

# Effect of Temperature on Wheat-Ryegrass Seedlings Interference

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**Abstract** Temperature and weed interference often occur simultaneously during the life cycle of wheat. Laboratory investigation was carried out to evaluate the combined effect of temperature and annual ryegrass seedlings interference on wheat seedlings at Agronomy laboratory, Charles Sturt University, Wagga Wagga, NSW 2650, Australia, during 2013. Seedlings of both species were grown simultaneously under two different temperature cycles (i) light/dark for 12/12 h at 20°C/15°C and (ii) light/dark for 12/12 h at 25°C/15°C. To evaluate wheat interference, two wheat densities e.g. 10 and 20 seedlings/medium were used against 10 seedlings of ryegrass. The results demonstrate that the high temperature cycle increased the seedling growth of both wheat and ryegrass. The root growth and seedling biomass of ryegrass increased dramatically at high temperature even under high interference of wheat. These preliminary outcomes indicate that ryegrass has the ability to persist under both high temperature and crop interference conditions. Thereby, such growth profile of ryegrass will may lead to become widespread weed flora under future elevated temperature climatic condition.

**Keywords** Wheat, Annual Ryegrass, Temperature, Interference

## 1. Introduction

Wheat (*Triticum* sp.) is one of the most important food crops of the world in terms of harvested area, trade value and human consumption. The world demand for cereal is projected to grow by 56% in 2050 from the demand for the base year 2000 [1], indicating that yield per unit area is needed to increase. However, there are several biotic factors including weed and abiotic environmental stresses such as temperature that adversely affect growth, development and final yield of wheat [2, 3]. The annual ryegrass (*Lolium rigidum*) is the Australia's most economically damaging crop weed [4], which can interfere (competition and

allelopathy) and reduce wheat yield. An infestation of 200 plants/m<sup>2</sup> can cause a 20-50% yield loss in wheat, costing \$A100-250/ha [5]. It is a primary weed of cropping systems in the Murrumbidgee catchment that affecting other crops as well.

On the other hand, the influence of high temperatures on growth and development of wheat and other crops is well documented [6,7]. High temperatures damage photosynthetic membranes (thylakoids) and cause chlorophyll loss [8], decrease leaf photosynthetic rate, increase embryo abortion [9], lower grain number, and decrease grain filling duration and rates thus may resulting in lower grain yield [10-13]. At the molecular level, high temperatures adversely affect cell metabolism [14, 15] and cause changes in the pattern of protein synthesis [16].

In addition, temperature is not only an impact on crops yield but it also affects the weed management system. Weeds will experience changes in their range, and some will become more productive and prolific owing to higher CO<sub>2</sub> and temperature levels [17]. The temperature and weed interference stresses often occur simultaneously at seedling stage of wheat causing severe losses for further development. The simultaneous effects of these two stresses on wheat and other crops seedling stage may be quite different than the individual stresses, but there are limited studies on this topic. Moreover, the importance of interaction between temperature and weed on wheat growth is understood qualitatively but quantitative knowledge is lacking. Thereby, the objective of this study was to quantify the independent and effects of temperature on ryegrass-wheat interference at seedling stage .

## 2. Materials and methods

### 2.1. Experimental and Treatment Conditions

This experiment was conducted under controlled environmental conditions, at Agronomy laboratory of Charles Sturt University, Wagga Wagga, Australia. Seeds of wheat (cv. Jazz) and ryegrass purchased commercially. To

verify the wheat density effect on crop-weed interference, two wheat densities 10 and 20 seeds were used against 10 ryegrass seeds. For the growth medium, the Equal Compartment Agar Method (ECAM) developed by Wu et al. [19] was used. In ECAM, both species were sown in 1000 mL glass beaker containing 40 mL of 0.3% water agar. The beakers were sealed with parafilm and, to verify two temperature regimes, kept in a controlled growth chamber under (i) light/dark cycle for 12/12 h at 20/15°C or (ii) light/dark cycle for 12/12 h at 25/15°C. After 15 days growth of both species, the root and shoot length and the biomass of both wheat and ryegrass seedlings were measured.

