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限水灌溉下春季追氮方式对小麦旗叶光合和衰老特性的影响

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Effects of nitrogen application methods on photosynthesis and senescence characteristics of flag leaves in wheat under limited irrigation

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摘要 限水条件下，等量氮不同施用方式对小麦旗叶光合和衰老特性的调控效应不同；不同抗旱性品种对施氮方式的响应也有所差异。与拔节初期1次施氮处理（SF）相比，拔节初期、挑旗期2次施氮处理（DF）增加了供试品种旗叶中后期的叶绿素含量（Chl）、可溶蛋白含量（SP）、RuBPCase活性、气孔导度（Gs）和光合速率（Pn），延长了叶绿素含量缓降期（RSP）、光合速率高值持续期（PAD），提高了叶源量（LSC）；使旗叶生长中后期的超氧化物歧化酶（SOD）活性和过氧化物酶（POD）活性增加，细胞的活性氧（O_2^-）含量和丙二醛（MDA）含量降低。与抗旱品种石麦12相比，DF处理对抗旱性中等的品种石新733的旗叶光合生理参数、光合功能高值持续期具有更大调控效应。DF处理使供试品种的千粒重、产量和水分利用效率增加，其中石麦12后两指标增幅达显著水平。表明在春季适宜施氮量范围内，在肥力中等偏下地力条件下，生育中后期（挑旗期）追施适量氮素，具有提高叶片的细胞保护酶活性、维持细胞的较强活性氧清除能力，改善限水条件下小麦旗叶光合碳同化能力、延缓旗叶衰老、促进子粒灌浆和提高水分利用效率的作用。

关键词： 小麦 限水灌溉 施氮方式 光合特性 衰老 产量 小麦 限水灌溉 施氮方式 光合特性 衰老 产量

Abstract: Under limited irrigation, the effects of different nitrogen application methods on photosynthetic parameters and senescent characteristics of flag leaves of two winter wheat cultivars (SX733 with low drought tolerance and SM 12 with high drought tolerance) was studied. Compared to single nitrogen application at the early stage of jointing (single fertilization, SF), split nitrogen application at the early stage of jointing and flag leaf expansion (3/4 amount at the early stage of jointing and 1/4 amount at flag leaf expansion, DF) increased the chlorophyll contents (Chl), soluble protein contents (SP), RuBPCase activities, stomatal conductance (G_s), and photosynthetic rate (P_n), prolonged the relative steady phase of Chl (RSP), photosynthetic active duration (PAD) and enhanced leaf source capacity (LSC) of flag leaves in both cultivars. The activities of superoxide dismutase (SOD) and peroxidase (POD) were higher, at mid- and late-growth stage of flag leaves in DF than in SF, while the active oxygen amount ($O^{\cdot}_2{}^-$) and malondialdehyde (MDA) contents were lower in DF. The regulation effects of DF on photosynthetic parameters and high-value duration of photosynthetic functions of flag leaf in Shixin733, were more pronounced than in Shimai12. The 1000-grain weights, yields and water use efficiencies in DF treatment in both tested cultivars were all higher than in SF, and the yield and water use efficiency in DF was significantly higher than in SF in Shimai12. It is suggested that suitable amount of nitrogen application at flag leaf expansion could increase the activities of the cellular protection enzymes, such as superoxide dimutase and peroxidase, and sustain a higher ROS scavenging capacities, consequently improve the photosynthetic assimilation capability of flag leaves, delay the flag leaf senescence, and increase the kernel dry matter accumulation and yield under limited irrigation.

Keywords:

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