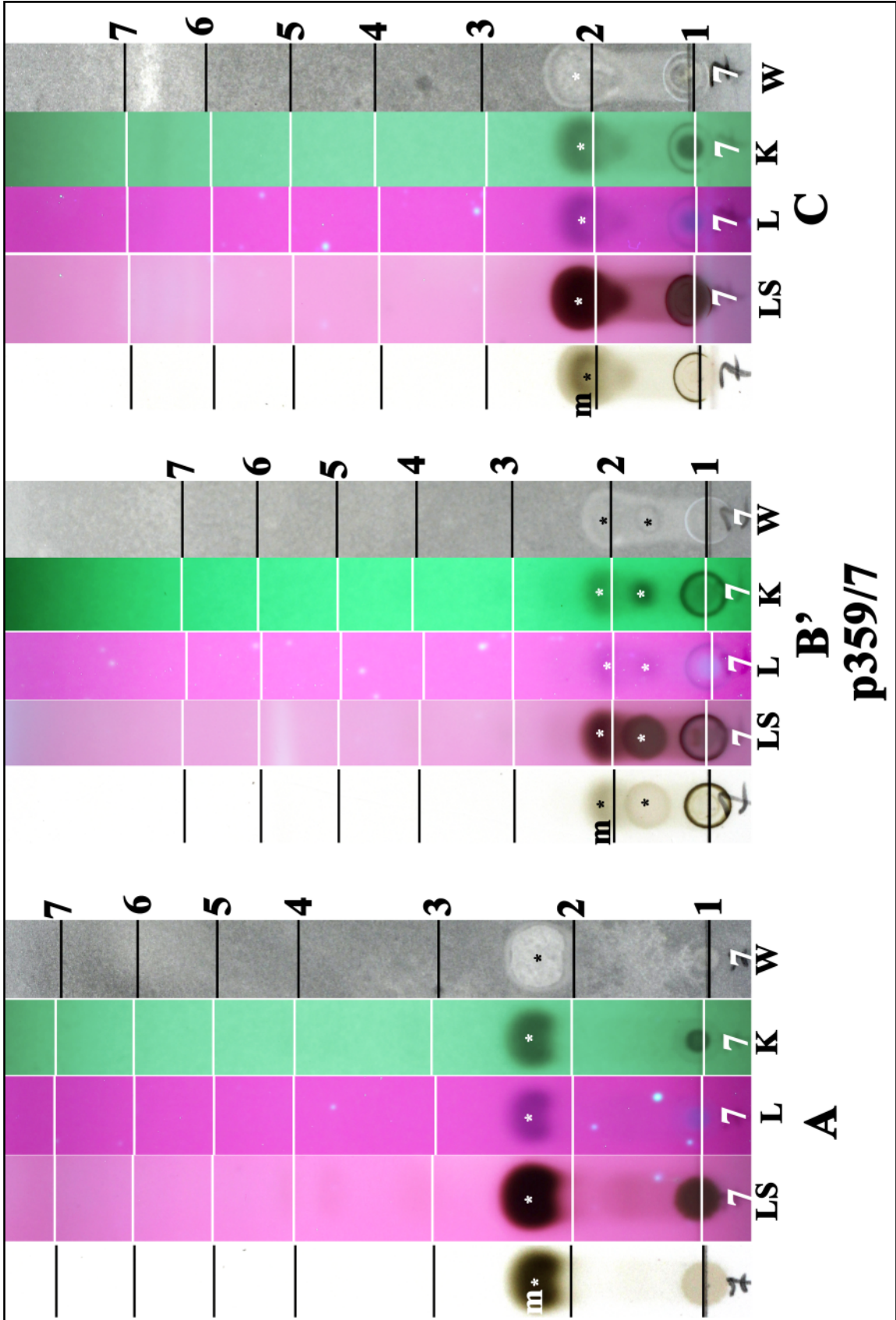
lobaric acid



l: lobaric acid, s: sublobaric acid, a:?

Purified lichen substance received from K. Kalb; origin S. Huneck.

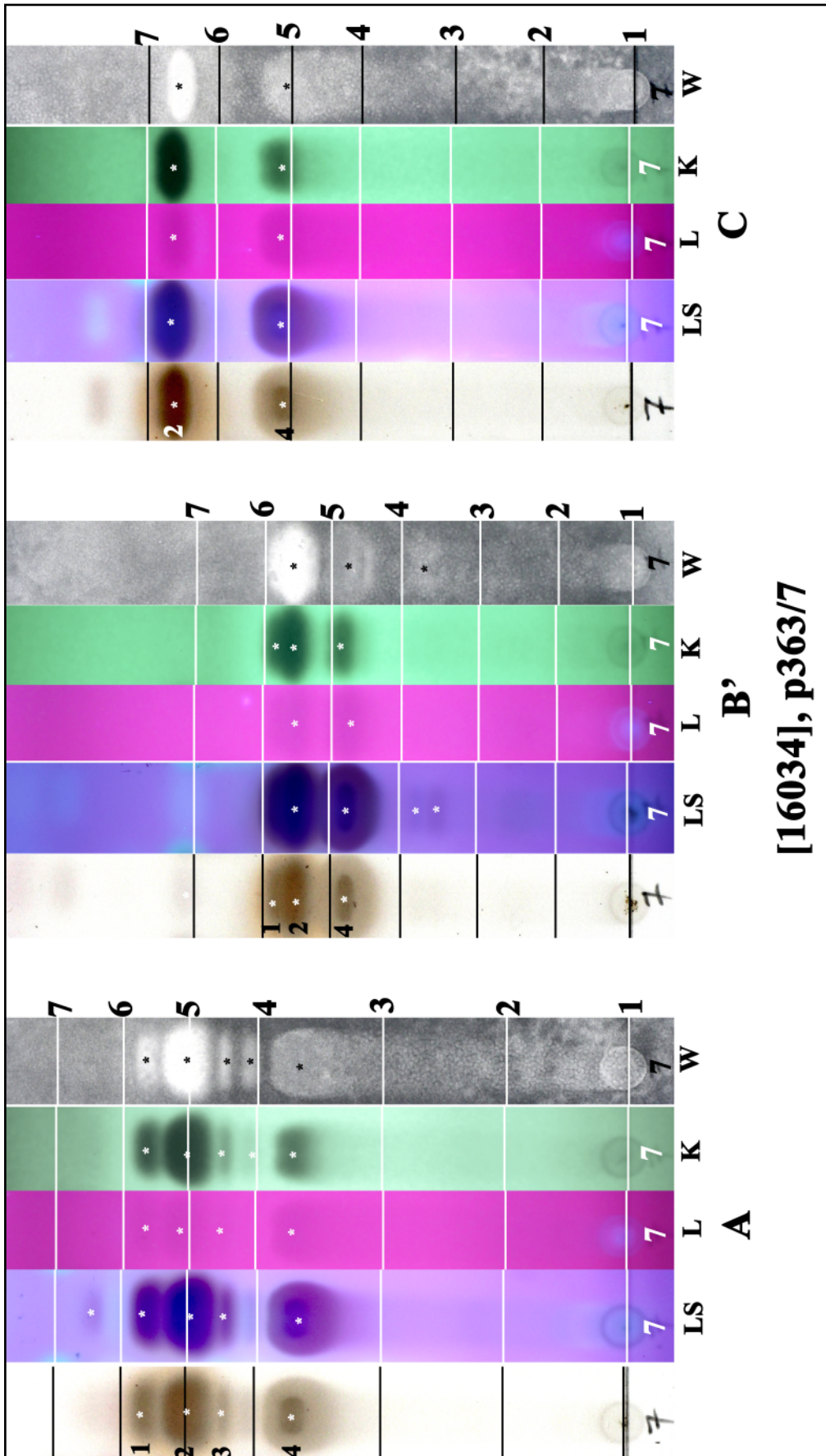
menegazzaiaic acid



m: menegazzaiaic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

**merochlorophaeic acid**

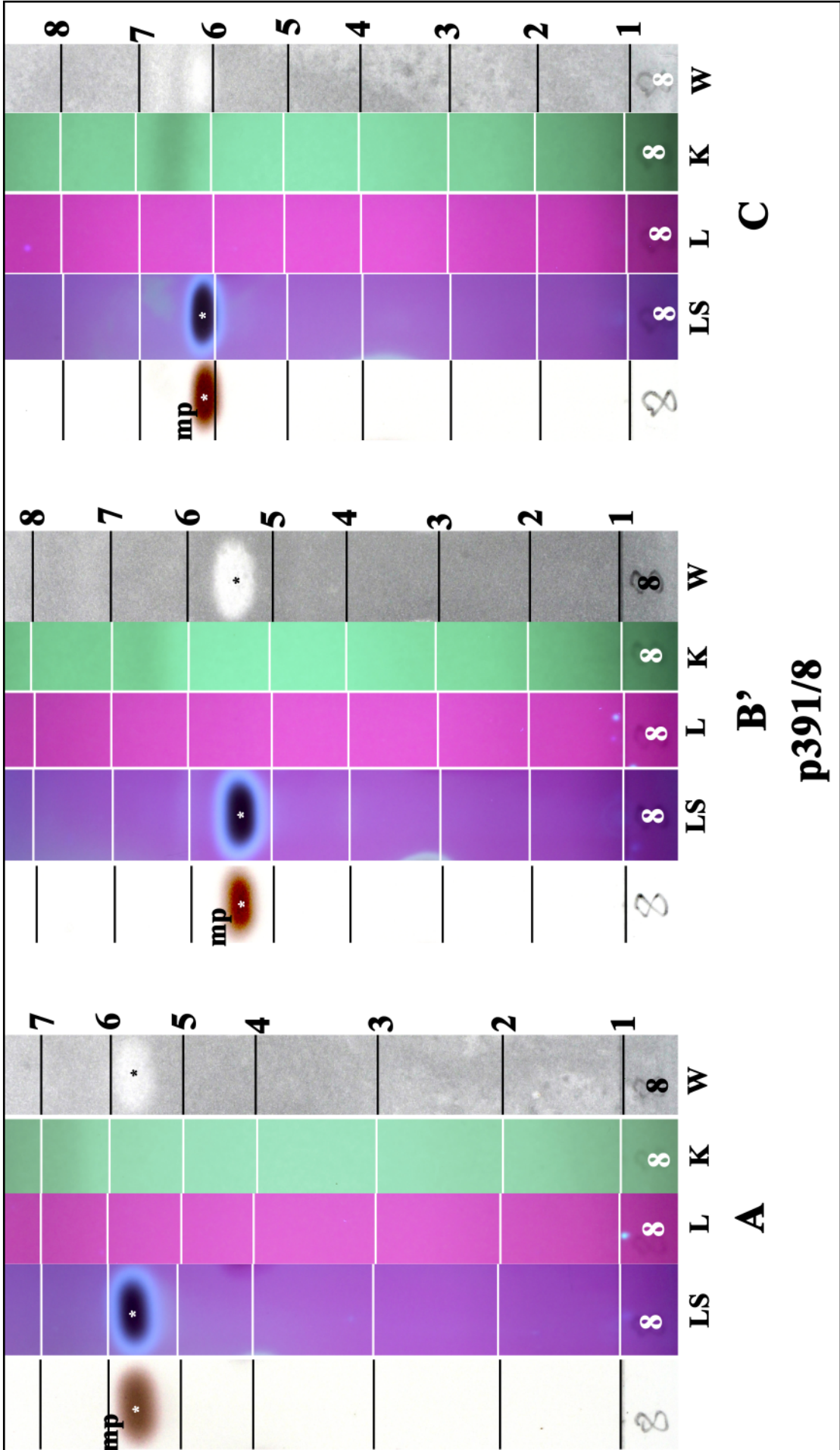


**[16034], p363/7**

- 1: 4-*O*-methylerythrochlorophaeic acid, 2: merochlorophaeic acid,
- 4: cryptochlorophaeic acid, 3: 2,4-di-*O*-methylnorsekikaic acid; conf. J.A. Elix.

*Cladonia merochlorophaea* Asahina, [16034], Australia, Australian Capital Territory, Canberra, Black Mountain Reserve, 35.27591° S, 149.09386° E, 760 m. Leg. J.A. Elix, F. Schumm & E. Stocker-Wörgötter, 07.11.2009, det. J.A. Elix.

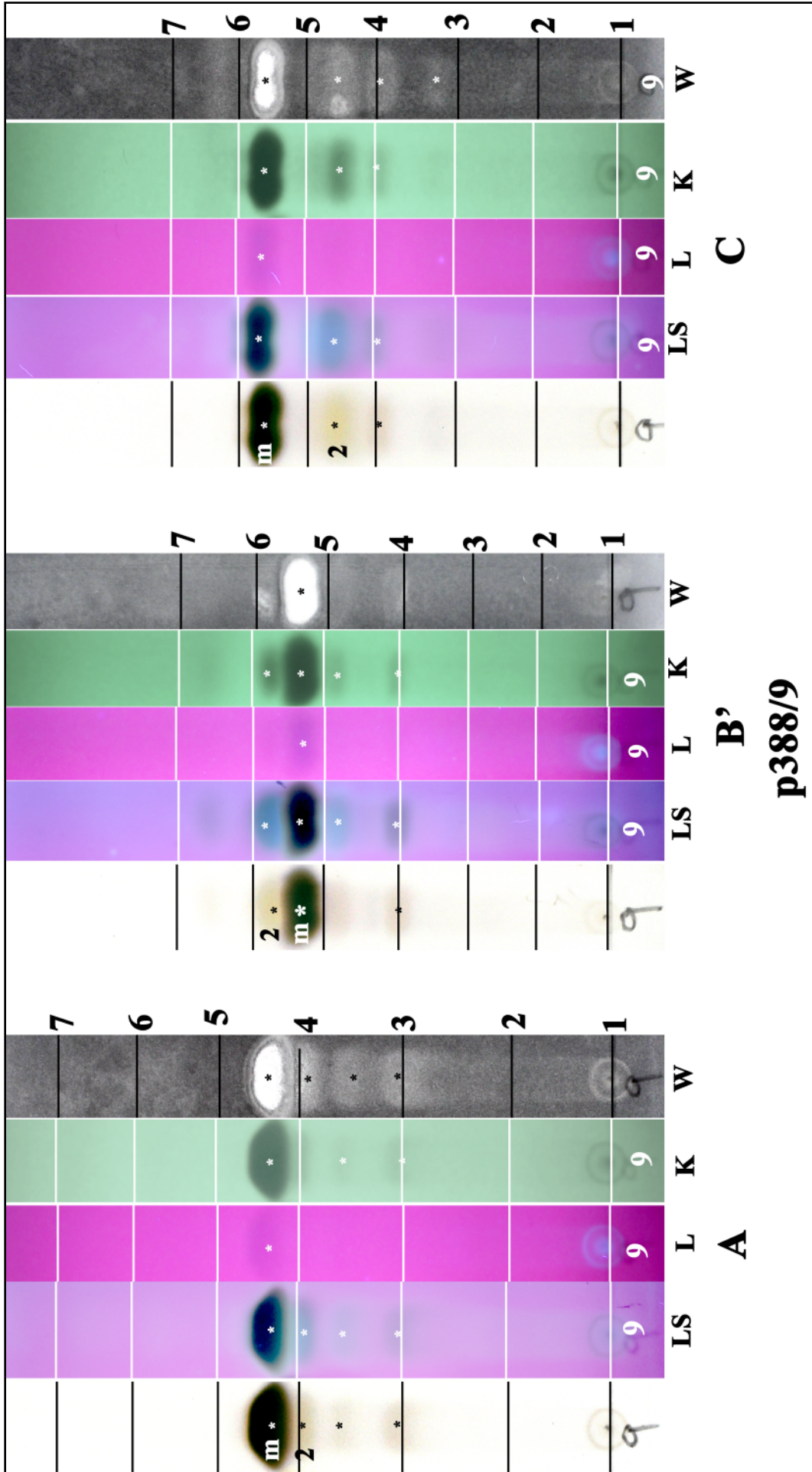
methyl pyxinate



mp: methyl pyxinate

Purified lichen substance received from K. Kalb; origin S. Huneck.

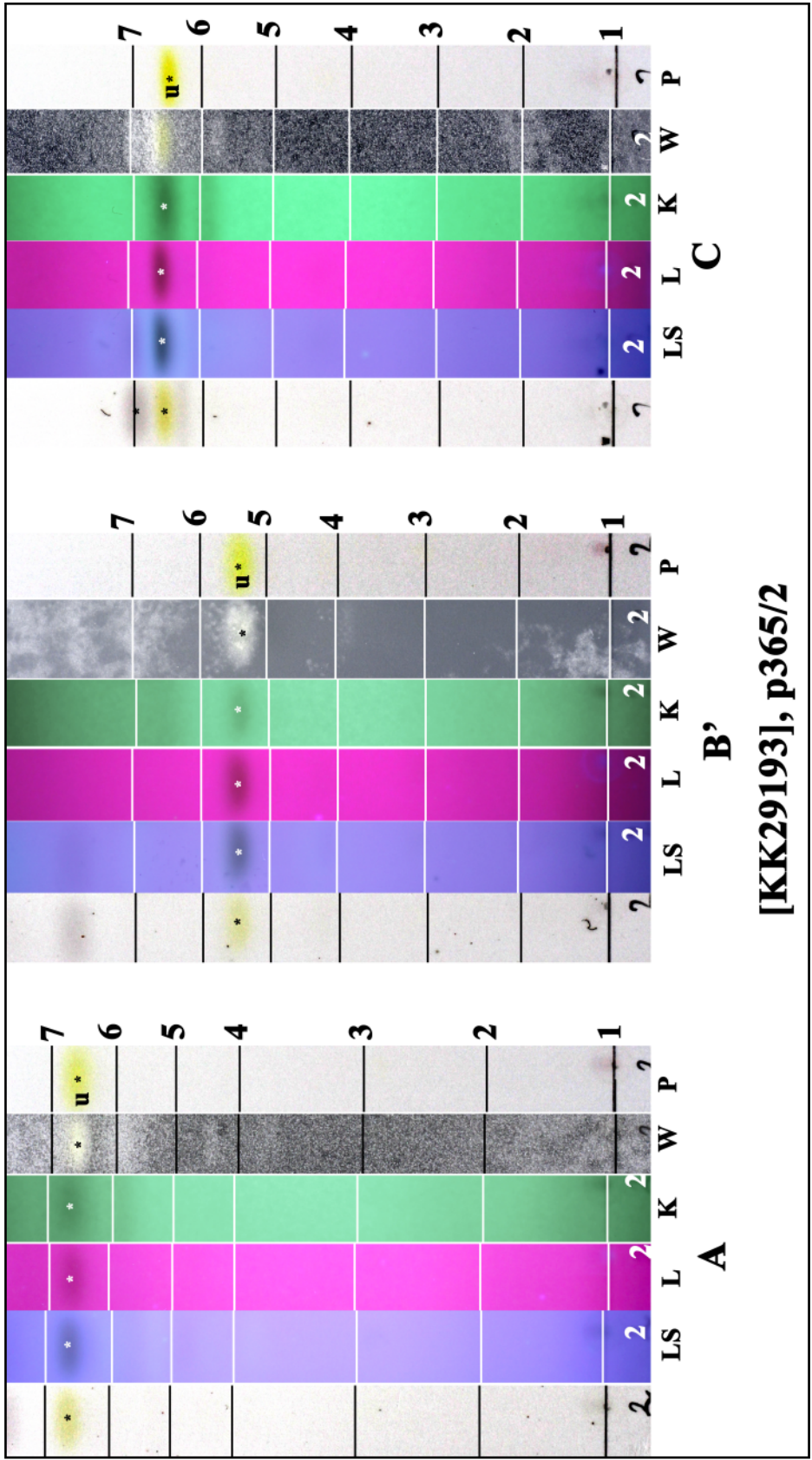
miriquidic acid



m: miriquidic acid, 2: unknown

Purified lichen substance received from K. Kalb; origin S. Huneck.

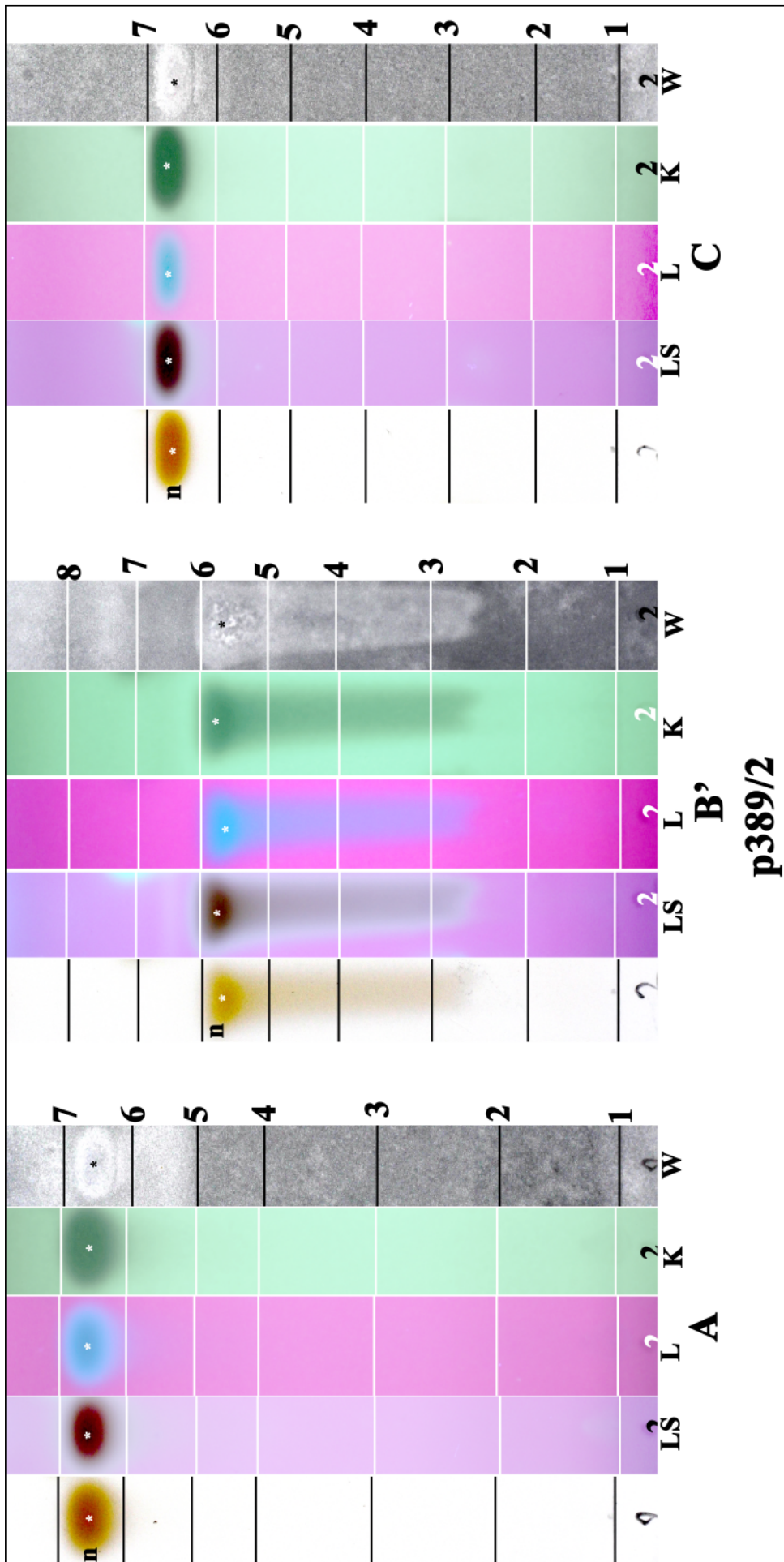
neochloroemodin (= 4-chloroemodin)



u: neochloroemodin (major) = 4-chloroemodin; conf. J.A. Elix

*Caloplaca marchantiorum* S.Y. Kondr. & Kärnefelt; [KK29193], Australia, ACT, Molongo Gorge Reserve, c. 16 km east of Canberra, in wet forest with *Acacia*, *Eucalyptus macrorhyncha*, *Calythris endlicheri*, 35°20' S, 149°16' E. Leg. K. Kalb, J. Elix & G. Kantvilas, 7.09.1995, det S. Kondratyuk 2008.

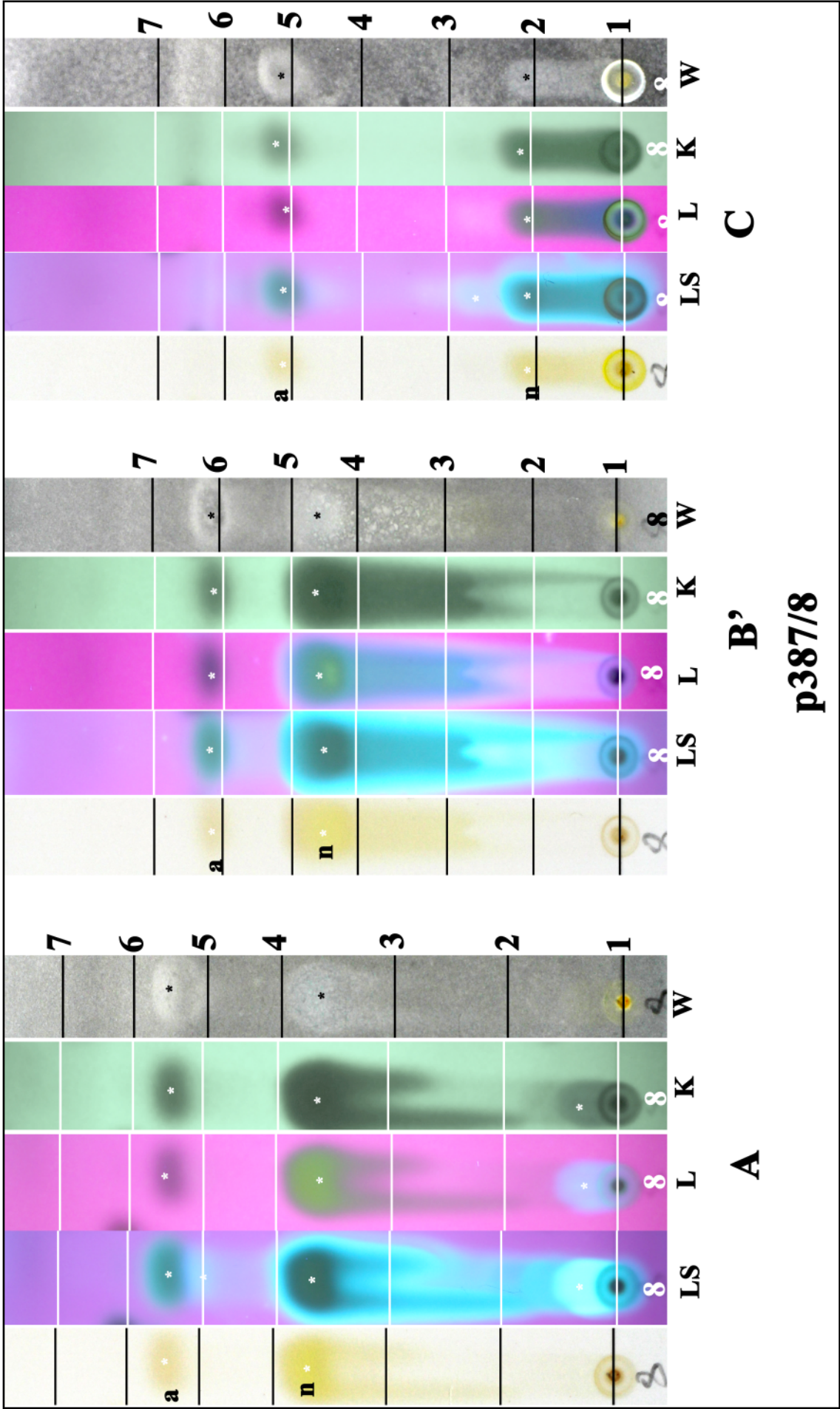
nephroarctin



n: nephroarctin

Purified lichen substance received from K. Kalb; origin S. Huneck.

**norlichexanthone**

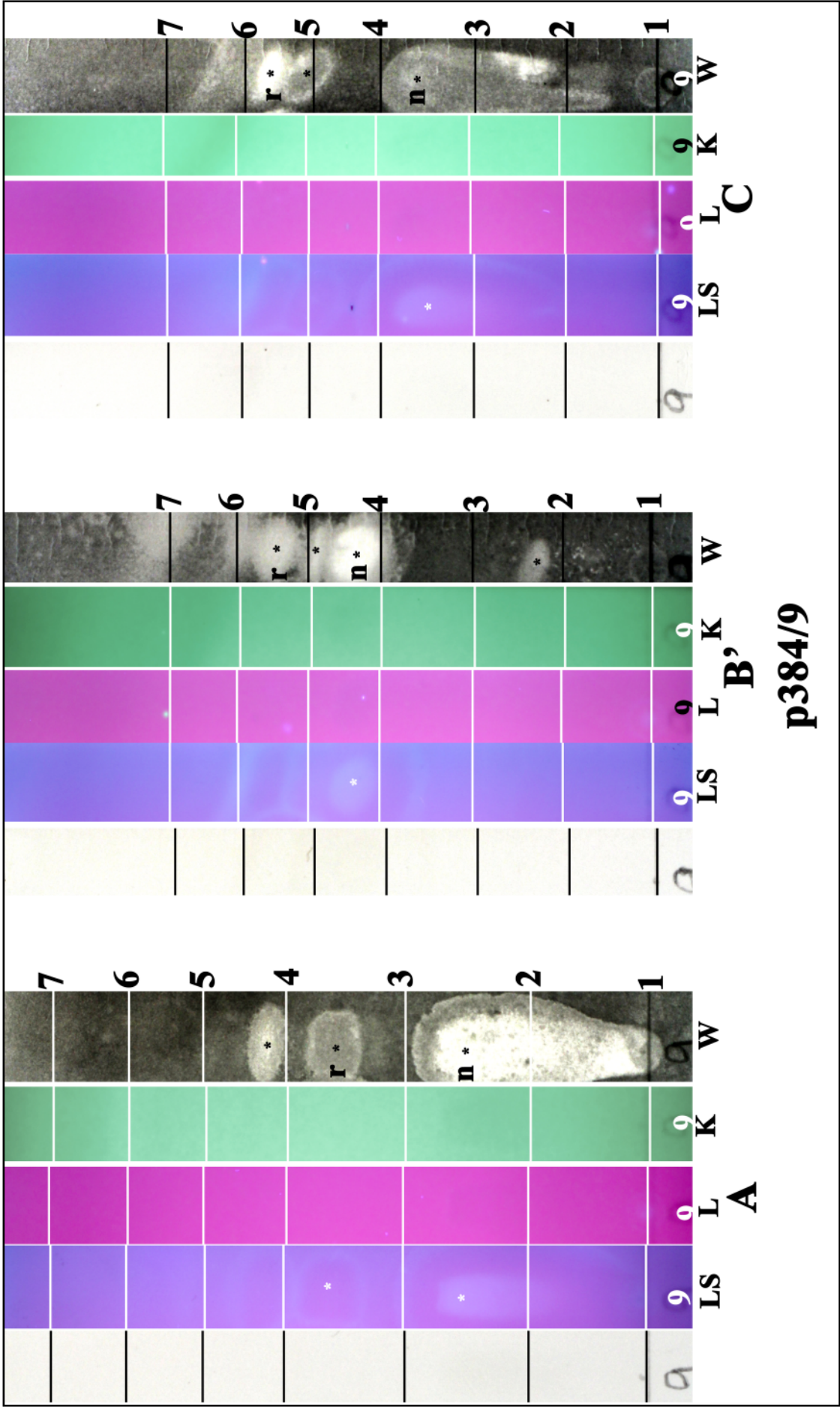


**p387/8**

n: norlichexanthone, a: unknown

Purified lichen substance received from K. Kalb; origin S. Huneck.

norrangiformic acid

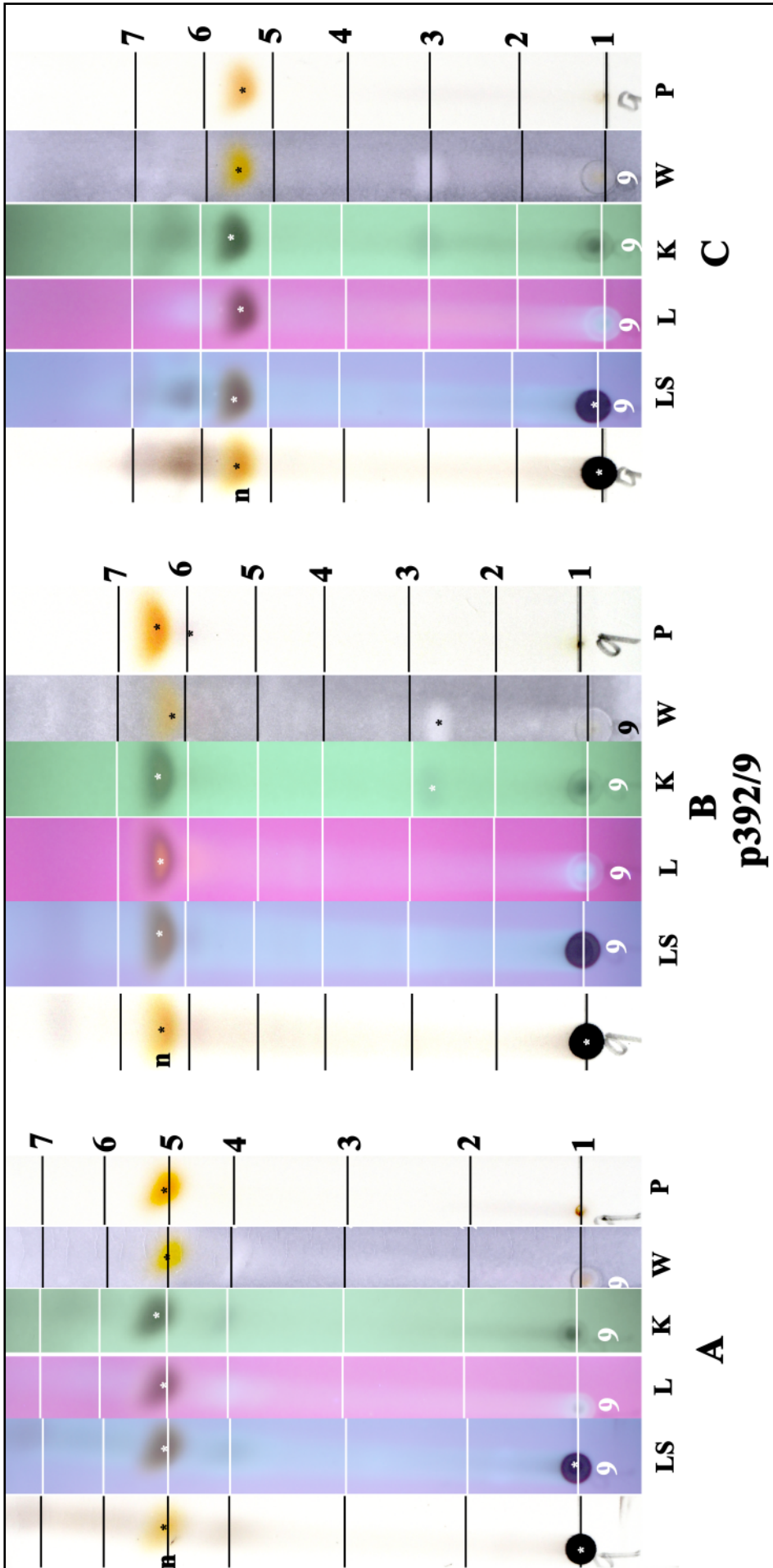


p384/9

n: norrangiformic acid, r: rangiformic acid

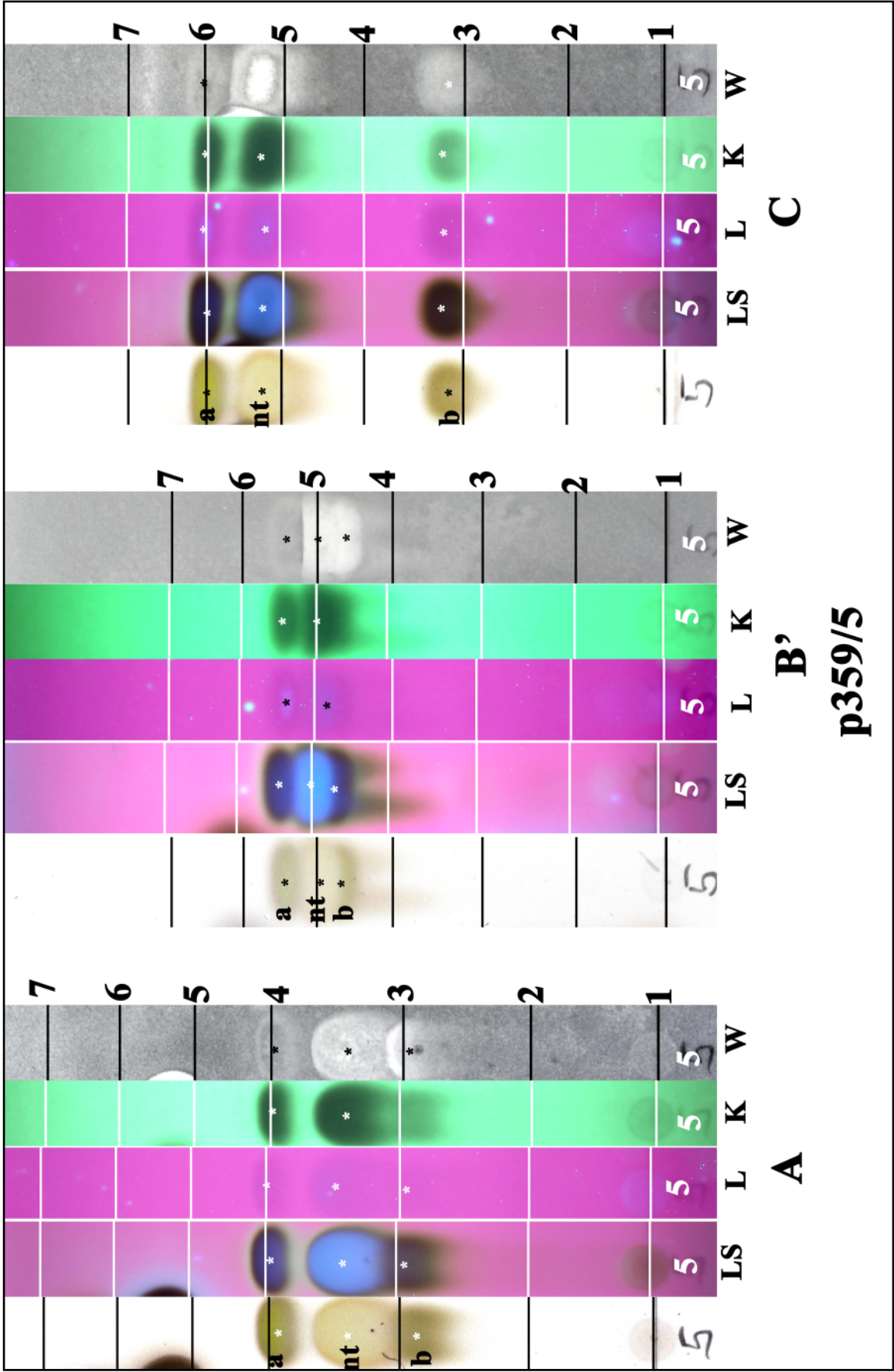
Purified lichen substance received from K. Kalb; origin S. Huneck.

norsolorinic acid



Purified lichen substance received from K. Kalb; origin S. Huneck.