### 2.2. Experimental Design and Statistical Analysis

The experiment comprised RCBD (Randomized Complete Block Design) along with four replications under controlled conditions. The experiment was repeated twice under the same conditions to check for consistent results. The data were statistically analyzed through Genstat (version 13) computer software program.

### 3. Results and Discussion

The research on growth performance of wheat seedling is very important because may provide advantages for wheat crop. In this study, it was found that the combined effect of temperature and ryegrass interference has a significant influence on the wheat seedlings growth. Between the two temperature conditions, the root and shoot length of ryegrass was greater at 25/15°C day/night temperature cycle (Fig. 1 and 2) than the temperature condition 20/15°C. We also found that the increased density of wheat did not have any negative effect on its seedlings growth (there are no differences, especially in shoots). In particular, no specific trend of decreasing was observed in wheat seedlings grown at high temperature with its high density (Fig. 3 and 4). Probably, the increased density of wheat enhanced biomass data which establishment through minimization of ryegrass interference (competition and allelopathy). This finding is in agreement with the reports of Khodabandeh, [19] that the most suitable temperature for wheat seed germination and seedling growth is 20 to 22°C. It has also been reported in literature that the short terms effect of temperature will increase the crop growth and development especially in C<sub>3</sub> plant but the long terms excess will begin to harm crop growth and yield [17]. The seedlings growth of ryegrass under the interference effect of wheat was significantly reduced (Fig. 5).

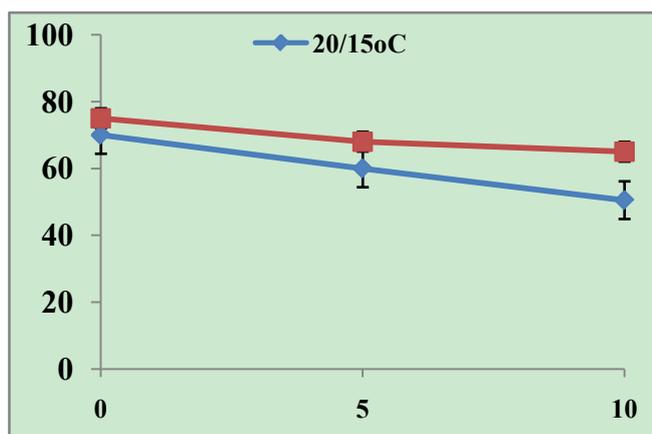


Figure 1. Effect of temperature on root length of ryegrass (LSD = 8,  $P < 0.05$ )

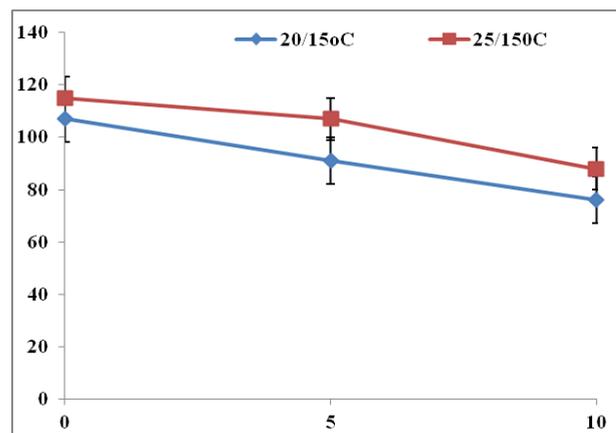


Figure 2. Effect of temperature on shoot length of ryegrass (LSD = 18,  $P < 0.05$ )

