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6个杧果品种耐寒性的研究

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摘 要:【目的】杧果易受冬季低温寒害,造成产量下降甚至绝收,严重影响杧果产业的发展。通过对杧果不同品种耐寒性的研究,为杧果耐寒品种选育及栽培布局提供理论依据。【方法】以'贵妃''凯特''红玉''金煌''热品6号'和'台农2号'为试材,测定了低温胁迫下其叶片相对电导率(REC)、丙二醛(MDA)含量和超氧化物酶(SOD)、过氧化物酶(POD)、过氧化氢酶(CAT)活性的变化。【结果】低温胁迫下,杧果叶片各指标均高于对照,且品种间存在极显著差异。随着温度下降及时间延长,6个杧果品种REC和MDA含量不断升高,CAT活性先升后降;不同品种SOD和POD活性变化不同,'凯特''红玉'和'金煌'3者活性先升后降,'贵妃'和'台农2号'SOD活性呈2种不同变化,'热品6号'SOD活性先升后降,'贵妃'和'台农2号'POD活性呈降-升-降变化,'热品6号'呈3种不同变化。【结论】低温胁迫过程中杧果叶片REC、MDA含量升高,SOD、POD和CAT活性先升后降,6个品种的耐寒性由弱到强依次为'台农2号'(-0.97 ℃)<'贵妃'(-1.68 ℃)<'热品6号'(-2.11 ℃)<'凯特'(-2.32 ℃)<'金煌'(-4.04 ℃)<'红玉'(-5.14 ℃)。

关键词:杧果;低温;耐寒性;半致死温度;保护酶

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A study on cold resistance in six mango cultivars

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Abstract:【Objective】Mango is susceptible to chilling injury in winter. Chilling injure causes yield reduction and even total crop failure, which is disastrous for farmers and seriously affects the development of mango production. Previous studies focused mainly on frozen injury in mango in winter, but there have been few reports about the mechanisms of response to cold temperatures. In this study, the semi-lethal temperature (LT_{50}) and changes in activities of protective enzymes in mangos under chilling stress were studied in order to provide a theoretical basis for cultivar introduction, cold resistance breeding and cultivation.【Methods】Two-year-old grafted seedlings of six mango cultivars including 'Guifei' 'Keitt' 'Hongyu' 'Chiin Hwang' 'Repin No.6' and 'Tainoung No.2' were placed in incubators for low temperature treatments. The experiment set six temperature treatments at 6, 3, 0, -3, -6 and -9 ℃ under darkness for 3, 6 and 9 h, and therefore there were totally nineteen treatment groups including the control group, each composed of three replicates (seedlings). Mature leaves were collected immediately after 3, 6 or 9 h of treatments and divided into two parts. One was used to determine the relative electric conductivity (REC); the other was frozen in liquid nitrogen then stored at -80 ℃ until analyses of malondialdehyde (MDA) and the enzymatic activities of superoxide dismutase (SOD), catalase (CAT) and peroxidase activity (POD). The method of REC measurement was modified from that of Yang Huageng's, and the semi-lethal temperature (LT_{50}) was determined according to Zhu Genhai. Activities of MDA, SOD, CAT, POD and the content of MDA were determined following the Assay Kit Protocols.【Results】The REC value of the six mango cultivars increased following an S curve with the decrease of temperature. The rapid increase in REC in different cultivars occurred at different temperatures. The REC values of 'Keitt' 'Repin No.6' and 'Tainoung