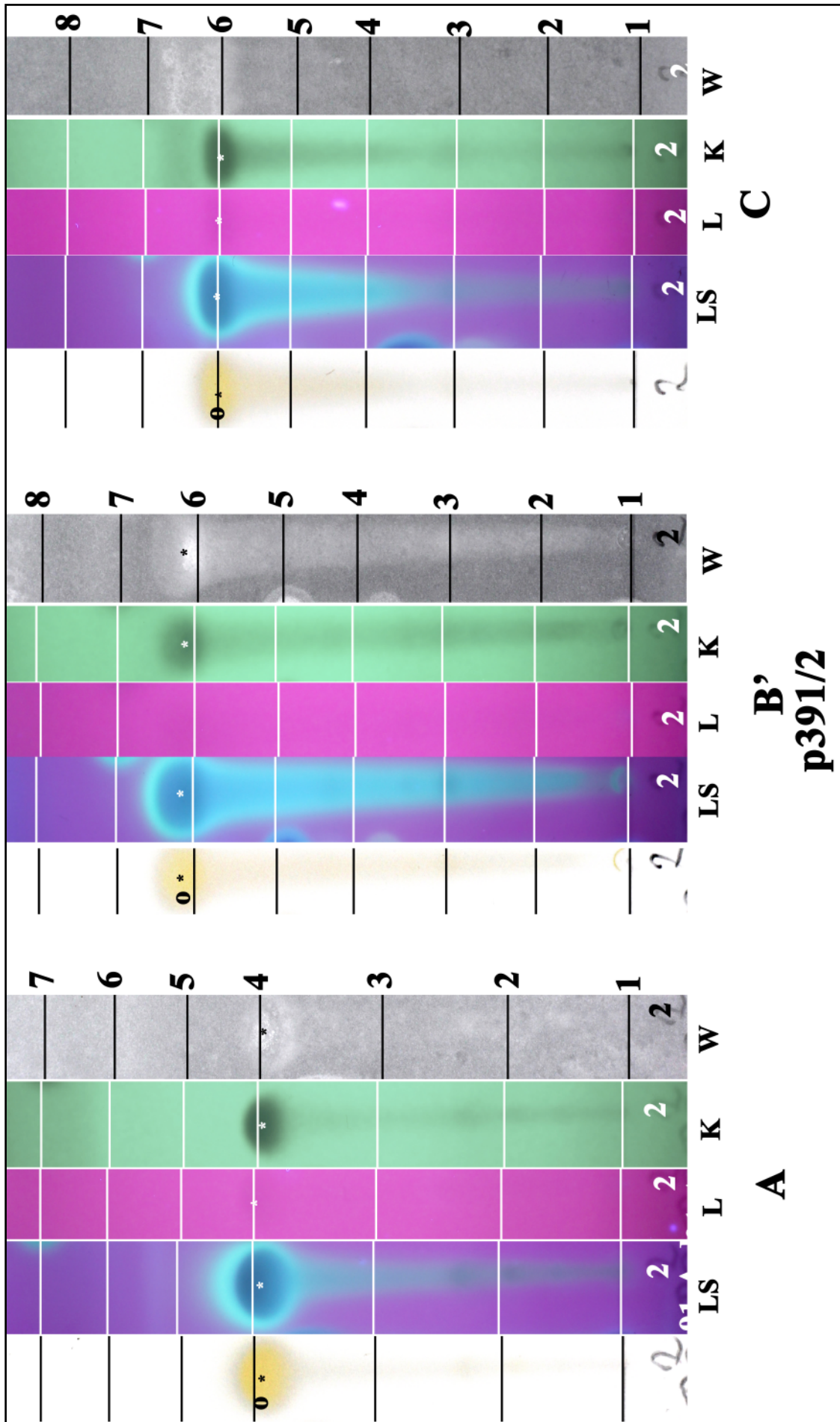
notatic acid



nt: notatic acid, a: 4-O-methylhypoprotocetraric acid, b: hypoprotocetraric acid.

Purified lichen substance received from K. Kalb; origin S. Huneck.

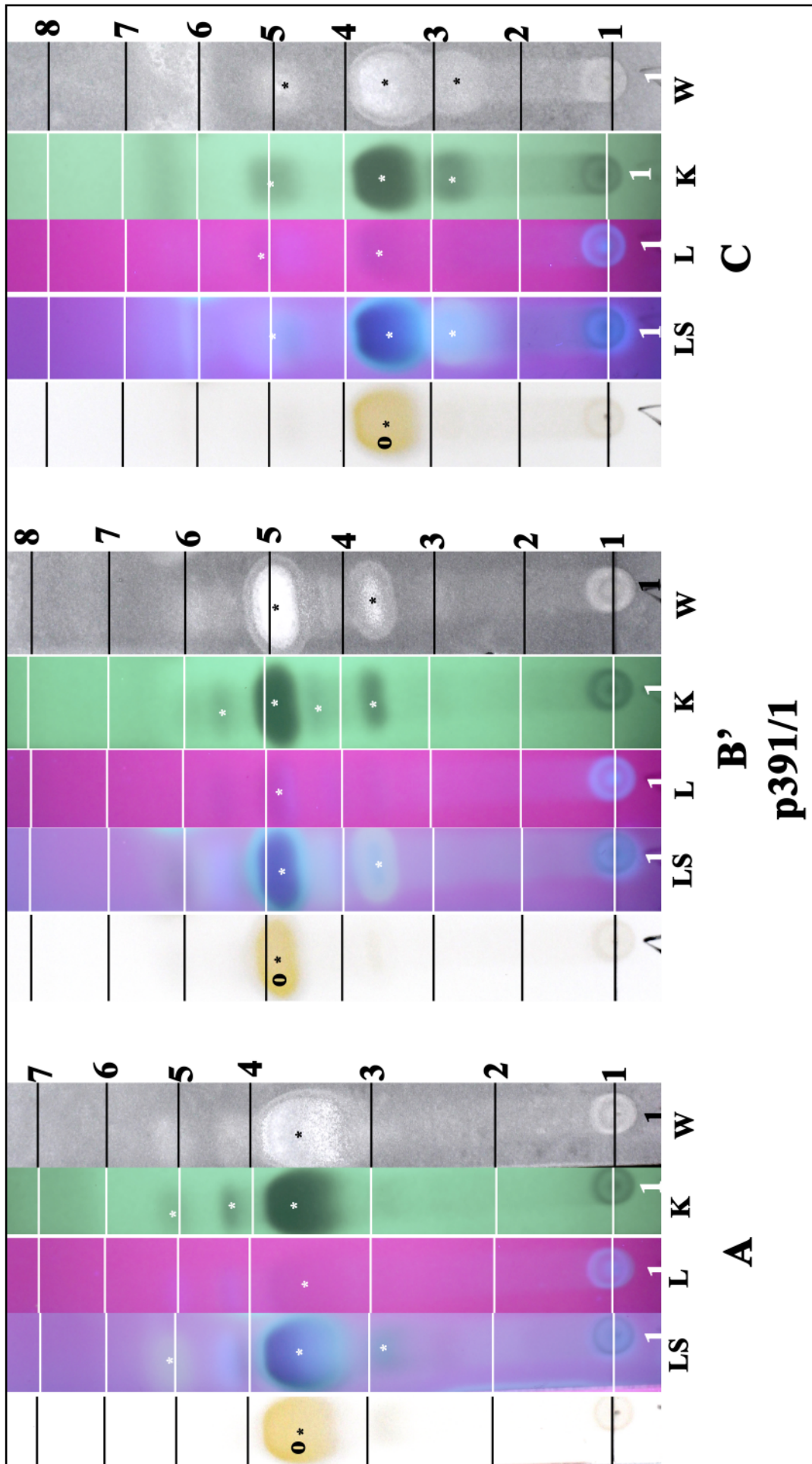
obtusatic acid



o: obtusatic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

olivetoric acid

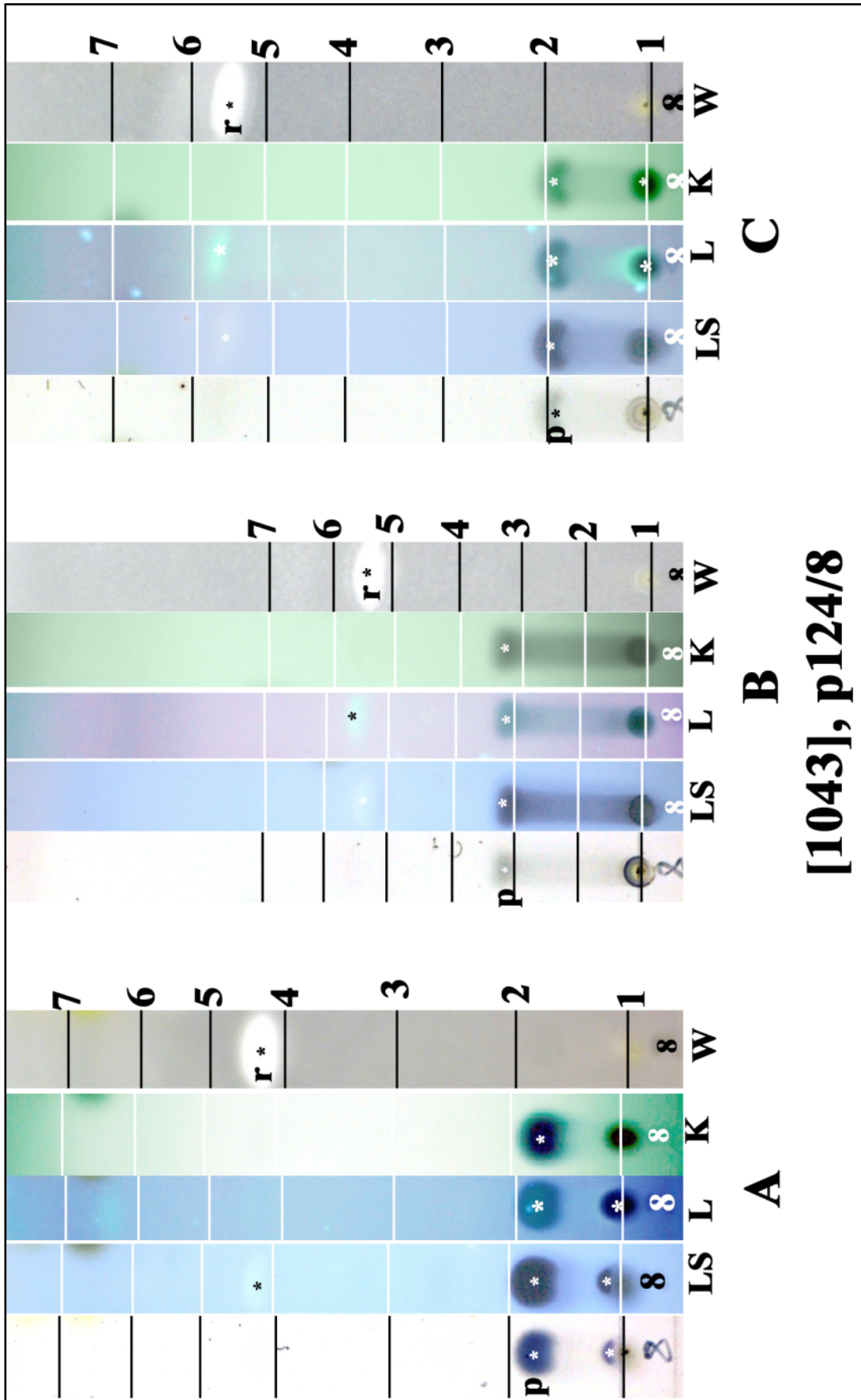


o: olivetoric acid

Purified lichen substance received from K. Kalb; origin S. Huneck.



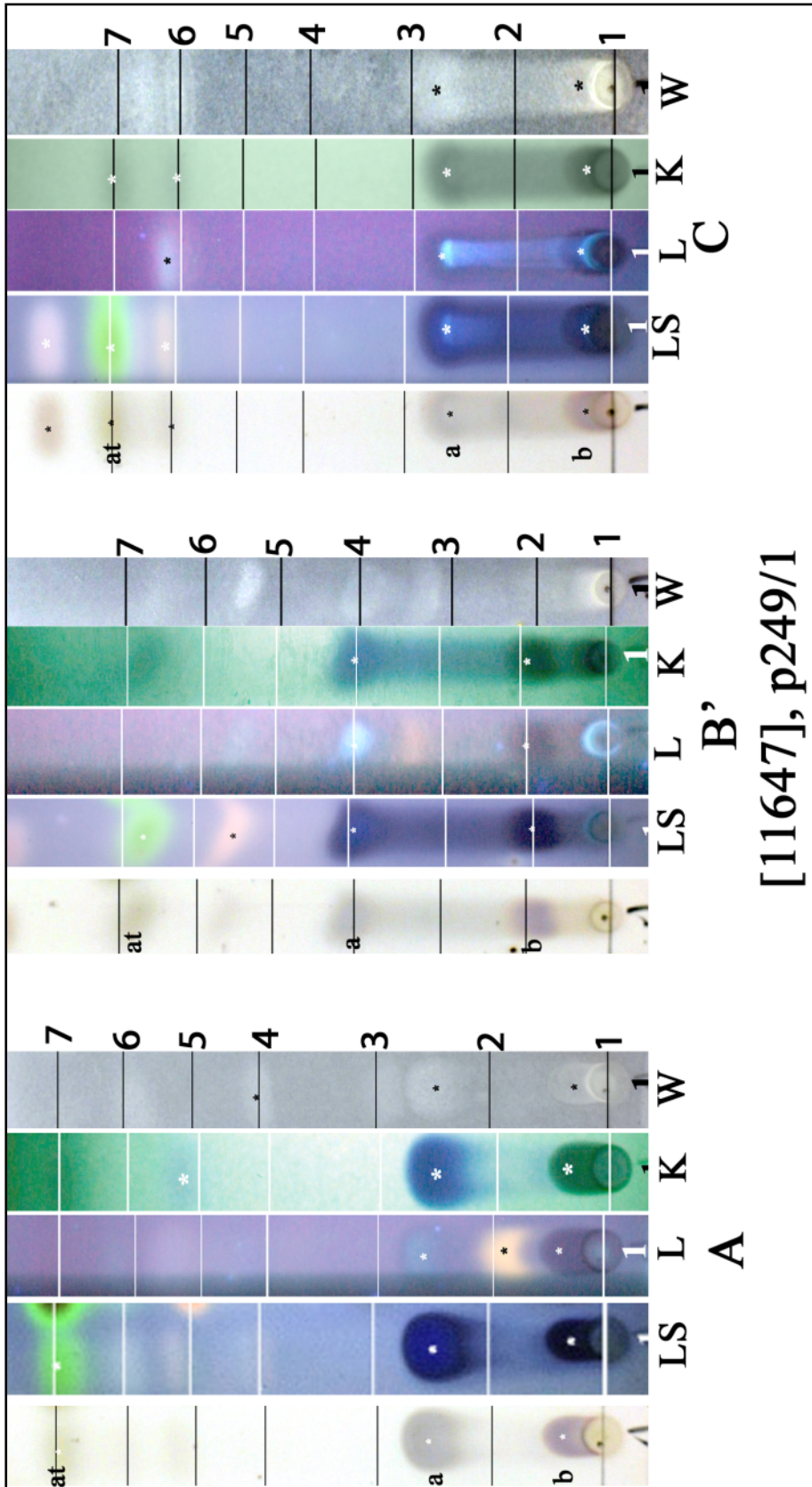
pannaric acid



p: pannaric acid, r: roccellic acid

*Lepraria membranacea* (Dicks.) Vain. [1043], Germany, Baden-Württemberg, Kreis Calw, Wildbad, am Fundament eines alten Heuschobers im Rennbachtal, TK 7217. Leg et det. Erich Putzler 18.04.1949, test. Wirth, Bayerova Juli 2002, Schumm 2002 (TLC p124/8).

**pannaric acid**

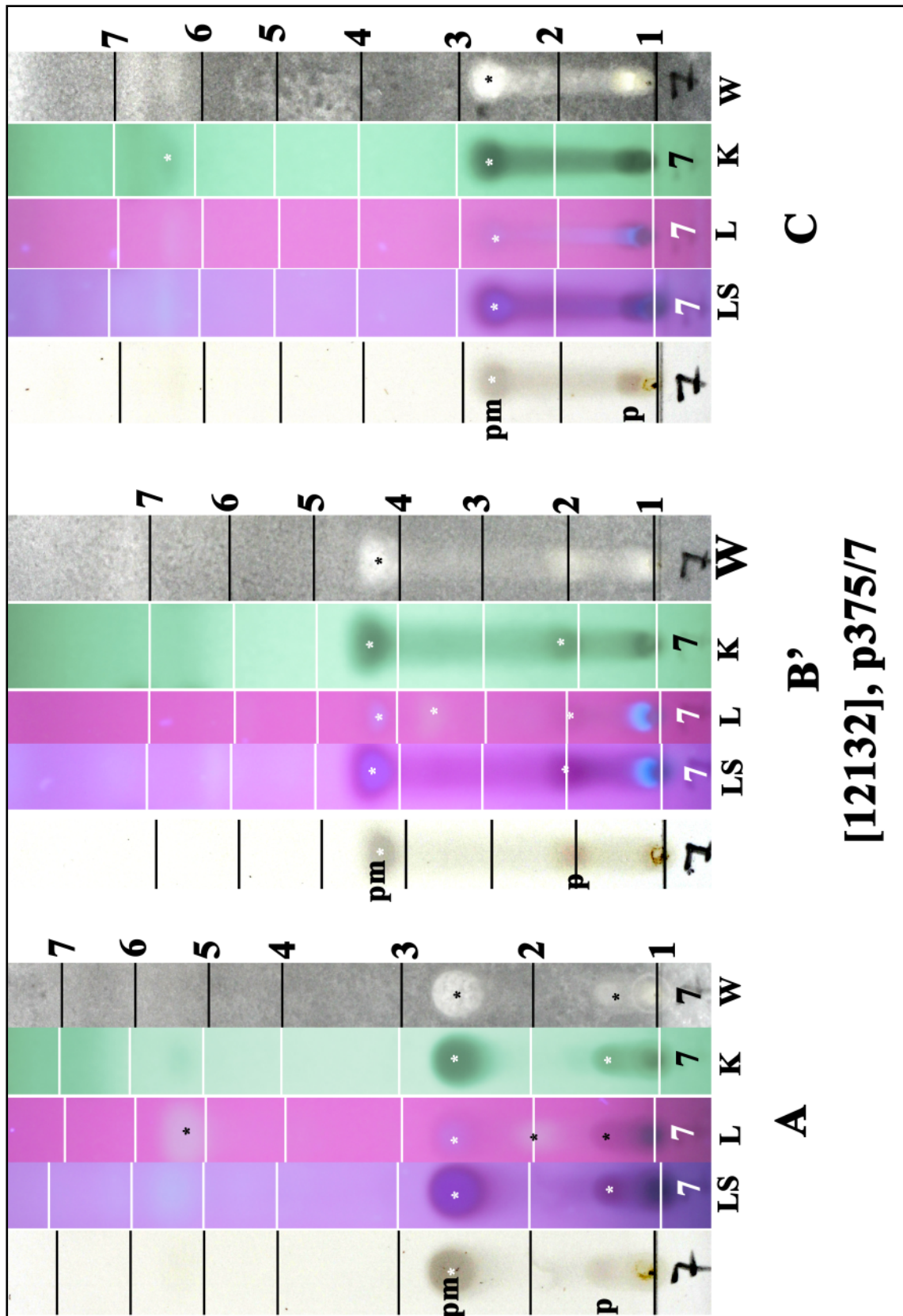


[11647], p249/1

at: atranorin, a: pannaric acid 6-methyl ester, b: pannaric acid

*Lepraria vouauxii* (Hue) R.C.Harris. USA, Nebraska, Scotts Bluff County, Wildcat Hill State Recreation Area, 12 miles (20 km) S of Scottsbluff off US Route 71; ponderosa pine and juniperus woodland on steep hillsides; 41°43'41" N, 103°40'00" W, 1380 m; on soil. Leg. Sara Morgan & Robert Egan, 26. May 2000. Ex Univ. of Nebraska at Omaha Herbarium (OMA).

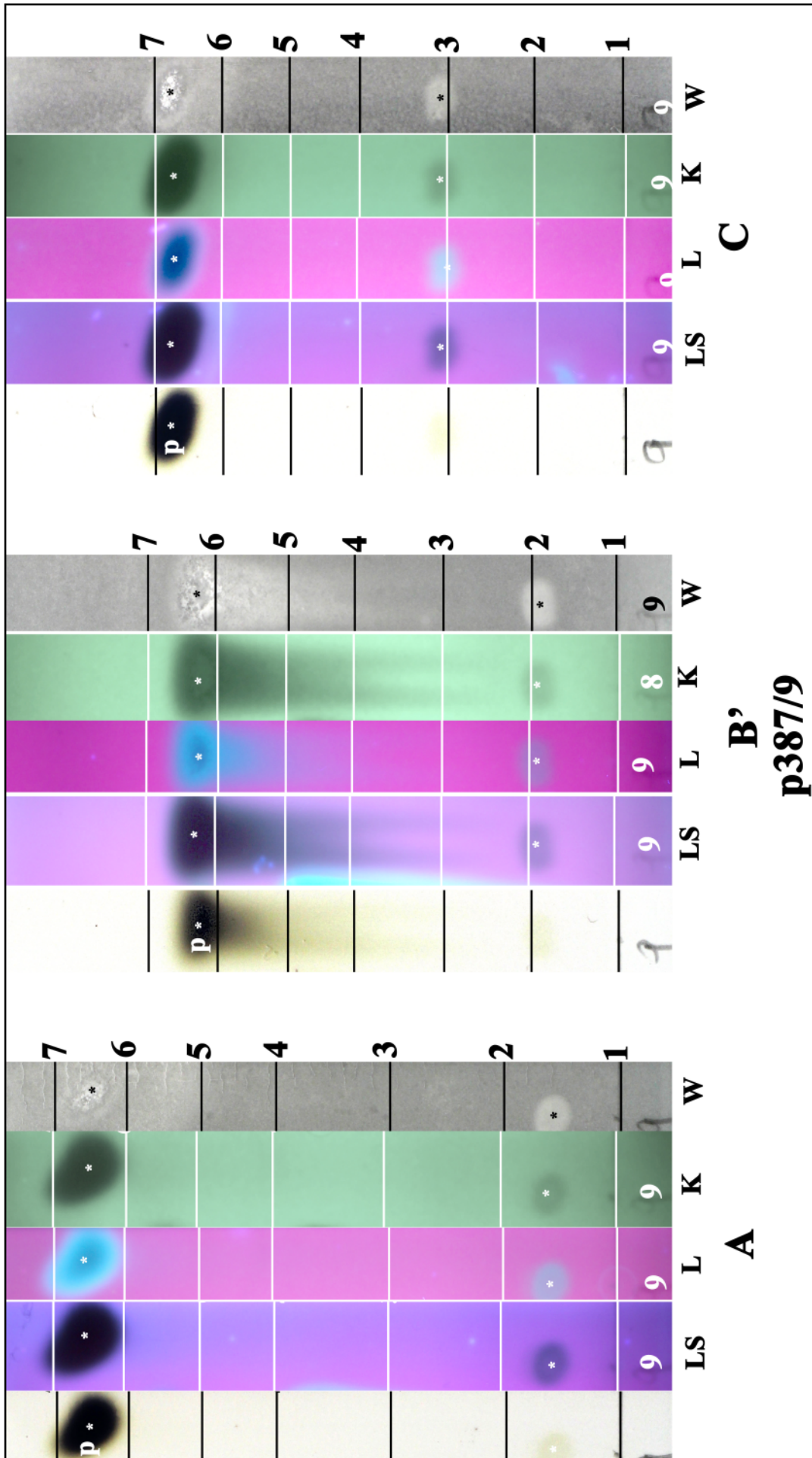
pannaric acid



p: pannaric acid, pm: pannaric acid 6-methyl ester.

*Lepraria vouauxii* (Hue) R.C.Harris. [12132], Turkey, Prov. Nevsehir (50), Uchisar village, wall of tuff-houses, 38°37' N, 34°48' E, 1250 m, on tuff. Leg. V. John & B. Öztürk 9.07.2001, det. M. Heklau. V. JOHN: LICHENES ANATOLICI EXSICCATI NR. 154.

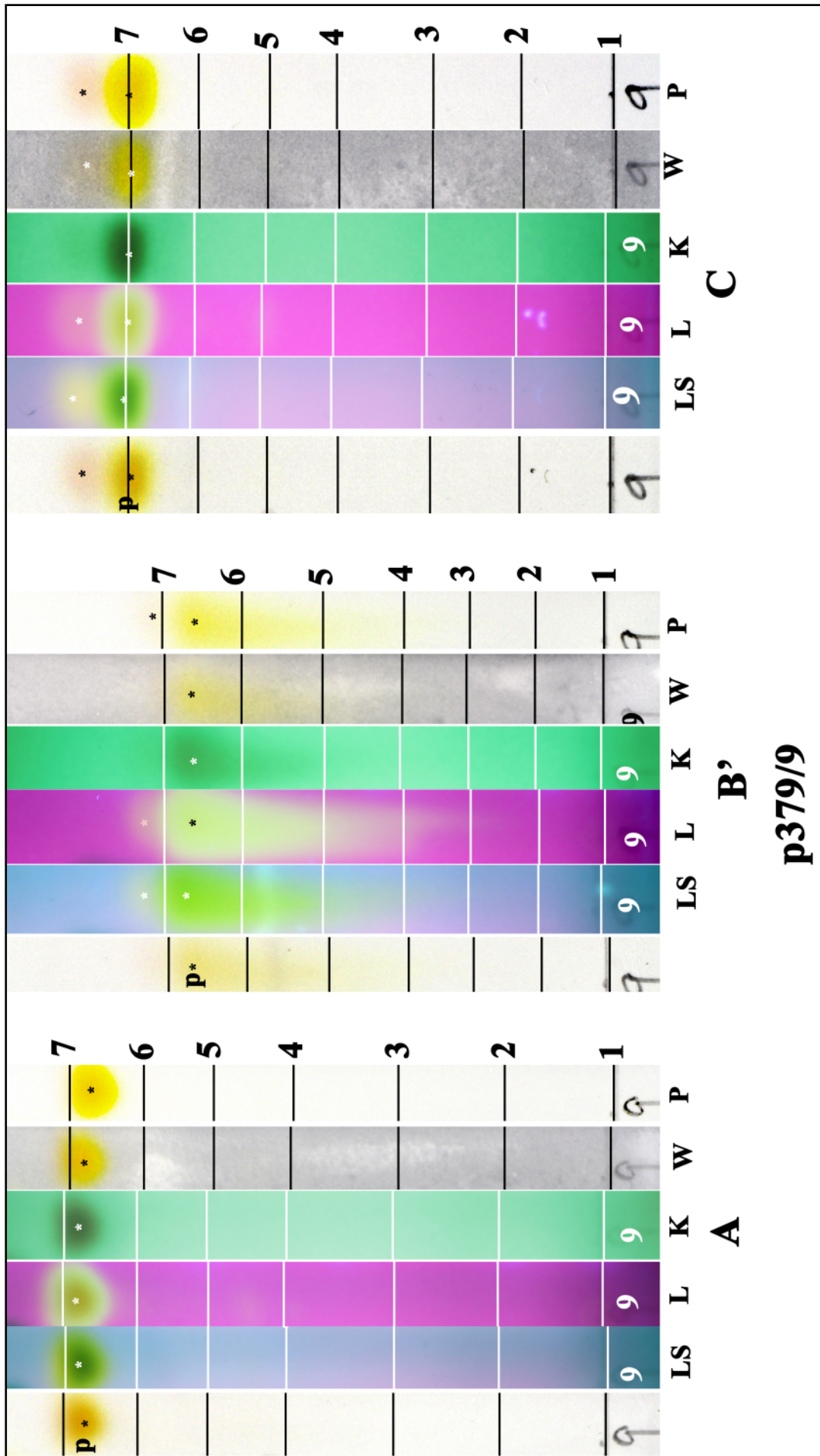
**pannarin**



p: pannarin, a: unknown

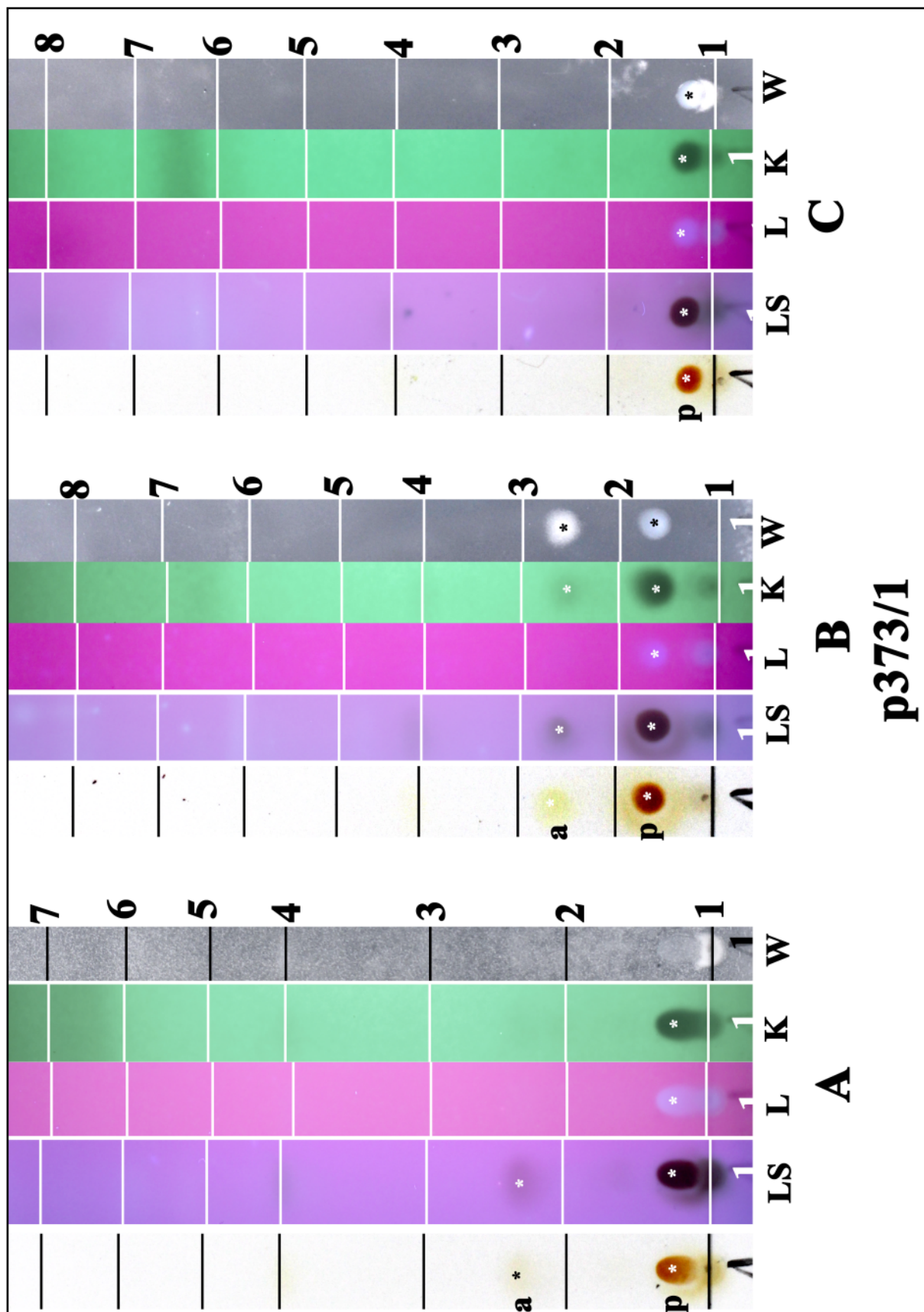
Purified lichen substance received from K. Kalb; origin S. Huneck.

parietin



Purified lichen substance received from K. Kalb; origin S. Huneck.

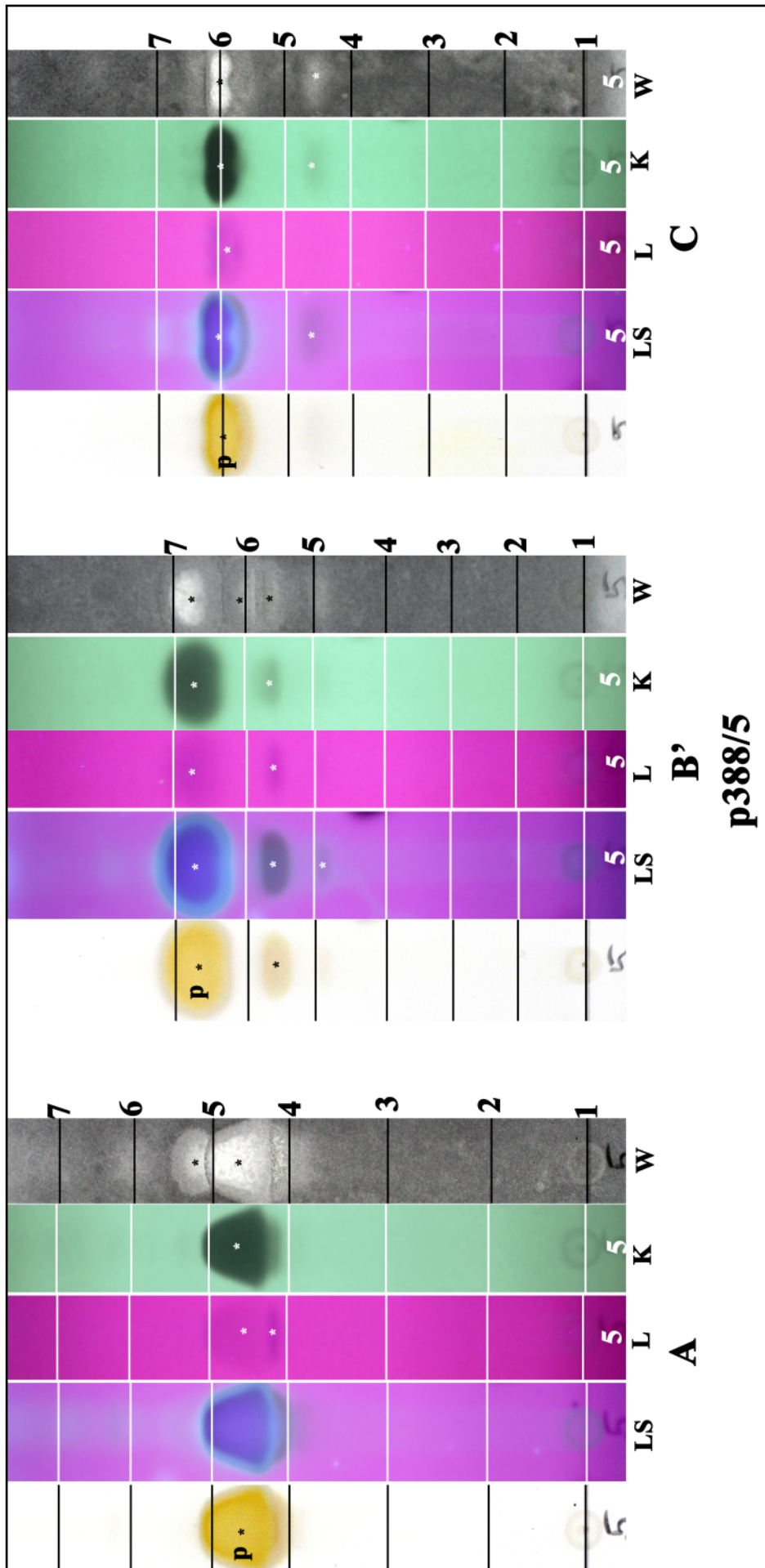
peristic acid



p: peristic acid, a: ?

Purified lichen substance received from K. Kalb; origin J.A. Elix.

