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Study of Primary Adaptation of Synthetic Lines of Bread Wheat in Ardabil Region (Iran)

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Abstract: The study was carried out in Research Field of Agriculture Department of Islamic Azad University of Ardabil in 2005 and 2006. One hundred synthetic wheat lines as well as 4 controls of region namely Kaspard, Kaskojen, Saysonz and MV17 were studied on the base of an augmented design. During growing season, harvest index was calculated out of grain yield and biomass and then evaluated data was calculated and analyzed. Variance analysis of grain yield showed that there was genetic diversity for some traits like spike length among genotypes on the probability level of 5%, but there was no significant difference among controls regarding other traits. First year results suggested that the lines 2, 4, 5 and 76 (with grain yields of 576.3, 549.3, 527.3 and 509.5 g/plot, respectively) had the highest grain yield. It seems that higher grain yield of these lines at first year was caused by higher mean fertile tiller number, spike length and grain number/spike. At the second year, lines 2, 3, 4, 5, 89 and 90 (with grain yields of 788.9, 721.1, 722.1, 769.6, 726.1 and 710.1 g plot^{-1}, respectively) had the highest grain yield. Controls were immune or resistant and/or semi-resistant to yellow rust. Field studies and records showed that 245 of synthetic wheat genotypes were immune, 55% were resistant, 19% were semi-resistant and 2% were semi-sensitive. All synthetic wheat lines were immune, resistant or semi-resistant to brown rust. The study of growth type of genotypes showed that 56% were spring type, 25% were autumn type and 19% were intermediate or facultative.

Key words: Genotype · Bread wheat · Synthetic · Preliminary adaptation

INTRODUCTION

The supply of required domestic nutrients through better-using of existing resources and facilities is an important and invaluable objective in Iran. Wheat (*Triticum aestivum* L.) is the most essential crop in food pattern of Iran and has always been the focus in policy-makings. Producing nutrients especially wheat has a close relation with political and economical power of a country. However, rapid and increasing growth of population and not using improved production methods in developing and undeveloped countries has amplified their reliance on wheat so that it is currently one of the important importing items in many developing countries. Global wheat planting area is 228 million hectares. It is ranked first both in cultivated area and production among all crops in Iran. Ministry of agriculture reports that its production varies in different years and its annual planting area is about 6.3 million hectares so that its irrigated and rain-fed cultivated area is 2.5 and 3.8 million and the shares of irrigated and rain-fed productions in total production is 40 and 60%, respectively [1].

Productive regions with northern hot as well as cold climate (suitable for the cultivation of spring and autumn wheat cultivars) including plains of Gorgan, Gonbad, Mazandaran, Moqan, Ardabil and Khorasan are main high-quality wheat production sites in Iran holding 40% of total wheat cultivated area. Given the area of fields and similarity of weather conditions in these regions, it is important to supply sustainable and adapted cultivars regarding yield and resistance against biotic and a biotic stresses. The regions have favorable conditions for wheat cultivation and play a vital role in it. They annually produce 2.5-5 million tons of high-quality wheat depending on weather condition [2]. Among them, Ardabil Province with more than 70 000 hectares of irrigated wheat and 250 000 hectares of rain-fed wheat is the most important country-wide wheat production site.

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Population growth and production resource constraints have necessitated the use of improved cultivars and consideration of breeding and agronomical practices to realize the maximum production potential. On the other hand, precise evaluation of the response of different wheat genotypes particularly synthetic ones to yellow rust and spike fusarium in the region which is the heart of yellow rust incidence in country was another objective of the study [3].

Considering the importance of self-sufficiency in wheat production, it is important to find wheat cultivars with genetic potential of high yield, resistant to diseases and optimum agronomical traits. To realize this objective, a vast range of genetic diversities are annually evaluated in the form of gene pools. These materials are supplied from different sources such as purified materials from separating generations and materials supplied by international research centers like Simit and Ikarda which are subjected to advanced experiments after preliminary assessments. Along with yield comparison assessments, all genotypes are evaluated with respect to their resistance against biotic stresses in diseases pool. The sustainable yields of all lines and cultivars are evaluated as well.

One important objective of plant breeding is to reach genotypes which have desirable agronomical trains beside high yield and is adapted to environment.

