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低温胁迫对两种樟树抗寒性生理的影响

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摘 要: MDA SOD “S” SOD MDA Fuzzy Logistic LT_{50} -12.43 -10.71

关键词: ; ; SOD ;

中图法分类号: S722.7 **文献标识码:** A **文章编号:** 1000-2324(2016)01-0037-06

The Effect of Cold Stress on the Cold Resistance Physiology of Two Camphor Species

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Abstract: Taking leaves of *Cinnamonum bodinieri* Levl and *C. camphora* L. (linalool-type) treated by cold temperature as test materials, the changes of MDA, Proline, Soluble protein and SOD activity, electrical conductivity in them were studied. The results indicated that for all the materials, with the decrease of temperature, the ion leakage percentage of the two species increased in S-shape, the SOD and POD activities decreased after an initial increase. The content of soluble protein, MDA and soluble sugar began to drop, then to increase and at last to drop again. By using fuzzy mathematics method, the cold resistance of two camphor tree species was evaluated as *Cinnamonum bodinieri* Levl > *C. camphora* L. (linalool-type), the semi-lethal temperature (LT_{50}) of two camphor tree species calculated by the Logistic equation of ion leakage percentage was -12.43, -10.71 , respectively. At last, by using a fuzzy mathematics method, the cold resistance of *C. bodinieri* Levl was divided into three periods, namely, the reducing stage, the enhancement setting stage, and the reducing stage.

Keywords: Camphor tree; cold resistance; SOD activity; comprehensive evaluation

[1]

[2]

(LT_{50}) 5 5 4 [3]

12 1 10 3 [4] -10 [5,6]

(*Cinnamonum bodinieri* Levl)

C. camphora L. (linalool-type)

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1 材料与方法

1.1 实验材料

1 a

113°12′ 113°13′ 28°22′ 28°23′

112°42′ 114°14′ 34°16′ 34°58′

14.2 0.2 °C -19.7 227 d 11

1.2 实验设计

2011 12 1 a 10

2 3 3 7

3 g 6 0 -5 -10

-15 -20 -25 24 h 2011 12 5

0/4 CK 3 3

1.3 测定项目及方法

[7]

MDA TBA

SOD NBT [8]

1.4 数据处理

Fuzzy [9,10] 1

$f(x_{ij})=(X_{ij}-X_{j\,min})/(X_{j\,max}-X_{j\,min})$ 2

MDA $f(x_{ij})=1-(X_{ij}-X_{j\,min})/(X_{j\,max}-X_{j\,min}$ $f(x_{ij})$ i

j X_{ij} $X_{j\,max}$ $X_{j\,min}$ j

Excel SPSS

2 结果分析

2.1 电导率的变化

1

50% LT_{50}

-10 48.69% 52.99% 50%

-10

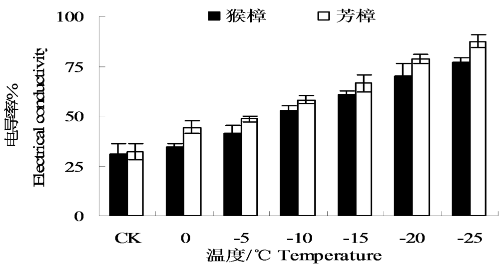

图 1 低温处理后两种樟树的电导率变化

Fig.1 The changes of electrical conductivity in leaves of two camphor species under low temperature

Logistic

$y=K/(1+\alpha e^{-bx})$ LT_{50} -12.43 -10.71 1

R^2 0.99

表 1 两种樟树电导率的 Logistic 方程参数及 LT_{50}

Table 1 The parameters of Logistic equation and LT_{50} of two camphor species

Species	α	b Minus b	k	LT_{50}( )	R^2 Fitting degree
	0.4692	0.0609	92.26	-12.43	0.9922**
	0.6021	0.0474	104.30	-10.71	0.9910**

注：*a*、*b*、*k* 分别表示曲线渐进度、曲线斜率、方程系数；**表示拟合度达到极显著水平。

Note: *a*, *b* and *k* indicates the gradual curve, curve slope and equation coefficient, respectively. ** Indicates the significance of R^2 at P< 0.01 respectively.

2.2 MDA 含量

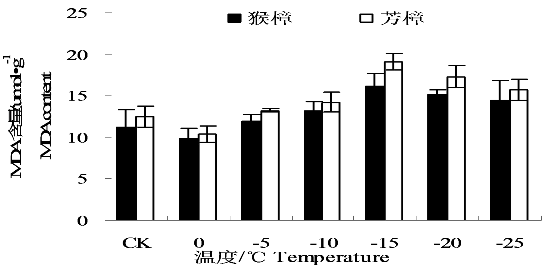

图 2 低温处理后两种樟树的 MDA 含量的变化

Fig.2 The changes of MDA content in leaves of two camphor species under low temperature

