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Study of Assimilate Amount Changes' Effect on Duration of Flowering in Three Wheat Cultivars on Grain Filling Rate, Yield and Yield Components in Mazandaran

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Abstract: Determination of assimilate limitation in wheat can be an important step in finding out production restrictive factors of this crop. In this research, this has been carried out by randomized complete blocks of factorial experimental design in four replications in Mazandaran in 2007. Two factors were studied in this experiment. The first factors were cultivars, which consist of Shanghai, Zagros, Tajan. The Second factor were assimilate amount change treatments at four levels which including: check, half, full flag leaf cutting and radiation increasing. Selective spikelets cutting used to determine grain growth. The results showed that cultivars have significant differences at 1% level in grain yield, biomass, grain weight, main spike kernel weight. The highest kernel weight and main spike kernel weight with averages 34.04 and 42.09 mg related to Zagros cultivar. Therefore, Tajan has higher yield in stress conditions. Also, the results of assimilate ratio changes treatments emphasize that these treatments have very significant effect on grain yield, biomass, grain weight, main spike kernel weight and harvest index. Radiation increasing treatment comparison to check cause to increases grain yield and kernel weight and main spike kernel weight and harvest index. Full flag leaf cutting comparison rather than check treatment leads to reduction in grain yield and biomass and main spike grain weight and 1000 kernel weight and harvest index. Assimilate changes treatments had very significant effect on grain filling rate. The half Flag leaf cutting caused decreases of grain filling rate.

Key words: Wheat · Flowering · Assimilate · Grain filling rate · Yield

INTRODUCTION

Finally, crop yield depends on leaf area and efficiency of the photosynthetic system and partitioning of photosynthetic material between different parts of a plant is very important. Assimilate amount change in plant growth stages, especially flowering stage and determination of source or sink limitation in wheat can be an important step in finding out production physiological restrictive factors of wheat [1-5].

Seed weight is one of the important factors in grain yield and this factor depends on assimilate amount, especially in primary stages of grain growth and capacity of grain growing assimilate available for use [2]. Range of genotypic variation on grain growth in removal of 70% of seeds per spike was 7.1 to 41.5% and GE interaction was not significant [3]. Doubling of source to sink in wheat showed that no significant change in grain weight was created [4]. Experiments on barley plant used by removal of 50% spikelets per spike in Mediterranean conditions mean of grain weight and its protein increased 20 and 47.6%, respectively [5].

Thinning of plants to 50% in two stages of wheat growth increased grain weight and the number of grains per spike in 1985, but in 1986 the only significant change made grain number and grain weight less due to more competition among grains, remains unchanged and the results obtained from thinning to depend on existing environmental conditions [6]. The Important role of leaf area to absorb solar radiation and its impact on growth and yield of wheat has been proved [7-12].

The further green area duration of new wheat varieties and positive correlation by yield indicates that higher crop growth rate can be correlated to green area index [9-13]. Open shading experiment and treatment of surface light reflection again showed that the light reflection from earth surface, the yield of cotton plant was 60% higher than the control. The stem carbohydrate

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contribution on grain weight from 10 to 12 % in non-stress condition increased to 40% drought or heat stresses condition [10-15]. The goal of this research was the understanding of wheat production limitation in the Mazandaran region.

MATERIALS AND METHODS

This research, which has been carried out by randomized complete blocks of factorial experimental method in four replication in the Jouybar city of Mazandaran at 2007, shows that field soil was salty loam. Two factors were studied in this experiment. Factorial experiment with a randomized complete block design in four replication, names of three wheat varieties Tajan, Zagros and Shanghai as the first factor treatment and assimilate changes during flowering, including control and removal of half flag leaf and radiation increasing and spikelets removing, were considered as the second factor. Treatment to remove spikelets was used to investigate grain-filling rate. According to soil, tests done on fertilizers consumed and seed density of planting for each variety were used with 450 seeds per square meter. Field density received to optimum level (350 plants per square meter) at 3-4 leaf stage by removal. The seed sowing was conducted in December 2007 and attempted irrigation and chemical fertilizers and weeds removal were performed. In order to evaluate grain filling rate and period, a week after the main heading the number of 150 main spikes were selected with colored ribbon at half of flowering treatments, flag leaf in half and fully were removed and cutting place of leaves were applied with Paraffin. Radiation increasing treatments and spikelets removal were used in causing of planting row and removal of four spikelets from below and six spikelets from the top of the colored ribbon spike, respectively. In addition, the treatments used to the final harvest area are discussed. Grain growth was investigated by the sampling of 10 colored ribbon spike picked randomly at intervals for 3 days, then five spikelets from each spike (spikelets No. 5 to 9) and two grains closer than main axis from each spike have been picked and isolated. Therefore, from each sampling number of 100 grains from each plot and samplings were separated and desiccated in an oven at 60°C temperature for 48 hours and then grains were weighed. Sampling continued until fixing of dry grain dry weight. Grain growth analyses and the related calculation method, assuming linear regression relationship by formula: $Y = a + bx$, were performed. Then, the grain growth curve was drawn. Four points from linear phase of grain growth curve were selected, regression analysis done, with two variables containing information for days after flowering and grain dry matter were obtained. Regression coefficient (b) was line slope in fact grain-filling rate (mg dry matter per day). Grain filling period was calculated with the following formula:

Grain filling period = The final average weight of grain at harvest / grain filling rate)) (1)

Also, an area equivalent to three square meters as the final harvest area to evaluation of yield and yield components including grain yield and biomass, number of grains per spike and area unit, grain weight per unit area and harvest index, were used.