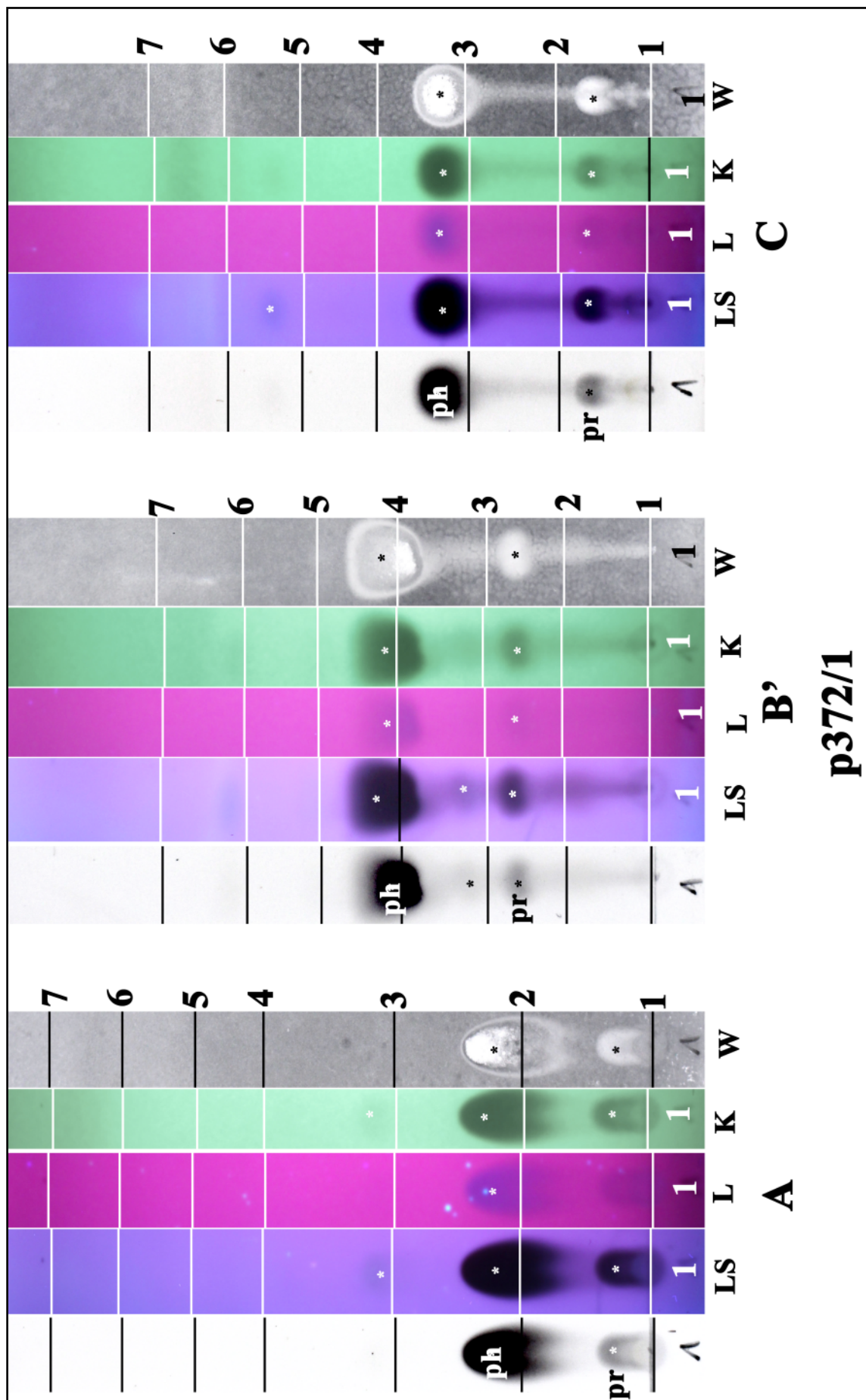
perlatolic acid



p: perlatolic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

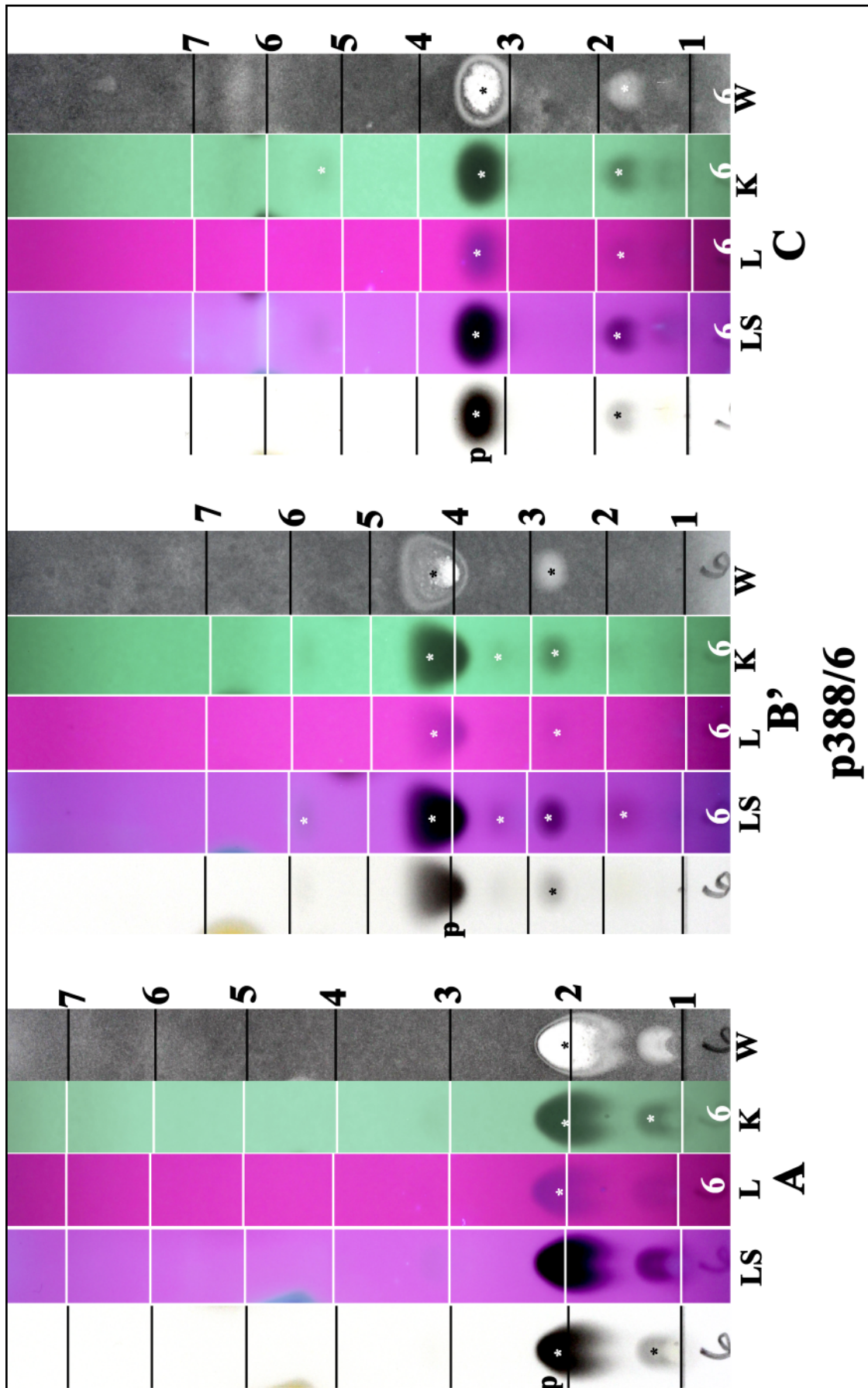
physodalic acid



ph: physodalic acid, pr: protocetraric acid

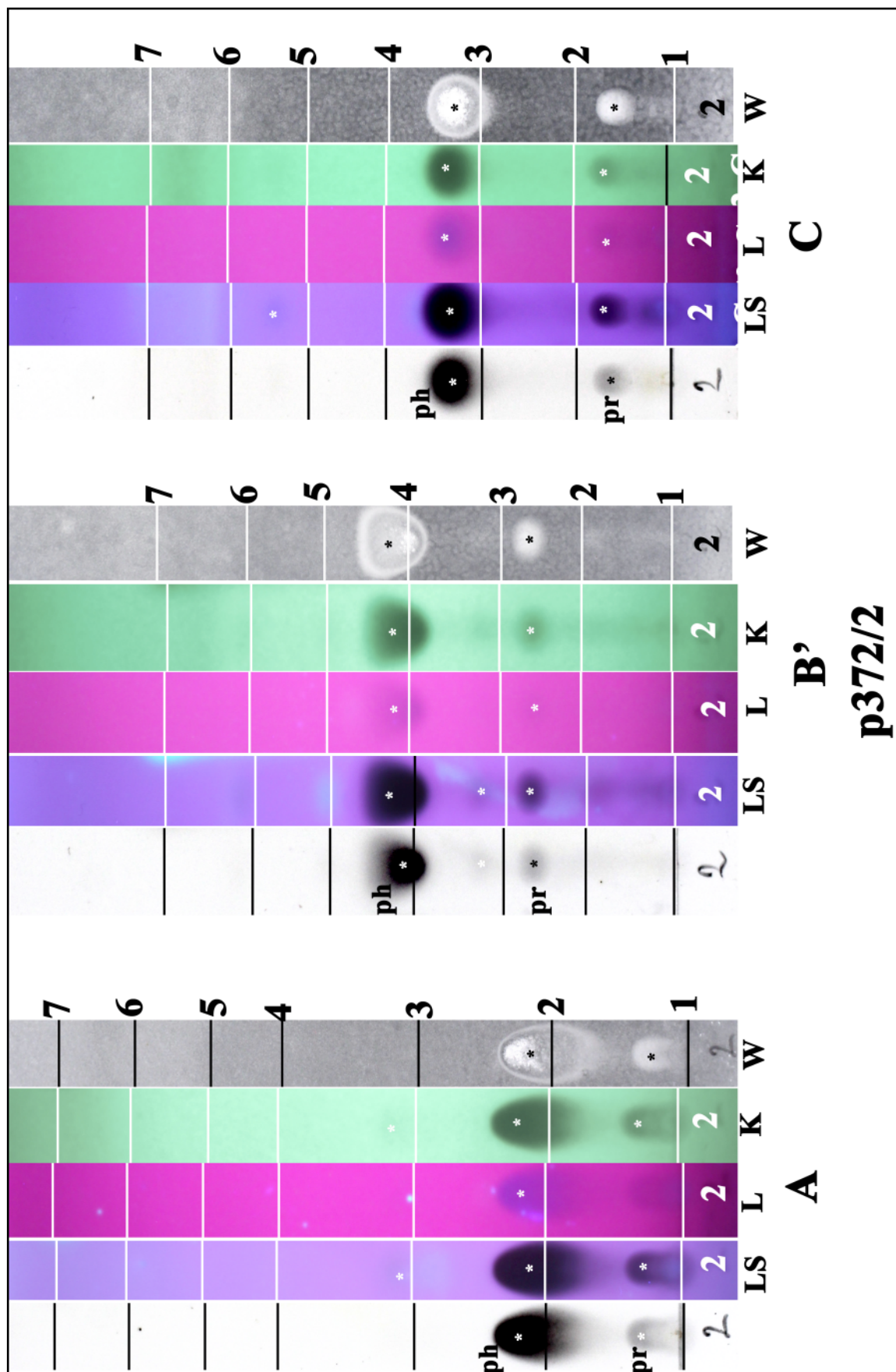
Purified lichen substance received from K. Kalb; origin S. Huneck.

physodalic acid



Purified lichen substance received from K. Kalb; origin S. Huneck.

physodalic acid

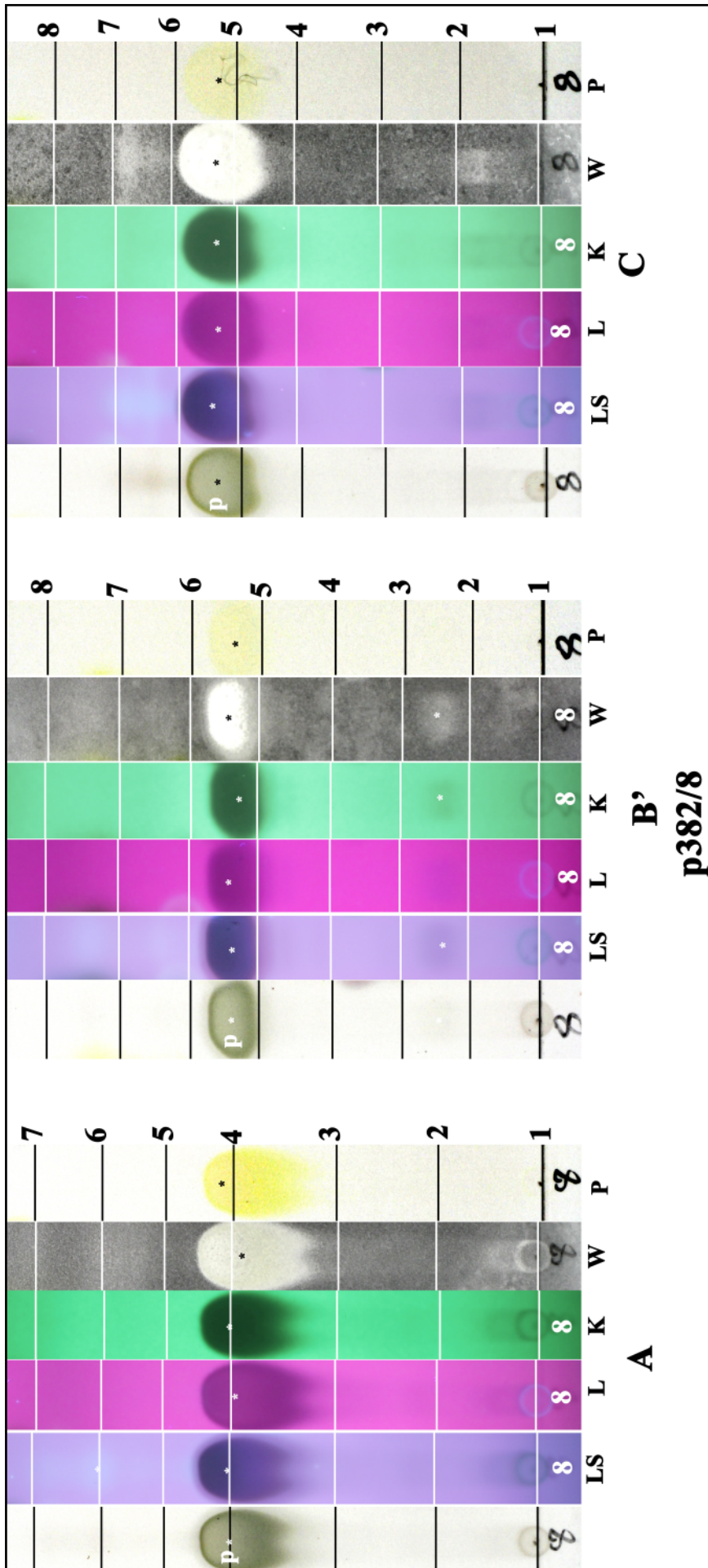


ph: physodalic acid, pr: protocetraric acid

Purified lichen substance received from K. Kalb; origin Zopf



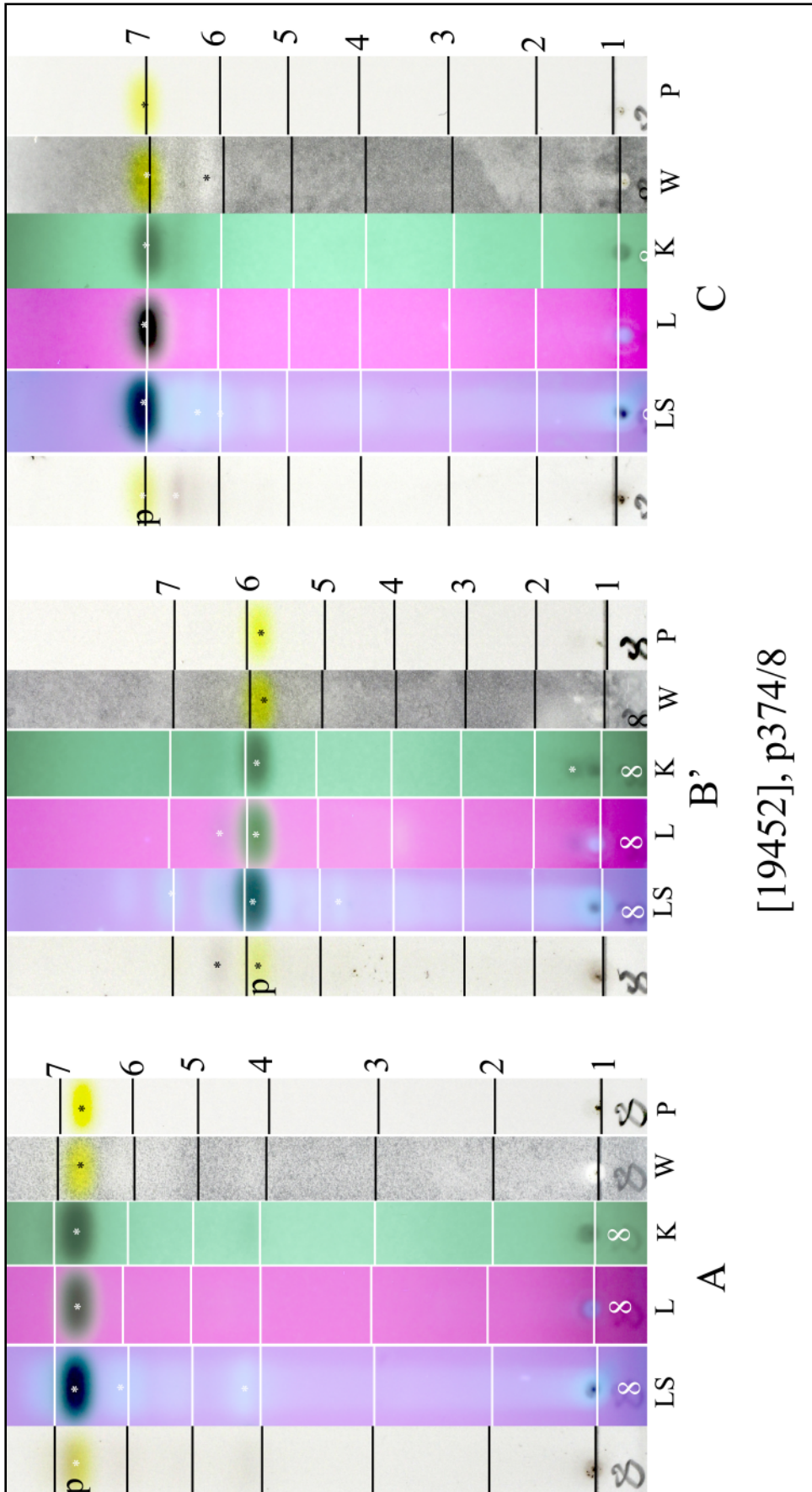
**picrolichenic acid**



**p: picrolichenic acid**

Purified lichen substance received from K. Kalb; origin S. Huneck.

**pinastric acid**

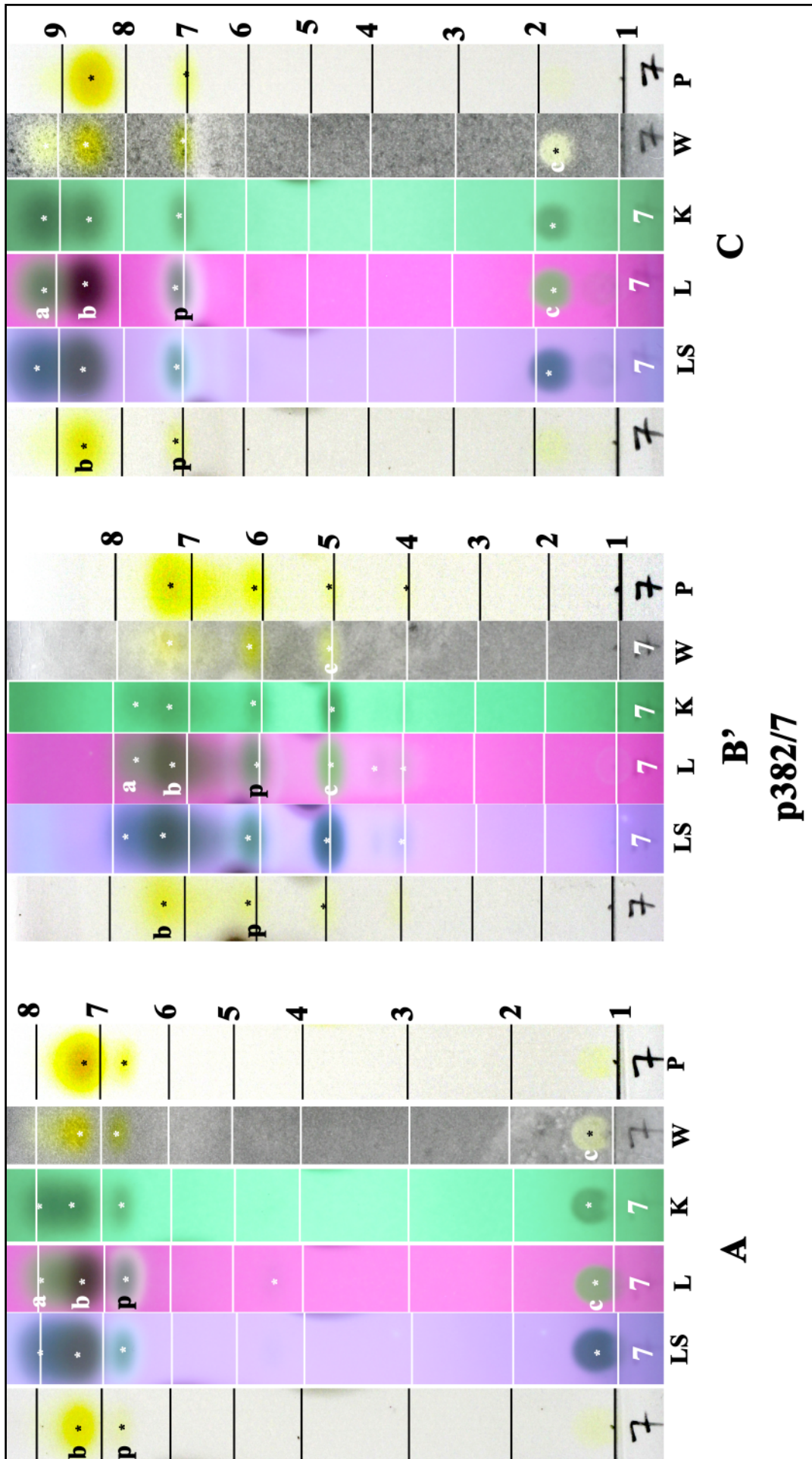


[19452], p374/8

p: pinastric acid.

*Chrysothrix candelaris*, [19452], Germany, Baden-Württemberg, Kreis Ludwigsburg, im Krumbachtal zwischen Büsnau und Gerlingen (Kücherain), 48.76951° N, 9.05428° E, 428 m, im Laubwald an der Stammbasis von *Quercus*, TK: 7220/NW. Leg. F. Schumm, 22.05.2016.

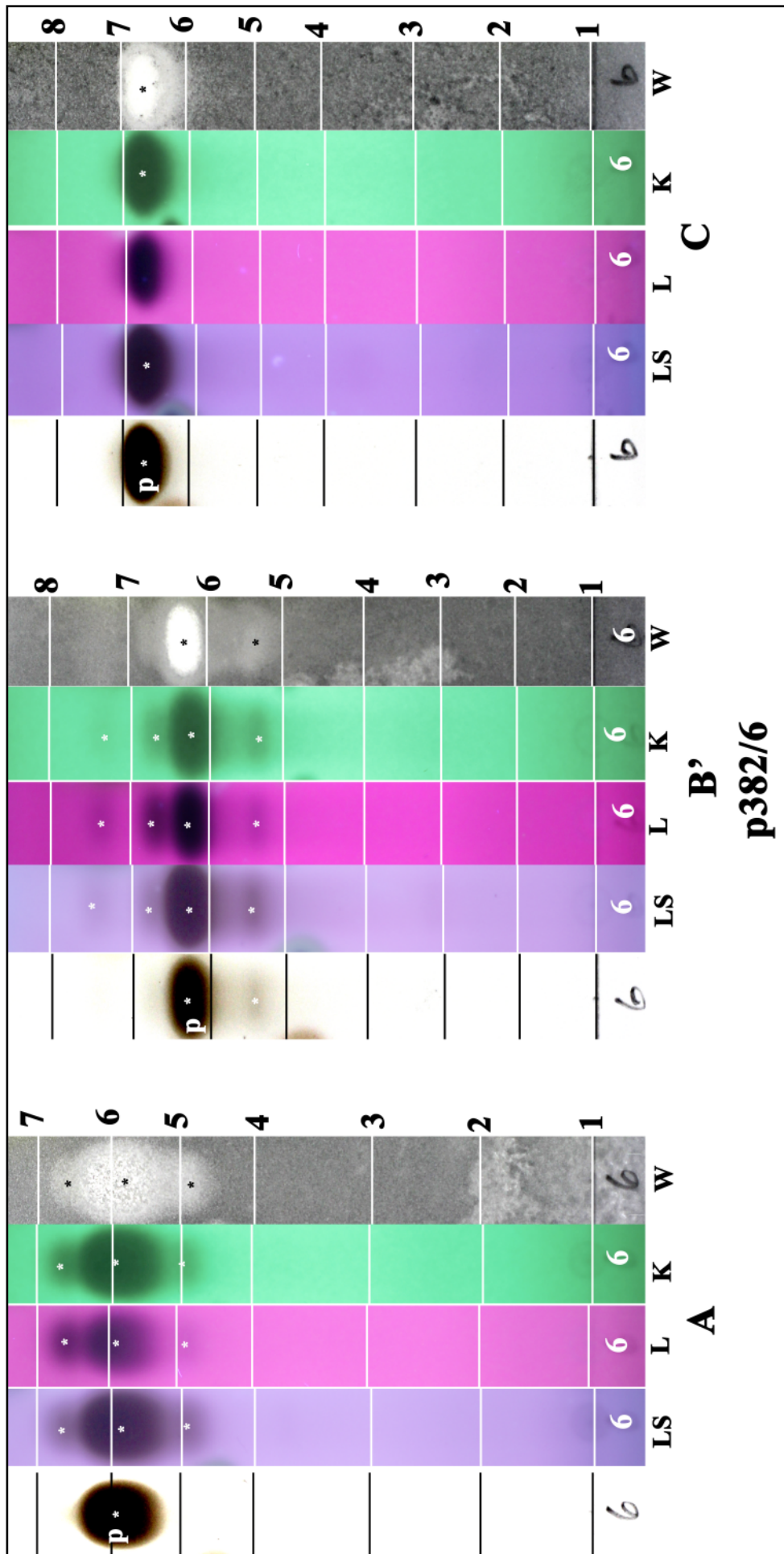
pinastric acid



p: pinastric acid, a: pulvinic dilactone, b: calycin, c: pulvinic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

placodiolic acid

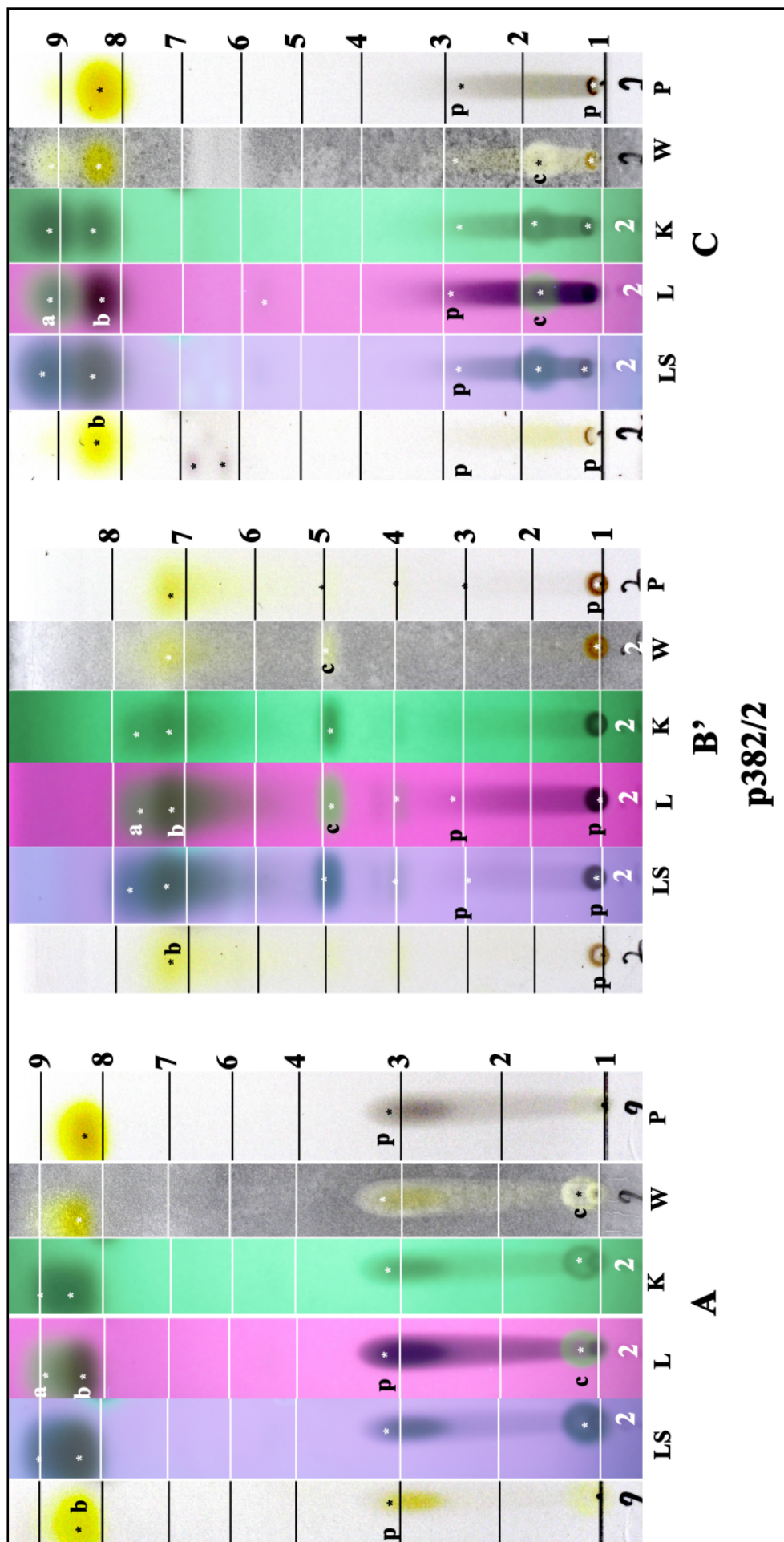


p: placodiolic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.



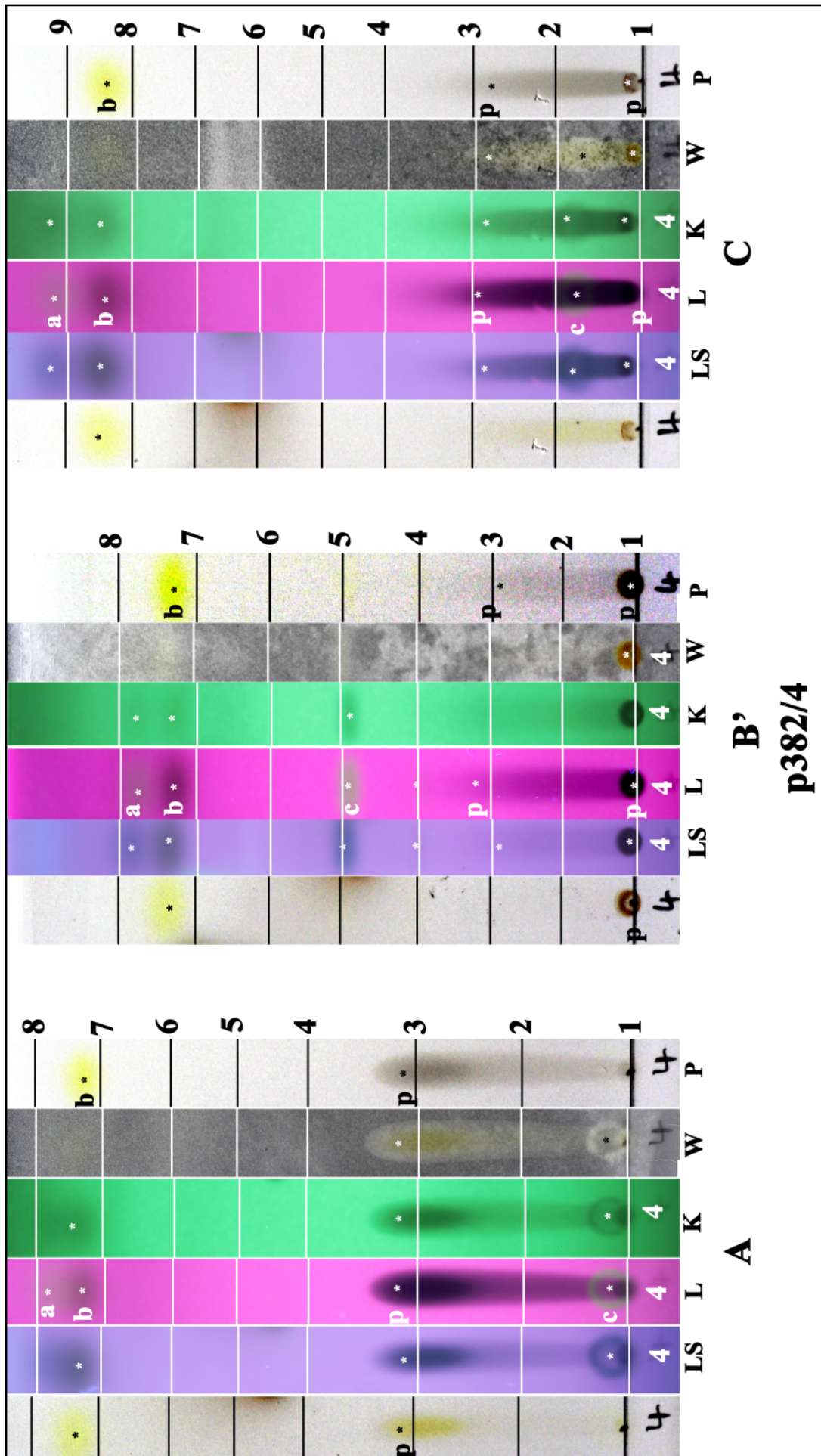
polyporic acid from *Pseudocyphellaria coronata*



p: polyporic acid, a: pulvinic dilactone, b: calycin, c: pulvinic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

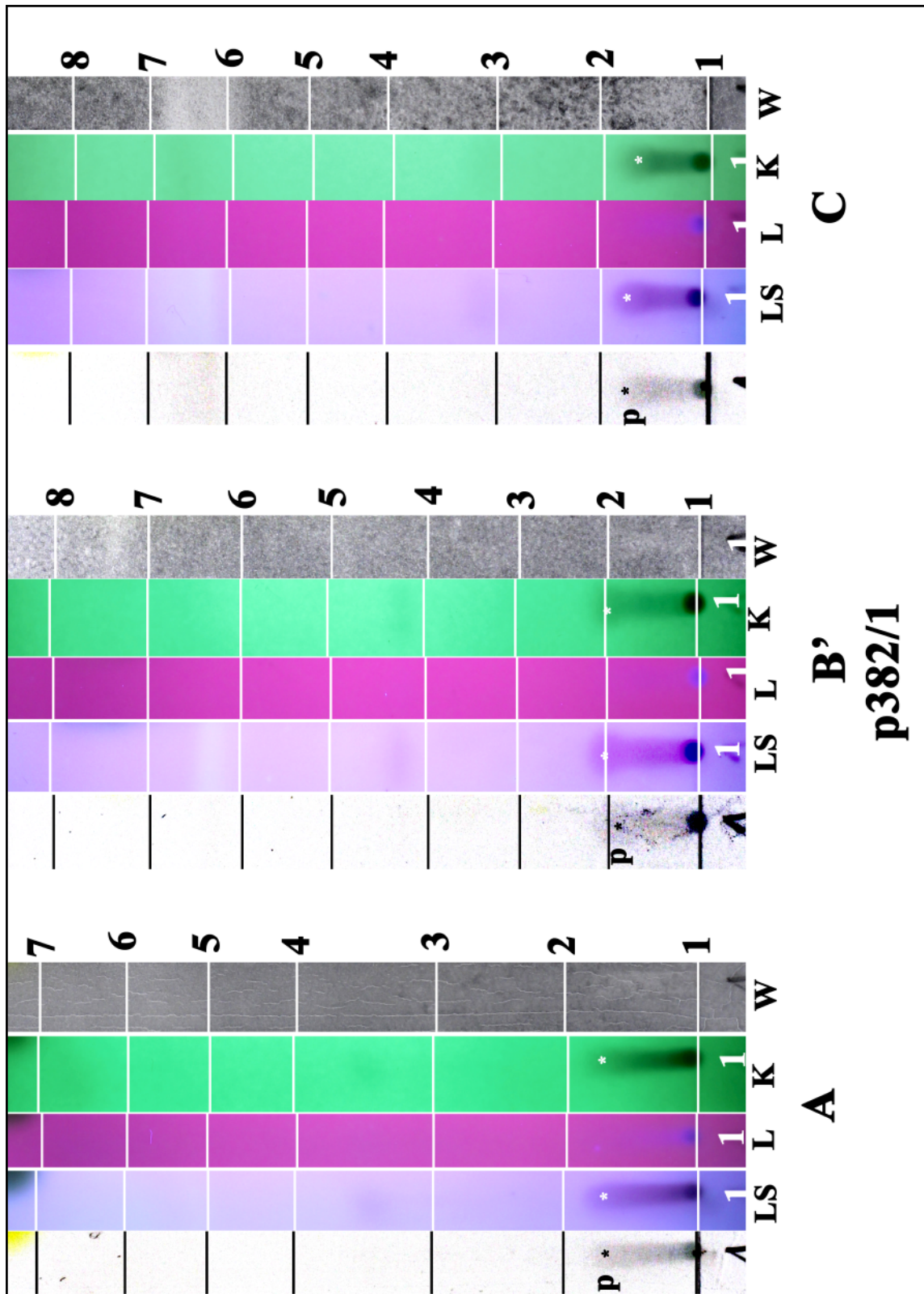
polyporic acid



p: polyporic acid, a: pulvinic dilactone, b: calycin, c: pulvinic acid

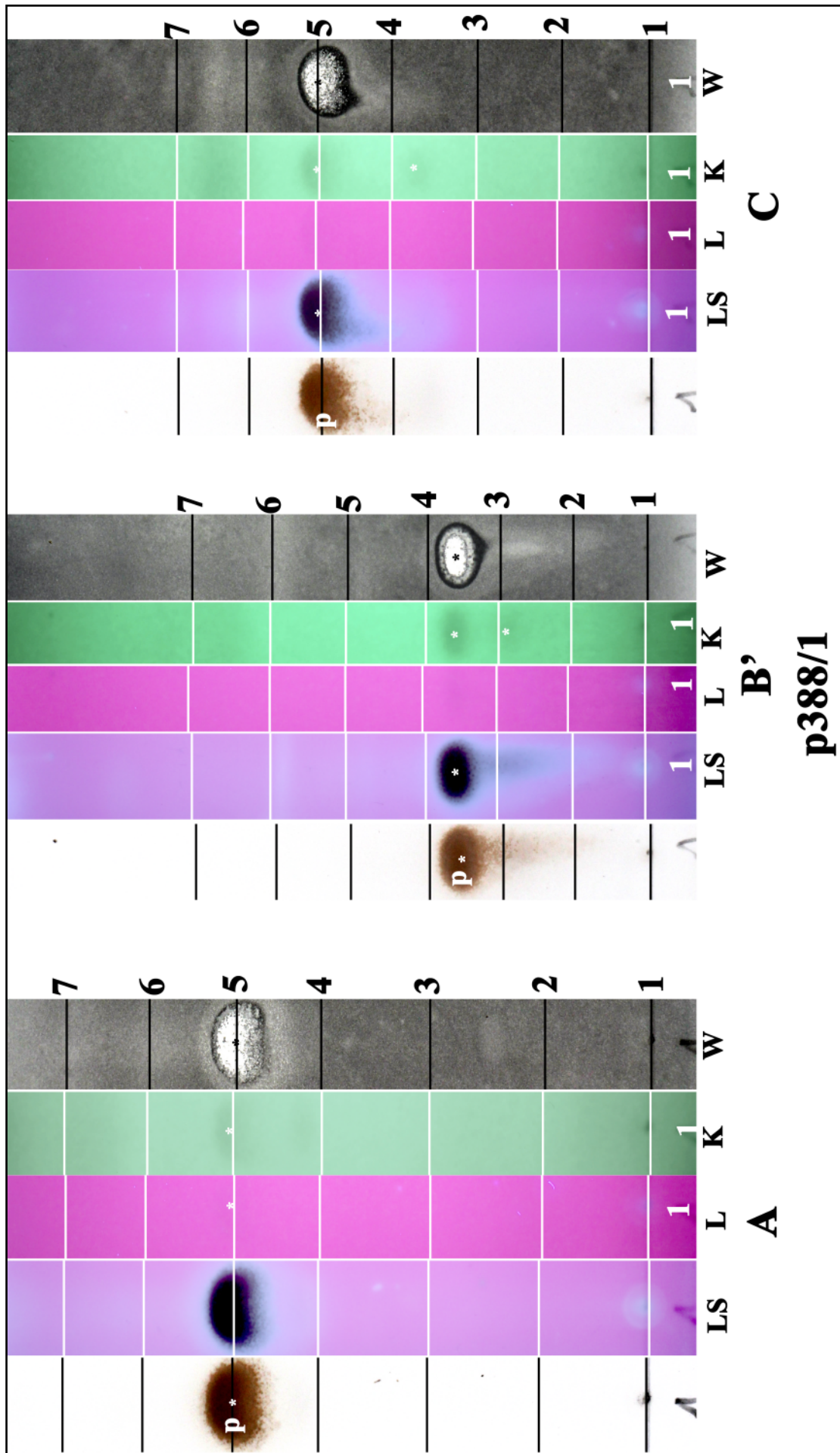
Purified lichen substance received from K. Kalb; origin S. Huneck.

porphyritic acid



Purified lichen substance received from K. Kalb; origin S. Huneck.

