

不同基因型冬小麦旗叶的稳定碳同位素比值及其与产量和水分利用效率的关系

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摘要 以我国北方12个冬小麦(*Triticum aestivum*)品种(系)和美国德克萨斯州3个冬小麦品种(系)为供试材料, 在甘肃陇东黄土高原旱作和拔节期有限补灌条件下, 比较研究了不同基因型冬小麦之间产量、水分利用效率(WUE)和灌浆期旗叶稳定碳同位素比值($\delta^{13}\text{C}$)的差异, 以及 $\delta^{13}\text{C}$ 值与产量和WUE的关系。旨在通过分析 $\delta^{13}\text{C}$ 值与产量和WUE的关系, 明确 $\delta^{13}\text{C}$ 值在评价植物WUE方面的可靠性, 为抗旱节水品种的筛选提供理论依据。结果表明: 不论旱作还是有限补灌, 不同基因型冬小麦之间产量、WUE、旗叶 $\delta^{13}\text{C}$ 值存在显著差异, 随着灌浆过程的进行, 旗叶 $\delta^{13}\text{C}$ 值呈缓慢增大的趋势, 而且旗叶 $\delta^{13}\text{C}$ 值旱作高于有限补灌。不论旱作还是补灌条件, 旗叶 $\delta^{13}\text{C}$ 值在4个测定时期的平均值与籽粒产量、WUE呈显著正相关关系($R^2 = 0.527\ 3 - 0.691\ 3$)。小麦拔节期补灌100 mm水分后, 不同基因型小麦表现出明显的水分超补偿效应。说明冬小麦灌浆期旗叶 $\delta^{13}\text{C}$ 值在旱作条件下和在补灌条件下均可较好地评价WUE, 可将冬小麦灌浆期旗叶 $\delta^{13}\text{C}$ 值作为筛选高效用水品种的参考指标之一。

关键词: 籽粒产量 稳定碳同位素比值 水分利用效率 冬小麦

Abstract: Aims Our objectives were to analyze differences of grain yield, water use efficiency (WUE) and stable carbon isotope ratio ($\delta^{13}\text{C}$) in various genotypes of dryland winter wheat (*Triticum aestivum*) and the correlation between $\delta^{13}\text{C}$ value and grain yield and WUE under two different ecological conditions. Findings will help clarify the reliability of using $\delta^{13}\text{C}$ to evaluate WUE and provide a basis for breeding water-saving types. Methods We studied 15 winter wheat genotypes (12 from north China and 3 from Texas, USA) on the Loess Plateau of East Gansu under dryland and supplemental irrigation treatments at the jointing stage. Important findings Different genotypes had considerable differences in grain yield, WUE and $\delta^{13}\text{C}$ value whether under dryland or irrigation, and the $\delta^{13}\text{C}$ value increased with grain filling proceeding. Moreover, the $\delta^{13}\text{C}$ value under dryland condition was higher than under limited irrigation. The correlation between $\delta^{13}\text{C}$ with grain yield and WUE is significant during the grain filling stages whether under dryland or irrigation, and the correlation under dryland is better than that under limited irrigation. With irrigation of 100 mm water at jointing stage, various genotypes of winter wheat had significant compensation or super compensation effects. The $\delta^{13}\text{C}$ value can indicate WUE well whether under dryland or irrigated condition. Therefore, the $\delta^{13}\text{C}$ value can be used by breeding programs as a potential selection criterion for grain yield and WUE in wheat.

Keywords: grain yield, stable carbon isotope ratio, water use efficiency, winter wheat

收稿日期: 2010-03-03; 出版日期: 2011-01-21

基金资助:

国家“十一五”科技支撑计划课题(2006BAD29B07)

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引用本文:

樊廷录, 马明生, 王淑英, 李尚中, 赵刚. 不同基因型冬小麦旗叶的稳定碳同位素比值及其与产量和水分利用效率的关系. 植物生态学报, 2011,35(2): 203-213.


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