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Investigating the Impact of Planting Delay on the Performance of Cluster Traits and the Prevalence of Wheat Yellow Rust in the Climatic Conditions of Northern Khuzestan Province (Iran)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Yellow rust disease is one of the important fungal diseases in wheat in the north of Khuzestan province. This research aims to investigate the effect of planting date on the amount of damage caused by wheat yellow rust disease on yield, yield components and agronomic traits of wheat cultivars in the climatic conditions of North Khuzestan (Iran) in the form of a split plot design in the form of randomized complete blocks with 3 replications. Crop year 2010-2011 was implemented. In this plan, planting dates were considered as main plots and cultivars as sub-plots. The results showed that the delay in planting is due to early placement in the growth period of winter rainfall as

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one of the most important factors in growth. This situation leads to a 25% increase in plants infected with this disease. All traits such as non-seed weight and number of seeds in the hollow of the cluster decreased and other traits (performance, seeds per cluster and length of the cluster) decreased. It is hoped that an effective step will be taken in controlling and reducing damage with resistant cultivars in order to properly manage them, especially at the beginning of the autumn rains. According to the obtained results, the need to breed and improve more resistant cultivars, as well as to use more efficient agricultural management, is clearly felt.

Keywords: Fungal disease; yield loss; wheat blight; delay in planting; humidity and cold; yellow rust.

1. INTRODUCTION

Yellow rust disease caused by the fungus *Puccinia striiformis* Westend.sp.tritici Eriks(PST) is an important and common disease of wheat in Iran, which is observed in all regions, especially in cold and humid regions, and the agent of this disease attacks wheat fields, and especially in the case of an epidemic, it causes a decrease The product is intense. During the years 1993-1994, the epidemic of yellow rust disease caused the loss of 30% of the wheat crop and destroyed about 1.5 million tons of wheat [1]. Yellow rust disease or stripe rust or linear rust of wheat affects triticale, rye and some other Gramines to some extent. Oats seem to be immune to this disease. So far no intermediate host is known for it. This disease occurs at a lower temperature than the suitable temperature for the development of stem and leaf rust. Wheat yellow rust disease can cause irreparable damage to this product if there are favorable weather conditions (cool temperature, cloudy weather, high humidity, periodic rainfall) and the cultivation of sensitive wheat cultivars. Euryides are formed as narrow yellow bands or lines mainly on leaves and spikes. When the spikes are infected, blisters appear on the inner surface of the pistils and pistils, sometimes attacking the forming seeds. Two-celled uredospore's are dark brown and similar in shape and size to P.recondita. Teliospores do not play much role in the life cycle of the fungus. Telia appear on the surface of the sheath and leaf as dark brown strips covered by the epidermis. In regions where the temperature is not too low, the fungus overwinters in the form of uredospore's and mycelium on cereals grown in the fall. Secondary outbreak and invasion begins in cool spring conditions [2]. During the last decade, a widespread outbreak of yellow rust has occurred in many countries of the world, especially in the central and western parts of Asia and North Africa. The first report of yellow rust disease in Iran was in 1947 [3]. Cummins considered a comprehensive concept for the species p.striiformis and introduced 24 species of different wheat families as hosts for this species [4]. Hassebrau (1965) investigated and studied the origin of the type of fungus that causes yellow rust and introduced the Eurasian origin for it and believed that it was first common among wild plant species and then appeared in fields [5]. According to Agrios, the mild climate and relatively high humidity can create a ground for the development of wheat yellow rust disease and the emergence of new species reduces general resistance among these species [6]. In 1997, the Institute of Research, Improvement and Supply of Cereals and Plants introduced the Chamran and Dez variety, which was resistant to yellow rust until 2003, which was due to the presence of the seedling resistance gene Yr27 in it [7]. PourAliBaba et al, (2002) in evaluating the resistance of 100 advanced wheat lines to yellow rust in Miyandoab reported that 62% of them were resistant at the stem stage and at the full plant stage, 29% were resistant at both stages [8]. Percent were fragile in both stages and 3% were resistant in the seedling stage and fragile in the full plant stage. According to the reports regarding the resistance of common wheat cultivars to yellow rust in the study conducted by Keshavarz and Torabi (1998), the first infection occurred on March 28, 1996 in Dogonbadan region on Azadi variety and on May 2, 1996 in Boyer Ahmad area it was also reported that Zagros varieties were also reported to be safe, Bayat semi-resistant, Maron, Sefid Sardari, Omid semi-fragile and Azadi fragile [9]. They reported a 4.5% reduction in crop losses due to this disease. In early 2002, yellow rust disease occurred in Washington State due to favorable weather conditions and was not controlled through chemical control, resulting in a 20-25% reduction in yield. In 2003, the resistance of wheat cultivars in the United States decreased and a 25% yield reduction was reported due to the emergence of new strains of this pathogen [10]. The purpose of this research is to evaluate the negative effect of delayed planting in fields infected with wheat yellow rust fungal disease in order to accurately estimate the damage caused by delayed planting in these lands.