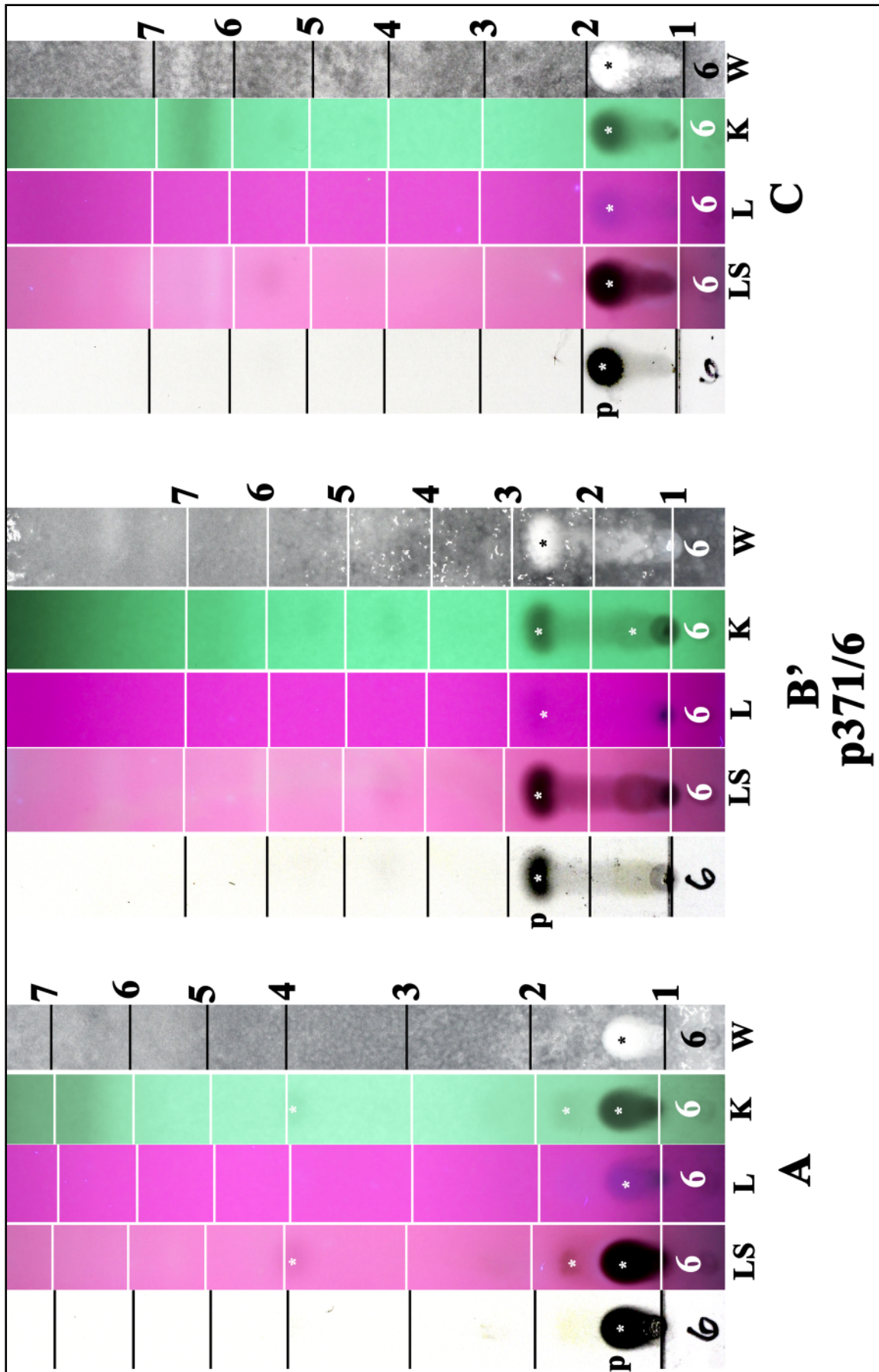
portentol



p: portentol

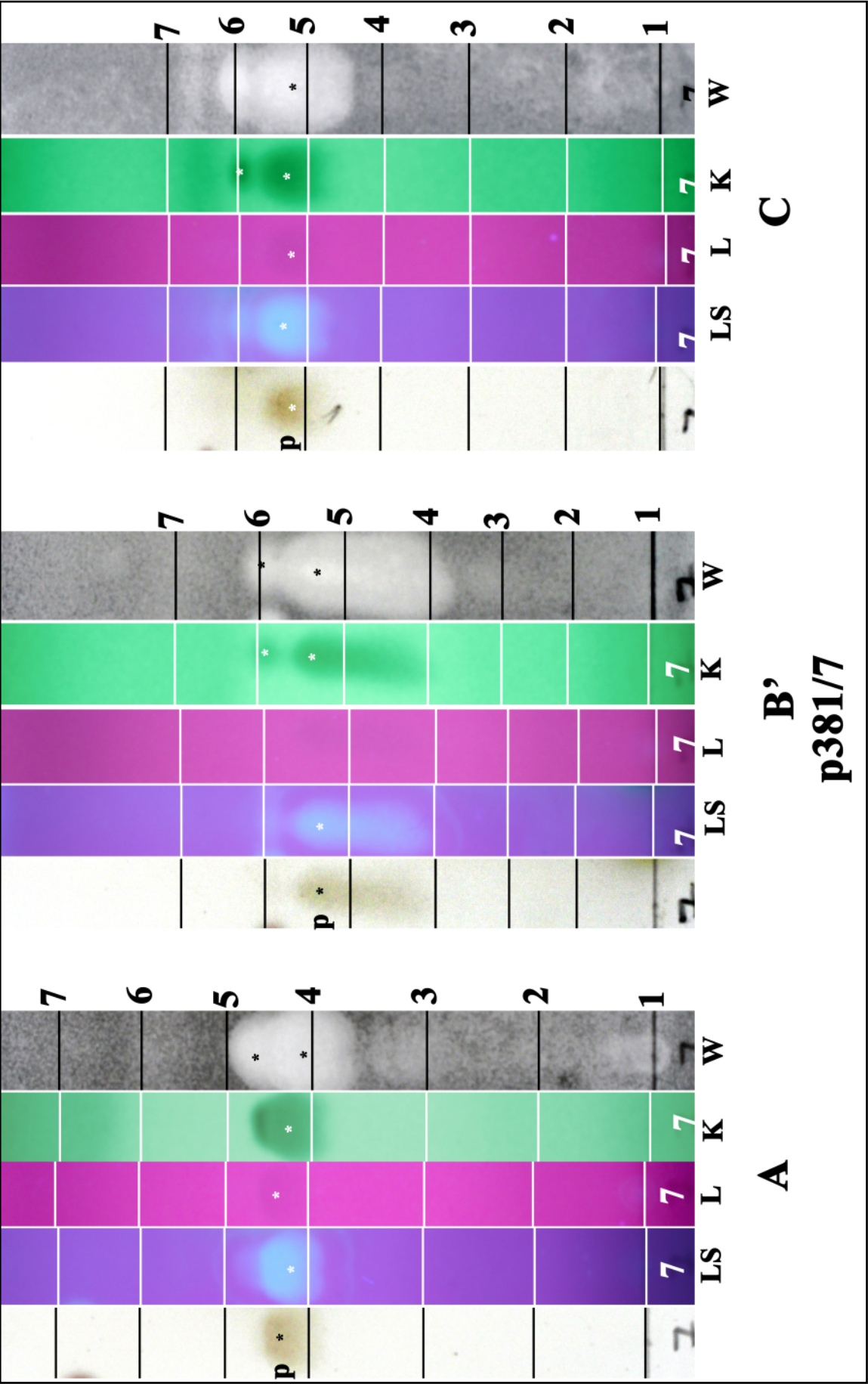
Purified lichen substance received from K. Kalb; origin S. Huneck.

protocetraric acid



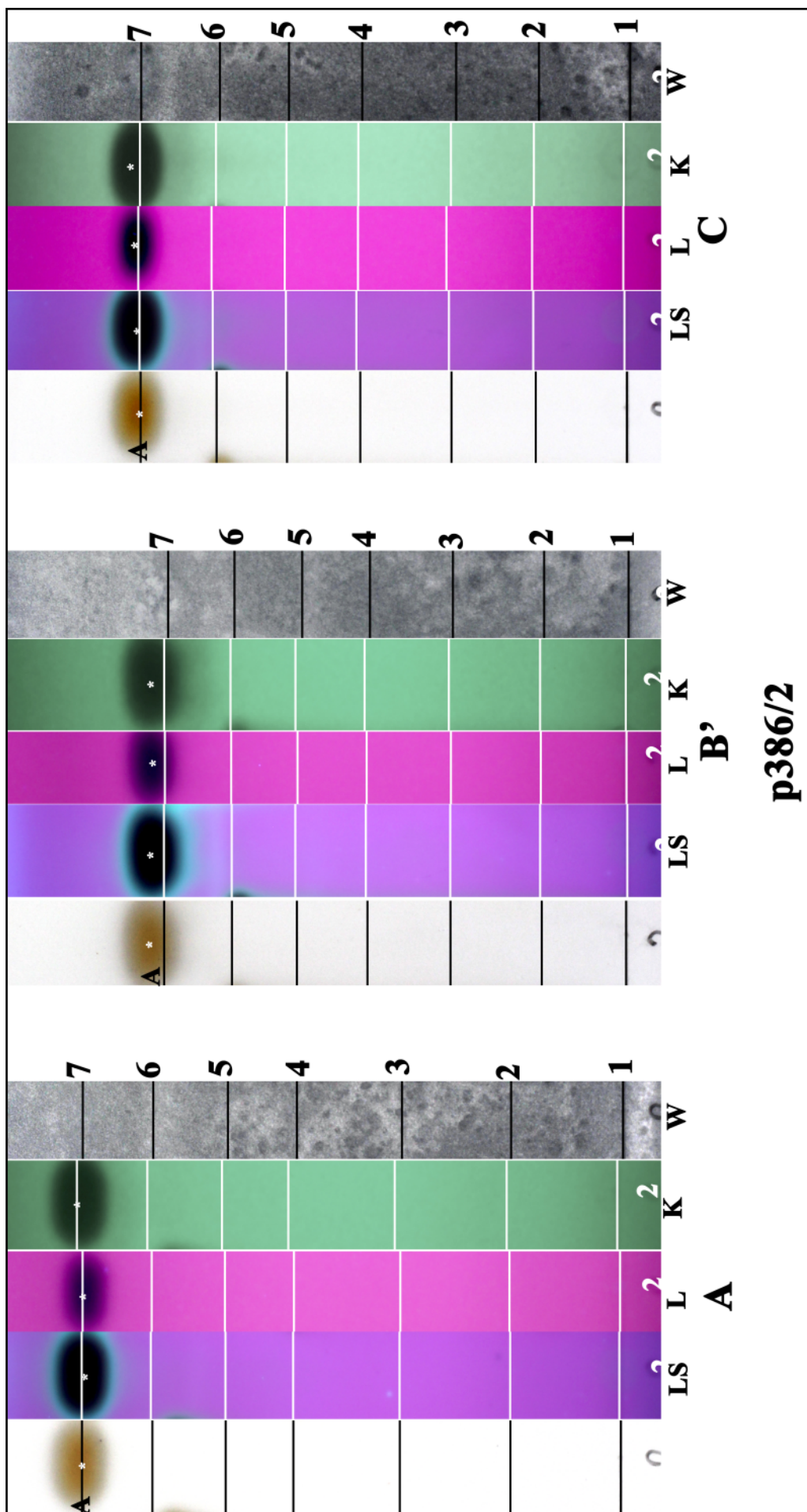
Purified lichen substance received from K. Kalb; origin S. Huneck.

**(+)-protolichesterinic acid**



Purified lichen substance received from K. Kalb; origin S. Huneck.

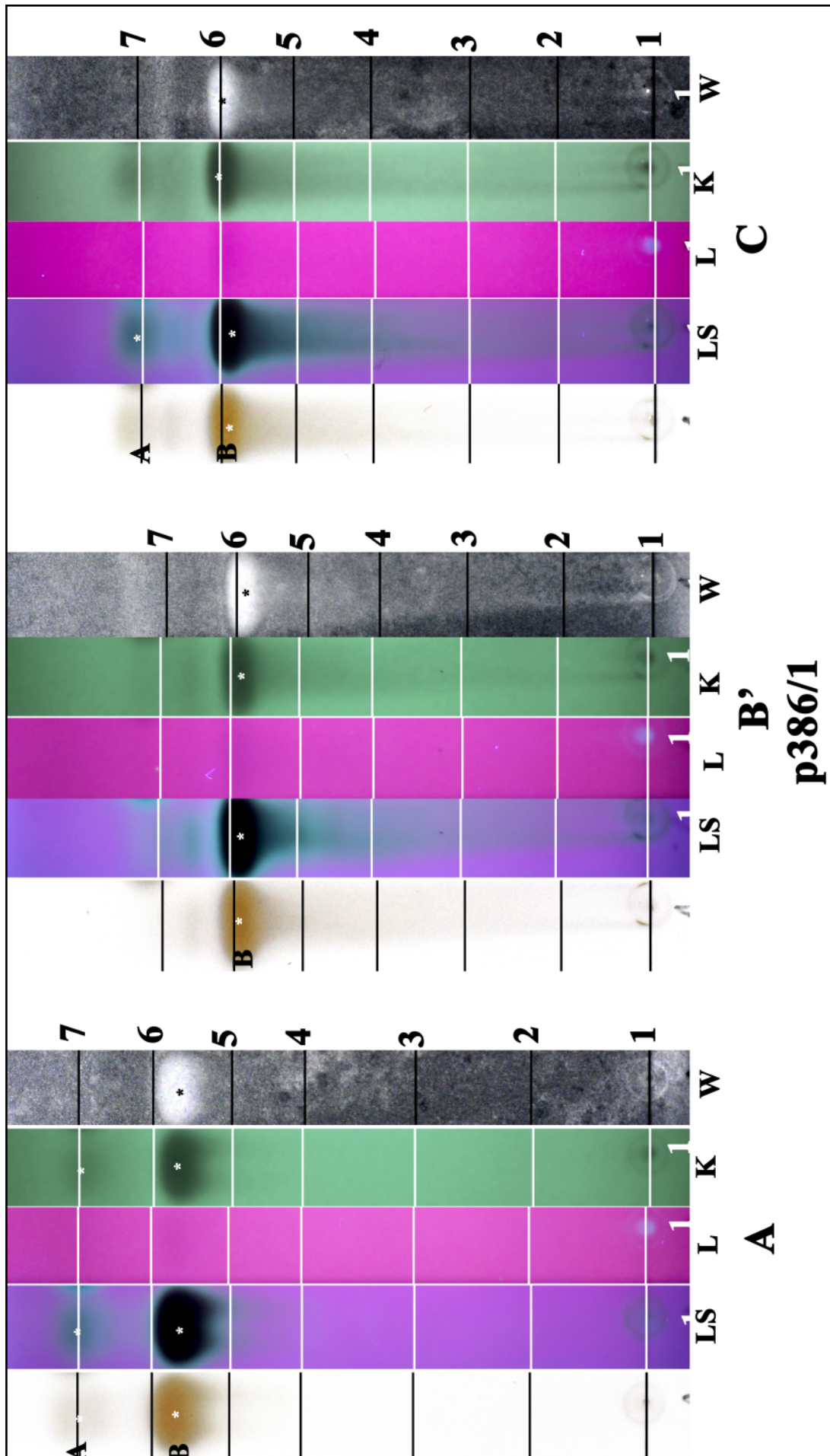
# pseudocyphellarin A



A: pseudocyphellarin A

Purified lichen substance received from K. Kalb; origin S. Huneck.

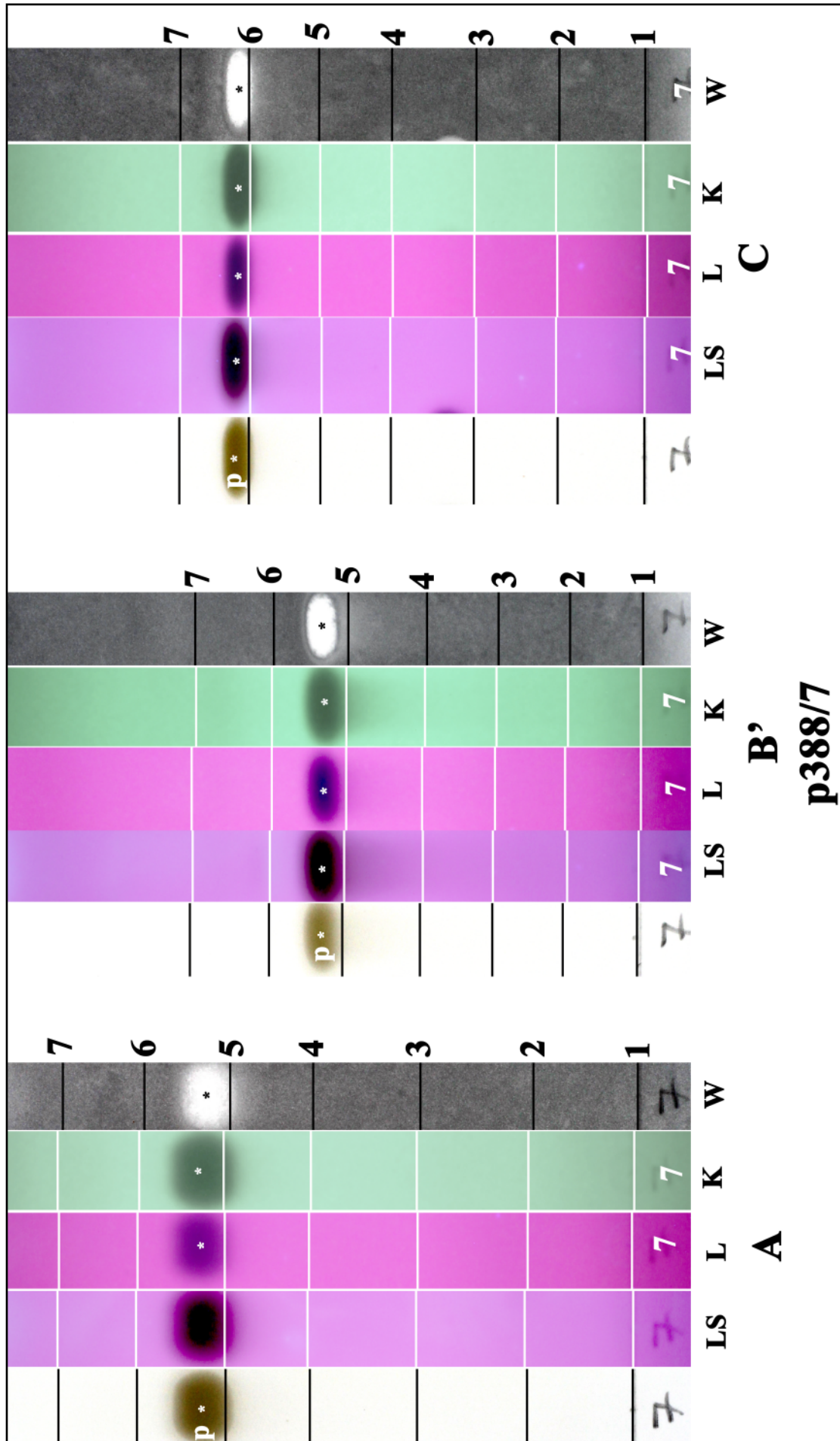
**pseudocyphellarin B**



**B: pseudocyphellarin B, A: pseudocyphellarin A (trace)**

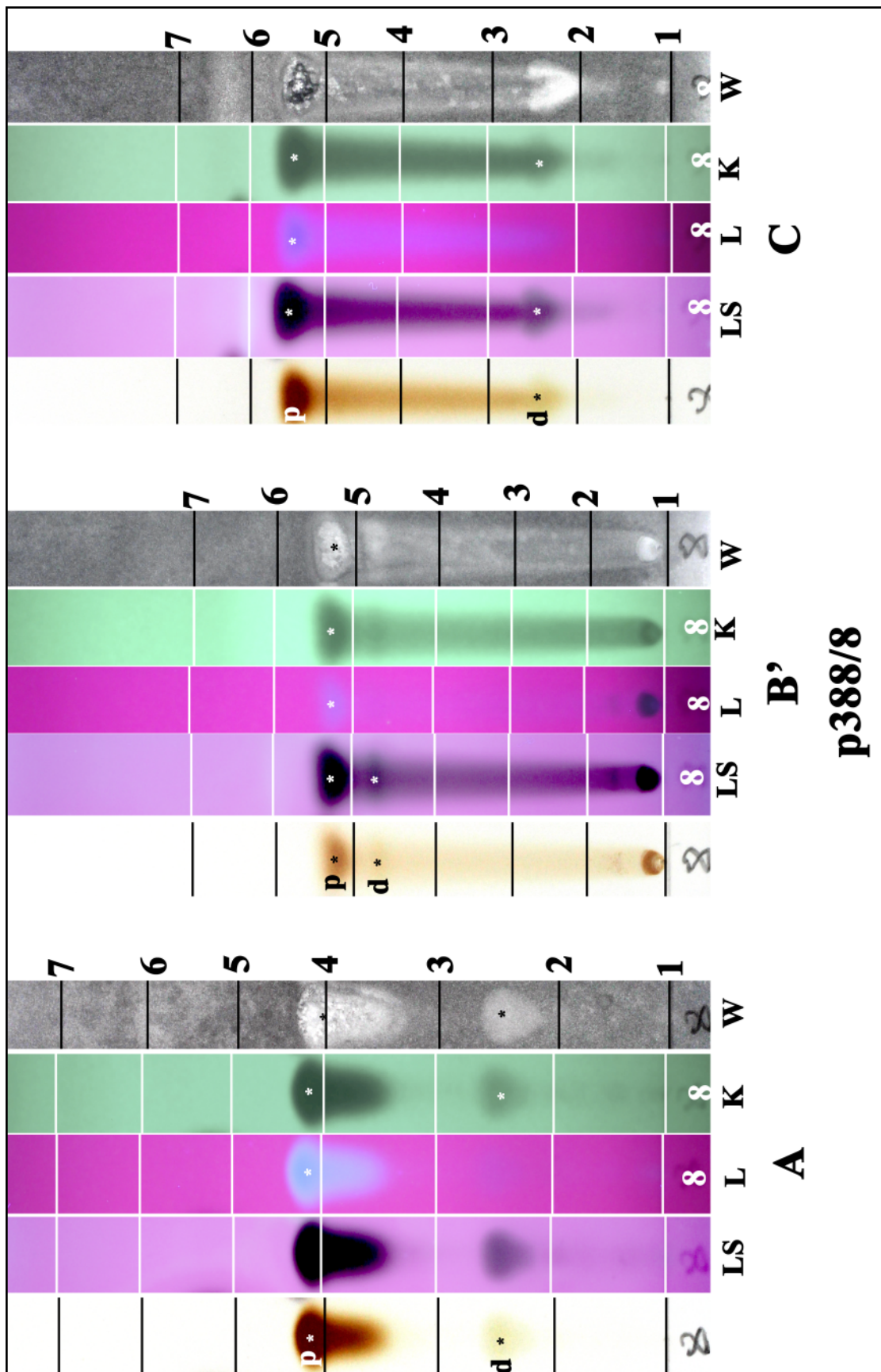
Purified lichen substance received from K. Kalb; origin S. Huneck.

pseudoplacodiolic acid



Purified lichen substance received from K. Kalb; origin S. Huneck.

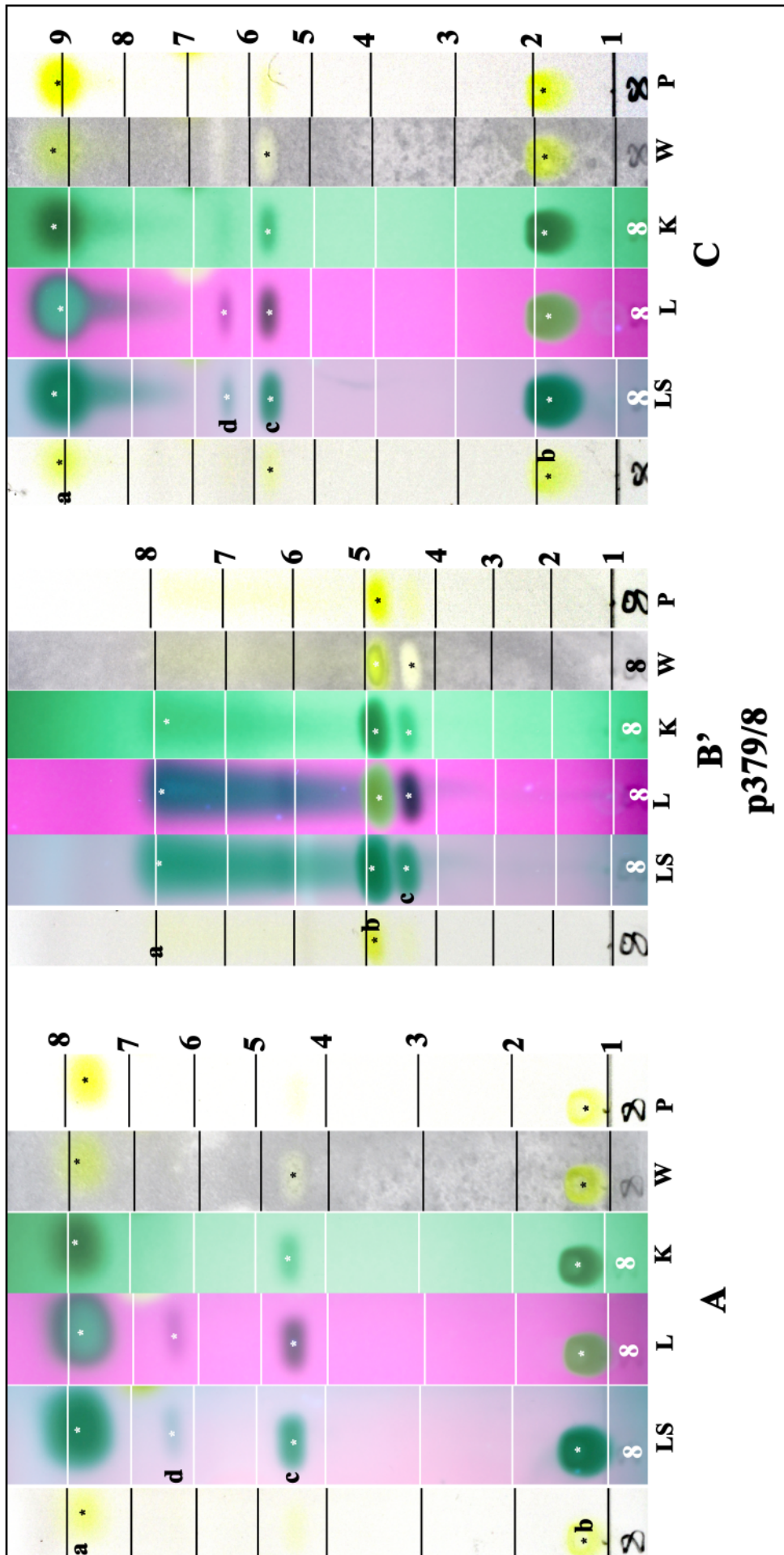
psoromic acid



p: psoromic acid, d: 2'-O-demethylpsoromic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

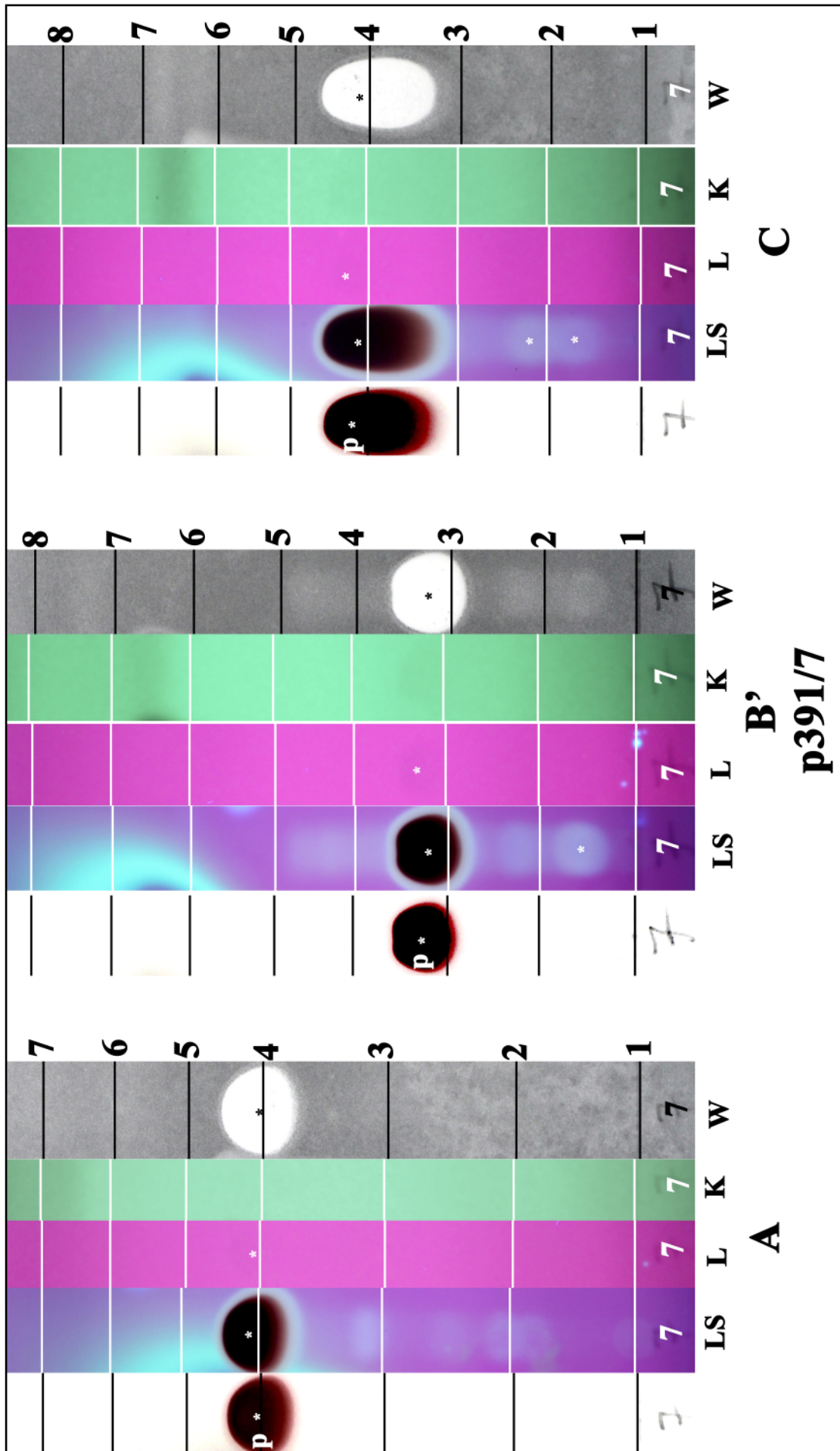
pulvinic dilactone



a: pulvinic dilactone, b: pulvinic acid, c,d: ?

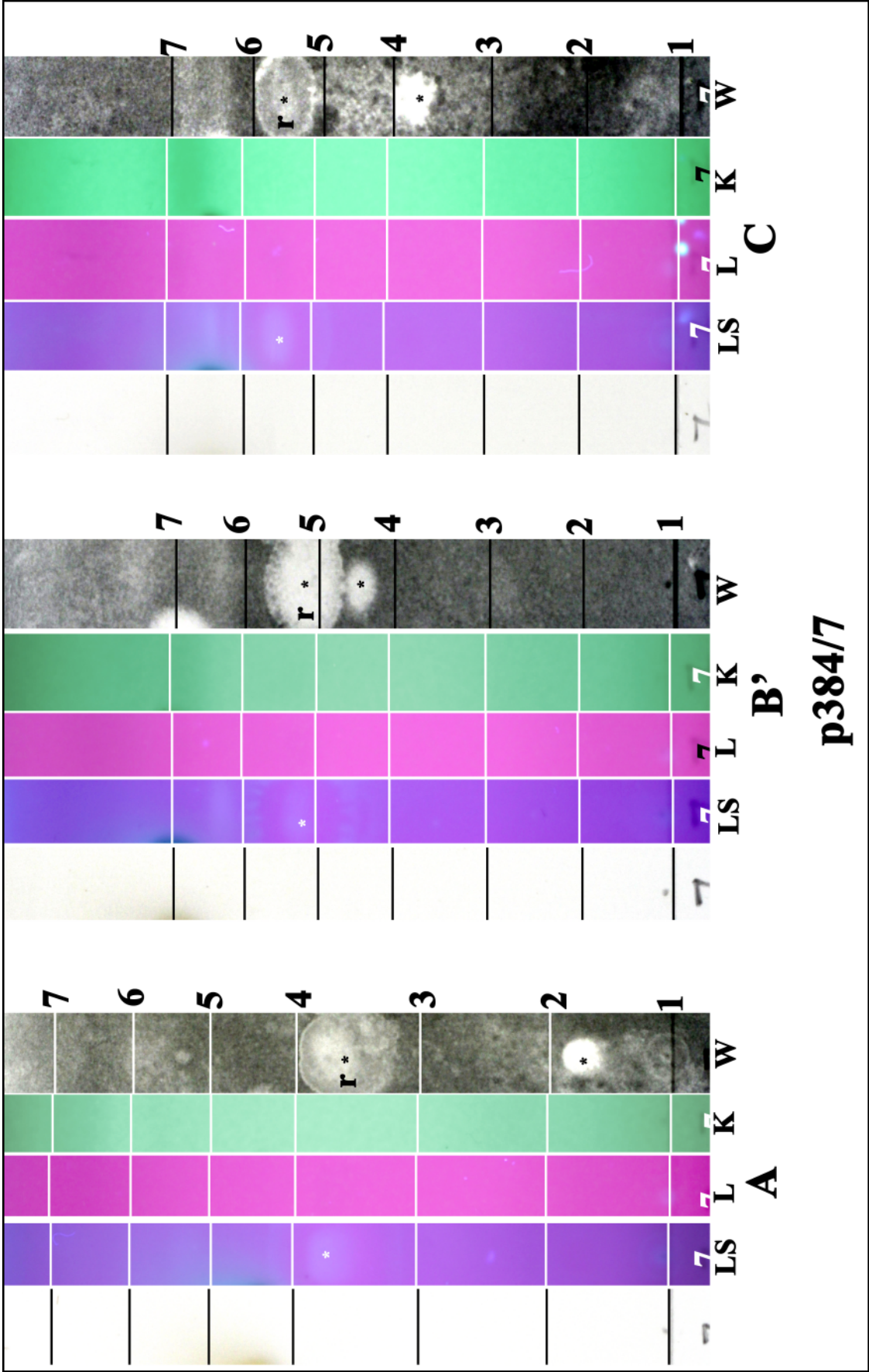
Purified lichen substance received from K. Kalb; origin S. Huneck.

pyxinol



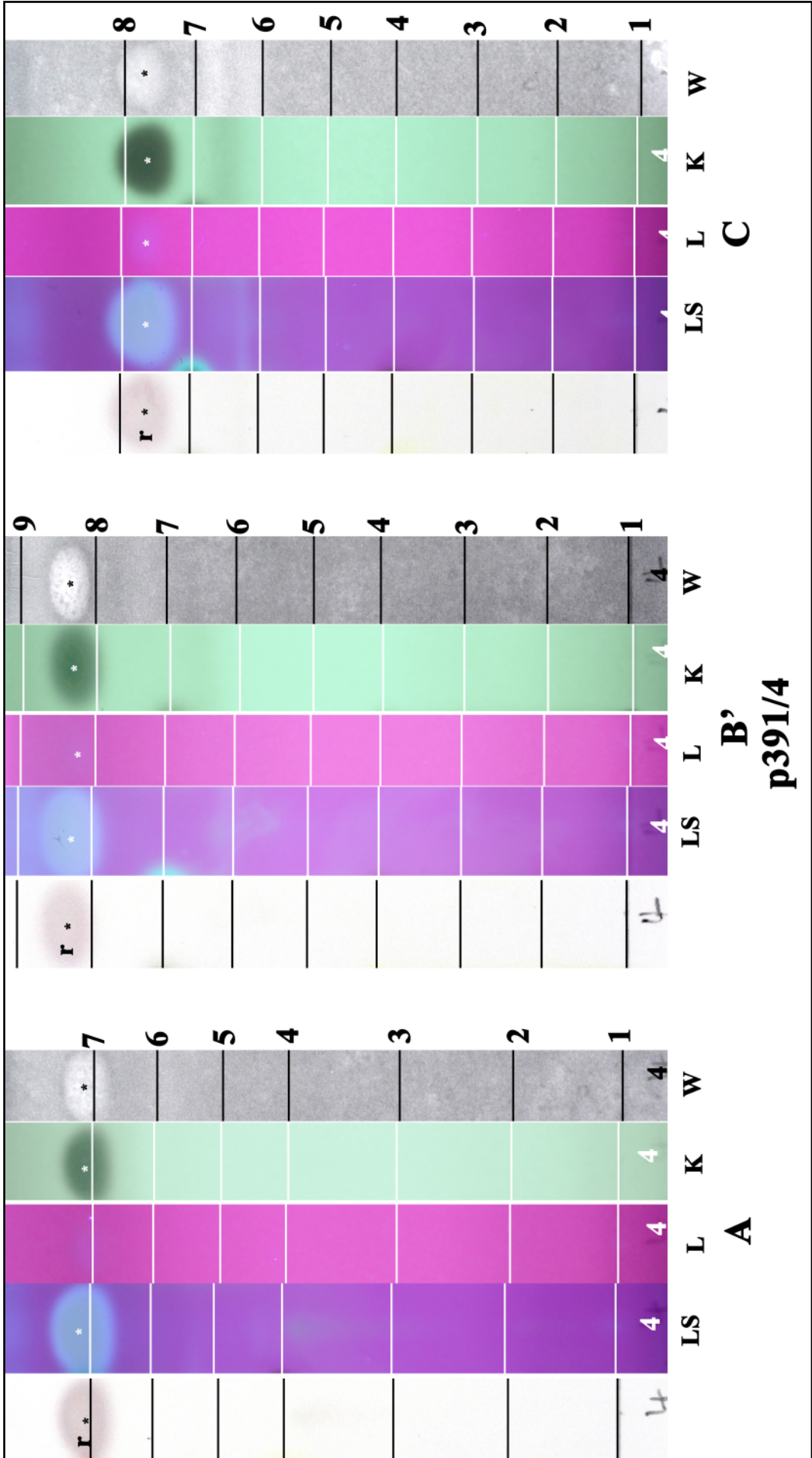
Purified lichen substance received from K. Kalb; origin S. Huneck.

rangiformic acid



Purified lichen substance received from K. Kalb; origin S. Huneck.