2 MDA MDA

MDA

MDA 0 -15 MDA 16.20 19.11 μmol·g^{-1} 64.47 84.46%

2.3 脯氨酸含量的变化

3

-15 0.3089 0.2548 mg·g^{-1}

24.14% 10.49% -15

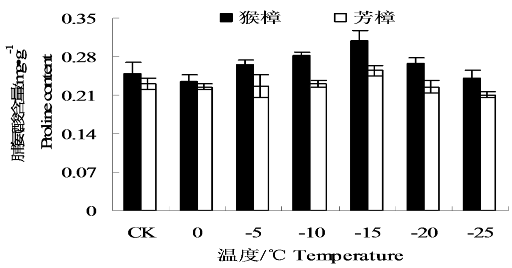

图 3 低温处理后两种樟树的脯氨酸含量的变化

Fig.3 The changes of proline content in leaves of two camphor species under low temperature

2.4 可溶性糖、可溶性蛋白含量的变化

4

-15

16.42% 17.74%

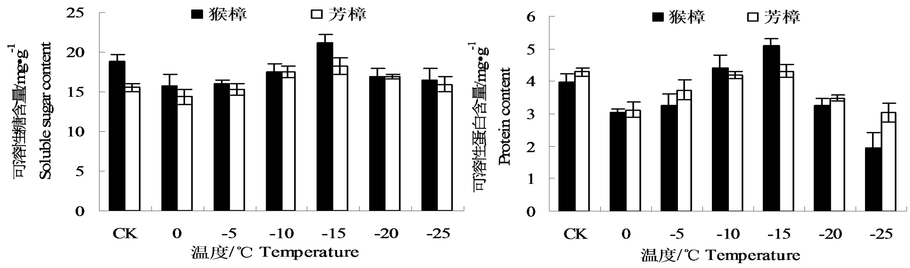

图 4 低温处理后两种樟树的可溶性糖、可溶性蛋白含量的变化
Fig.4 The changes of soluble sugar and protein content in leaves of two camphor species under low temperature

2.5 SOD 活性的变化

SOD O_2^-

SOD 5 SOD

-5 61.86 85.65%

13.27% SOD

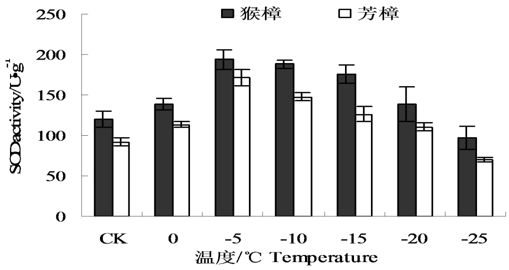

图 5 低温处理后两种樟树的 SOD 活性的变化
Fig.5 The changes of SOD activity in leaves of two camphor species under low temperature

2.6 隶属函数法综合分析抗寒性

2.6.1 低温胁迫过程中各抗寒指标隶属值 2

“ - - ”

2 1

CK 0 -15

2 0 -10

表 2 猴樟低温胁迫过程中各抗寒指标隶属值
Table 2 The membership values of cold resistance indicators under cold stress

( ) Treatment	Electrical conductivity	MDA MDA content	Proline content	Soluble sugar	Soluble protein	SOD SOD activity	Synthetic evolution	SN
CK	0.1729	0.1597	0.0275	0.0684	0.1245	0.0388	0.0986	3
0	0.1588	0.2049	0.0000	0.0000	0.0657	0.0711	0.0834	5
-5	0.1338	0.1368	0.0611	0.0072	0.0799	0.1630	0.0969	4
-10	0.0899	0.0949	0.0934	0.0397	0.1499	0.1534	0.1035	2
-15	0.0606	0.0000	0.1451	0.1226	0.1915	0.1333	0.1089	1
-20	0.0251	0.0319	0.0660	0.0286	0.0791	0.0699	0.0501	6
-25	0.0000	0.0549	0.0114	0.0165	0.0000	0.0000	0.0138	7

2.6.2 抗寒性综合评价 (1) (2)

2 6 3 >

表 3 两种樟树抗寒性综合评判

Table3 Synthetic evaluation of cold resistance of two camphor trees

Species	Electrical conductivity	MDA MDA content	Proline content	Soluble sugar	Soluble protein	SOD SOD activity	Synthetic evolution	SN
	0.1667	0.1667	0.1667	0.1667	0	0.1667	0.1389	1
	0	0	0	0	0.1667	0	0.0278	2

3 结 论与讨 论

3.1 不同低温对两种樟树的抗寒性影响

3.1.1 低温对细胞膜透性的影响

[11] [12,13]

[14-16]

S

Rajashekar C [17] Logistic

(LT_{50}) [18-20]

R^2 0.9922 0.9910

[21]

-12.43 -10.71

3.1.2 低温对渗透调解物质的影响

[22-24]

[25]

[26]

[16]

3.1.3 低温对膜脂过氧化的影响 MDA

[27] MDA

[28] [29]

[30]

[31] [32]

3.1.3 低温对保护酶活性的影响 SOD

[33,34] [35]

SOD

SOD [36]

[37] [38]

3.1.4 抗寒性综合评价

[9] [39] [40] Fuzzy

MDA SOD 5

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