In a study of drought indices of wheat on SAWYT international materials in Simit in 122 regions in 6 years, Richards *et al*. [4] clustered various regions. They put Southern Asia, India and Bangladesh in one cluster and Western Asia, Africa and Southern US in another cluster, although the quantity of materials in second cluster was lower.

Feli [5] suggests that new high-yield cultivars often have greater grain/spike and their harvest index is 50-60%.

In a study on agronomical potential of hexapoloid populations of synthetic wheat, Del Blanco *et al*. [6] found that there was a positive correlation among spike no./m^2, biomass, grain no./m^2 and grain yield. Cause analysis of yield components showed that spike no./m^2 and grain no./spike had greater effects on yield. They suggested that hexapoloid synthetic wheat cultivars are invaluable sources for improving 1000-grain weights in common cultivars.

Berzonsky *et al*. [7] introduced four synthetic spring wheat cultivars which were resistant to spike fusarium. They evaluated resistance to spike fusarium in both greenhouse and field conditions.

In a study on the resistance of 100 wheat genotypes against leaf disease Tan Spot, Tadesse *et al*. [8] concluded that 2%, 20.4% and 40.8% were immune, very resistant and semi-resistant, respectively. Monosomi analysis of F2 hybrids using Chinese spring wheat showed that the gene responsible for this resistance occurs on Chromosome 3D.

Lubbers *et al*. [9] reported that synthetic wheat with family tree of LDN (Dic-3A)-32/TA 2452 whose parent TA 2452 had been collected from the Iranian coast of Caspian Sea exhibited immunity to fungal disease of yellow rust.

After comparing the resistance of bread wheat and synthetic wheat to wheat diseases, Xu *et al.* [10] reported that synthetic wheat lines had higher genetic variation to different wheat diseases than ordinary wheat.

In a study on 31 arbitrary wheat cultivars supplied by SIMIT in which main spike yield had been considered as grain yield, Azizi-niya *et al*. [11] concluded that there were considerable diversity among studied cultivars concerning all considered traits and 1000-grain weight, spike weight, fertile tiller no., spikelet no./ spike and grain no./ spike had positive relations with grain yield. Also they found that lines with lower days to flowering and maturity had higher yield because of escaping mechanism from drought.

In a study on the resistance of 28 spring wheat genotypes under greenhouse condition and spot inoculation method, Abedini *et al*. [12] rated cv. Wangshubai as very resistant, 10 genotypes as resistant and semi-resistant and the remaining as sensitive and semi-sensitive. Cv. Tadjan was rated as resistant. The results of correlation between resistance and four morphological traits indicated that the traits plant height, peduncle length and spike density had positive and significant correlation. Therefore, they can be used in selecting for the resistance against spike fusarium.

The results of the researches in Grain Department showed that under appropriate planting date, seed no. of 500 grains/m^2 in cold regions and of 400 grains/m^2 in moderate and hot regions is optimum [13].

Using resistant cultivars accompanied by suitable cultivation operation has been determined as the best and most effective way of controlling spike fusarium in humid and semi-humid regions.

Radmehr [13] showed that the optimum planting periods in cold, moderate and hot regions are late-September to late-October, early-October to mid-November and early-November to early-December. If planting is delayed, seed no. should be added by 10% per each week delay in planting. In hot parts of Ardabil

Province including Moghan, late-December-planting is not recommended because firstly this period is mostly rainy which complicates field preparation, secondly germination is delayed by 20-25 days due to the temperature fall which causes the attack of insects, birds and fungal diseases and decreases green harvest, thirdly plant growth is decelerated in this month which is the coldest month of year and fourthly wheat growing season shortens, pollination and grain filling are delayed and the increase in temperature during pollination will sterilize florets and decrease grain set and weight which will eventually result in yield fall [13].

Synthetic wheat is the result of the crossing wheat as maternal and corn or wheat's wild parents like Agilops as parental. They are hybridized after 24 hours (stamen elimination). However, excessive chromosomes should be eliminated from resulted embryo in 2-3 days. The embryo for survival should be put in Agar media (nutrition) after 14 days. After 21 days, the embryo develops in this environment and primitive leaves are emerged. The plants which are synthetic wheat are transferred to pots in controlled greenhouse environment in 1-1.5 months and after 2-2.5 months and doubling of chromosomes they are transferred to Cochicines. These types of wheat are well-resistant to the fungal diseases of yellow rust, brown rust and stem rust. Also they are especially tolerant to drought particularly late-season drought. They can be used in hybridization with indigenous wheat varieties to result cultivars resistant to spike fusarium, septoriosis and karnal bunt [5].