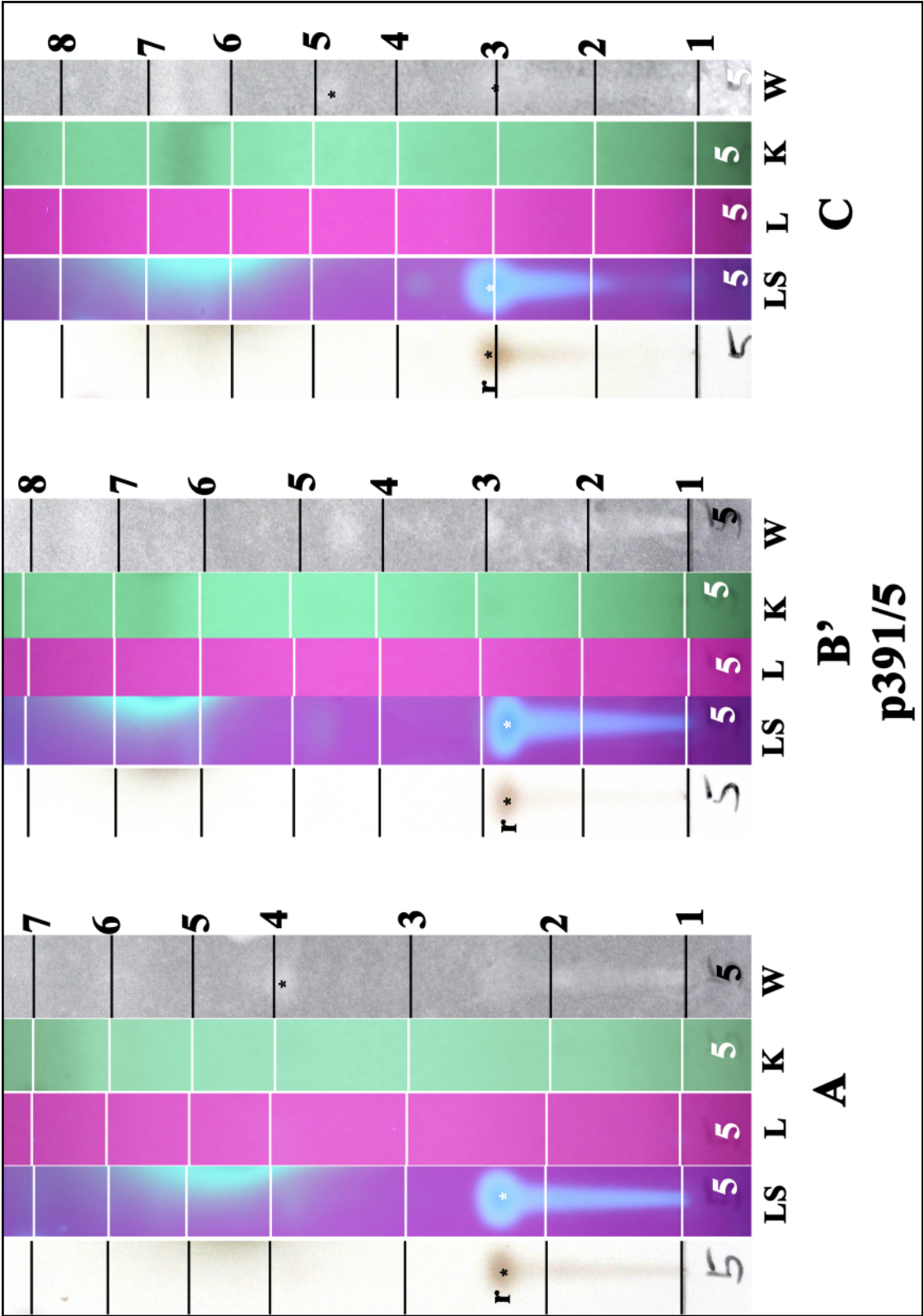
retigeranic acid



r: retigeranic acid

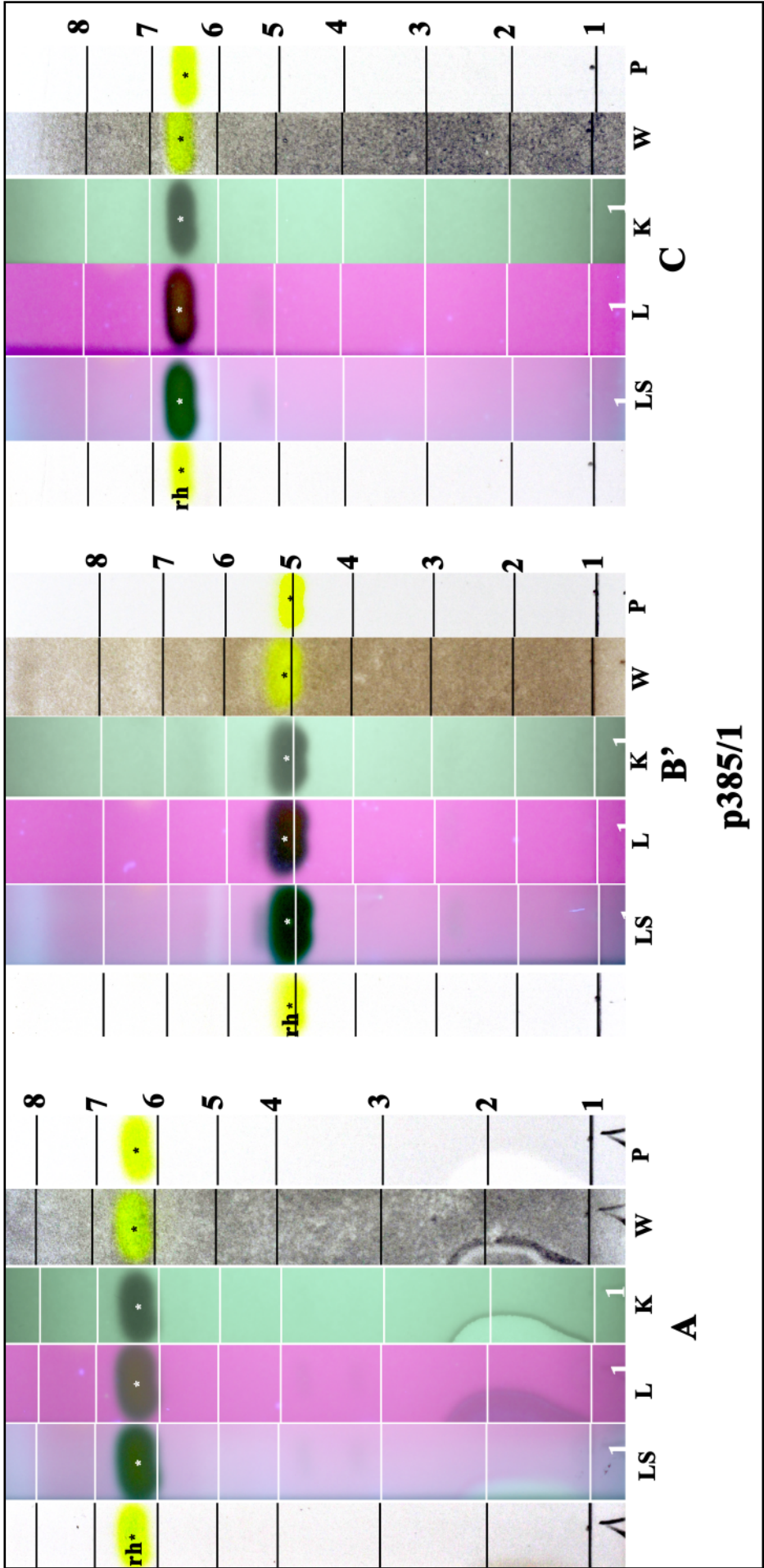
Purified lichen substance received from K. Kalb; origin S. Huneck.

retigeric acid A



Purified lichen substance received from K. Kalb; origin S. Huneck.

rhizocarpic acid

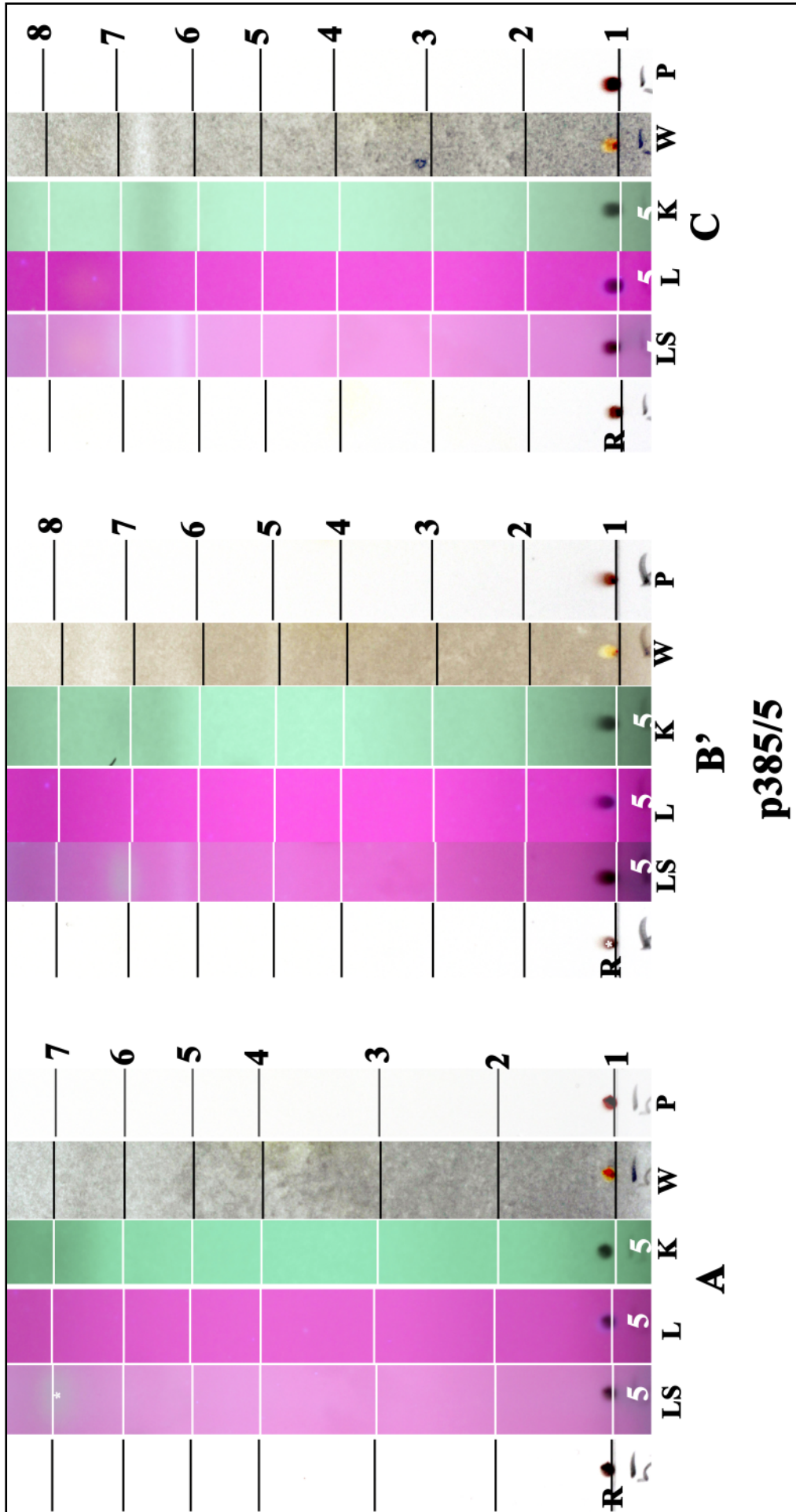


rh: rhizocarpic acid

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Purified lichen substance received from K. Kalb; origin S. Huneck.

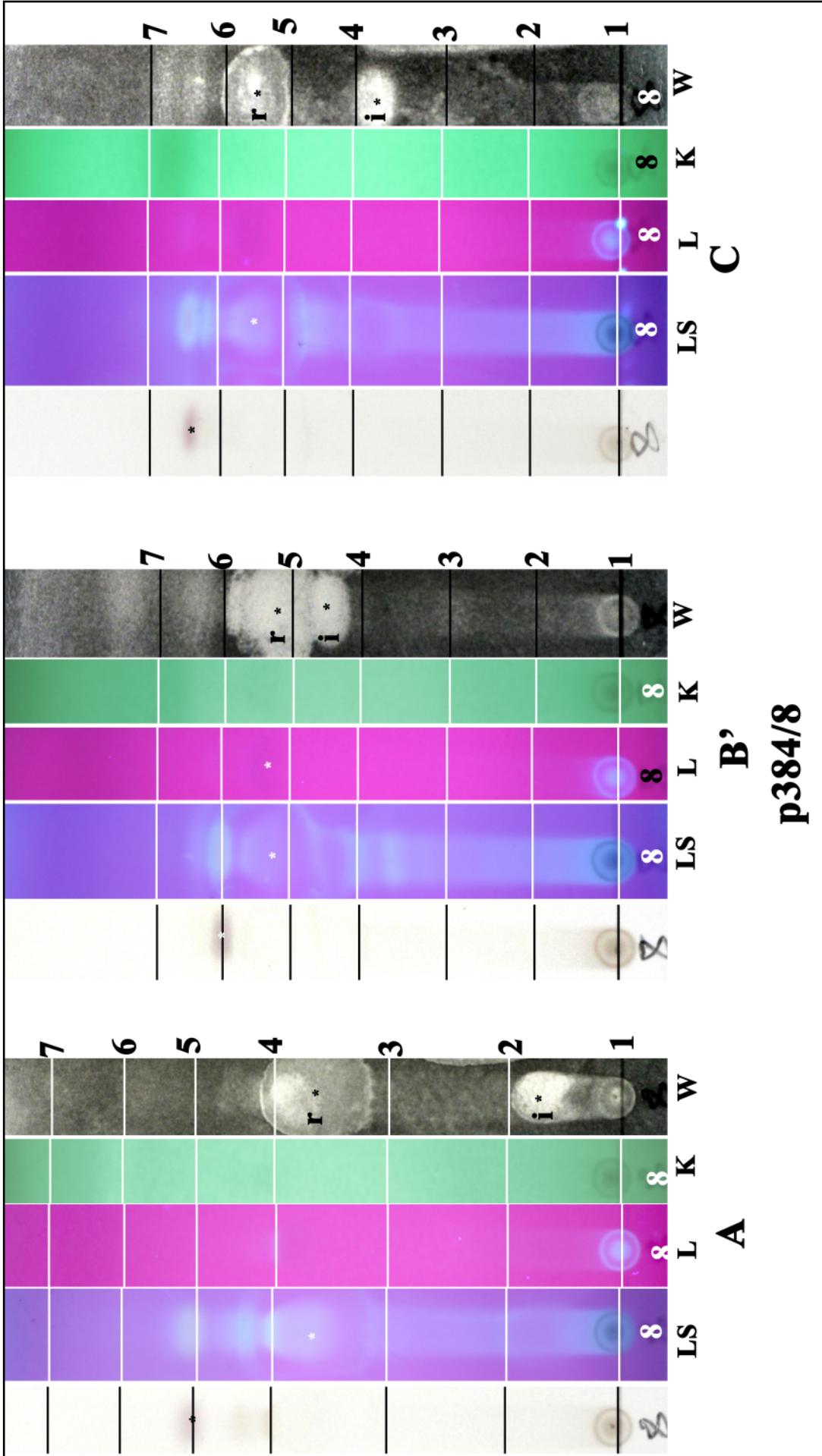
rhodocladonic acid



R: rhodocladonic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

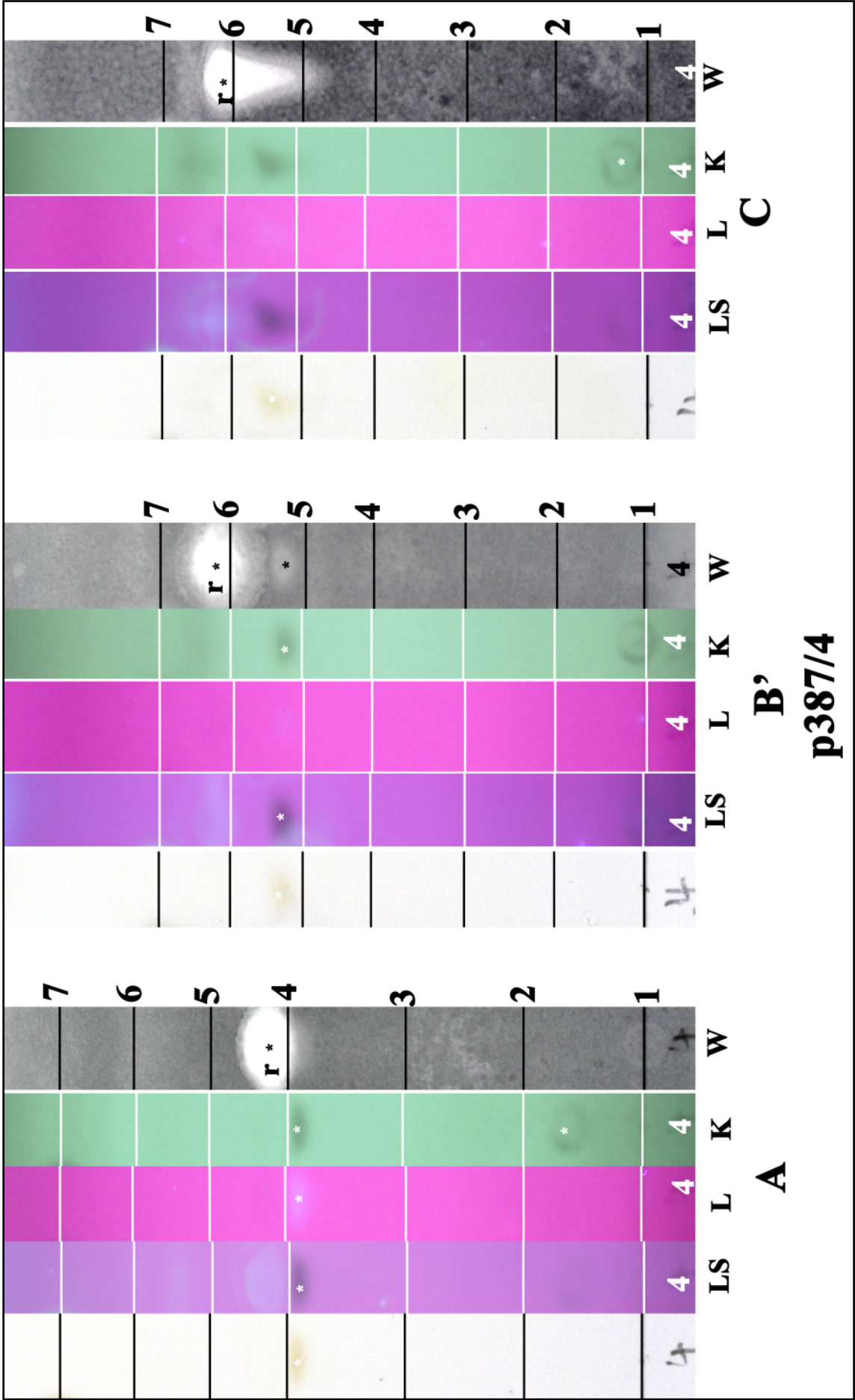
rangiformic acid



r: rangiformic acid, i: isorangiformic acid

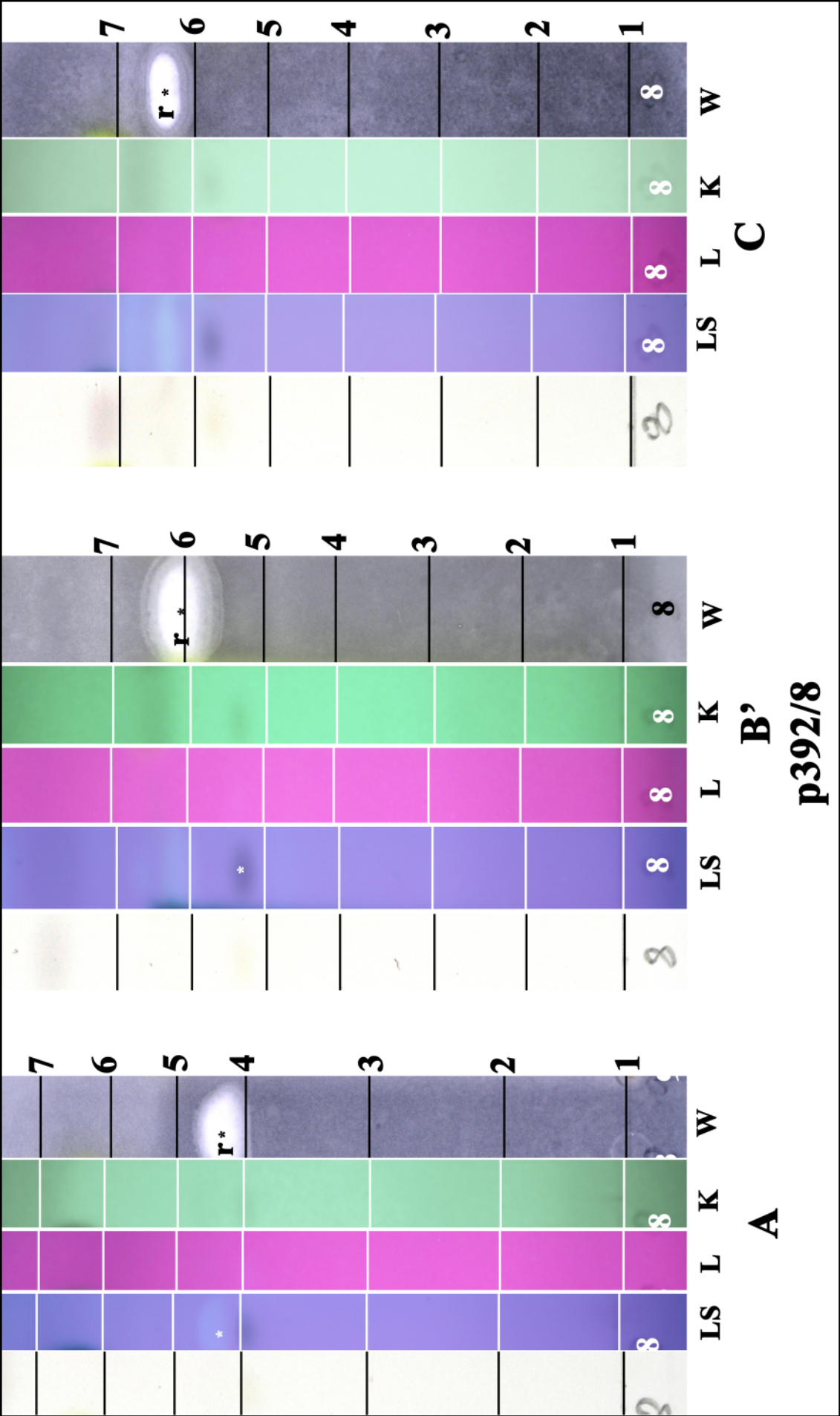
Purified lichen substance received from K. Kalb; origin S. Huneck.

roccelic acid



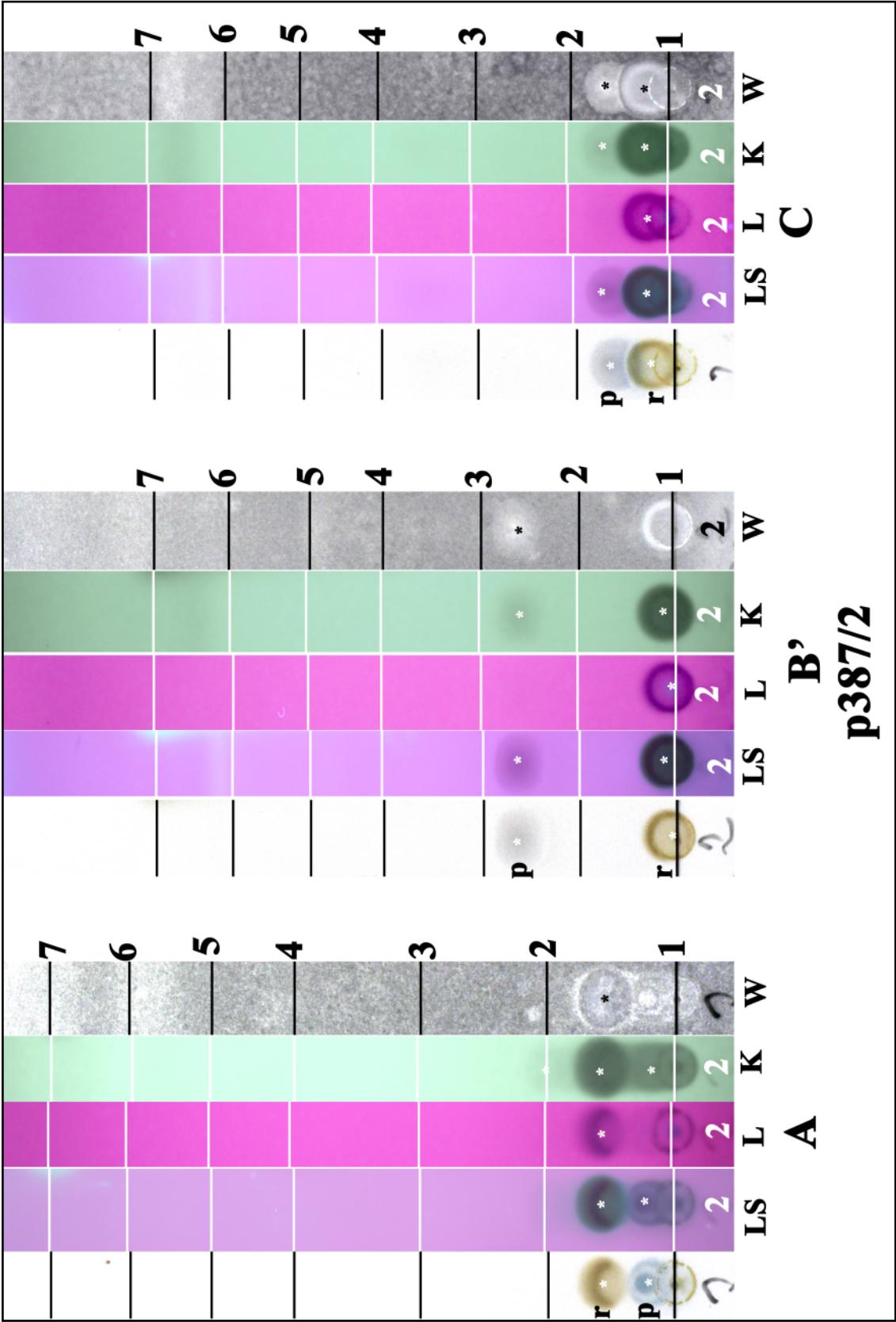
Purified lichen substance received from K. Kalb; origin S. Huneck.

roccelic acid



Purified lichen substance received from K. Kalb; origin S. Huneck.

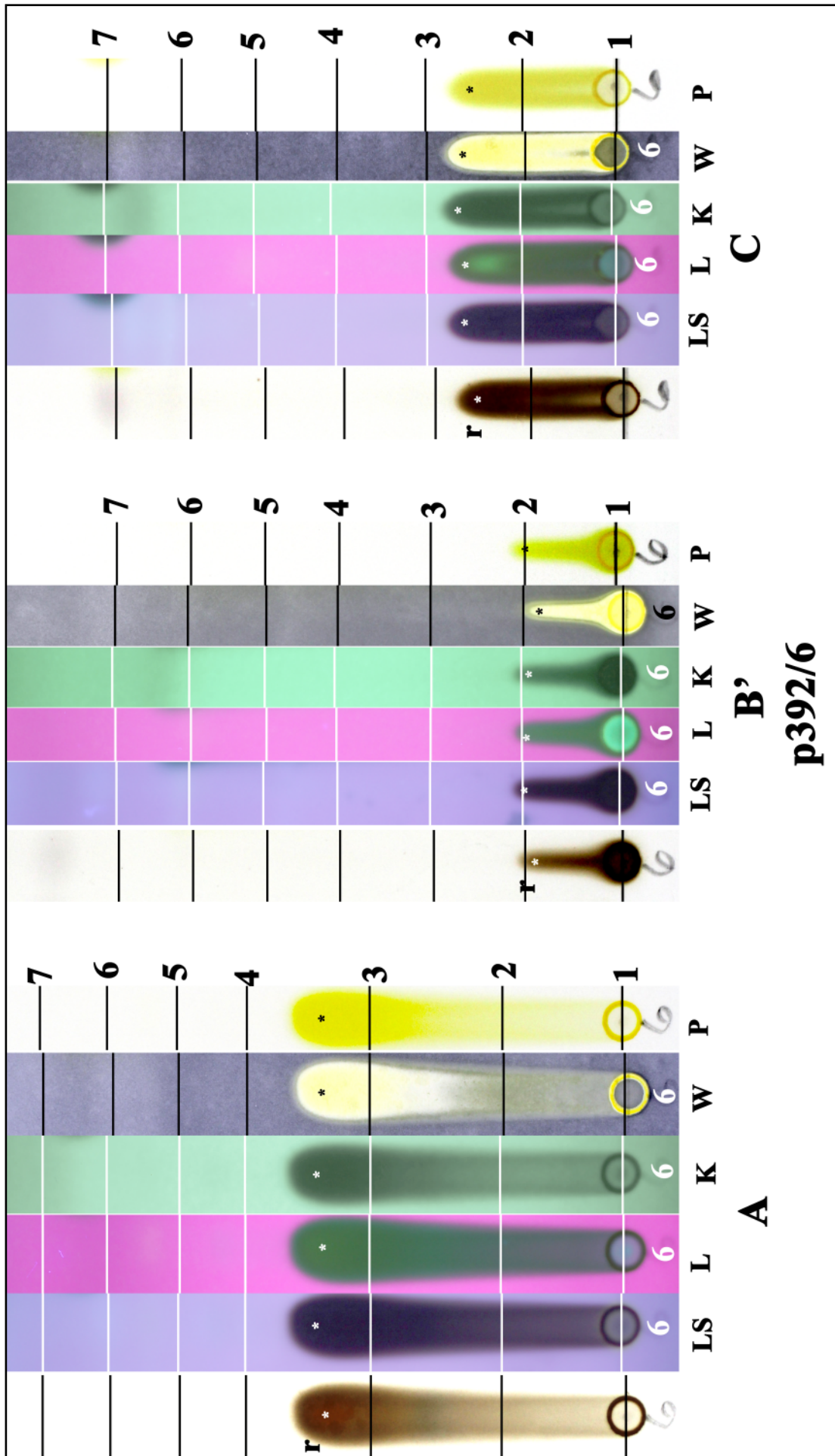
roccellin



r: roccellin, p: protocetraric acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

rugulosin

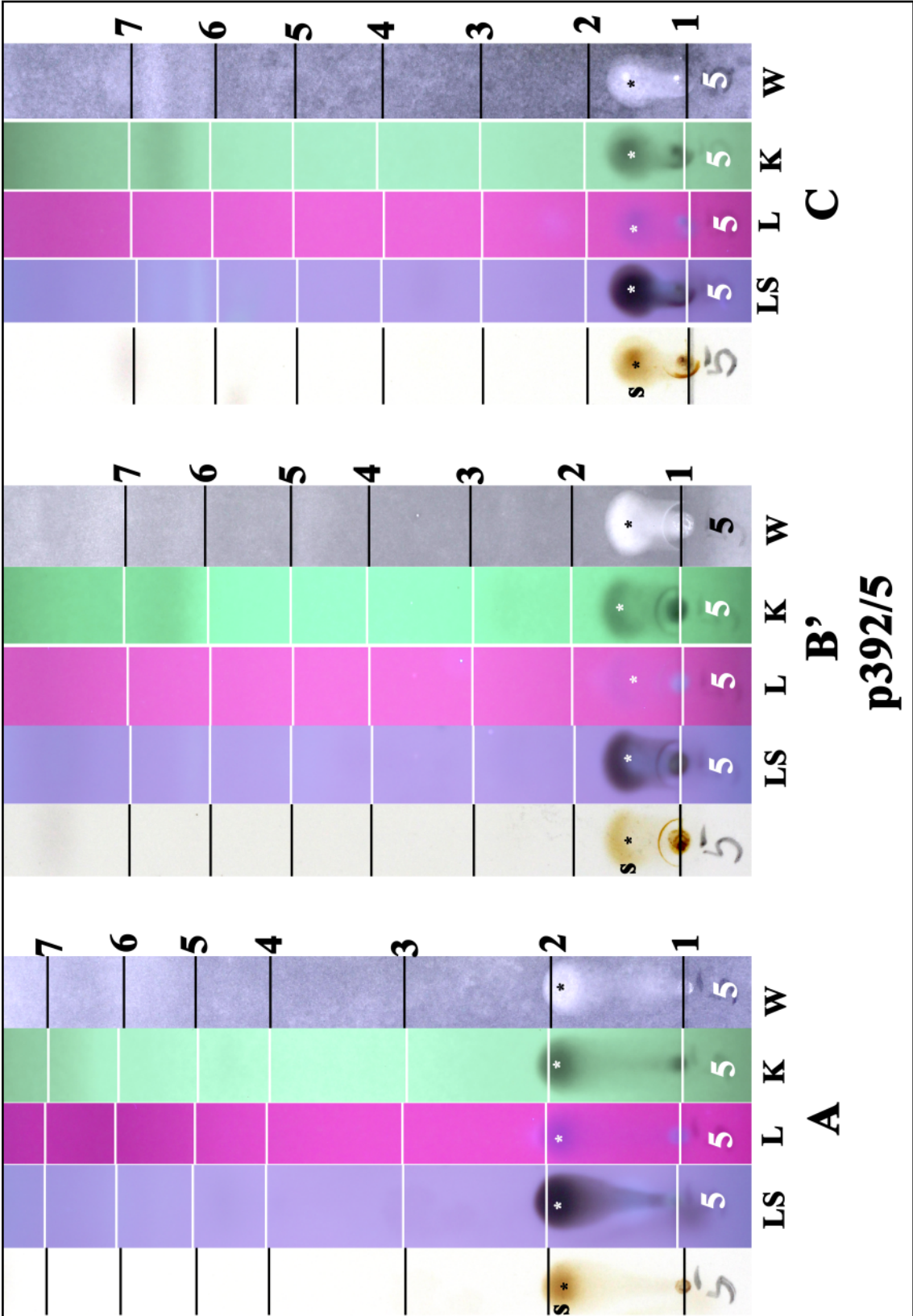


p392/6

r: rugulosin

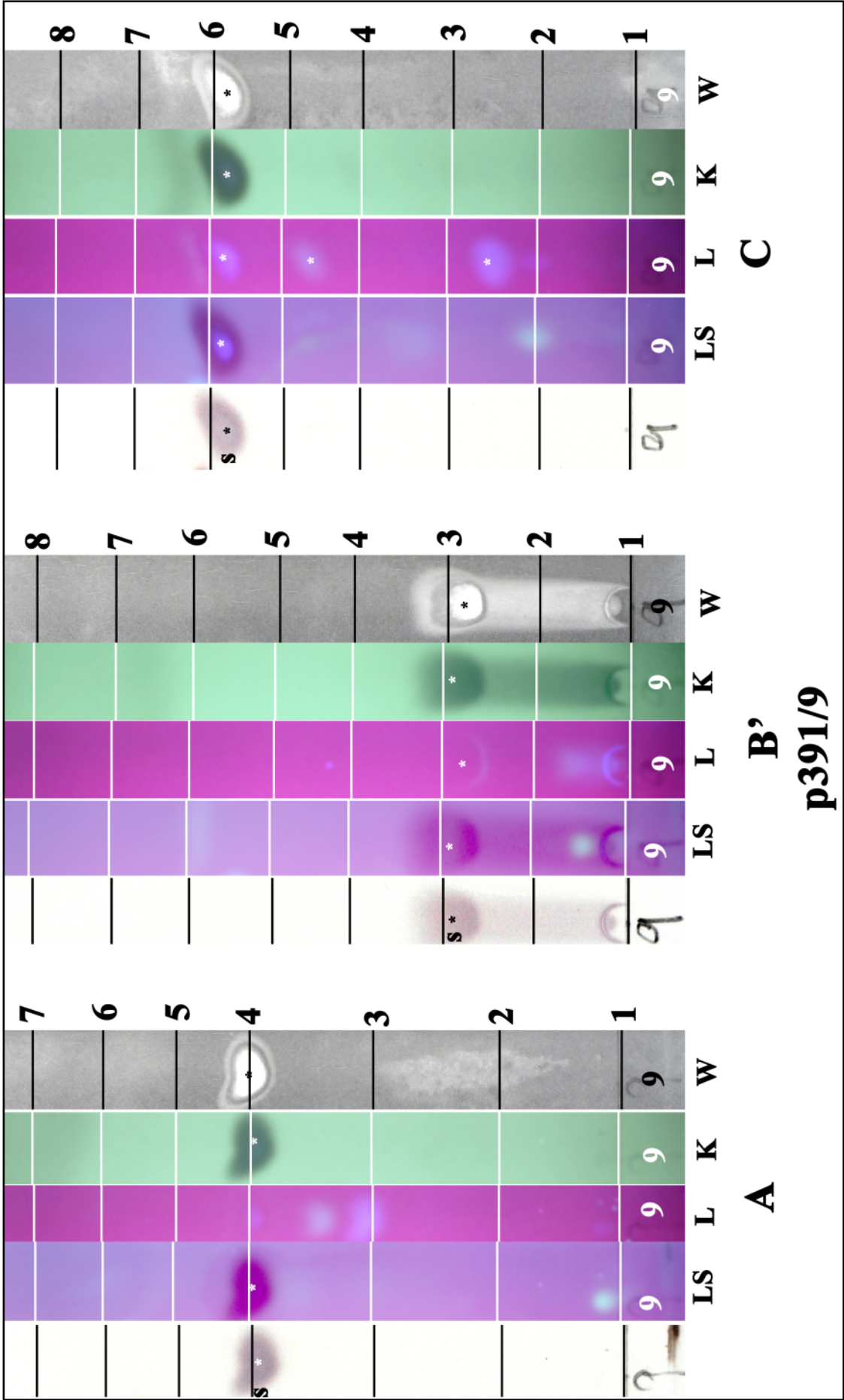
Purified lichen substance received from K. Kalb; origin S. Huneck.

salazinic acid



Purified lichen substance received from K. Kalb; origin S. Huneck.

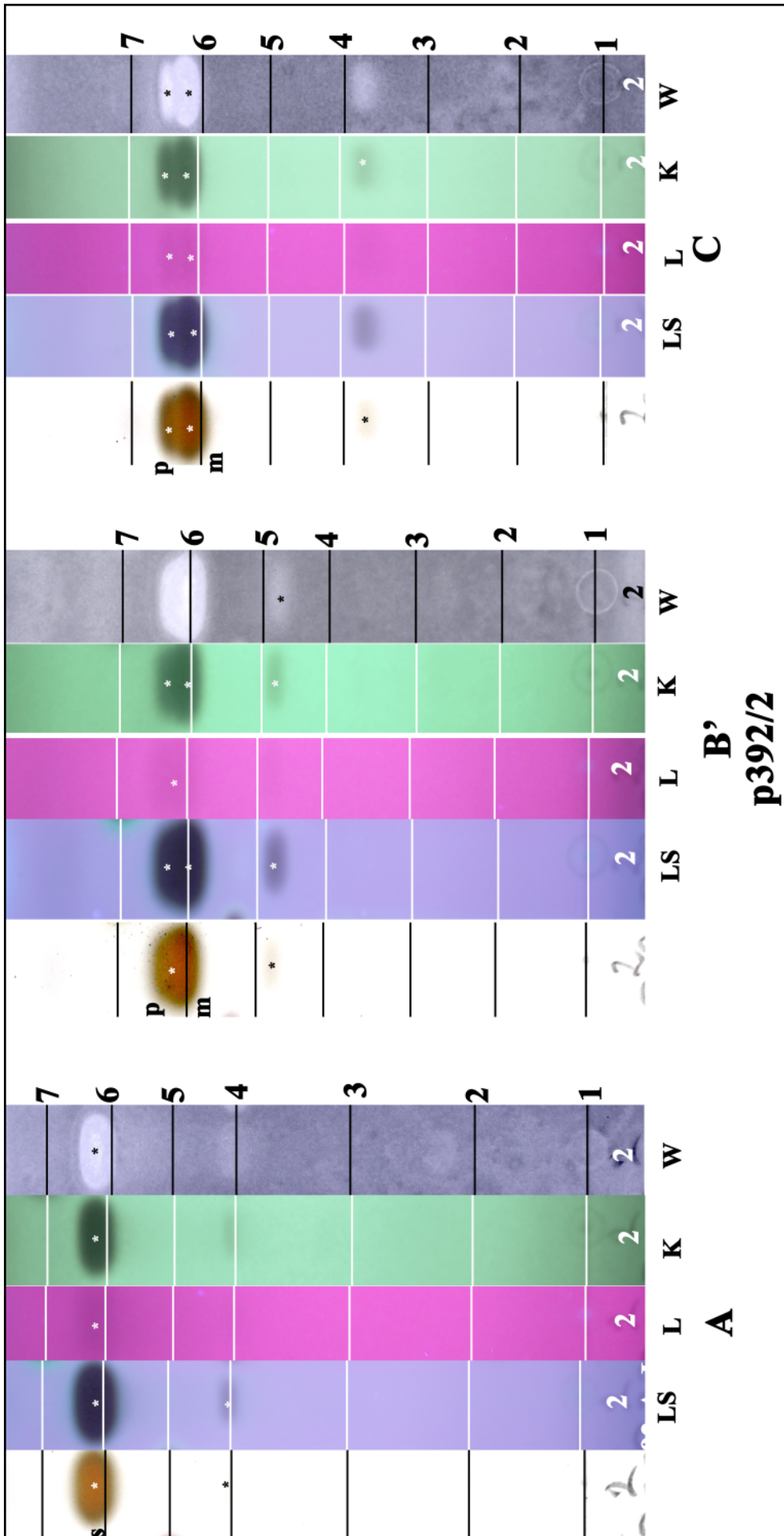
schizopeltic acid



s: schizopeltic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

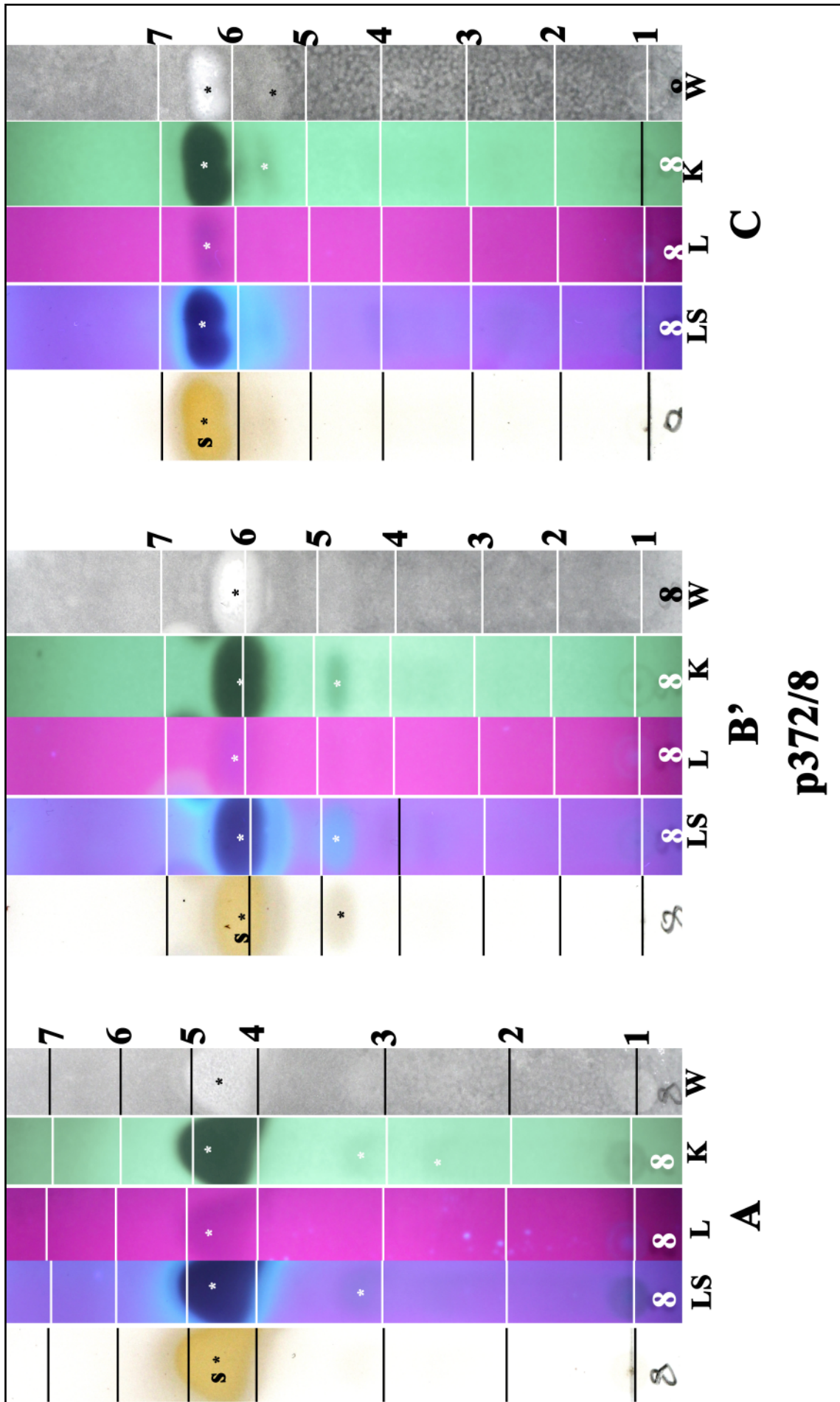
scrobiculin



s: scrobiculin, m: meta-scrobiculin, p: para-scrobiculin

Purified lichen substance received from K. Kalb; origin S. Huneck.