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No.2' increased significantly when temperature was below 0 ℃; those of 'Guifei' and 'Chiin Hwang' under chilling stress for 6 and 9 h were similar to those of 'Keitt' and others. When temperature was lower than −3 ℃, the REC values of 'Guifei' and 'Chiin Hwang' exposed to low temperature for 3 h rose significantly. Regressed logistic equations between temperature and REC values in the 6 cultivars exposed to the temperatures for 9 h were established. LT_{50} value was calculated from the established equations, which can be used to measure the cold resistance of mango. The cold resistance based on LT_{50} in six mango cultivars was in the order of 'Hongyu' (−5.14 ℃)> 'Chiin Hwang' (−4.04 ℃)> 'Keitt' (−2.32 ℃)> 'Repin No.6' (−2.11 ℃)> 'Guifei' (−1.68 ℃)> 'Tainoung No.2' (−0.97 ℃). MDA content in all cultivars under cold stress was higher than the control. MDA content in all the cultivars gradually increased with the decrease of temperature, and reached the highest value at −9 ℃. Highest value of MDA was found in 'Tainoung No.2', and the lowest value was in 'Hongyu'. MDA in 'Tainoung No.2' was higher than in the other cultivars. MDA contents in 13 treatments were significantly were higher than the other cultivars at the same condition. 'Hongyu' had the lowest MDA content among all the cultivars, its peak value being 61.22% that of 'Tainoung No.2'. The range of increase in MDA was the largest in 'Guifei' and lowest in 'Hongyu' and 'Chiin Hwang'. With drop in temperature, SOD and POD activities showed different change patterns in different cultivars. SOD activity in 'Keitt' 'Hongyu' 'Chiin Hwang' and 'Repin No.6' rose first and then declined. There were differences in trend in 'Guifei' and 'Tainoung No.2' with time of treatment. The curve of 'Guifei' under cold stress for 3 h was in an M pattern similar to that of 'Keitt' under cold stress for 6 and 9 h. SOD activity in 'Tainoung No.2' showed an N pattern in the cases of cold exposure for 3 and 9 h, while it increased continuously in the case of cold exposure for 6 h. 'Guifei' maintained a significantly higher SOD activity than other cultivars at all the low temperatures, followed by 'Chiin Hwang' and 'Keitt'. Low temperature stress increased SOD activity. Compared to the control group, the rising range of 'Repin No.6' was larger, while those of 'Hongyu' and 'Guifei' were smaller than the others'. POD activity 'Keitt' 'Hongyu' and 'Chiin Hwang' increased in the early period and then decreased. The enzyme activity 'Guifei' and 'Tainoung No.2' displayed a trend of decreasing- increasing-decreasing, but its change was slight. 'Repin No.6' showed different trends at different durations of cold exposure, W shape for 3 h, N shape for 6 h and decreasing-increasing-decreasing for 9 h. POD activity in 'Hongyu' was significantly higher than that in the other cultivars. In all the treatments in 'Tainoung No.2', POD activities were lower than in the other cultivars. POD activity in the six mango cultivars exposed to low temperatures was higher than in the control. POD activity rose significantly when temperature dropped below 3 ℃, and the rising range was the largest in 'Hongyu' and smallest in 'Tainoung No.2'. CAT activity was higher in chilling stressed groups than in the control. CAT activity in the six mango cultivars increased and then decreased with temperature drop but its peak values were different. 'Guifei' 'Keitt' 'Repin No.6' and 'Tainoung No.2' had their peak CAT activities at 0 ℃, and 'Hongyu' and 'Chiin Hwang' at −6 ℃. CAT activities in 'Hongyu' in 9 cold treatments were all significantly higher than in the other cultivars. Fourteen treatments in 'Tainoung No.2' were lowest among all the cultivars. Same to POD, the largest and lowest increasing range was found in 'Hongyu' and 'Tainoung No.2', respectively. 【Conclusion】REC, MDA content and SOD, POD and CAT activities were higher under chilling stresses compared with the control. With temperature drop, REC and MDA content in the six mango cultivars increased; CAT activity rose first and then decreased; the change patterns of SOD and POD activities differed among the six mango cultivars. The LT_{50} and the changes in protective enzyme activities showed that cold resistance in the six mango cultivars was in the order of 'Hongyu' > 'Chiin Hwang'> 'Keitt'> 'Repin No.6' > 'Guifei' > 'Tainoung No.2'.

Key words: Mango; Low temperature; Cold resistance; Semi-lethal temperature (LT_{50}); Protective enzyme