

Assessment of Biologic Yield and Harvest Index of various Wheat Cultivars during Two Year in Ardabil Region

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ABSTRACT: In order to evaluation the biologic yield and harvest index in Various Cultivars of Wheat in Ardabil region, an experiment was carried out in a randomized complete block design with three replications in Ardabil Islamic Azad University Agricultural Research Station in two agricultural years of 2014-2015 and 2015-2016. The studied cultivars included Pishgam, Gaskogen, Gaspard, Siosson and MV17. Analysis of variance results suggested that there was a significant difference between the studied cultivars on seed yield at one percent. Also, results showed that there was no significant difference found between the years and the interaction of the year on cultivar. There was a significant difference between the cultivars based on harvest index at five percent, while there was no difference found between the cultivars based on other factors. However, there was no significant difference found between the studied factors based on biologic yield. Mean comparison suggested that the highest harvest index (46.11 percent) was from the cultivar of Siosson, although it did not show any significant difference with other cultivars of Pishgam, Gascogne and Gaspard, and they were in one level. Also, the cultivar of MV17 with a mean of 39.14 percent had the lowest harvest index.

Keywords: wheat, biologic yield, harvest index

INTRODUCTION

58% of the harvest area in the world is dedicated to grains (Nelson et al., 2010). Today, around half of the area under cultivation of crops in the world is dedicated to grains and grains provide around 70 percent of the calorie need for humans. Grains are rich sources of vitamins, minerals, carbohydrates, fats, oil and protein (Sarwr et al., 2013). In 2013-2014 agricultural year, wheat production in Iran was estimated to be around 10.58 million tons which is equal to 14.28 percent of total crop production and 60.3 percent of total grains production in Iran. 66.91 percent of the production is related to irrigated lands and 30.09 percent of the production is related to dryland farming (Ahmadi et al., 2015). Reaching a high yield potential is the objective of the majority of breeders and considering the recent accomplishments on increasing yield potential (0.5-2 percent per year), they have been successful in reaching their goals (Evans and Fischer, 1999). Producing cultivars which could benefit from the available environmental resources could have a great role on increasing the region yield. However, despite the fact that currently there are cultivars produced which have a high yield comparing to the other cultivars, it takes a long time for the farmers to accept these cultivars and this factor could be considered as one of the reasons for the yield decrease (Torabi et al., 2013). Harvest index is the ratio of biological yield which forms the economic yield and expresses the dry matter transmission into the parts of the plant which are harvested. The yield of a plant could be

increase through increasing the biologic yield or increasing the economic yield share or both of them. Early planting date leads to an increase in the number of grains, the number of pods and harvest index. However, lower number of grains in each pod is produced in late planting date (Pedersen and Lauer, 2004).

Grain harvest index as a quantitative trait represents plant efficiency in distributing photosynthesis materials towards grain and introducing genotypes with high grain index is among the main objectives of wheat breeding programs (Giunta, 1995). Due to the suitable conditions from planting to pollination in semiarid regions climate, biomass is produced at a high level during pollination level, while by the decrease in soil moisture and occurrence of drought stress during grain growth period and its impact on the plant internal processes, the grain harvest index might not be as expected (Gent and Kiyomoto, 1989; Loss and Siddique, 1994).

Materials and Methods

In order to determine the biological yield and harvest index in Various Cultivars of Wheat in Ardabil region, an experiment was carried out in a randomized complete block design with three replications in Ardabil Islamic Azad University Agricultural Research Station in two agricultural years of 2014-2015 and 2015-2016. The studied cultivars included Pishgam, Gaskogen, Gaspard, Siosson and MV17.

Wheat genotypes were planted in controlled condition (without water limitation, nutrient elements limitation, pests and diseases) during 2014-2015 and 2015-2016 in a randomized complete block design with three replications. Each experiment plot was planted based on 500 seeds per square meter, with a length of 6 meters and in 6 rows with a distance of 20 cm. The seeds were planted in October 2014 and the irrigation was carried out according to the norms of the region, two times of irrigation in fall and three times of irrigation in spring.

Fertilizer Amount According to the results from laboratory analysis of the research department, soil, water, and phosphorus fertilizer from ammonium phosphate source in basal application and nitrogen fertilizer from urea source in two stages of basal and topdressing applications. Also, control of broadleaf and grass weeds was done through application of by Topic and Granstar herbicides and also by hand weeding.

In both agricultural years several samples were chosen from each experiment unit after taking out the marginal effects and all desired characteristics were studied on chosen bushes and ultimately, at harvest, after taking out the margins, yield of each plot was estimated and transformed into hectare. Shrubs with whole straw and grain were put in paper pockets and left in a pounder for 48 hours at 70 °C so they dry. Subsequently, the dry weight was determined and the biologic yield per unit area was measured. The harvest index is calculated by the following formula:

Harvest Index = Economic Yield / Biologic Yield or Biomass × 100

Before conducting statistical analysis, data was tested for its normality. After reassuring the normality of the data distribution, data was analyzed through statistical methods such as analysis of variance and mean comparison by Duncan test at 5 percent. To carry out the statistical calculation, SPSS software was used. Also, for drawing the diagrams, Excel was used.