RESULTS AND DISCUSSION

Cereal grain makes only part of the total biomass. Studies showed that economical yield of new varieties were related to biological yield if shoot biomass production and distributions have been allocated in order to enhance grain production. Production processes must be coordinated with the yield components and plant ability to transfer photosynthetic material about grain, is very important. It seems that the production processes and economic yield in cereals is more complicated than other crops.

Analysis of variance showed in the Table 1. Varieties and assimilate amount change treatments had significant effect on grain yield and the highest grain yield by mean of 7.72 ton per hectare belong to radiation increasing and the lowest mean 5.06 ton per hectare was in full flag leaf cutting (Figure 1). Effects of these treatment on 1000 kernel weight were detected very significant (Figure 2).

The highest and lowest mean of 1000 kernel weight with 41.26 g and 26.40 g were in radiation increasing and full flag leaf cutting treatments. Effect of treatment at harvest index was diagnosed very significant. The highest and lowest harvest index by means of 31 and 27% related to the radiation increasing and full flag leaf cutting respectively. Grain number spike of varieties and assimilate treatments had no significant differences, statistically, from each other. The result showed that, at beginning of flowering time, available assimilate was sufficient for grain formation and their survival but assimilate deficiency occurred in later stages of grain growth [1-10].

Table 1: Means comparison between varieties and assimilate changes treatment on yield and yield components

Source of Variation	Grain number/m^2	Grain number/spike	1000 kernel weight (gr)	Biomass (ton/ha)	Grain yield (ton/ha)	Harvest index
Variety						
Shang hang	19045.5b	40.2a	30.45b	19.81b	5.78b	0.29a
Zagros	16510.8c	39.7a	34.04a	20.06b	5.61b	0.27a
Tajan	21859.2a	37.76a	31.25b	23.75a	6.81a	0.28a
Assimilate changes						
Control	19221a	36.8a	31.14b	21.15b	5.95b	0.28b
1/2 flag leaf cutting	19208.8a	41.2a	28.85b	19.67c	5.52bc	0.28b
Full flag leaf cutting	19215.7a	38.2a	26.40c	18.93c	5.06c	0.27b
Radiation increase	18909.5a	40.5a	41.26a	25.07a	7.72a	0.31a

* The numbers subscribe letters no significant on 1% level

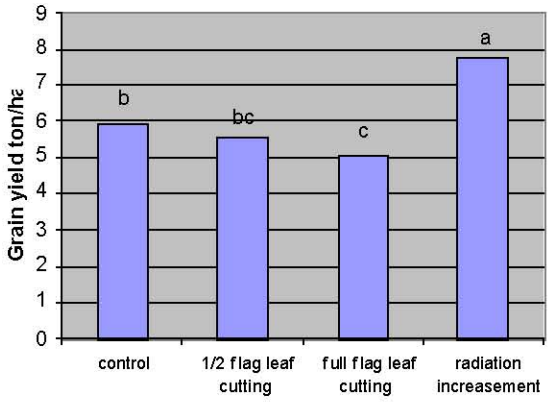

Fig. 1: Effect of assimilate changes on grain yield, * the numbers subscribe letters no significant on 1% level

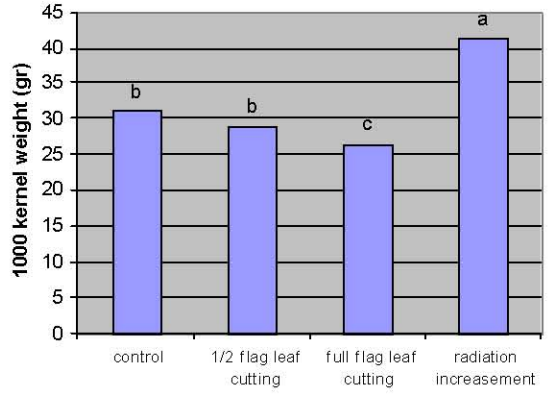

Fig. 2: Effect of assimilates changes on 1000 kernel weight, * the numbers subscribe letters no significant on 1% level

The results showed that half and full flag leaf cutting and radiation-increasing treatments had grain filling with no significant difference in grain filling rate to control, but spikelets removing treatment caused increase of grain filling rate. Maximum grain filling rate with mean of 2.23 mg per day to spikelets removing treatment and the lowest mean 1.35 mg per day related to full flag leaf cutting in Shanghai variety. Assimilate amount change treatments during of flowering had very significant effect on grain filling period. The highest grain-filling period with average of 25.8 days related to radiation increasing treatment and the lowest average treatment with 24.5 days to half of the flag leaf cutting [5-8, 15-20].

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