2. MATERIALS AND METHODS

Table 1. Average temperature and rainfall during the wheat growth period at the time of the experiment

Agent	Jul	Jun	May	Apr	Mar	Feb	Jan	Dec
The average temperature	38	36.6	31.1	24.5	18.4	13.5	13.6	16.9
Rainfall	0	0	2.9	3.4	3.7	8.85	13.4	8.4

This experiment was conducted in the agricultural years of 2010-2011 in Khuzestan province of Iran at 28˝:48˚ Longitude 50˝:31˚ to 33 m above sea level and in loamy soil with pH = 2.7 in Shaver agricultural farm as a small plot design. Done in the form of randomized complete block design with three replications in plots of 5.8 x 10 meters away from the main plot at repetition intervals of 10 meters to 20 meters, which was implemented for each plot of irrigation and drainage systems separately. The main factor was the delayed planting date (planting one: 22th November, planting delay: 22th December) with the amount of 250 kg of seeds per hectare and the Chamran cultivar were sub-plots.

In this experiment, the irrigated soil was plowed to a depth of 25-30 cm using a plow after reaching the optimum level of agricultural capacity (16-18% of dry weight). According to the soil test results, 100 kg of phosphorus and 50 kg of nitrogen from the source of urea ammonium phosphate were added to the agricultural land. All agricultural operations (with the exception of treatments) such as fertilization and spraying, etc., were the same in all plots. The previous cultivation was vegetable land, which one month before planting for harvest, the remaining remains were buried with plowed soil and left as fallow. During the growing season, especially in the early stages of weed growth, Granstar insecticide was sprayed at the rate of one liter per hectare and 25 grams per hectare. Efforts were also made to control the spread of yellow rust fungus by removing field weeds, especially millet as a host for yellow rust control. Parameters such as grain yield and weight, grain, hollow grain in the cluster and length of the cluster were measured. Finally, the data obtained from analysis of variance with SAS and comparing the mean with Duncan's test was calculated at the probability level of 5%. Some meteorological parameters are given in Table 1.

3. RESULTS AND DISCUSSION

3.1 Yield

Based on the variance analysis of grain yield, planting dates and different planting cultivars were significantly different at the 1% level and the interaction between the two factors was significantly different at the 5% level (Table 2), it must be one of the main reasons for yield changes. Yield reduction under temperature stress conditions delayed planting (Table 3). The maximum total yield of Chamran was obtained on the 22th of November with an average of 3.733 ton/ha and the minimum amount of Dez was obtained on the 22th of December with an average of 1.633 ton /ha (Table 4). The results of the study by Agrios (2004) showed that the increase in yellow rust disease has a direct relationship with the increase in humidity and rainfall, and this study is in agreement with the results of PourAliBaba et al (2002). The delay corresponds to the planting date. The results of Afshari et al.'s study (2003) on the resistance of Chamran cultivar wheat to yellow rust disease were more consistent with Mansuri (2006) regarding the reduction of resistance of resistant cultivars such as Chamran in conditions of delay in planting time [11]. Torabi et al. (1995) also stated that the delay in the planting date caused a 30% decrease in resistance and Chen (2005), also reported that the delay in planting date reduced the resistance of 25% of the crop varieties that are resistant to yellow rust.

3.1.1 Thousand Kernel weight

Analysis of variance showed that there was no significant difference between different planting dates, cultivars and the interaction of two factors, although this study did not show a significant difference between the two cultivars in seed weight gain. That these traits are the traits that are most affected by the genotype are completely normal numbers (Table 2).

Delay in wheat planting date According to the obtained data (Table 3) seed weight decreased Has the most important factors in the reduction of grain weight stress Environment such as the occurrence of early frost and a smaller plant growth and winter dormancy and cold-resistant and virulence factor increases to 25 percent for wheat stripe rust fungus can infect plants.

3.2 Grain

Analysis of variance analysis showed that it was statistically significant at 1% level among different levels of cultivars, but there was no significant difference between planting date and cultivar interaction between the two factors. According to the comparison of the average number of seeds on November 22, 12.14 seeds were the highest number and in delayed planting, the lowest number of seeds per cluster was 8.17. Among the varieties, Dez cultivar had the highest average number of seeds per cluster with an average of 11.88 and Chamran variety had the lowest number of seeds per cluster with an average of 8.51 seeds per cluster (Table 3). The genotypic difference between cultivars and hybrids can be the main reason for the difference in the number of seeds per cluster. This result is in agreement with the results of Agrios (2004) study that the yield decreases due to the increase of the disease with increasing humidity and rainfall and with the results of Pour Ali Baba et al. The planting matches perfectly.

3.3 The Numbers of Deaf Grains per Panicle

Analysis of variance analysis showed that the number of unripe seeds in each cluster was significant only between cultivars at the 1% level. The observations from the results showed that the average of these traits did not have a significant difference in the comparison between different planting dates in a statistical class, but the variety Dez 13.66 was assigned to the higher number of kernels in the cluster and the hollowness of the seed because this number represents The potential to increase, therefore, the potential number of the crop and the total yield depends on the past genotype, so it can be said that the number of potential seed production is not as good as its inputs, and it causes a significant waste of agriculture and energy, and this is important because of the decrease in resistance to the yellow rust disease. It is caused by a plant pathogen (Table 3). The results of Afshari et al.'s (2003) study on the resistance of Chamran wheat cultivar with the aim of increasing yield efficiency are consistent. Clustering along the trait cluster of related genotypes is less affected by external conditions, and the results of variance analysis also confirm this statement, so that according to the results obtained from the data in Table 2, this trait only has a probability of 1 % is significant.