Results and Discussion

Results from analysis of variance suggested that there was a significant difference in seed yield between various cultivars of wheat at one percent, and this could be due to the high genetic diversity among the studied cultivars (Table 1). Also, results indicated that there was no significant difference between the years and the year × cultivar interactions (Table 1). Results from mean comparison showed that the cultivar of Siosson with the mean of 6,627.7 kg per hectare had the highest seed yield and the lowest yield means were for cultivars of Gaspard and MV17, which were in the same statistical level and ranked last (Diagram 1).

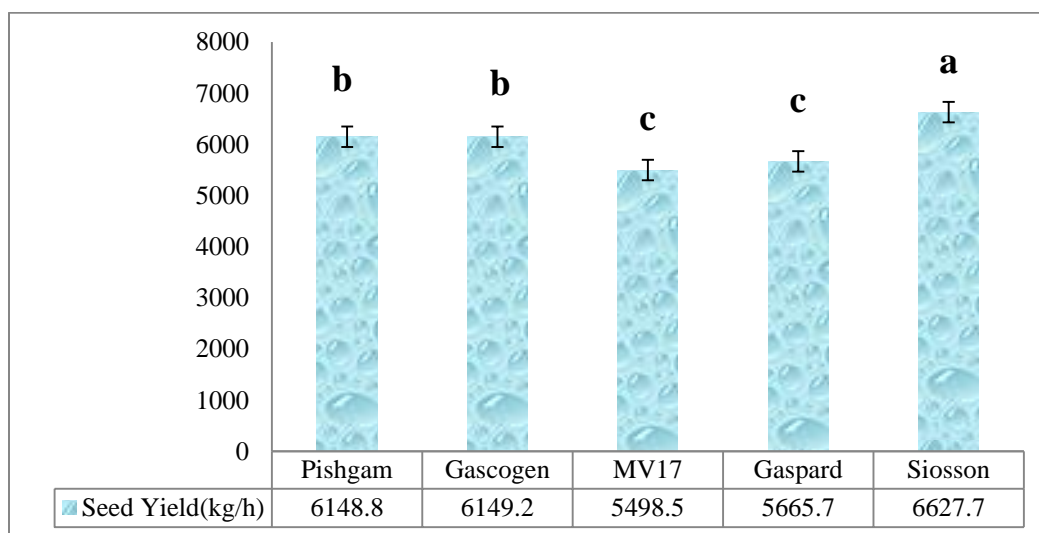


Diagram 1. Mean of Seed Yield in various Wheat Cultivars at the Research Center

Emergence of characteristics such as seed yield in plants is due to the impact of genetics and environmental factors and their interactions. Various genotypes might react differently to the environmental factors such as climate and planting date based on crop production and quality (Adund and Labuschagne, 2003). Wheat seed yield is the result of simple and interaction effects of its yield such as the number of ears per unit, number of grains in ear and grain weight, plant growth environment, plant adaptation with the environment and the efficiency of using effective environmental factors on production and intra- and inter-plant competitions (Kiniry, 1993).

Mackay et al. (2010) expressed that the condition in perennial experiments in various cultivars is different, since yield increase is not retained through cultivar breeding only, but better crop improvement has a role as well (and any positive interaction), for it is an index of progress, as potential yield rate experiment is determined in the experiment year, and not the cultivar release year.

Actual yield in a certain region, in addition to physical factors such as climate and soil, is affected by managerial factors such as access to irrigation, consumption of inputs (chemical fertilizers and pesticides) and also substitution of older cultivars with new and yielding cultivars (Kropff et al., 1994).

In studying the cultivars, Zhou et al. (2007) observed that increase in seed yield in China during 1970 and 2000 was around 0.54. in a research in Spain to increase seed yield of Spanish and Italian cultivars released between 1945 and 2000, Ruyu et al. (2007) observed that yield increase for Spanish and Italian cultivars were 0.36 percent and 0.44 percent, respectively.

Biologic Yield

Results from biological yield ANOVA among the studied factors suggest that there was no significant difference found between the factors (Table 1).

Harvest Index

Based on data ANOVA, this trait was affected by the experimental treatment; that is; the difference between the cultivars was significant at five percent (Table 1). However, there was no significant factor found between the studied factors.