sekikaic acid

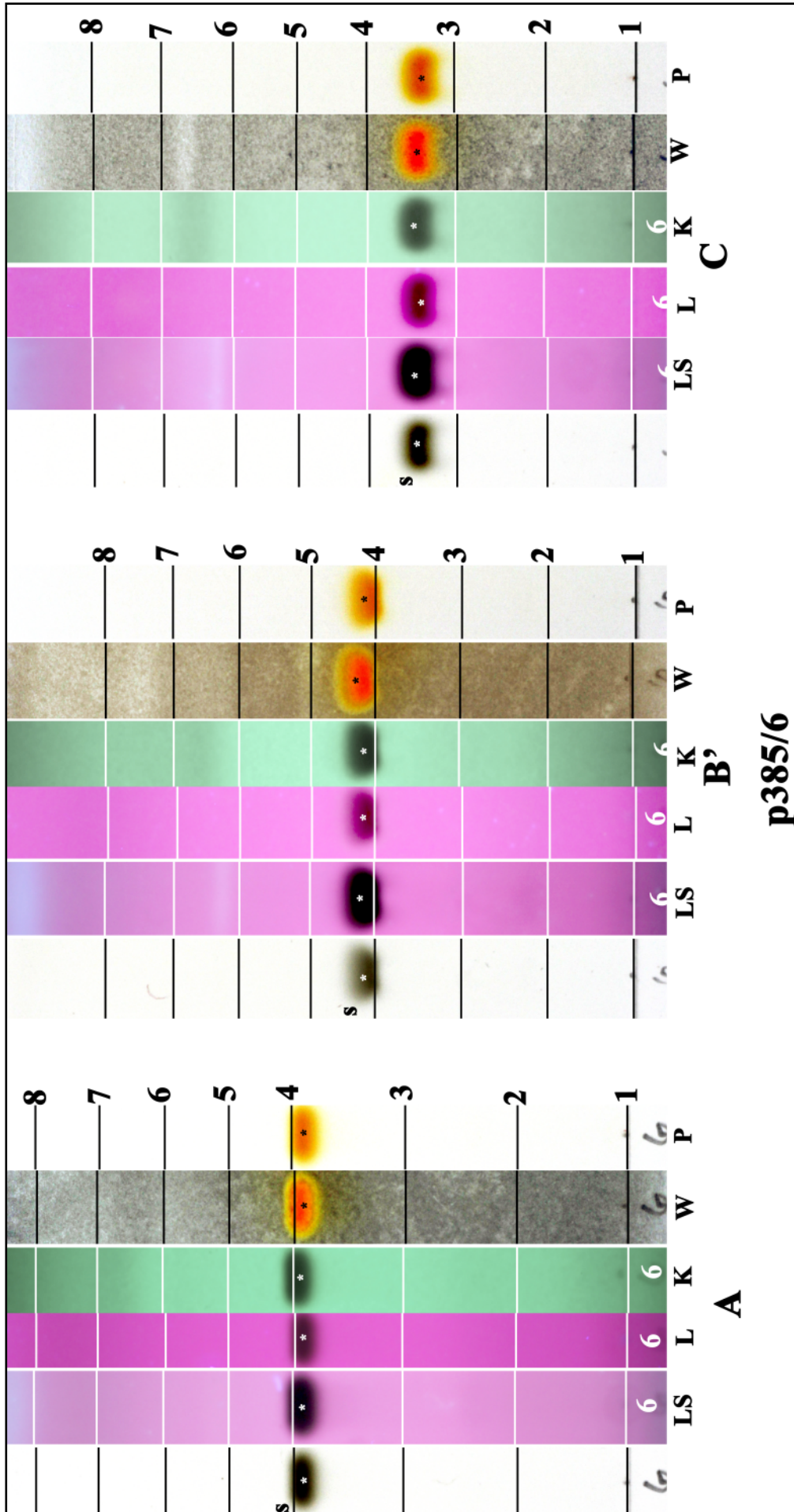


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s: sekikaic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

skyrin

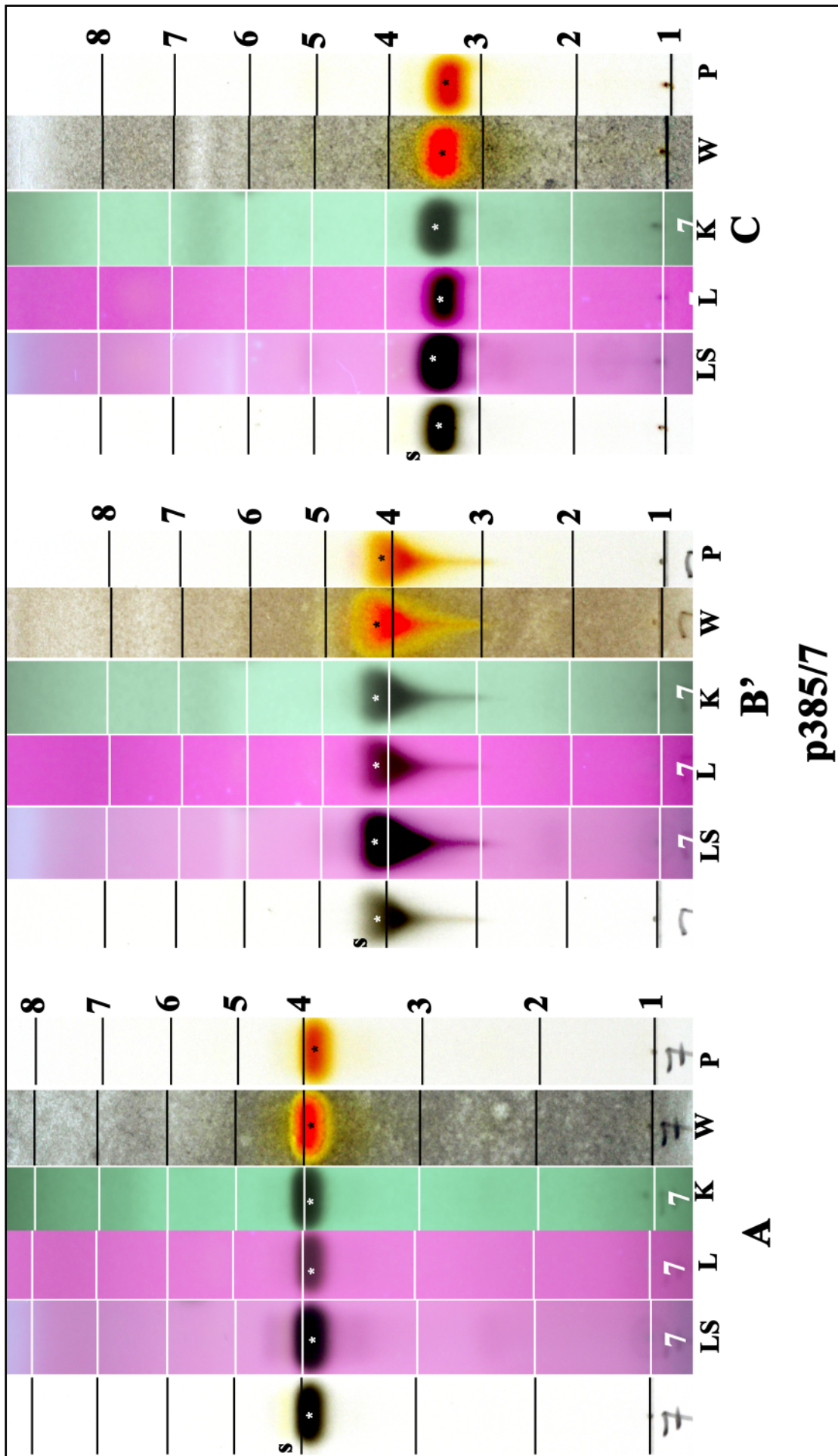


p385/6

s: skyrin

Purified lichen substance received from K. Kalb; origin S. Huneck.

skyrin

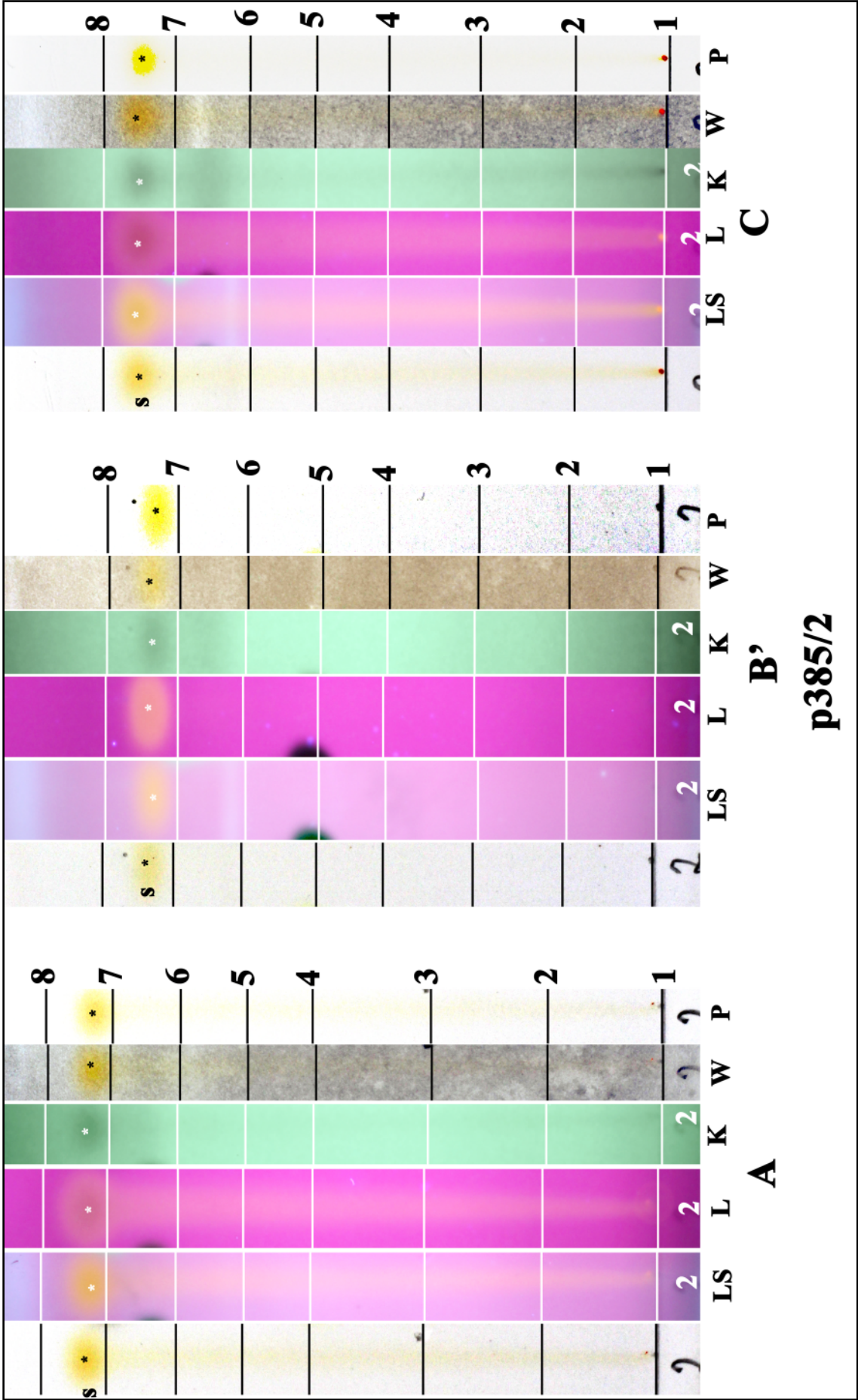


p385/7

s: skyrin

Purified lichen substance received from K. Kalb; origin S. Huneck.

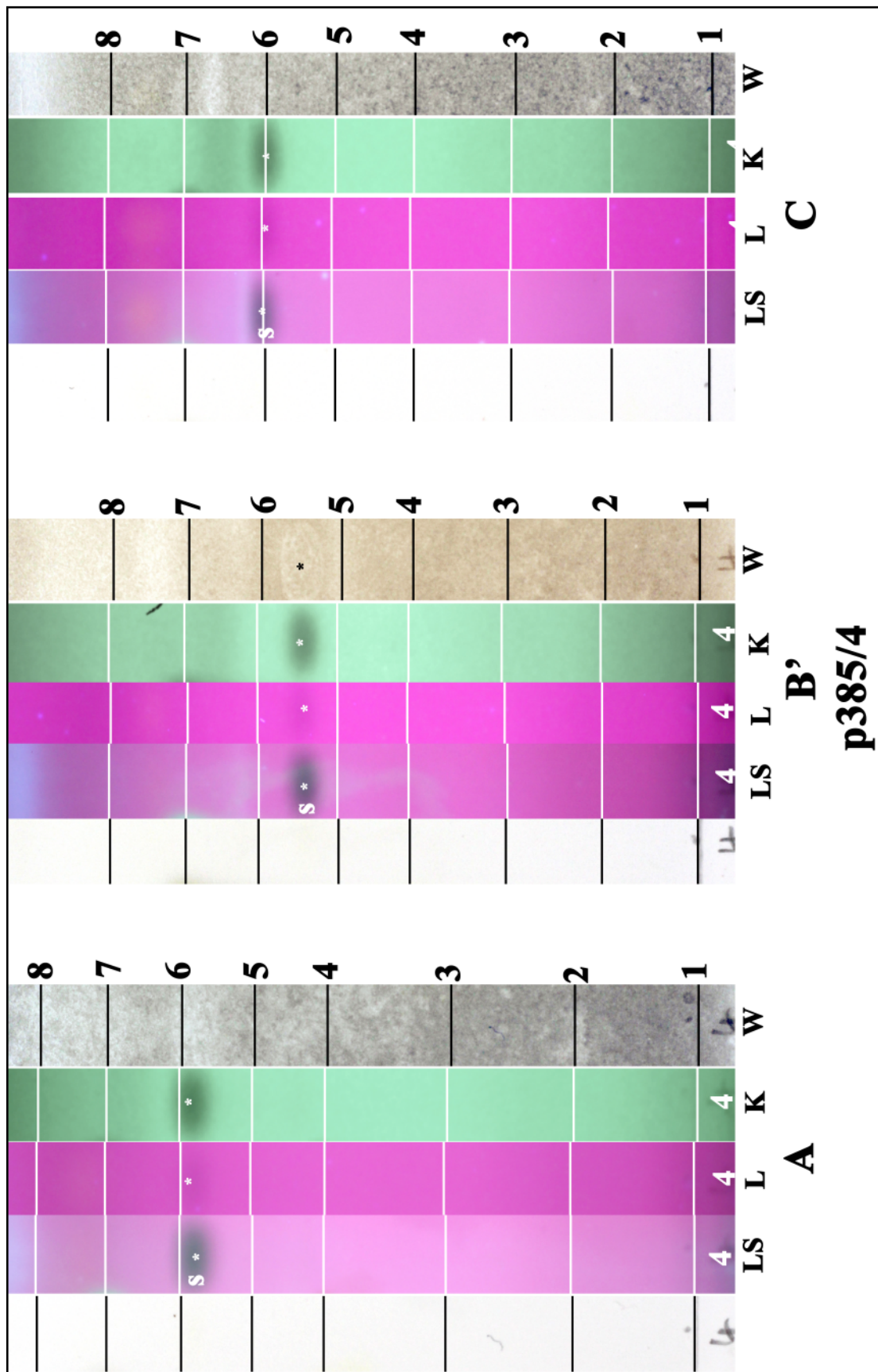
**solorinic acid**



**s: solorinic acid**

Purified lichen substance received from K. Kalb; origin S. Huneck.

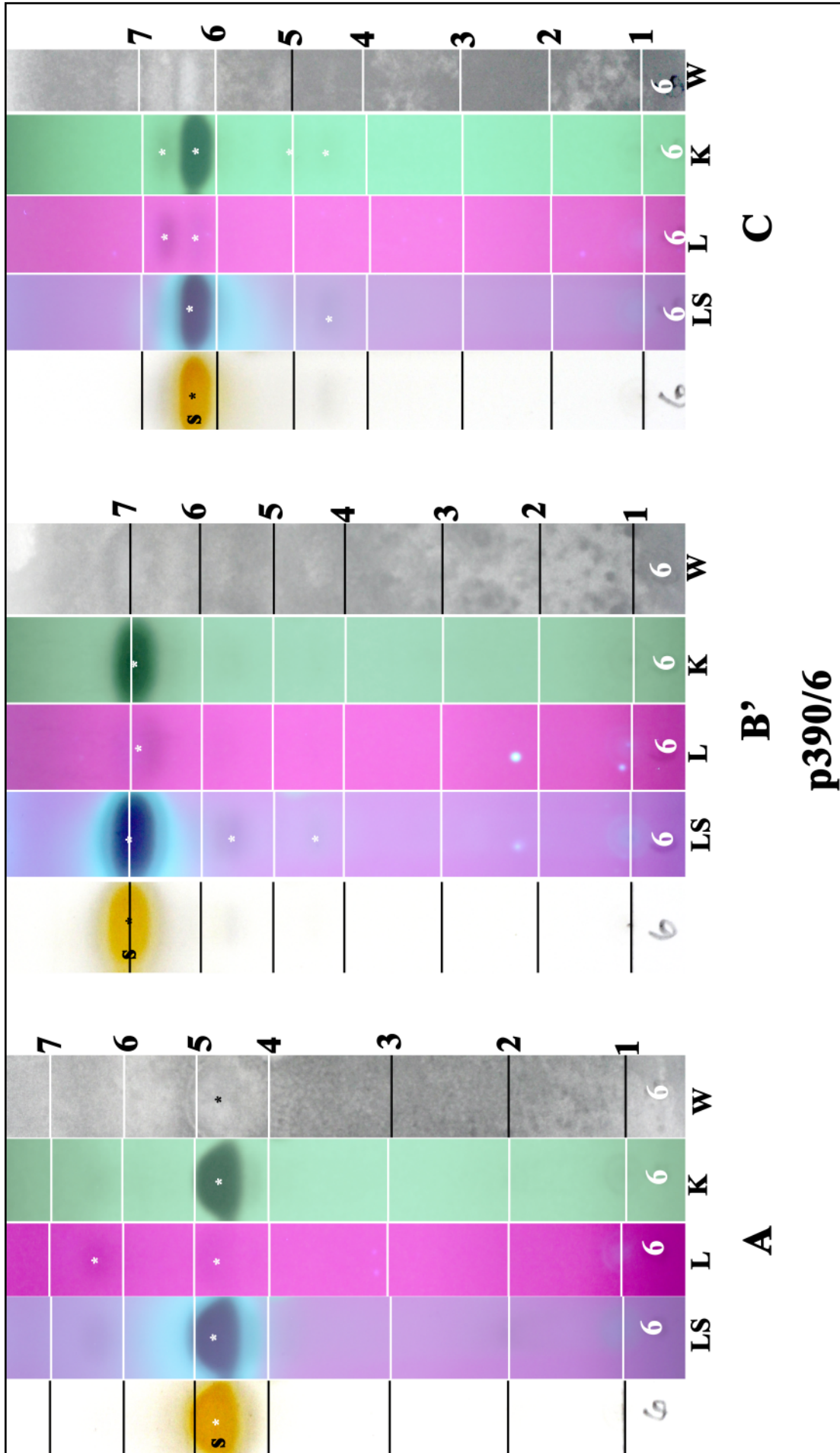
**sordidone**  
only a trace



s: sordidone (trace)

Purified lichen substance received from K. Kalb; origin S. Huneck.

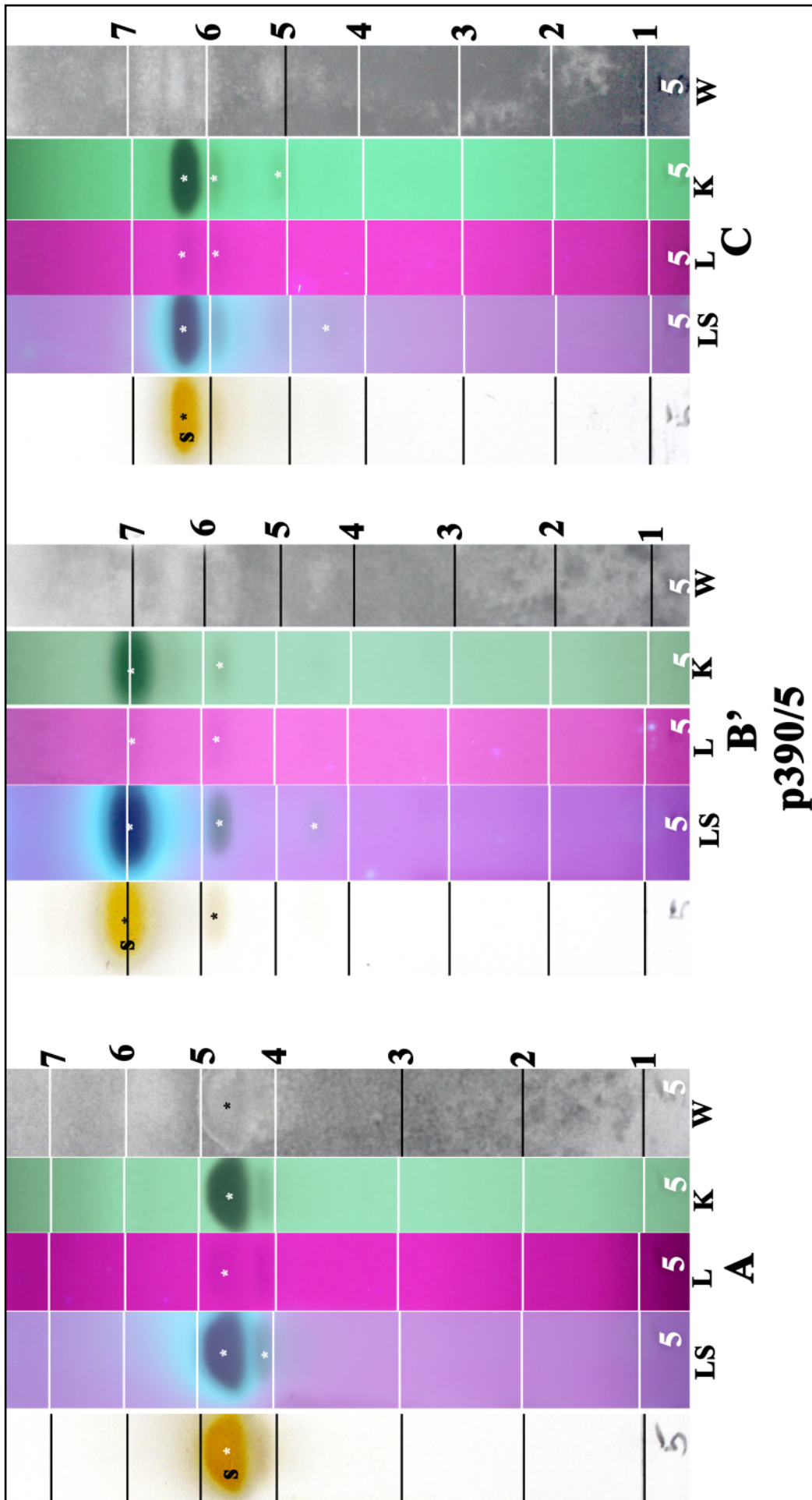
**sphaerophorin**



**s: sphaerophorin**

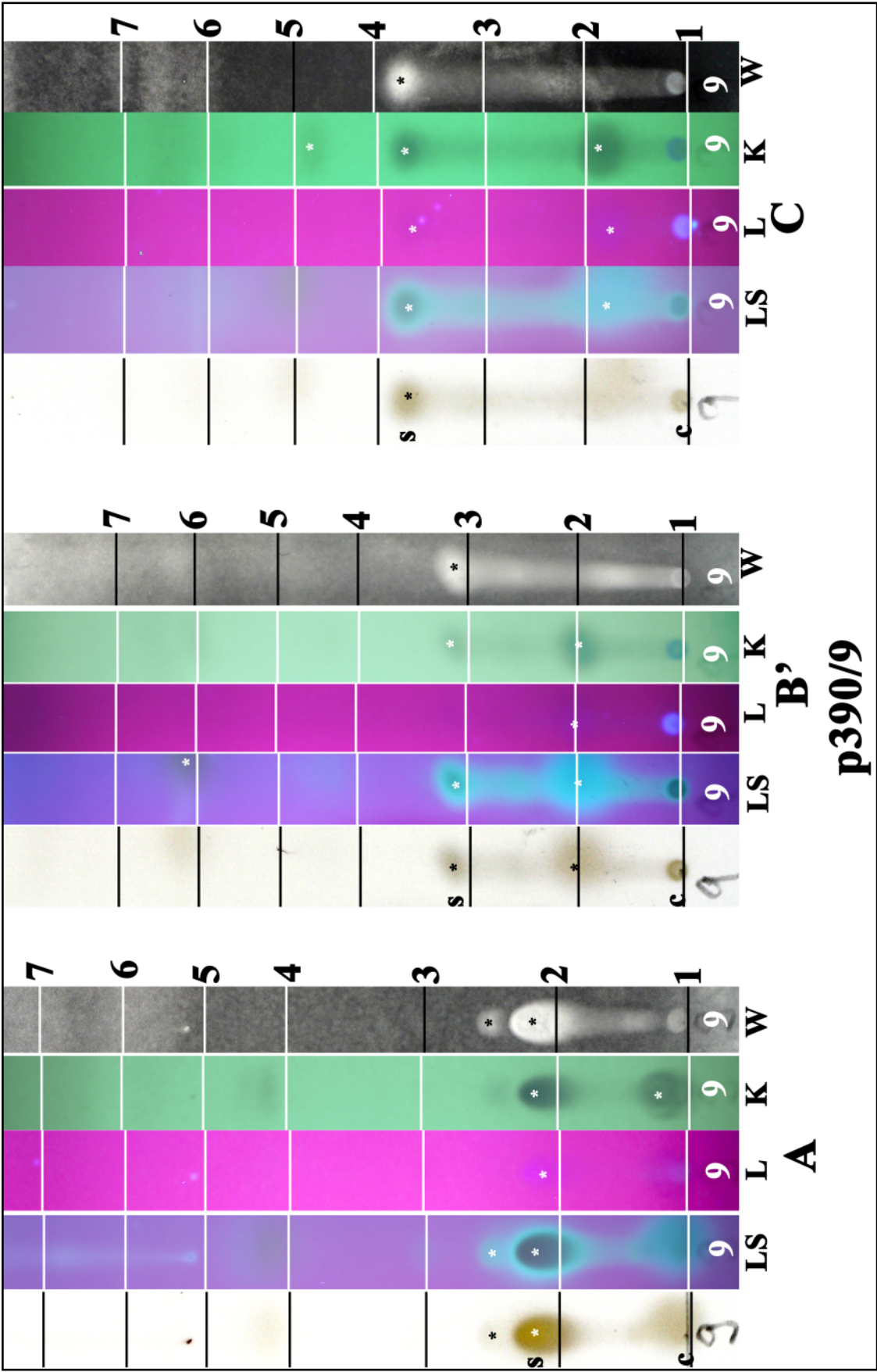
Purified lichen substance received from K. Kalb; origin S. Huneck.

**sphaerophorin**



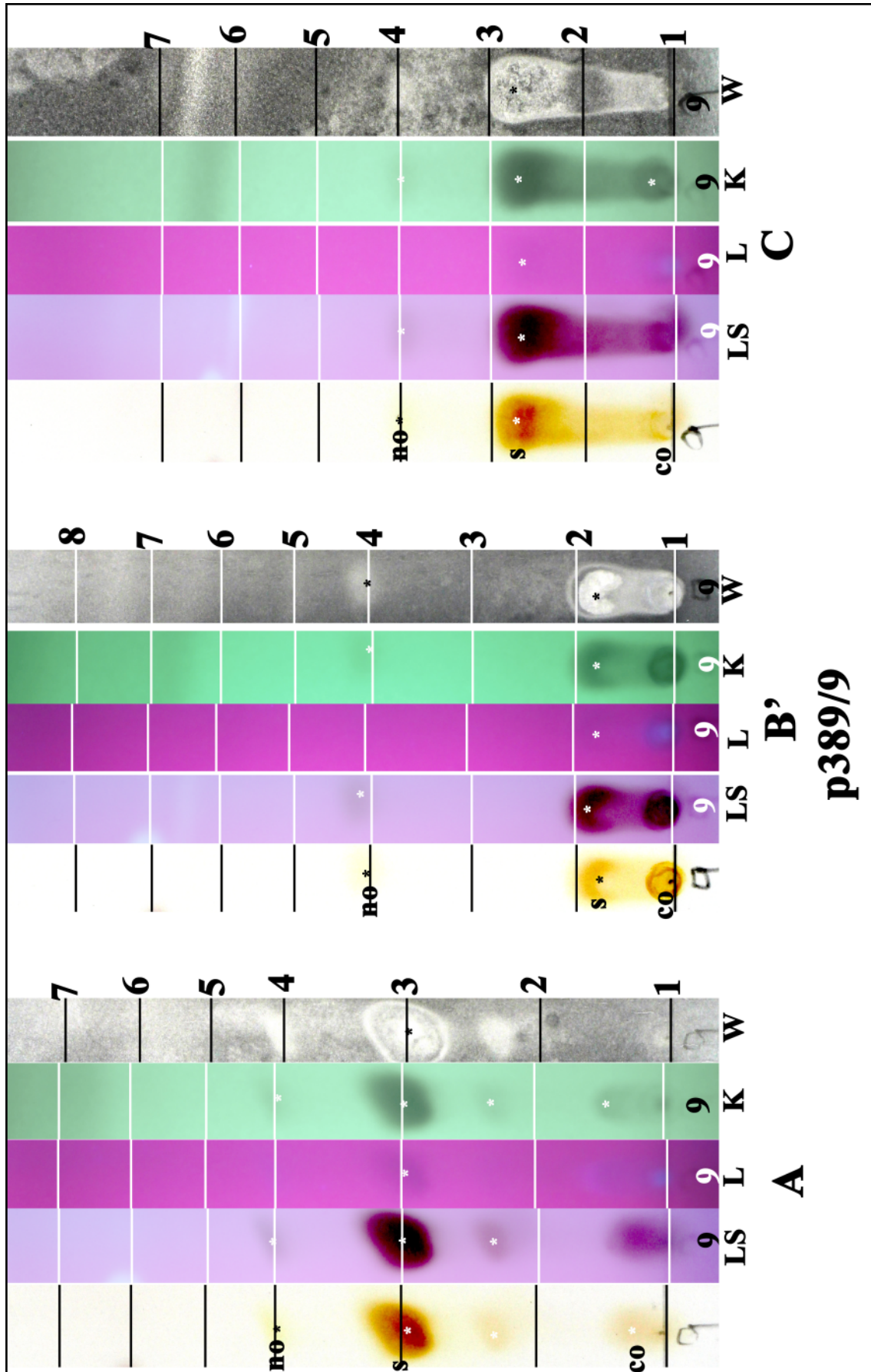
Purified lichen substance received from K. Kalb; origin Zopf.

squamatic acid



Purified lichen substance received from K. Kalb; origin S. Huneck.

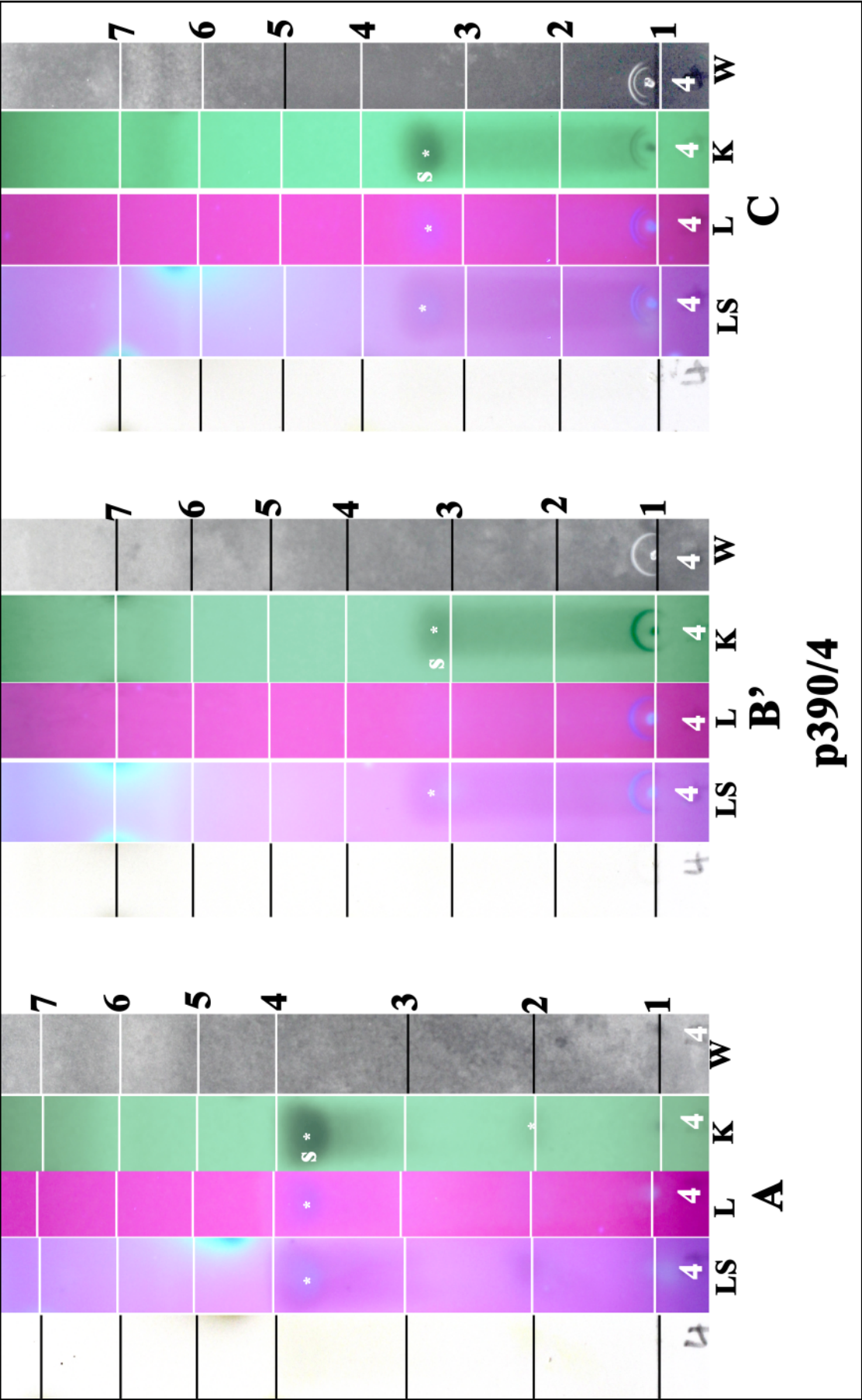
stictic acid



s: stictic acid, no: norstictic acid, co: constictic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

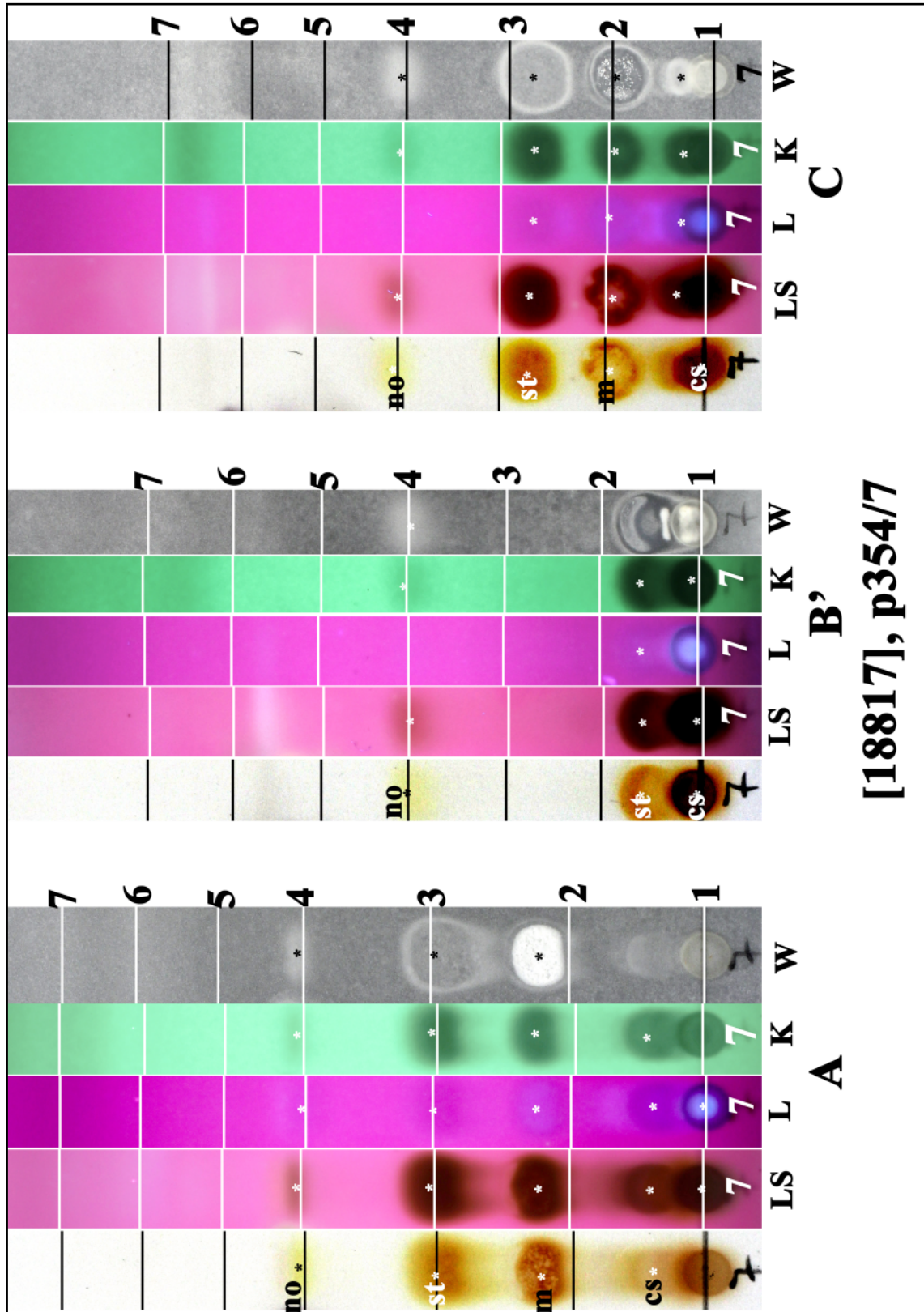
strepsilin



s: strepsilin

Purified lichen substance received from K. Kalb; origin S. Huneck.