Wheat plant height is an important trait in breeding and is often related to seedling growth capacity and weed control [14]. Longitudinal growth of stem is the result of the activities of meristem in internodes bases [15]. This trait is controlled and adjusted by dwarf genes (Rht1, Rht2 and Rht3). Concerning plant height genes, wheat cultivars are divided into three groups including tall (100-130 cm), semi-dwarf (75-100 cm) and dwarf (50-75 cm) (49, 83, 96 and 97). Synthetic wheat is classified as tall wheat but dwarf occurs under the effects of environment too [15]. If enough water is supplied, dwarf and semi-dwarf varieties produce greater grain yield than old and tall varieties due to having higher harvest index [16]. But in the case of water deficit, grain yield of tall plants (100 cm or more) is greater than that of dwarf ones because as height decreases, aerial dry weight drops and higher harvest index of dwarf cultivars does not lead to higher grain yield [17]. In addition, swift initial growth of tall wheat in rain-fed farming causes the decrease in surface evaporation and the increase in water share which is used for perspiration. It increases water use efficiency and consequently increases resistance to drought especially in synthetic wheat [18].

The higher fertile tiller is an optimum trait for producing higher yield in appropriate environmental conditions. But it often decreases yield in regions where drought stress occurs before flowering. Under this condition, low-tiller varieties will have higher yield since high-tiller varieties lose most tillers due to drought stress before flowering and their fertile spike will have lower grain no. than those in low-tiller varieties [19].

The length of peduncle has a positive and significant correlation with biological yield under stress. On the other hand, having stores of water-soluble carbohydrates such as fructan and starch, it acts as a transferable temporary store during grain filling. It has been estimated that stem carbohydrate content constitutes 10-12% of final wheat yield under normal conditions and more than 40% under drought and heat stress [20]. Therefore, peduncle length and its role during grain filling in increasing biological yield and grain yield under stress is very important. Longer peduncle has been reported in most synthetic wheat cultivars.

Harvest index of wheat is the ratio of grain yield to biological yield. It shows the ratio of grain yield to biological yield as well as photosynthetic matter partitioning efficiency to grain yield. It is affected by genotype, environment and their interaction [21].

The factors affecting harvest index can be classified in two categories. The first category are main components of grain yield that the more they are, the higher the harvest index would be. The second category includes all other traits which make non-grain yield and the more they are, the lower the harvest index would be [14]. Efficient partitioning of processed materials to grain yield should be considered as a trait of an ideal type in plants breeding practices [22]. Higher harvest index does not imply a higher grain yield. A crop may have a high harvest index but a low biological yield due to low grain yield/unit area. In field study it is impossible to exactly measure dry matter produced by roots and hence, harvest index is calculated by the ratio of grain yield to total dry matter produced by aerial organs. The increase in the yield of semi-dwarf wheat cultivars in recent years has been resulted from the improvement of harvest index through breeding under optimum field conditions [19]. Obviously, harvest index is directly related to grain content. The latter is the result of photosynthetic aggregation in green organs and the transfer of materials produced by stem to grain. Naturally, if photosynthesis is interrupted or the materials produced by it are not transferred, harvest index will decrease. There is a good knowledge about grains and it has been shown that grain growth is effectively supported by the transfer of stored materials in stem [5]. So when photosynthetic material production is affected by drought stress, stored materials in stem especially carbohydrates play more important role in filling the grains. Studies on spring synthetic wheat show that up to 12-14 days after flowering, stems store materials and then they become assimilate exporter. A direct significant relation between stem dry matter fall and grain production capacity under post-flowering drought stress has been reported.

The objective of the study was to investigate the preliminary adaptation of synthetic wheat lines and cultivars and their comparison with commercial cultivars present in Ardabil as well as to introduce tolerant superior lines to prevailing diseases in the region (yellow rust and powdery mildew) and their recommendation and extension.

MATERIALS AND METHODS

Plant Materials: One hundred synthetic bread wheat lines and cultivars were studied which were supplied by Grain Research Department of Seed and Seedling Research and Supply Institute.