Mean comparison suggested that the highest harvest index (46.11 percent) was from the cultivar of Soisson, although it did not show any significant difference with other cultivars of Pishgam, Gascogne and Gaspard, and they were in one level (Diagram 2). Also, the cultivar of MV17 with a mean of 39.14 percent had the lowest harvest index (Diagram 2).

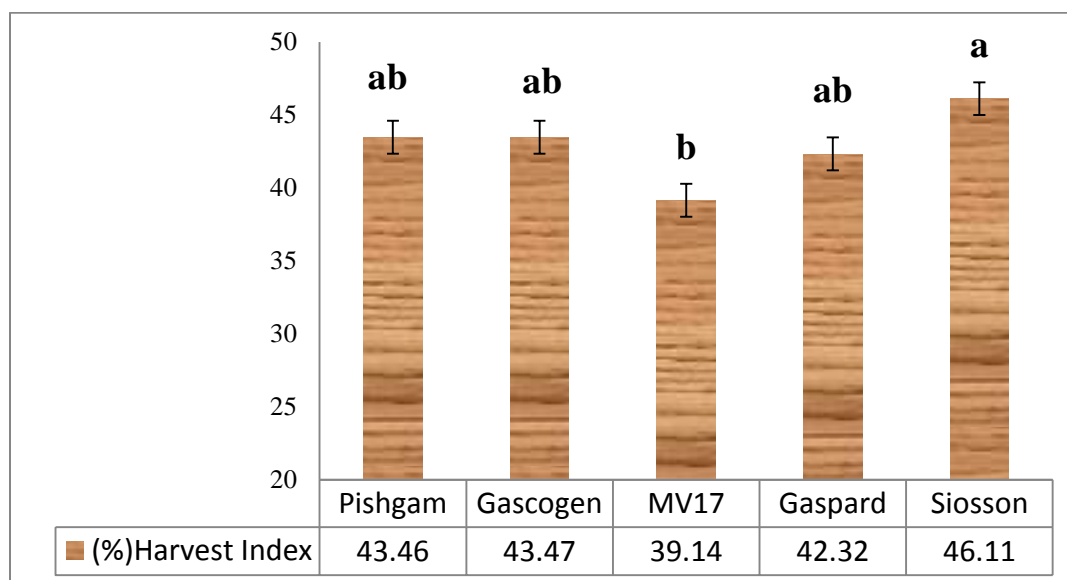


Diagram 2. Harvest Index Mean for Various Wheat Cultivars

Harvest index around 0.45 does not create possible constraints, while some evidence suggests that the last increase in Yaqui Valley was related to higher dry matter and surprisingly with higher grain weight (Aisawi, 2011). Higher dry matter is reached when higher number of grains and higher grain weight (or both of them) are reached and the constraint factors are critical comparing to RUE. Another method to increase the dry matter is to increase the green durability of the crop.

While comparing the new and old cultivars, Austin et al. (1980) observed that increase in yield is mostly due to the increase in harvest index. Also, Austin et al. (1989) reported that wheat harvest index from 30 percent in old cultivars had increased to 50 percent in new cultivars. Abet et al. (1998) in Argentina and Xu et al. (2007) in China, showed that increase in grain yield in new wheat cultivars is due to their potential in distributing processed materials to the ears. The harvest index had a great role in increasing the grain yield in modified cultivars in Iran, so that harvest index in old cultivars such as the cultivars of Tabasi and Shahpasand had reached to 50 percent in new cultivars (such as the cultivar of Shiraz) from around 25 percent, with a ratio of 0.44 percent per year (Miri, 2007).

Using dwarf genes in wheat led to a considerable increase in the yield in 1960s. the main role of these genes was to decrease the stem height and as a result increase the grain share of processed materials and increasing yield components (Reynolds et al., 2007; Fischer, 2007; Folks et al., 2007).

Tollenaar (1989) expressed that choosing to decrease the height could increase the harvest index in corn. Regarding this, the share of harvest index in increasing new hybrids yield comparing to the old hybrids of corn was reported to be 15 percent. Russel (1985) concluded that there was a relatively high correlation between the harvest index and yield among 28 lines with various ages, which included a range of lines with free pollination to hybrids from 1980s ($r=0.83$).

Table 1. Analysis of Variance of Evaluated Characteristics for various Wheat Cultivars

S.O.V	df	Mean Square		
		Harvest Index	Seed Yield	Biologic Yield
Replication	2	52.25	1425503.33	1045809.70
Cultivar	4	38.07*	1200051.78**	1204465.78 ^{ns}
Year	1	0.012 ^{ns}	45864.30 ^{ns}	464758.53 ^{ns}
Y * C	4	0.063 ^{ns}	1583.55 ^{ns}	32402.12 ^{ns}
Error	18	12.39	120061.70	1185607.63
CV (%)	-	8.21	5.76	7.79

* and ** Significantly at $p < 0.05$ and < 0.01 , respectively.

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