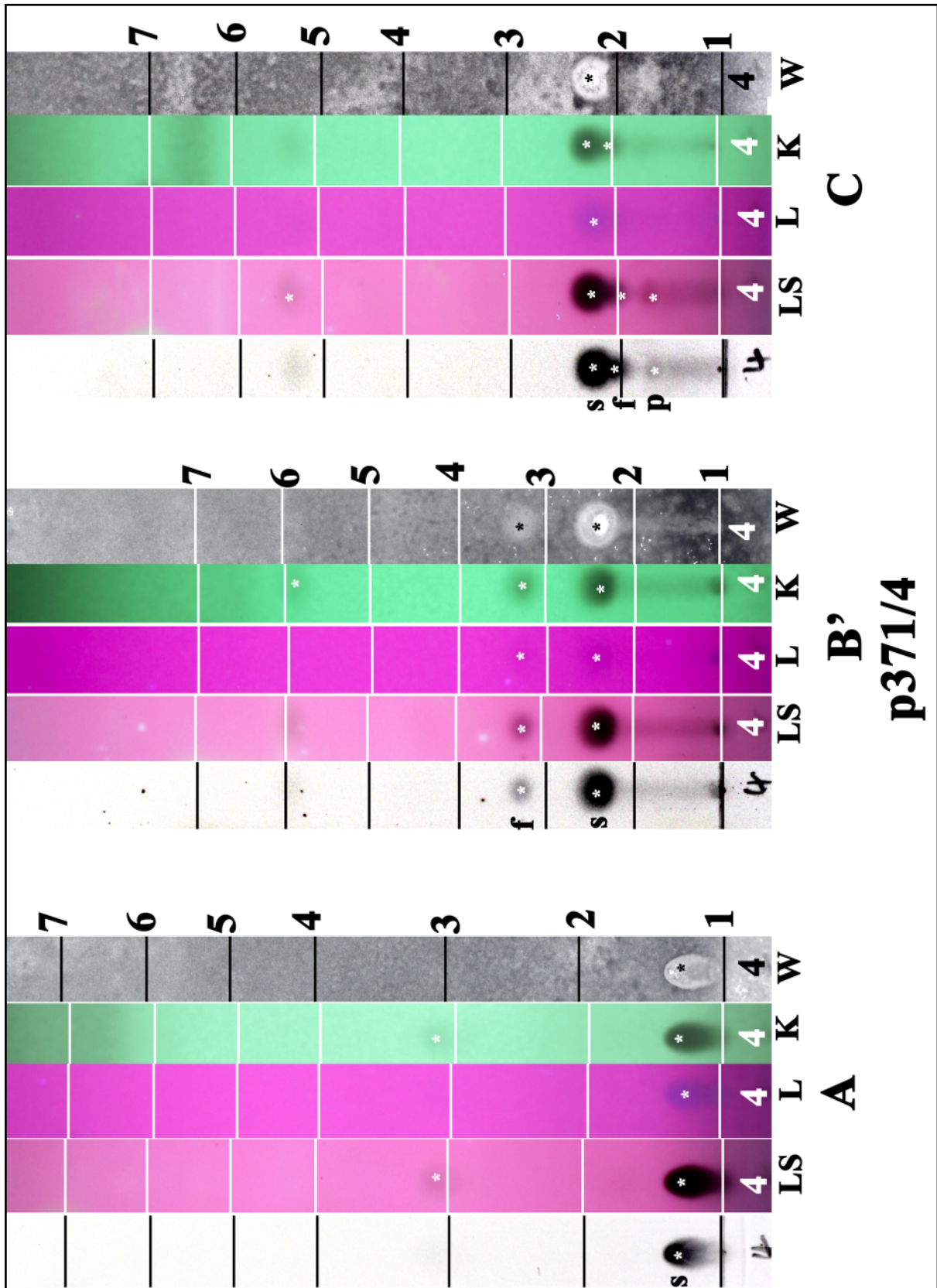
substictic acid



n: norstictic acid, st: stictic acid, m: substictic acid, cs: constictic acid, conf. J.A. Elix

*Diorygma hieroglyphicum* (Pers.) Staiger & Kalb, [18817], India, Western Ghats, Prov. Karnataka, Distr. Coorg (Madikeri), Area Kabbinakad, W of Virajpet, Wasserfall unterhalb des Chingaara Estate House im Honey Valley, ca. 12.23188° N, 75.65520° E, ca. 950 m. Leg. F. Schumm & J.-P. Frahm 06.11.2012, det. F. Schumm 2015.

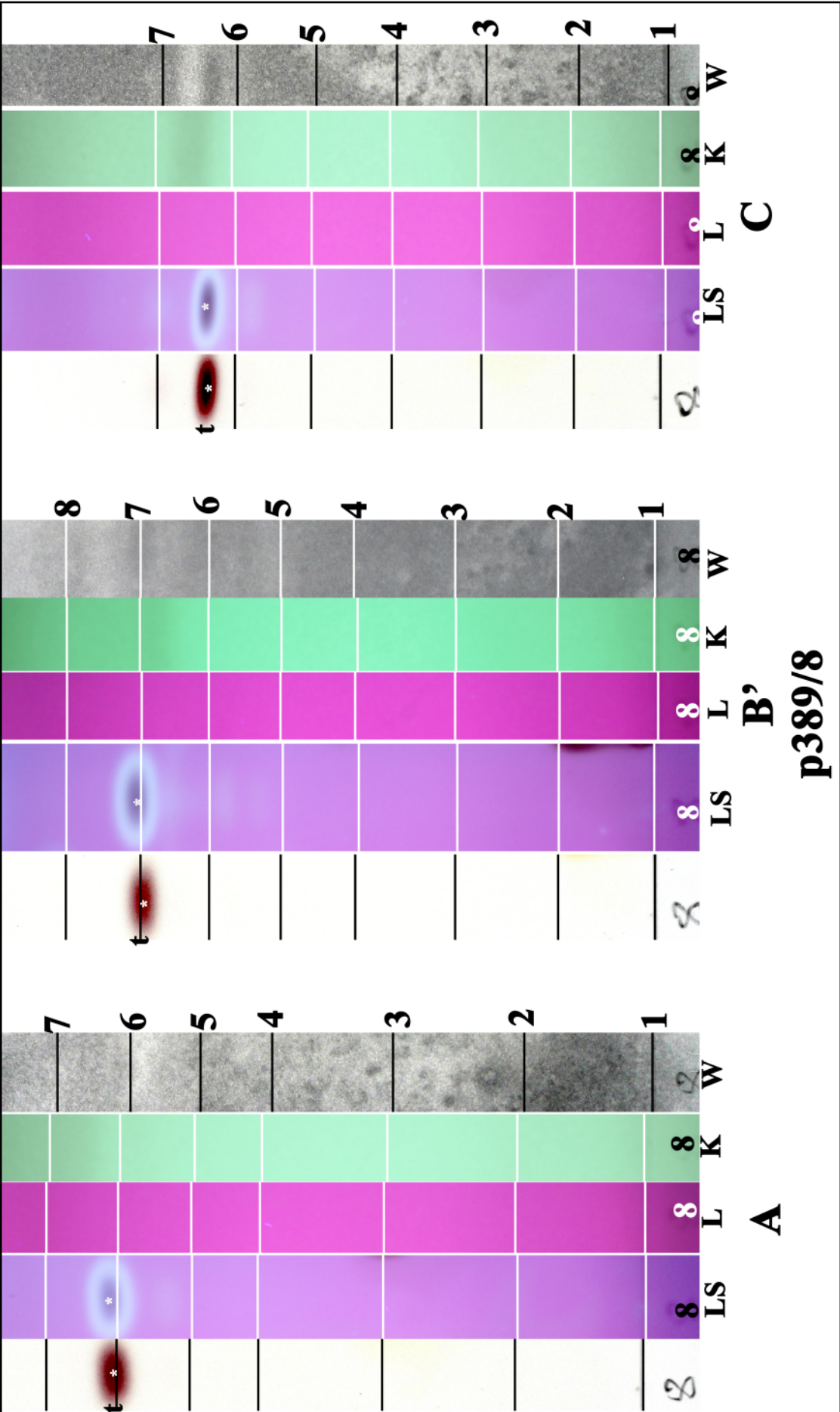
succinprotocetraric acid



**s:** succinprotocetraric acid,  
**p:** protocetraric acid, **f:** fumarprotocetraric acid

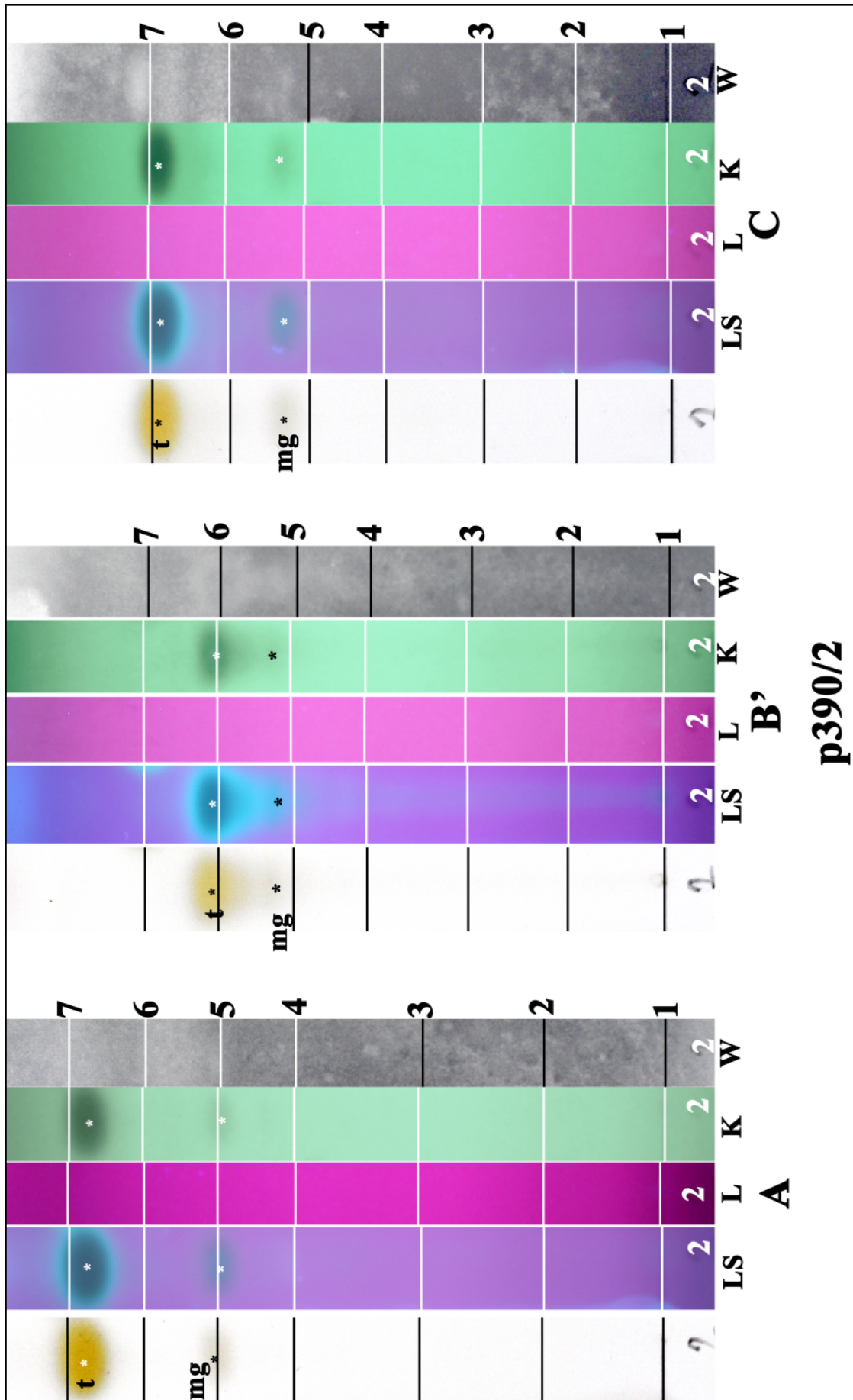
Purified lichen substance received from K. Kalb; origin S. Huneck.

taraxerol



Purified lichen substance received from K. Kalb; origin S. Huneck.

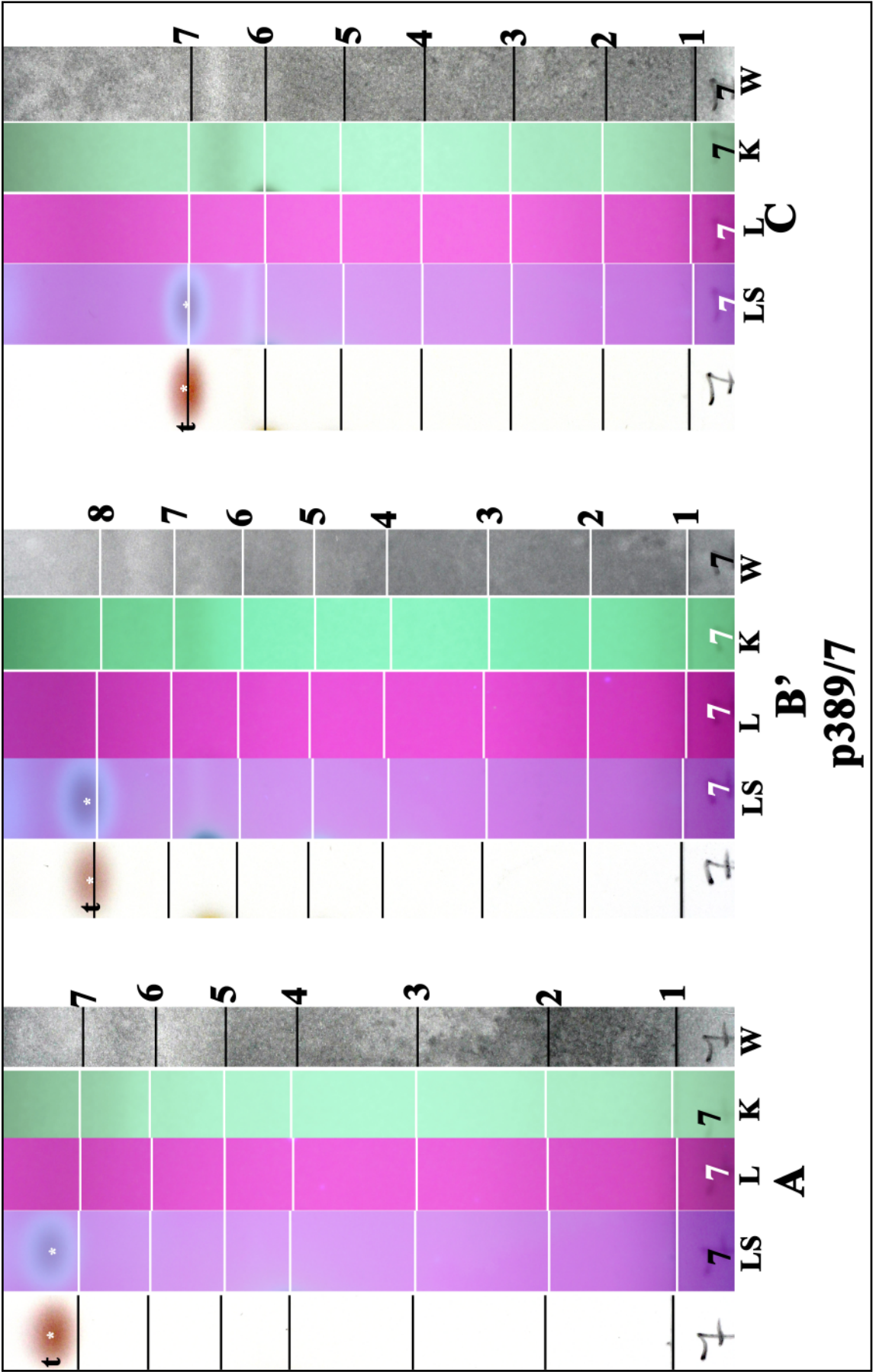
tenuiorin



t: tenuiorin, mg: methyl glycyphorate

Purified lichen substance received from K. Kalb; origin S. Huneck.

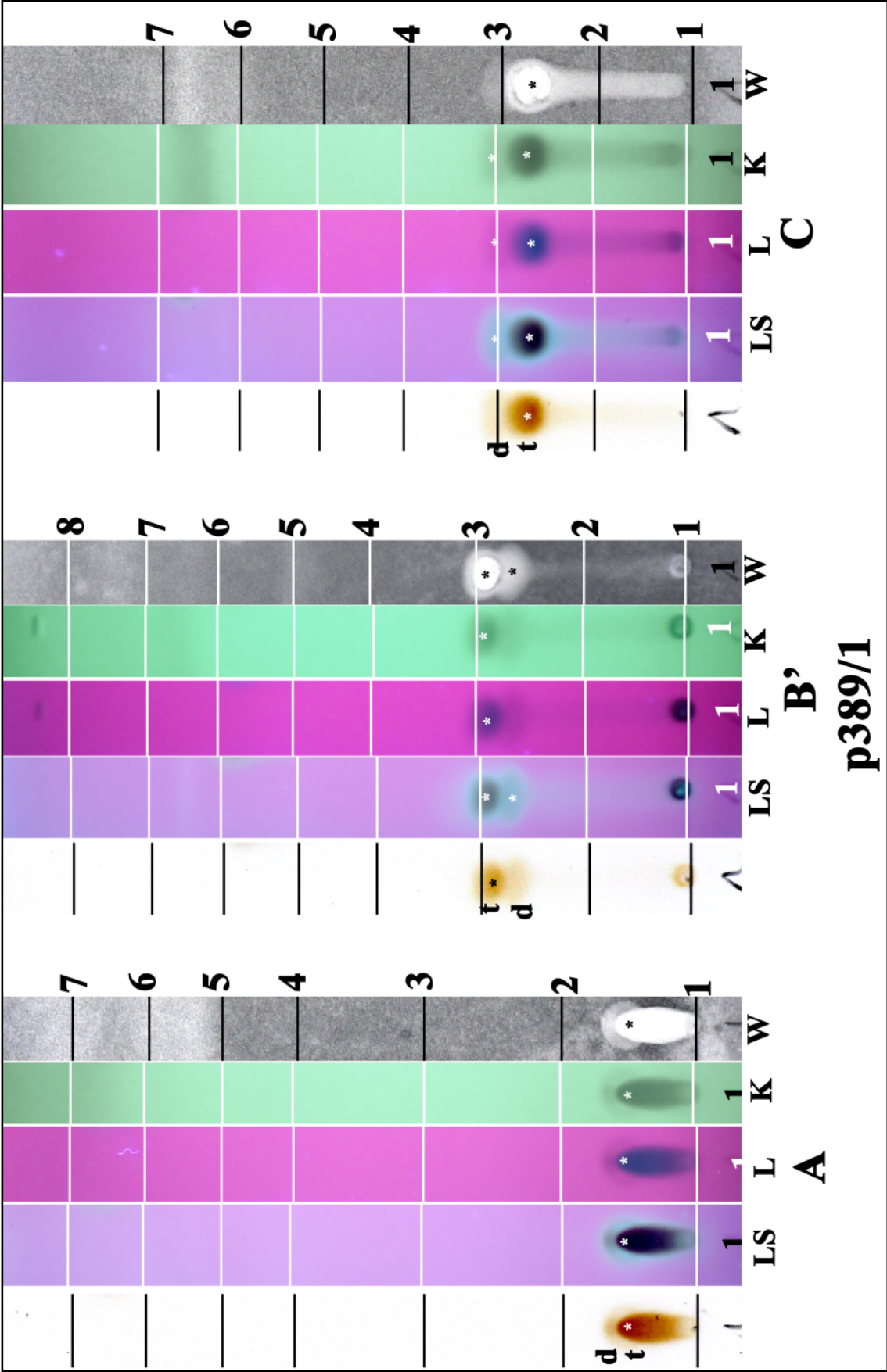
taraxerone



t: taraxerone

Purified lichen substance received from K. Kalb; origin S. Huneck.

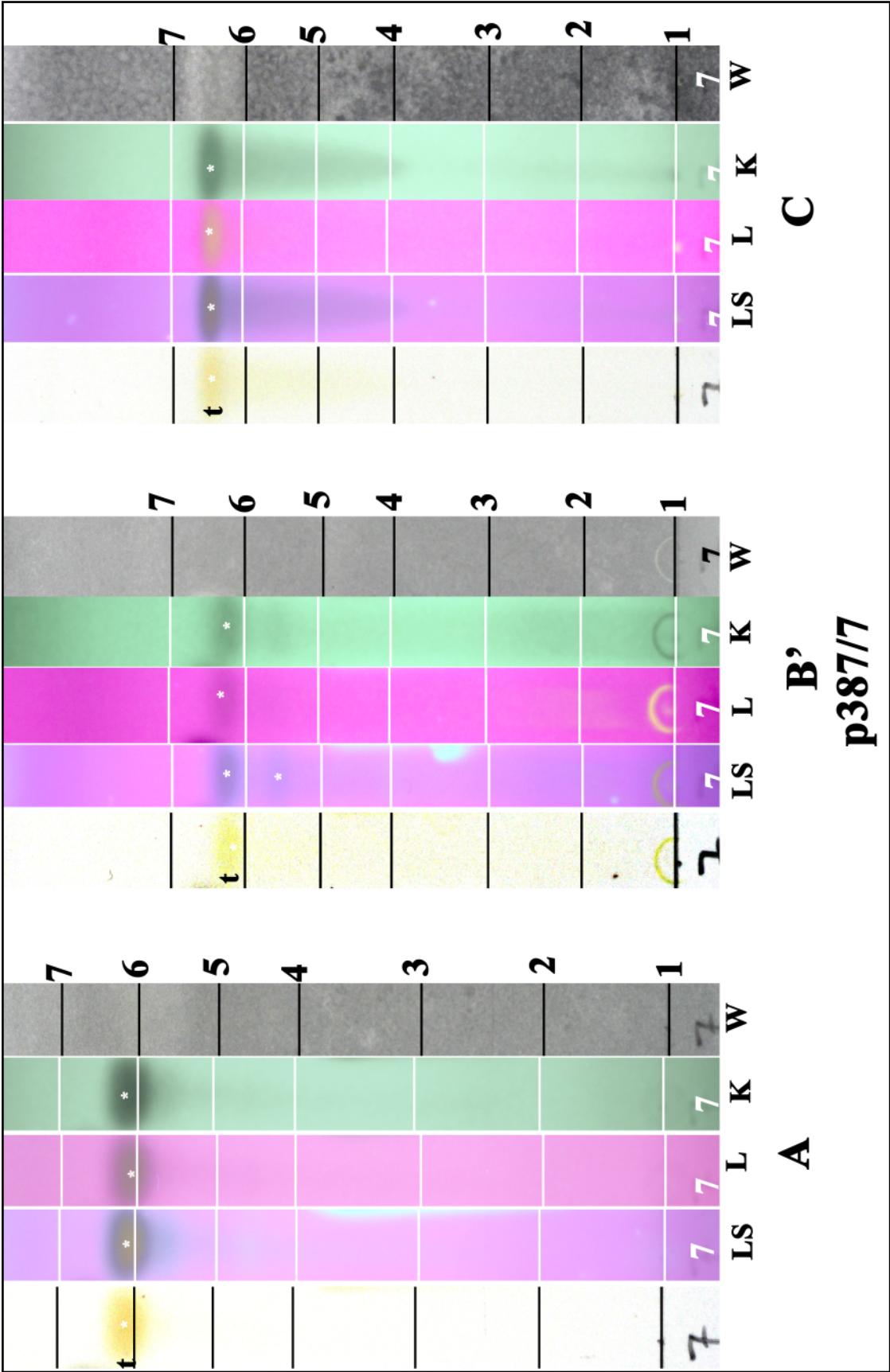
thamnolic acid



t: thamnolic acid, d: decarboxythamnolic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

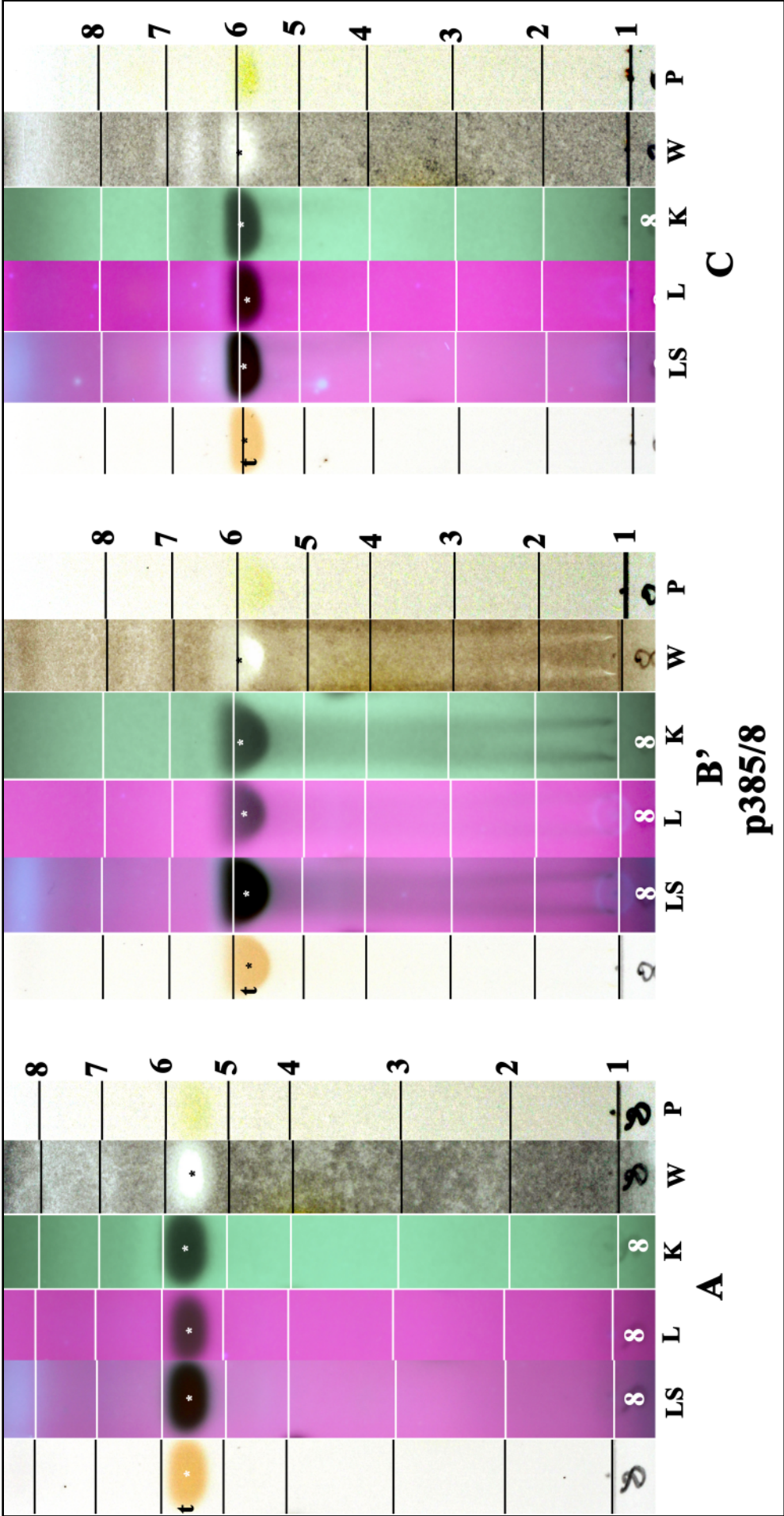
thiophaninic acid



t: thiophaninic acid

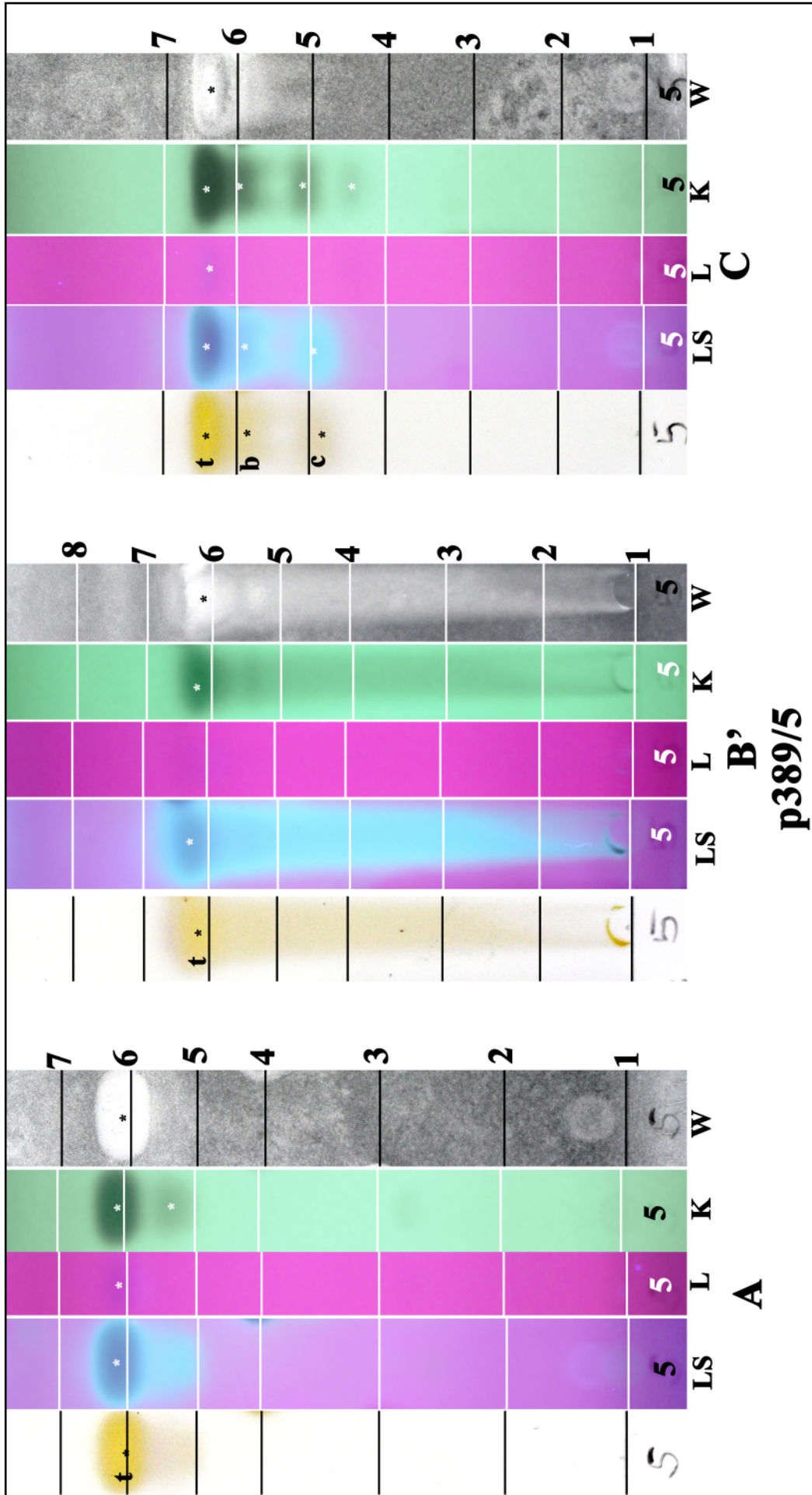
Purified lichen substance received from K. Kalb; origin S. Huneck.

thuringione



Purified lichen substance received from K. Kalb; origin S. Huneck.

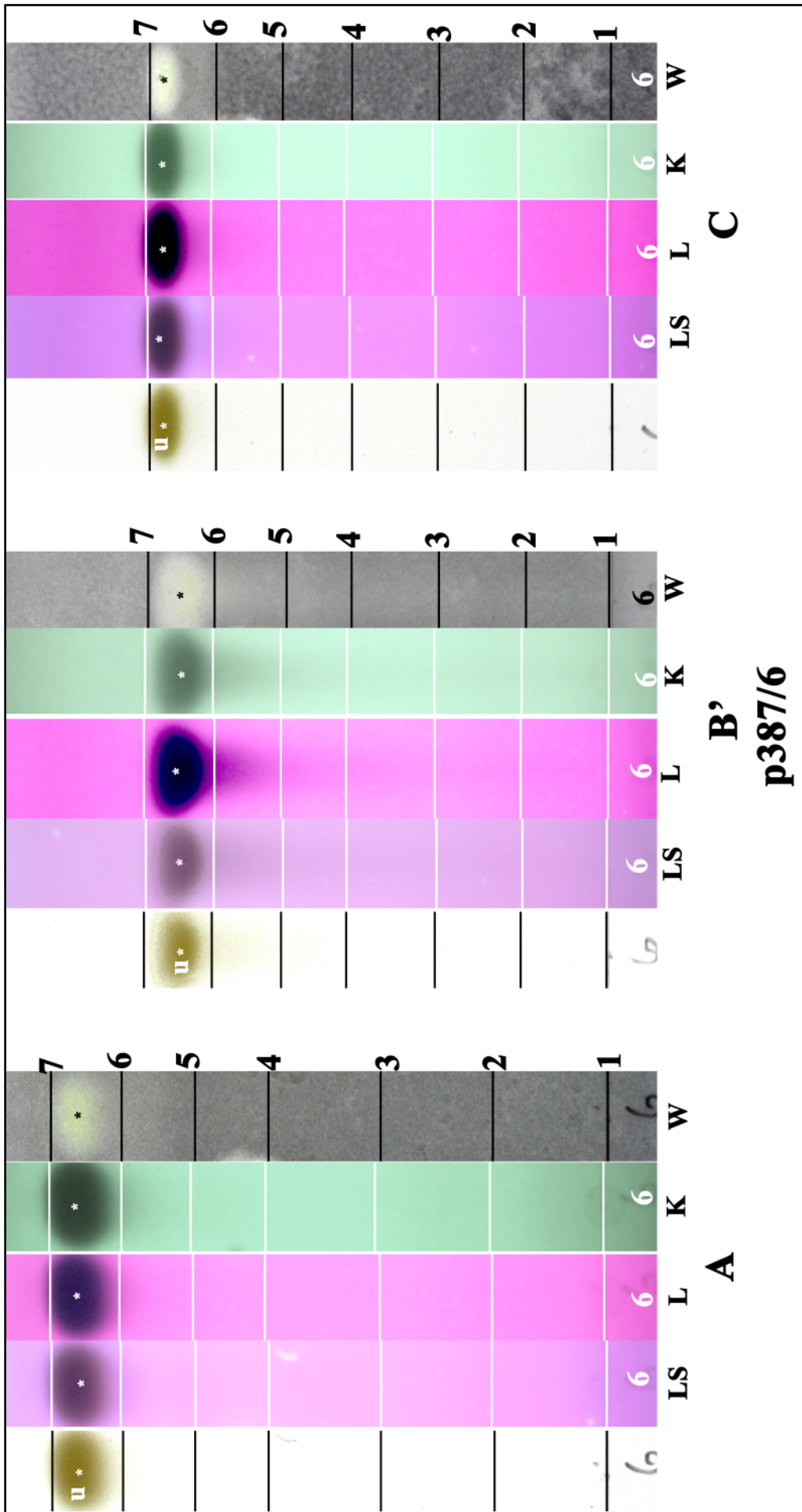
tumidulin



t: tumidulin, b,c: unknown

Purified lichen substance received from K. Kalb; origin S. Huneck.

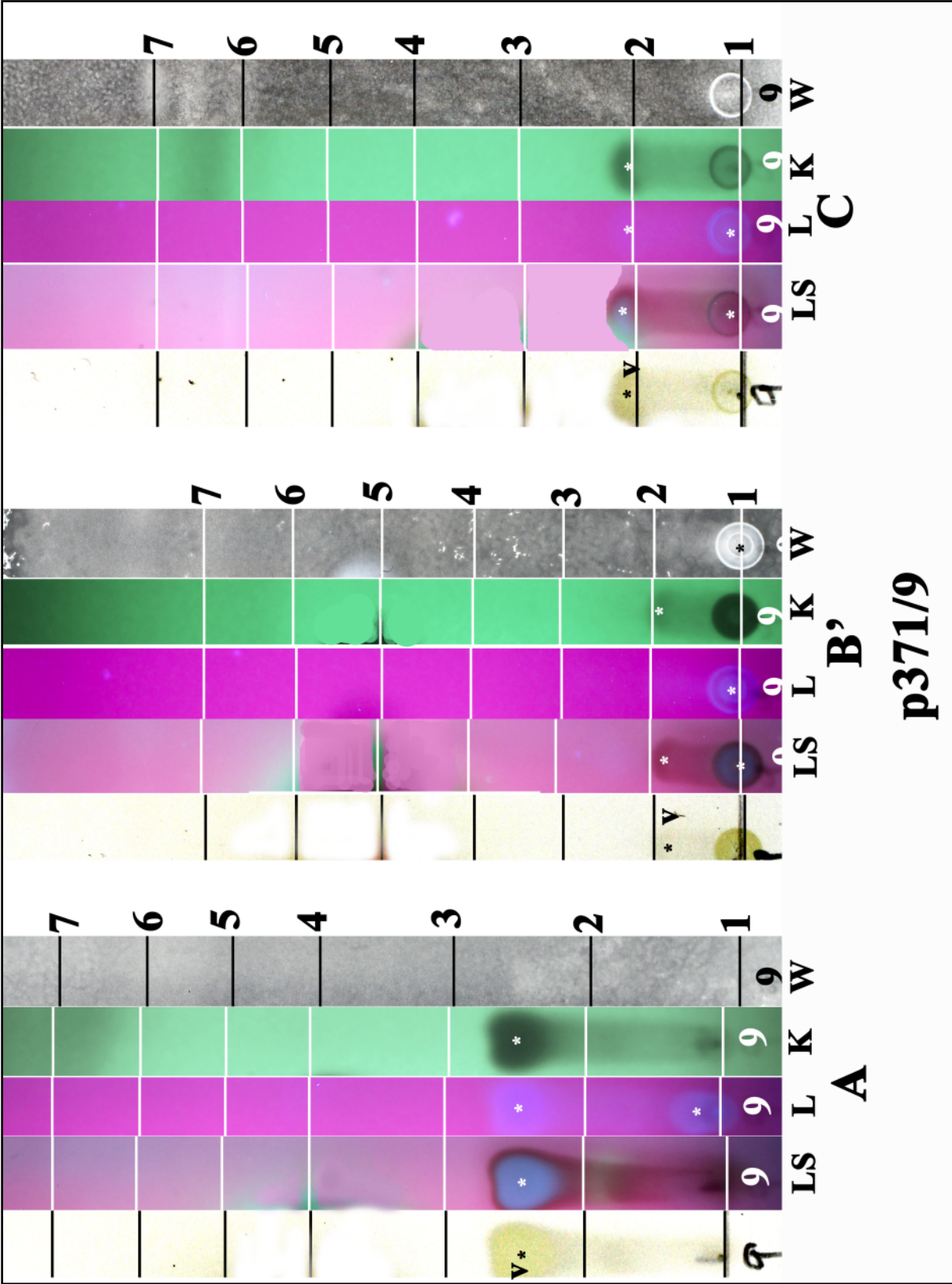
**(+)-usnic acid**



**u: usnic acid**

Purified lichen substance received from K. Kalb; origin S. Huneck.

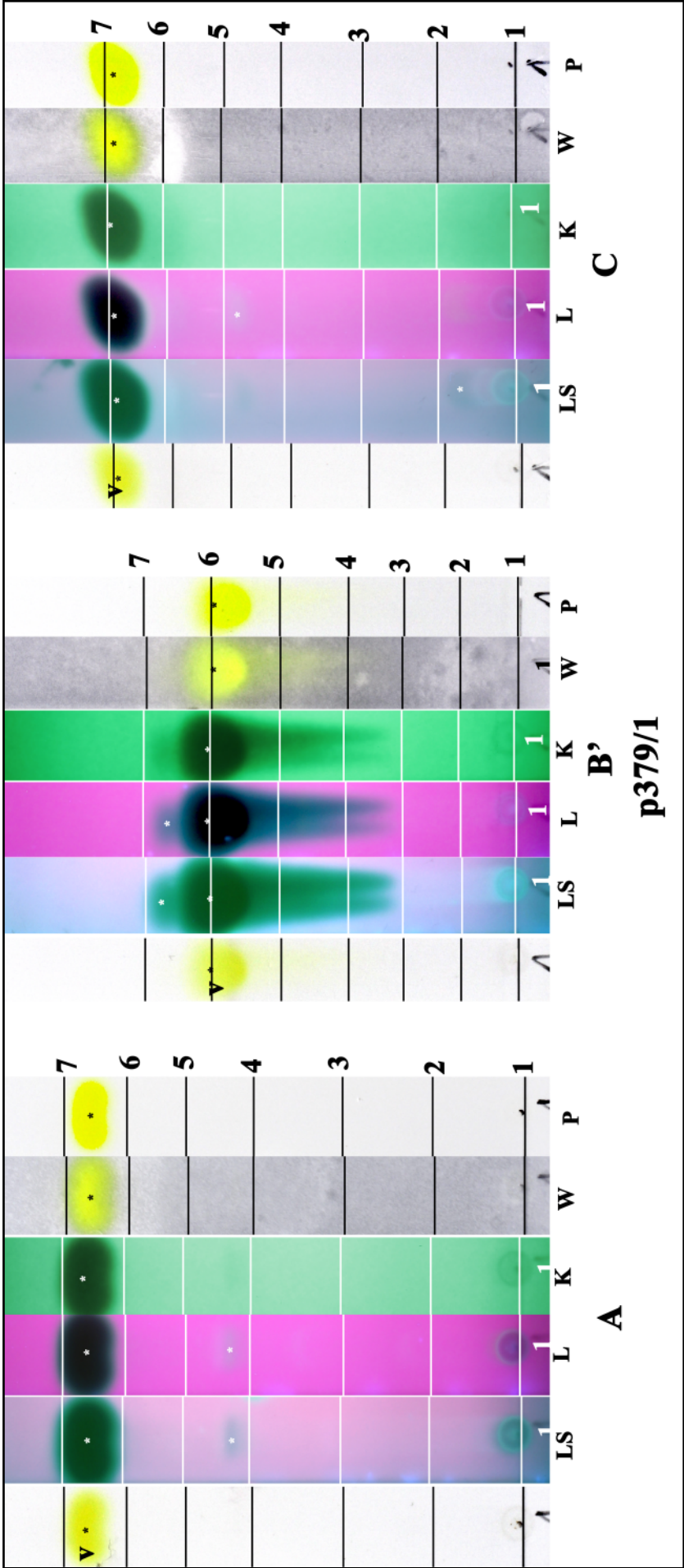
**variolaric acid**



**v: variolaric acid**

Purified lichen substance received from K. Kalb; origin S. Huneck.

