

冬季异常高温对亚热带地区树木休眠解除的影响

常¹ Heikki Hänninen¹ 吴家胜^{1*} 张瑞^{1*}

(1. 浙江农林大学 亚热带森林培育国家重点实验室 临安 311300)

摘要:【目的】冬季积冷是影响树木休眠解除的主导因子,受全球气候变暖影响,冬季异常高温的发生频率增加,尤其是亚热带地区冬季常出现 20℃ 及以上异常高温。然而,现有积冷模型是基于温带气候特征建立,温带地区冬季气温偏低,无法真实准确地识别和处理这种异常高温,导致模型不能完全适用于亚热带树种。在气候变暖背景下,冬季异常高温对亚热带树种休眠解除的作用究竟如何,积冷模型如何处理这种异常值,亟待研究解决。【方法】为了探究亚热带地区树种对冬季异常高温的响应规律,本研究以香榧(*Torreya grandis*),檫木(*Sassafras tzumu*),浙江樟(*Cinnamomum camphora*),浙江楠(*Phoebe chekiangensis*),苦槠(*Castanopsis sclerophylla*),银杏(*Ginkgo biloba L.*),薄壳山核桃(*Carya illinoensis*),金钱松(*Pseudolarix Kaempferi(Lindl)Gord*)等亚热带地区树种为试材,采用五种不同积冷处理(积冷时间均为 66d):4℃ 恒定低温、冬季自然低温、以及在 4℃ 恒定低温累积不同阶段(1w、4w、7w)进行高温(20℃,模拟气候变暖引起的冬季异常高温)处理一段时间,随后将苗木转移至积温气候室(20℃)观察萌芽展叶情况。【结果】1)各树种萌芽时间与其本身的低温需求量相关,低温需求量(Ccrit)高的树种,恒温积冷萌芽更快;低温需求量低的树种,自然积冷萌芽更快。2)与现有研究假设(冬季高温对积冷无作用或起抵消作用)不同,本研究发现冬季异常高温对亚热带地区树木萌芽整体起促进作用,表明异常高温可能起到微弱积冷作用,促进树木休眠解除从而促进萌芽;或者起积温作用,促进个体发育,进而促进树木萌芽。3)经进一步分析发现,异常高温在亚热带树木休眠解除过程中起到积温作用,并且其对萌芽的作用与各树种所处的休眠解除状态相关:当积冷越多,休眠解除越充分,异常高温对萌芽的促进效果越明显。【结论】异常高温实际在积冷过程中起到积温作用,并且这种积温作用和积冷交互同步进行。本研究揭示出冬季异常高温对亚热带树木休眠的影响及其在休眠解除不同阶段的作用规律,可为优化现有积冷模型提供科学依据。

关键词: 气候变暖; 冬季异常高温; 积冷模型; 休眠解除; 亚热带树种; 萌芽

Influence of abnormally high temperature in winter on tree dormancy release in subtropical region

Abstract:【Objective】Cold accumulation in winter is the main factor affecting tree dormancy release. Under the influence of global warming, the occurrence frequency of abnormal high temperature in winter increases, especially in subtropical regions where abnormal high temperature is often 20℃ or above in winter. However, the existing cold accumulation model is based on the characteristics of the temperate climate, the temperature in the temperate region is low in winter, and it is unable to truly and accurately identify and deal with this abnormal high temperature, resulting in the model cannot be fully applicable to subtropical tree species. Under the background of climate warming, the effect of abnormal high temperature in winter on the dormancy release of subtropical tree species and how to deal with such abnormal value in cold accumulation model need to be studied urgently. Cold accumulation in winter is the main factor affecting tree dormancy release. Under the influence of global warming, the occurrence

基金项目: 国家自然科学基金面上项目(32171832); 国家林草局科技创新青年拔尖项目(2020132604); 中国科协青年托举项目(2020QNRC001); 浙江省尖兵领雁项目(2022C02009)

* 通讯作者

frequency of abnormal high temperature in winter increases, especially in subtropical regions where abnormal high temperature is often 20°C or above in winter. However, the existing cold accumulation model is based on the characteristics of the temperate climate, the temperature in the temperate region is low in winter, and it is unable to truly and accurately identify and deal with this abnormal high temperature, resulting in the model cannot be fully applicable to subtropical tree species. Under the background of climate warming, the effect of abnormal high temperature in winter on the dormancy release of subtropical tree species and how to deal with such abnormal value in cold accumulation model need to be studied urgently. 【Method】 In order to explore the response of tree species in subtropical regions to the abnormal high temperature in winter, *Torreya grandis*, *Sassafras tzumu*, *Torreya grandis*, *Sassafras tzumu*, *Cinnamomum camphora*, *Phoebe chekiangensis*, *Castanopsis sclerophylla*, *Ginkgo biloba* L, *Carya illinoensis*, *Pseudolarix Kaempferi*(Lindl)Gord and other tree species in subtropical areas were used as test materials, and five different accumulation and cooling treatments were used (the accumulation and cooling time were all 66d) : Constant low temperature at 4°C, natural low temperature in winter, and high temperature (20°C, simulating abnormal high temperature in winter caused by climate warming) at different stages of accumulation of constant low temperature at 4°C (1w, 4w, 7w) were treated for a period of time, and then the seedlings were transferred to accumulated temperature climate chamber (20°C) to observe the germination and leaf spread. 【Conclusion】 Abnormal high temperature actually plays the role of temperature accumulation in the process of cold accumulation, and the temperature accumulation and cold accumulation interact and synchronize. This study revealed the effects of abnormal high temperature in winter on dormancy of subtropical trees and its effects in different stages of dormancy release, which can provide scientific basis for optimizing the existing cold accumulation model.

Key words: Climate warming; Unusually high temperatures in winter; Cold accumulation model; Dormancy release; Subtropical tree species; germinate.