According to the comparison table, the average length of the cluster also decreased during delayed planting, which can be effective in reducing the number of seeds in the cluster, because this trait is more influenced by genotype data, so the final result of past stressors (conditions and temperature) can be due to The reduction of the plant growth period has been delayed among the cultivars, the average Dez on the spike is 6.43 cm with the average maximum spike length and Chamran 5.46 cm to the shortest spikes. Compared to the maximum length of the cluster, Dez cultivar has the highest number of seeds per cluster and seed weight, unlike Chamran cultivar, and it also has the lowest number of deaf seeds (Table 3).

3.4 Percent Plant Pollution

The percentage of plant contamination actually indicates the percentage of infected and diseased plants (the amount of plants (more than 20% of plants) is observed) it shows the difference in the treatments of the planting date (with proper management, the contamination was maintained in a 2-digit ratio), in other words, the absence of the spread of the agent It shows the disease and as a result reducing the amount of damage caused to planting. Table 4 shows that delay in planting due to precocious plant during rainfall was the main cause of fungal spread for growth with yellow rust of wheat compared to plants that grew by 25%. It is the fact that the longer the growing cycle of the plant, the more the infected losses from the early stages of plant growth begin, and the amount of damage can be much higher.

Table 2. Summary of analysis of variance of some investigated traits

S.O. V	df	yield	Grain weight	Grain	Deaf grains per panicle	Panicle length
Repeat	2	17659.33^{na}	0.09^{ns}	3.57^{ns}	6.57*	0.01^{ns}
Date of Planting	1	1449175.00**	11.90^{ns}	47.90**	1.32^{ns}	0.48*
Error (a)	2	21575.00	0.26	1.74	3.09	0.01^{ns}
Cultivar	1	5923075.00**	16.31^{ns}	33.32**	33.32**	2.80**
Date of Planting × Cultivar	1	170418.33*	1.31^{ns}	0.32^{ns}	0.00^{ns}	0.01^{ns}
Error (b)	4	19126.66	2.34	0.84	0.65	0.04
CV (%)		5.29	6.88	8.96	7.21	3.29

*ns, * and **: no significant and significant at 5 and 1% level of probability, respectively*

Table 3. Comparison of the average agricultural traits studied

Acting		Yield(ton/ha)	Grain weight (g)	Grain (Number /panicle)	deaf grains per panicle (Number /panicle)	Panicle length (Cm)
Date of planting	**November 22**	2.911 a	23.00 a	11.33 a	12.14 a	6.15 a
	December 22	2.216 b	21.00 b	11.33 a	8.17 b	5.75 b
Cultivars	**Dez**	1.861 b	21.16 a	13.66 a	11.88 a	6.43 a
	Chamran	3.266 a	23.66 a	10.33 b	8.51 b	5.46 b

Means in each column, followed by at least one similar letter(s) are not significantly different at 5% probability level using Duncan's Multiple Range Test.

Table 4. Comparison of some agricultural traits in the studied experimental treatments

Acting	Cultivars	Yield(ton/ha)
November 22	2.090 c	2090.0 c
	3.733 a	3733.3 a
December 22	1.633 d	1633.3 d
	2.800 b	2800.0 b

Means in each column, followed by at least one similar letter(s) are not significantly different at 5% probability level using Duncan's Multiple Range Test

4. CONCLUSION

Yellow rust is a widespread disease in major wheat growing areas with different cropping systems, growing seasons and Germplasm characteristics. The resulting losses are estimated to be at least 5.5 million tons per year globally. In the last decade, a series of regional epidemic outbreaks of yellow rust disease have been reported all over the world, including Central and Western Asia and East and North Africa. High disease pressure was observed from 2009 onwards in North Africa, especially in Morocco. Since 2010, yellow rust disease has spread widely in East Africa, causing economic losses in low-input farming systems. Widespread epidemics were observed in Tajikistan in 2010 and later in Uzbekistan and other Central Asian countries. In 2010, high outbreaks of the disease were observed in Syria and Lebanon in 2010, causing economic losses. These epidemics not only caused economic losses and increased the use of fungicides, but also threatened the availability of seeds for the next period.

The research results showed; yellow rust caused an average reduction of about 54% of wheat yield. In the case of yellow rust disease, yield reduction should be one of the main reasons for yield reduction in temperature stress conditions that delayed planting, but in general, due to the great decrease in yield affected by this disease, it is necessary to consider the date of planting. Correct, accurate and calculated control, such as using the right poisons and determining the right time for irrigation, especially during high humidity, which is the main factor in the spread and spread of yellow rust, can help control this disease.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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