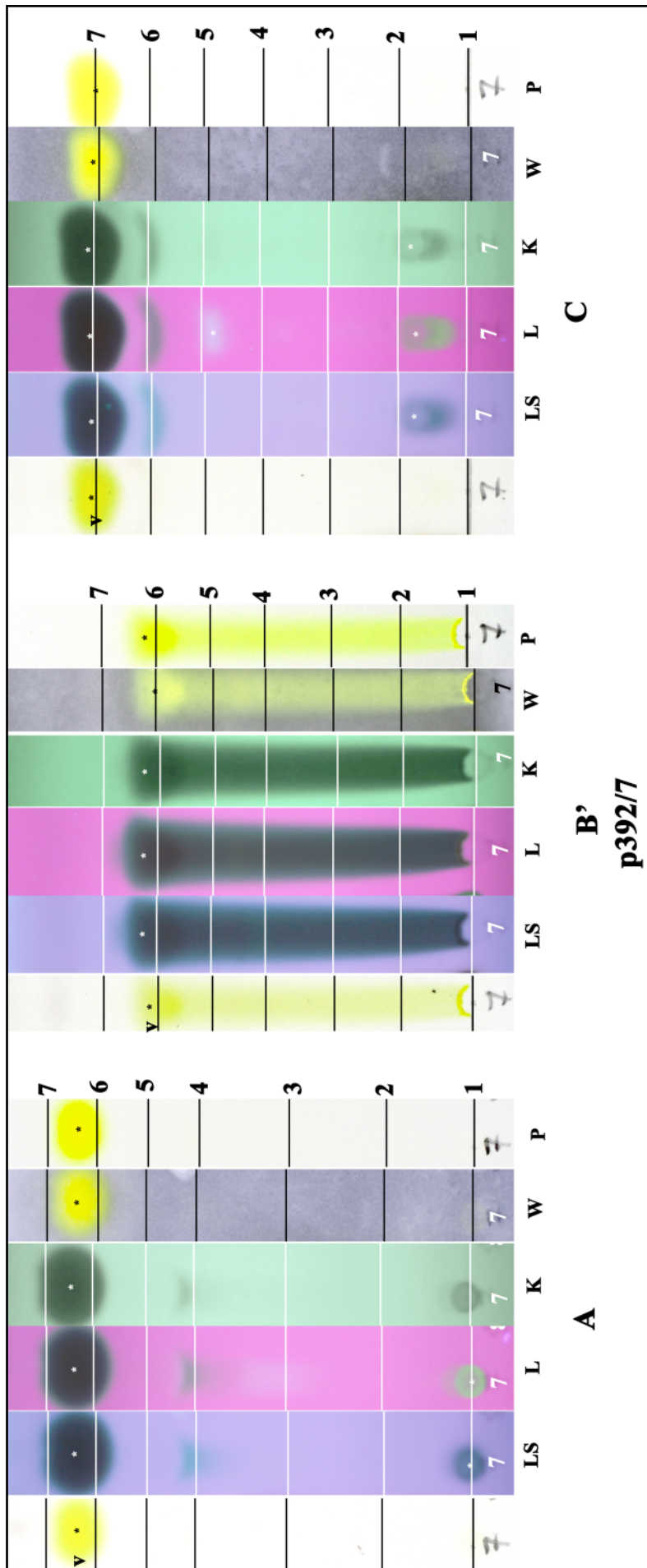
**vulpinic acid**



v: vulpinic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

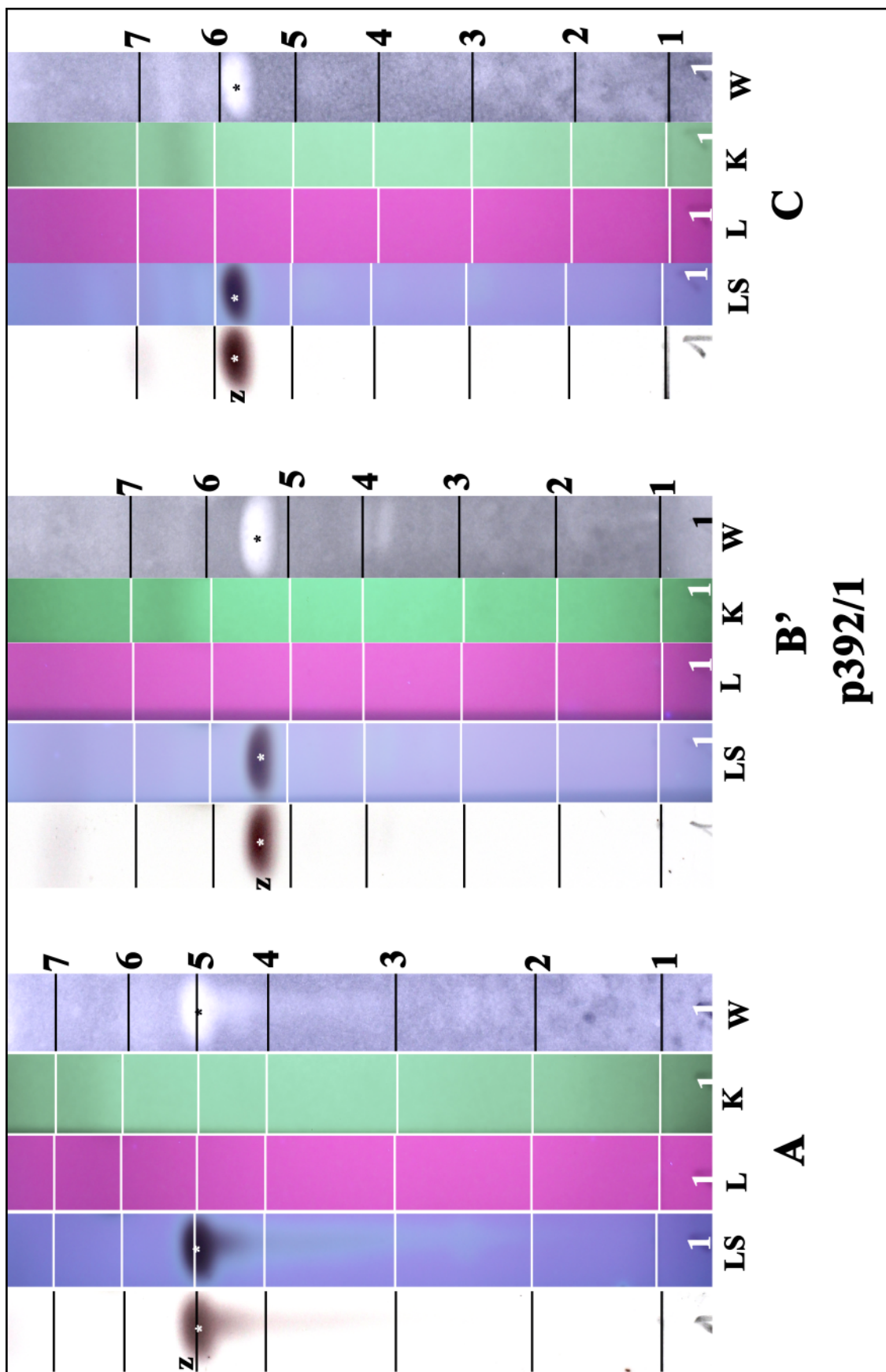
**vulpinic acid**



v: vulpinic acid

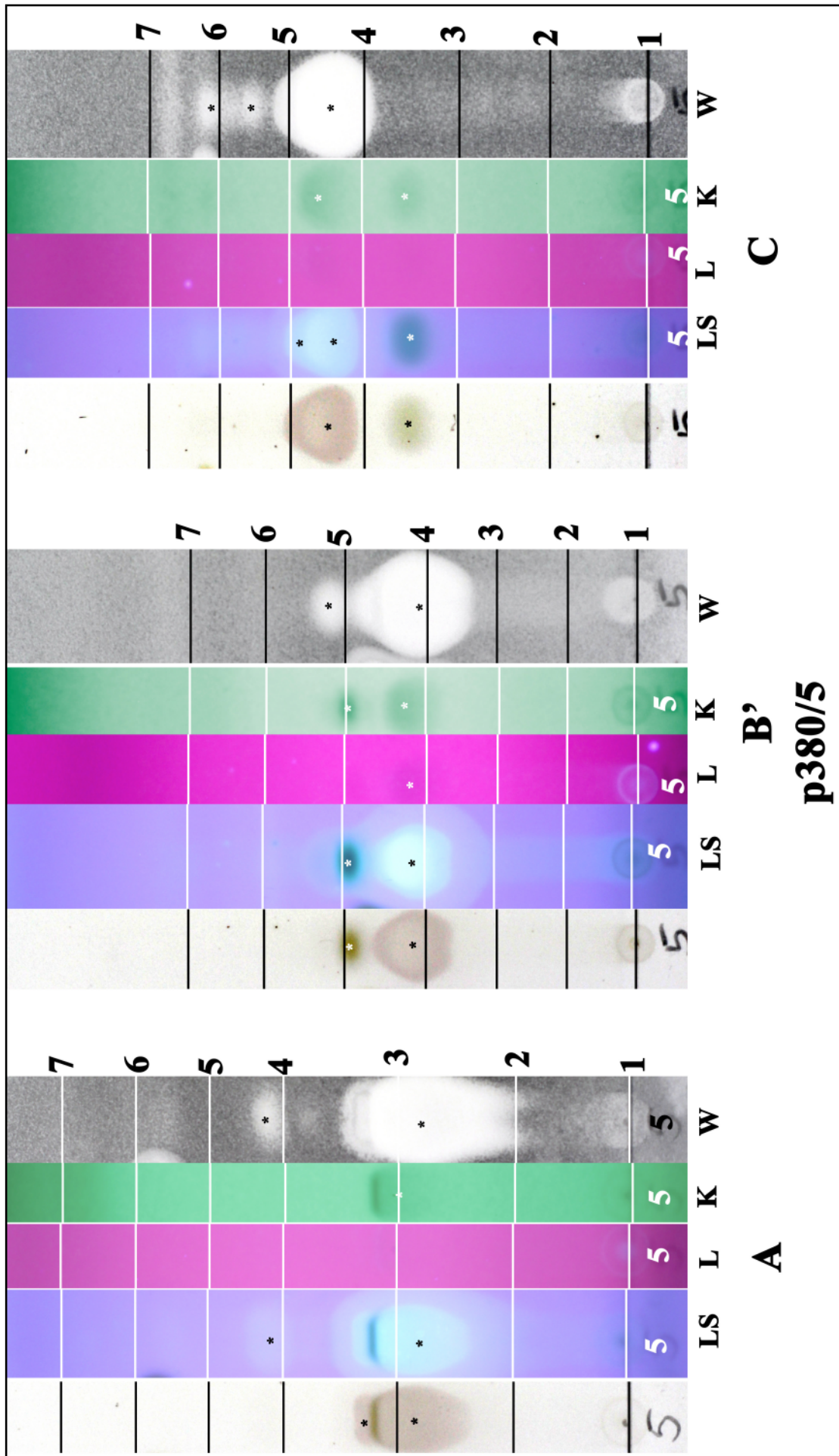
Purified lichen substance received from K. Kalb; origin S. Huneck.

zeorin



Purified lichen substance received from K. Kalb; origin S. Huneck.

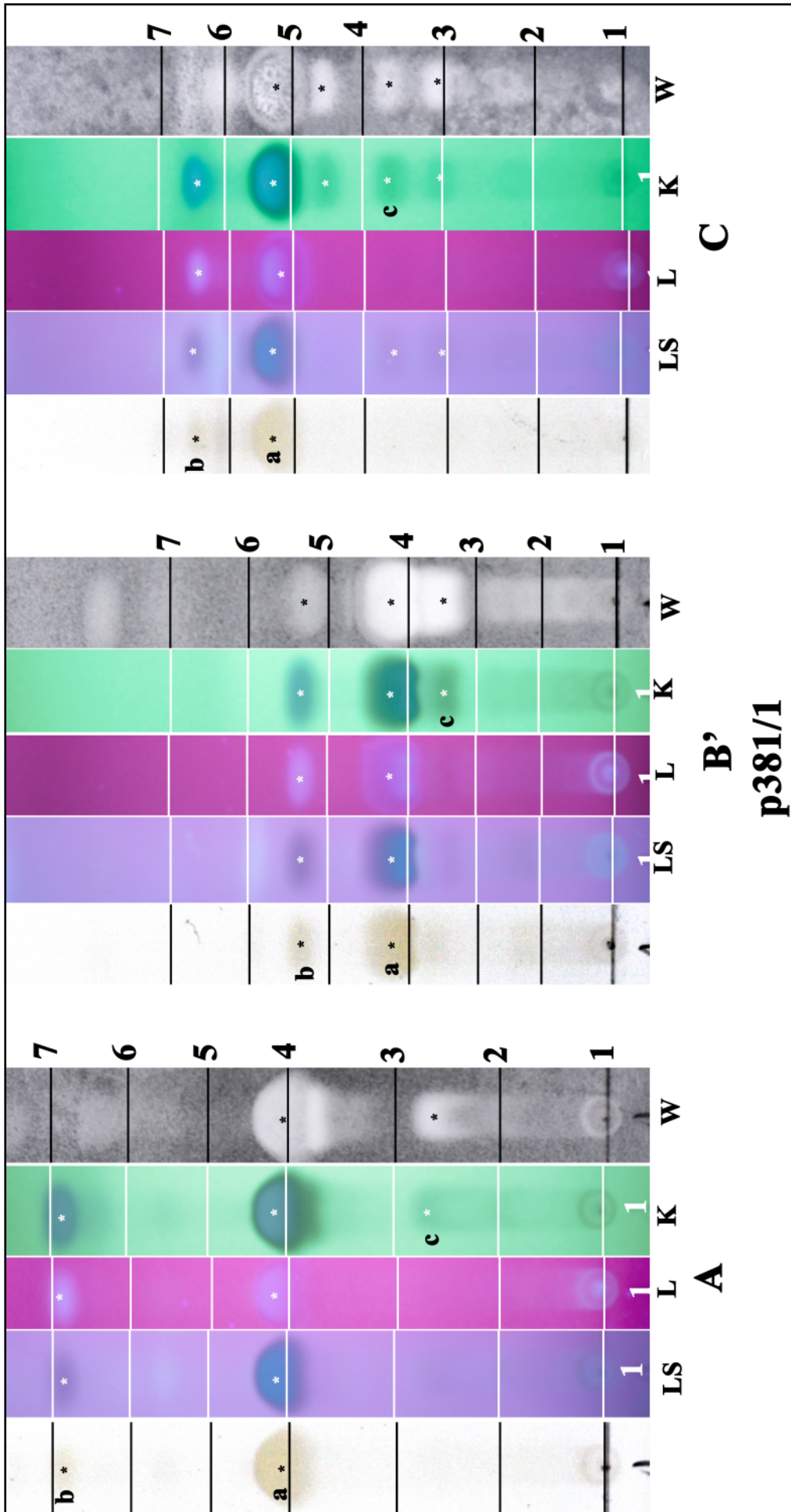
$\alpha$ -(15-hydroxyhexadecyl)itaconic acid



$\alpha$ -(15-hydroxyhexadecyl)itaconic acid

Purified lichen substance received from K. Kalb; origin S. Huneck.

**$\alpha$ -collatolic acid**



a:  $\alpha$ -collatolic acid, b,c: ?

Purified lichen substance received from K. Kalb; origin S. Huneck.

**Table 1: spot positions sorted alphabetically**

<b>Substanz (a. = acid)</b>	<b>A</b>	<b>B'</b>	<b>C</b>
1,4-di-O-methylnorsekikaic a.	4,5	?	?
15 $\alpha$ ,22-dihydroxyhopane	4,2	4,8	5,5
1 $\alpha$ 3 $\beta$ ,22-hopantriol	2,8	3,2	3,3
25-acetoxy-30(S),24(R)-epoxy-3-oxodammaran-3on	7	6,4	6,5
2'-O-demethylpsoromic a.	2,5	4,8	2,4
2-O-methylconfluentic a.	4,4	3,5	5,9
2-O-methylconfluentic a.	4,5	3,4	5,9
2'-O-methylperlatolic a.	4,9	5,5	6,4
2-O-methylsekikaic a.	4	4,8	5,9
2 $\alpha$ ,3 $\beta$ ,22 $\alpha$ -triacetoxystictane	6,8	5,9	6,5
3-O-demethylschizopeltic a.	3,9	4,2	5,9
3 $\beta$ -acetoxyhopane-1 $\beta$ ,22-diol	5,4	4,5	5,8
3 $\beta$ -hydroxy-25-acetoxy-20(S),24(R) epoxydammarane	6,3	5,9	6,2
4-O-demethylgrayanic acid	2,2	4,5	3,2
4-O-demethylgrayanic acid	3,3	4,5	3,2
4-O-methylcryptochlorophaeic a.	5,8	5,9	?
4-O-methylhypoprotocetraric a.	3,9	5,5	6
4-O-methylhypoprotocetraric a.	4	5,4	6
4'-O-methylpaludosic a.	3,4	4	3,5
5-chloro-4-O-demethylbarbatic a.	4,1	6,6	6
7-chloroemodin	5,5	6	5,9
7 $\beta$ -acetoxy-22-hydroxyhopan	6,1	5,9	6,2
9-methyl pannarate	3	3,9	3,2
acaranoic a.	4,2	4,9	5,6
acarenoic a.	3,8	4,5	4,9
acetylportentol	5,5	2,9	5,6
alectorial a.	3,9	5,5	4
alectoronic a.	3,3	3,9	2,9
allo-pertusaric a.	4	4,7	5
allo-protolichseterinic a.	4	5,2	5,4
anziaic a.	4	5,8	5
arthonin	4,5	2,8	5,1
atranorin	7	7	7
baeomycesic a.	4	4,8	5,6
barbatic a.	4,5	6,5	6,1
bourgeanic a.	5,3	6	6
caloploicin	6,3	6,5	6,5
calycin	7,3	7,4	8,5
calycin	7,4	7,4	8,1

calycin	7,4	7,4	8,6
calycin	7,4	7,5	8,2
caperatic a.	1,7	3,4	1,9
cetraric a.	2,6	4,8	3,8
chiodectonic a.	1	1	1,1
chloroatranorin	7,1	7,1	7,1
confluentic a.	4,8	4	5,9
confluentic a.	4,8	4	5,9
congrayanic acid	2,9	5,6	4,2
congrayanic acid	3,8	5	4,2
connorstictic a.	1,8	1,9	1,4
conprotocetraric a.	1,1	1,4	1,1
consquamnatic a.	1,2	1	1
constictic a.	1,3	1,1	1,1
constictic a.	1,5	1,1	1,3
convirensic a.	1,6	3,4	1,8
cryptochlorophaeic a.	3,7	4,8	5,1
cryptochlorophaeic a.	4,1	5,1	4,9
cryptostictic a.	2,3	1,6	1,9
decarboxythamnolic	1,6	2,8	3
diacetylleucotylin	5,5	4,8	5,7
didymic a.	4,6	6,8	6,4
diffractaic a.	4,5	6	6
diploicin	6,2	6,5	6,5
divaricatic a.	3,9	6,6	6,2
ent-kauran-16 $\alpha$ -ol	5,8	6,3	6,3
epanorin	6,5	5,3	6,7
eriodermin	6,7	6,1	6,9
erythrin	1,4	1,3	1,1
erythrin	1,5	1,3	1,2
evernic a.	3,9	5,9	5,9
fragilin	7	6,5	7
friedelan-3 $\beta$ -ol	6,4	6,8	6,5
fumarprotocetraric a.	1,3	3,3	2,1
galapagin	1,4	1,1	1,1
galbinic a.	3,3	2,2	2,8
gangaleoidin	5,8	4,7	6,1
glomellic a.	3,7	3,6	4,5
glomelliferic a.	4,2	5,5	6
haemathamnioc a.	2,7	4,5	4,2
homosekikaic a.	4,5	6,4	6,4
hybocarpone	3,4	5,2	3
hypoprotocetraric a.	2,9	4,7	3,2
hypoprotocetraric a.	3	4,9	3,3

hypthallin	4,5	3	5,1
imbricaria a.	4,4	6,8	6,1
isorangiformic a.	2	4,5	3,8
isousnic a.	6,8	7,2	7,1
leprapinic a.	6,6	5,6	7
leucotylin	2,7	3,2	3
lichesterinic a.	4,5	6,3	5,9
lichexanthone	6,9	6,3	6,9
lobaric a.	3,8	5,6	5,3
menegazziaic a.	2,3	2,1	2,1
merochlorophaeic a.	5	5,6	6,7
methyl pyxinate	5,8	5,4	6,1
miriquidic a.	4,3	5,3	5,7
neochloroemodin = 4-chloroemodin	6,7	5,5	6,6
nephroarctin	6,5	5,9	6,7
norlichexanthone	3,7	4,6	2,1
norrangiformic a.	2,5	4,4	3,7
norsolorinic a.	5	6,4	5,5
norstictic a.	4	4	4
notatic a.	3,5	5	5,3
obtusatic a.	4	6,2	6
olivetoric a.	3,6	4,9	3,5
orsellinic a.	4	5,2	3,7
oxyphysodic a.	2,5	4	2,5
paludosic acid	4	4,3	2,6
pannaric a.	1,4	2	1,3
pannaric a.	1,4	2	1,3
pannaric a.	1,8	3,1	1,9
pannaric acid 6-methylester	2,6	4	2,6
pannaric acid 6-methylester	2,6	4,2	2,8
pannarin	6,5	6,4	6,9
parietin	6,8	6,8	7
peristictic a.	1,3	1,7	1,2
perlatolic a.	4,6	6,6	6
physodalic a.	2,1	4,2	3,3
physodalic a.	2,3	4,1	3,3
physodalic a.	2,3	4,2	3,3
physodic a.	3,6	4,9	3,5
picrolichenic a.	4	5,5	5,4
pinastric a.	6,6	6	6,6
pinastric a.	6,8	5,9	7
pinastric a.	6,8	6,1	7
placodiolic a.	6	6,3	6,7
planaic a.	4,5	4,9	6,3

polyporic a.	3,1	3	2,9
polyporic a.	3,1	3,1	2,9
porphyrillic a.	1,7	2	1,8
portentol	5	3,6	5
protocetraric a.	1,3	2,6	1,7
protocetraric a.	1,3	2,7	1,6
protocetraric a.	1,3	2,7	1,7
protocetraric a.	1,3	2,7	1,8
protolichesterinic a.	4,3	5,4	5,1
pseudocyphellarin A	7	7,2	7
pseudocyphellarin B	5,8	5,9	6
pseudoplacodiolic a.	5,3	5,3	6,1
psoromic a.	4,2	5,2	5,5
pulvinic a.	1,2	4,9	1,8
pulvinic a.	1,3	4,9	1,9
pulvinic dilactone	7,8	8	9
pulvinic dilactone	<b>8</b>	<b>7,9</b>	<b>9,1</b>
pyxinol	4	3,3	4,2
ramgiformic a.	3,7	5,1	5,5
rangiformic a.	3,6	5,2	5,6
rangiformic a.	3,6	5,2	5,5
rangiformic a.	3,6	5,5	5,7
retigeranic a.	7,1	8,4	7,8
retigeric a. A	2,3	2,9	3,1
rhizocarpic a.	6,4	5	6,5
rhodocladonic a.	1	1,1	1,1
roccellic a.	4,3	5,5	5,5
roccellic a.	4,3	6,2	6,1
roccellic a.	4,4	6	6,4
roccellin	1,7	1	1,2
rugulosin	3,5	2	2,7
salazinic a.,.	1,9	1,5	1,6
schizopeltic a.	3,9	2,9	5,8
scrobiculin	6,1	6,2	6,3
sekikaic a.	4,6	6,1	6,4
skyrin	3,9	4,1	3,3
skyrin	3,9	4,2	3,4
solorinic a.	7,3	7,3	7,5
sordidone	5,9	5,5	6
sphaerophorin	4,6	7	6,3
sphaerophorin	4,8	7	6,2
squamatic a.	2,3	3,1	3,8
stictic a.	3	1,8	2,8
strepsilin	3,8	3,2	3,3

substictic acid	2,2	1,6	2
succinprotocetraric a.	1,3	2,5	2,3
taraxerol	6	7	6,4
taraxerone	7,3	8	7
teloschistin	4,8	3,8	4,8
tenuiorin	6,8	6	6,9
thamnolic a.	1,5	3	2,8
thiophanic a	6,1	6,1	6,5
thuringione	5,6	5,8	6
tumidulin	6	6,1	6,4
usnic a.	6,8	6,5	6,9
variolaric a.	2,5	1,9	2,1
vulpinic a.	6,5	6,1	7
vulpinic a.	6,6	6	6,9
zeorin	5	5,3	5,8
$\alpha$ -(15-hydroxyhexadecyl)itaconic a.	2,9	4,1	4,5
$\alpha$ -collatolic a.	4,1	4,2	5,3

**Table 2: spots sorted after positions in A,B',C**

<b>Substanz (a. = acid)</b>	<b>A</b>	<b>B'</b>	<b>C</b>
chiodectonic a.	1	1	1,1
rhodocladonic a.	1	1,1	1,1
conprotocetraric a.	1,1	1,4	1,1
consquamnatic a.	1,2	1	1
pulvinic a.	1,2	4,9	1,8
constictic a.	1,3	1,1	1,1
peristictic a.	1,3	1,7	1,2
succinprotocetraric a.	1,3	2,5	2,3
protocetraric a.	1,3	2,6	1,7
protocetraric a.	1,3	2,7	1,6
protocetraric a.	1,3	2,7	1,7
protocetraric a.	1,3	2,7	1,8
fumarprotocetraric a.	1,3	3,3	2,1
pulvinic a.	1,3	4,9	1,9
galapagin	1,4	1,1	1,1
erythrin	1,4	1,3	1,1
pannaric a.	1,4	2	1,3
pannaric a.	1,4	2	1,3
constictic a.	1,5	1,1	1,3
erythrin	1,5	1,3	1,2
thamnolic a.	1,5	3	2,8
decarboxythamnolic	1,6	2,8	3
convirensic a.	1,6	3,4	1,8
roccellin	1,7	1	1,2
porphyrillic a.	1,7	2	1,8
caperatic a.	1,7	3,4	1,9
connorstictic a.	1,8	1,9	1,4
pannaric a.	1,8	3,1	1,9
salazinic a.,	1,9	1,5	1,6
isorangiformic a.	2	4,5	3,8
physodalic a.	2,1	4,2	3,3
substictic acid	2,2	1,6	2
4-O-demethylgrayanic acid	2,2	4,5	3,2
cryptostictic a.	2,3	1,6	1,9
menegazziaic a.	2,3	2,1	2,1
retigeric a. A	2,3	2,9	3,1
squamatic a.	2,3	3,1	3,8
physodalic a.	2,3	4,1	3,3
physodalic a.	2,3	4,2	3,3
variolaric a.	2,5	1,9	2,1

oxyphysodic a.	2,5	4	2,5
norrangiformic a.	2,5	4,4	3,7
2'-O-demethylpsoromic a.	2,5	4,8	2,4
pannaric acid 6-methylester	2,6	4	2,6
pannaric acid 6-methylester	2,6	4,2	2,8
cetraric a.	2,6	4,8	3,8
leucotylin	2,7	3,2	3
haemathamnolioc a.	2,7	4,5	4,2
1 $\alpha$ 3 $\beta$ ,22-hopantriol	2,8	3,2	3,3
$\alpha$ -(15-hydroxyhexadecyl)itaconic a.	2,9	4,1	4,5
hypoprotocetraric a.	2,9	4,7	3,2
congrayanic acid	2,9	5,6	4,2
stictic a.	3	1,8	2,8
9-methyl pannarate	3	3,9	3,2
hypoprotocetraric a.	3	4,9	3,3
polyporic a.	3,1	3	2,9
polyporic a.	3,1	3,1	2,9
galbinic a.	3,3	2,2	2,8
alectoronic a.	3,3	3,9	2,9
4-O-demethylgrayanic acid	3,3	4,5	3,2
4'-O-methylpaludosic a.	3,4	4	3,5
hybocarpone	3,4	5,2	3
rugulosin	3,5	2	2,7
notatic a.	3,5	5	5,3
olivetoric a.	3,6	4,9	3,5
physodic a.	3,6	4,9	3,5
rangiformic a.	3,6	5,2	5,5
rangiformic a.	3,6	5,2	5,6
rangiformic a.	3,6	5,5	5,7
glomellic a.	3,7	3,6	4,5
norlichexanthone	3,7	4,6	2,1
cryptochlorophaeic a.	3,7	4,8	5,1
ramgiformic a.	3,7	5,1	5,5
strepsilin	3,8	3,2	3,3
acarenoic a.	3,8	4,5	4,9
congrayanic acid	3,8	5	4,2
lobaric a.	3,8	5,6	5,3
schizopeltic a.	3,9	2,9	5,8
skyrin	3,9	4,1	3,3
skyrin	3,9	4,2	3,4
3-O-demethylschizopeltic a.	3,9	4,2	5,9
alectorial a.	3,9	5,5	4

4-O-methylhypocetraric a.	3,9	5,5	6
evernic a.	3,9	5,9	5,9
divaricatic a.	3,9	6,6	6,2
pyxinol	4	3,3	4,2
norstictic a.	4	4	4
paludosic acid	4	4,3	2,6
allo-pertusaric a.	4	4,7	5
baeomycesic a.	4	4,8	5,6
2-O-methylsekikaic a.	4	4,8	5,9
orsellinic a.	4	5,2	3,7
allo-protolichseterinic a.	4	5,2	5,4
4-O-methylhypocetraric a.	4	5,4	6
picrolichenic a.	4	5,5	5,4
anziaic a.	4	5,8	5
obtusatic a.	4	6,2	6
$\alpha$ -collatolic a.	4,1	4,2	5,3
cryptochlorophaeic a.	4,1	5,1	4,9
5-chloro-4-O-demethylbarbatic a.	4,1	6,6	6
15 $\alpha$ ,22-dihydroxyhopane	4,2	4,8	5,5
acaranoic a.	4,2	4,9	5,6
psoromic a.	4,2	5,2	5,5
glomelliferic a.	4,2	5,5	6
miriquidic a.	4,3	5,3	5,7
protolichesterinic a.	4,3	5,4	5,1
roccellic a.	4,3	5,5	5,5
roccellic a.	4,3	6,2	6,1
2-O-methylconfluentic a.	4,4	3,5	5,9
roccellic a.	4,4	6	6,4
imbricatic a.	4,4	6,8	6,1
arthonin	4,5	2,8	5,1
hypthallin	4,5	3	5,1
2-O-methylconfluentic a.	4,5	3,4	5,9
planaic a.	4,5	4,9	6,3
diffRACTaIC a.	4,5	6	6
lichesteric a.	4,5	6,3	5,9
homosekikaic a.	4,5	6,4	6,4
barbatic a.	4,5	6,5	6,1
1,4-di-O-methylnorsekikaic a.	4,5	?	?
sekikaic a.	4,6	6,1	6,4
perlatolic a.	4,6	6,6	6
didymic a.	4,6	6,8	6,4
sphaerophorin	4,6	7	6,3
teloschistin	4,8	3,8	4,8

confluentic a.	4,8	4	5,9
confluentic a.	4,8	4	5,9
sphaerophorin	4,8	7	6,2
2'-O-methylperlatolic a.	4,9	5,5	6,4
portentol	5	3,6	5
zeorin	5	5,3	5,8
merochlorophaeic a.	5	5,6	6,7
norsolorinic a.	5	6,4	5,5
pseudoplacodiolic a.	5,3	5,3	6,1
bourgeanic a.	5,3	6	6
3 $\beta$ -acetoxyhopane-1 $\beta$ ,22-diol	5,4	4,5	5,8
acetylportentol	5,5	2,9	5,6
diacetylleucotylin	5,5	4,8	5,7
7-chloroemodin	5,5	6	5,9
thuringione	5,6	5,8	6
gangaleoidin	5,8	4,7	6,1
methyl pyxinate	5,8	5,4	6,1
pseudocyphellarin B	5,8	5,9	6
4-O-methylcryptochlorophaeic a.	5,8	5,9	?
ent-kauran-16 $\alpha$ -ol	5,8	6,3	6,3
sordidone	5,9	5,5	6
tumidulin	6	6,1	6,4
placodiolic a.	6	6,3	6,7
taraxerol	6	7	6,4
7 $\beta$ -acetoxy-22-hydroxyhopan	6,1	5,9	6,2
thiophanic a	6,1	6,1	6,5
scrobiculin	6,1	6,2	6,3
diploicin	6,2	6,5	6,5
3 $\beta$ -hydroxy-25-acetoxy- 20(S),24(R)epoxydammarane	6,3	5,9	6,2
caloploicin	6,3	6,5	6,5
rhizocarpic a.	6,4	5	6,5
friedelan-3 $\beta$ -ol	6,4	6,8	6,5
epanorin	6,5	5,3	6,7
nephroarctin	6,5	5,9	6,7
vulpinic a.	6,5	6,1	7
pannarin	6,5	6,4	6,9
leprapinic a.	6,6	5,6	7
pinastric a.	6,6	6	6,6
vulpinic a.	6,6	6	6,9
neochloroemodin =4-chloroemodin	6,7	5,5	6,6
eriodermin	6,7	6,1	6,9

2 $\alpha$ ,3 $\beta$ ,22 $\alpha$ -triacetoxystictane	6,8	5,9	6,5
pinastric a.	6,8	5,9	7
tenuiorin	6,8	6	6,9
pinastric a.	6,8	6,1	7
usnic a.	6,8	6,5	6,9
parietin	6,8	6,8	7
isousnic a.	6,8	7,2	7,1
lichexanthone	6,9	6,3	6,9
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chloroatranorin	7,1	7,1	7,1
retigeranic a.	7,1	8,4	7,8
solorinic a.	7,3	7,3	7,5
calycin	7,3	7,4	8,5
taraxerone	7,3	8	7
calycin	7,4	7,4	8,1
calycin	7,4	7,4	8,6
calycin	7,4	7,5	8,2
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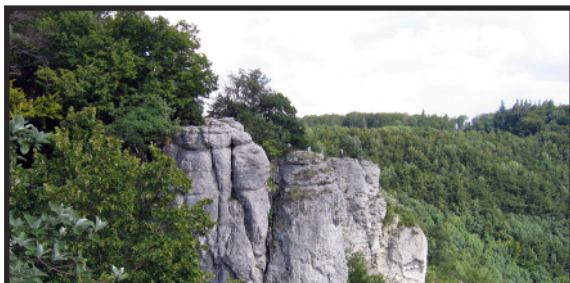
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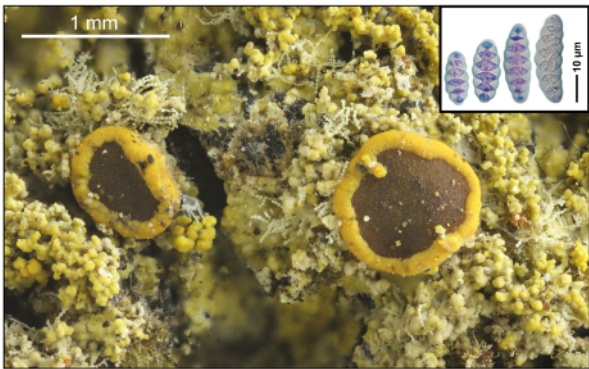


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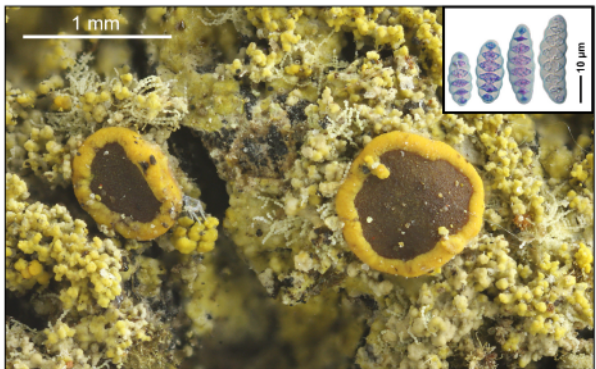


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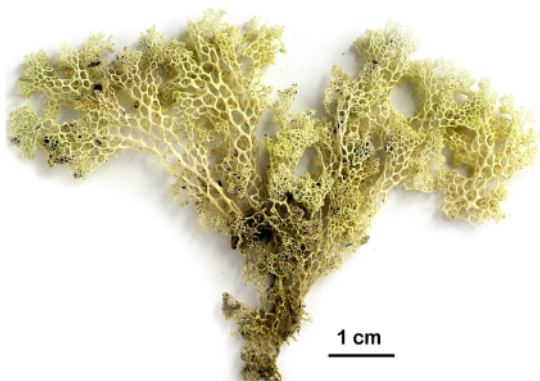
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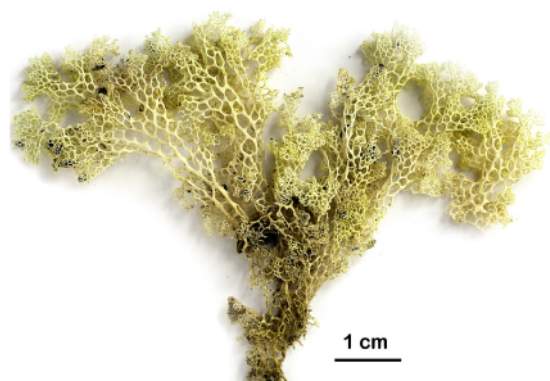
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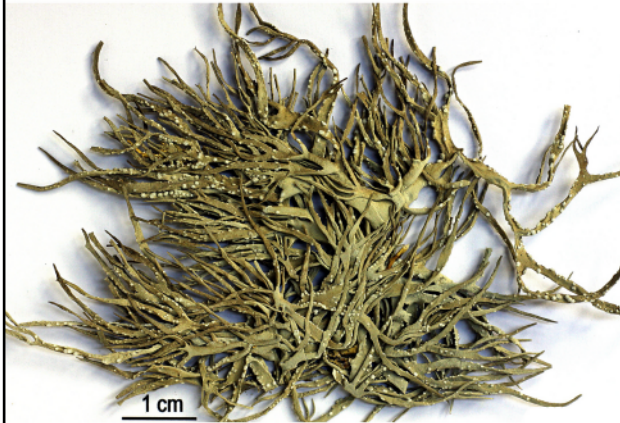
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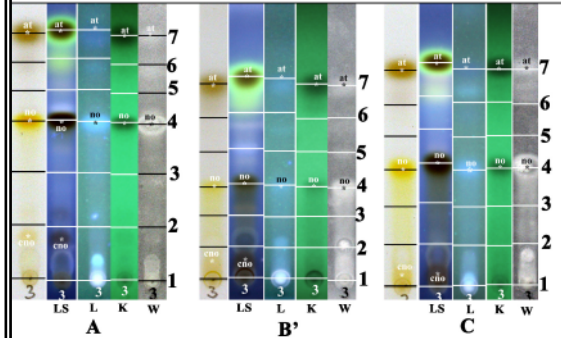
Fruticose Roccellaceae  
-  
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Guide with a worldwide Key and further  
Notes on some crustose Roccellaceae  
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Atlas of Images of Thin Layer  
Chromatograms of Lichen  
Substances

Bilderatlas von Dünnschicht-  
chromatogrammen von  
Flechten-Inhaltsstoffen



*Platismatia glauca* [3030] und *Cladonia symphycharpa* [4698]  
p289/3

The book contains a further collection of coloured images of plates obtained by thin layer chromatography of many lichen substances as an aid for their determination. The images show mounted runs obtained in solvents A, B/B' and C commonly used in lichenology. They show results obtained using 5 x 5 cm HPTLC plates in daylight and under UV light, before and after treating with sulfuric acid. The origin of each lichen substance (or substances) is recorded.

Das Buch enthält eine weitere Sammlung farbiger Bildtafeln von Dünnschicht-Chromatogrammen von vielen Flechteninhaltsstoffen und soll als Hilfe zu deren Bestimmung dienen. Die Bilder zeigen montierte Laufbahnen zu den in der Lichenologie üblichen Laufmitteln A, B/B' und C. Sie zeigen die Ergebnisse auf 5 x 5 cm HPTLC-Platten bei Tageslicht und UV-Licht vor und nach der Behandlung mit Schwefelsäure. Die Herkunft jeder Flechtensubstanz (oder Substanzen) ist angegeben.