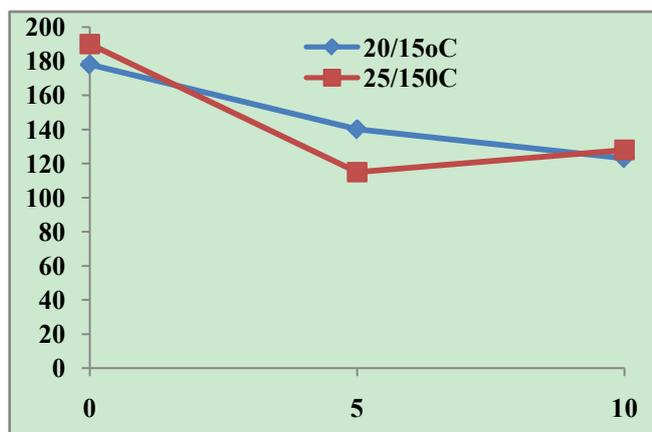


Figure 3. Effect of temperature on root length of wheat (LSD = 11,  $P < 0.05$ )

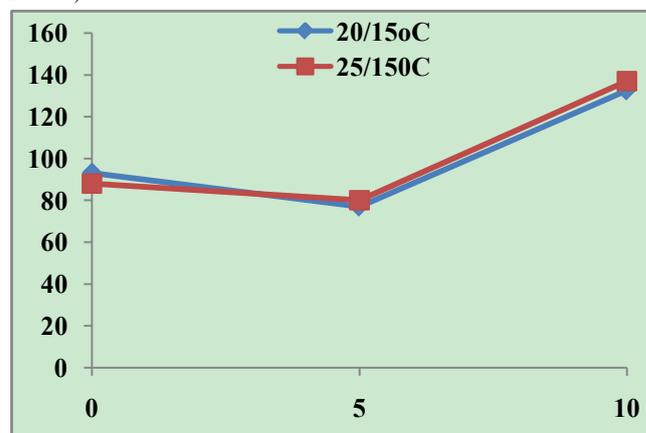
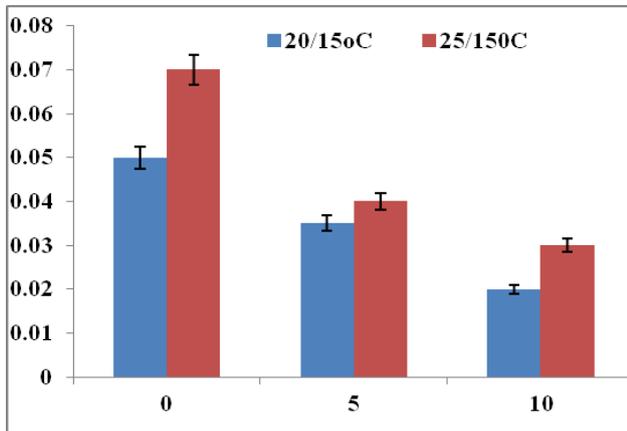


Figure 4. Effect of temperature on shoot length of wheat (LSD = 11.5,  $P < 0.05$ )



**Figure 5.** Effect of temperature on dry biomass of ryegrass (LSD = 0.02, P < 0.05)

In our experiment, we interestingly found that wheat interference had effect on the root growth of ryegrass under both low and high density of wheat. But value of two density treatment was not significant with each other. Moreover, at high temperature and low density of wheat, the root length of ryegrass was decreased but it was increased at high density of wheat, indicating wheat density could effect on ryegrass root growth but there is no effect of temperature on it.

On the contrary, shoots of ryegrass initially decreased by the high density of wheat but they increased again under both temperature regimes. It might be due to that shoots of ryegrass are less sensitive to wheat interference. Similar findings also reported by Asaduzzaman *et al* [18] in canola and Wu *et al* [19] in wheat. The other explanation could be that ryegrass could develop defensive mechanisms.

## 4. Conclusions

Regarding temperature and wheat-ryegrass interference, seedlings of both species responded well. However, ryegrass possesses better mechanisms to cope with biotic and abiotic stress.

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