Study Location: The study was carried out in Agricultural Research Station of Islamic Azad University of Ardabil located in 3 km west of Ardabil in Hasan Barooq village with a cold semi-arid climate. According to 10-year statistics of meteorological station, annual precipitation is 310 mm and means annual temperature is 8.6°C. Mean minimum temperature is -22°C (Dec-Jan) and mean maximum temperature is +30°C (Jul-Aug) [23]. The altitude is 1350 m from sea-level.

Soil Characteristics: To determine the physical and chemical characteristics of the soil, it was sampled from the depths of 0-30 and 30-60 cm before soil preparation. They were analyzed in Water and Soil Laboratory of Islamic Azad University of Ardabil. The results are presented in Table 1.

Experimental Designs and Cultivation: For the experiment a 1000-m^2 land was selected from Research Field of Agriculture Department of Islamic Azad University of Ardabil (Hassan Barooq) which was left fallow in the previous year. After conventional operation including field preparation, fertilizing, disking, leveling and furrowing, the seeds were manually planted. The fertilizer regime included 200 kg ammonium phosphate/ha as base and 250 kg urea/ha as base and dressing.

One hundred synthetic wheat lines and cultivars as well as four control cultivars prevailing in region including Kaspard, Kaskojen, Saysonz and MV17 were studied based on an augmented design with no replications. The area of each plot was 0.8 m^2 so that each line and cultivar was planted in two lines 2 m in length and 20 cm of interspacing. In each block (20 genotypes), controls were randomly planted in each line for their evaluation. During growing period emergence rate, stem elongation date, spike emergence, maturity date, response to yellow rust and brown rust and growth type of each line were recorded. To determine growth type, the percentage of plants, which proceeded from tillering stage to stem elongation stage and/or spike formation, was used. The lines which totally proceeded to spike formation phase were regarded as spring type, the lines which proceeded to spike formation phase in half were regarded as semi-spring type and the rest remained tillering stage were regarded as autumn type. Five plants were randomly sampled from each plot and their plant height, peduncle length, fertile tiller no., main spike length, grain no./spike, grain weight/ spike, 1000-grain weight, grain yield at first and second year and mean biennial grain yield were determined. The data was analyzed by software MSTAT-C, SPSS and MS-EXCEL.

To measure grain yield, plants were threshed after harvesting and the grains were weighed. The period from first irrigation to the stage when 50% of spikes of each experimental unit came out of anther was regarded as days to flowering. Completely yellowing of glumes of 50% of spikes was regarded as physiological maturity and the period from the first irrigation to this point was regarded as physiological maturity. The period from flowering to physiological maturity was regarded as grain filling

Table 1: Soil analysis results

Depth (cm)	Saturation (%)	Electrical conductivity (ds/m)	Total acidity (pH)	Neutral materials	Organic carbon (%)	Total N (%)	Absorbable P(ppm)	Absorbable K (ppm)	Texture Clay	Silt	Sand	Soil type
0-30	48	2.66	7.8	4.8	0.97	0.103	4.8	460	28	41	31	Loamclay
30-60	45	2.4	8.2	7	0.48	0.056	2	290	24	36	40	Clay

period. Plant height was defined as the length from crown to main spike tip without considering awns and the length from the first node on main spike to its tip without considering awns was regarded as spike length. Peduncle length was defined as the space between the first node at the base of spike to that on the stem. Spikelet no. of five random spikes was counted and regarded as spikelet no. The number of fertile spikelet on 10 spikes was regarded as fertile spikelet no. As well, in these 5 random spikes grain no. and grain weight were measured and averaged. COBB method (infection type) and PETERSON (infection intensity) were used to record the response of cultivars to yellow rust. In COBB method, infection type was recorded with the titles of immune, resistant, semi-resistant, semi-sensitive and sensitive and infection intensity was specified in terms of infection cover on leaf surface. Plant response to infection type is as following:

O = immune (with no symptom of uridia)
R = resistant (with small and time uridia)
MR = semi-resistant (with small uridia)
MS = semi-sensitive (with moderate uridia)
S = sensitive (with full and large uridia)

In the case of leaf diseases such as mildews the response of cultivars and lines was recorded in terms of degrees from 1 to 9 [1].

RESULTS AND DISCUSSION

Variance Analysis of Grain Yield and Some Measured Traits: Variance analysis of grain yield and some measured traits based on an augmented statistical design and controls are presented in Table 3. Results showed that there was a significant difference among controls only regarding spike length and they did not have any significant differences concerning other traits (Table 2).

Grain Yield at First Year: After harvesting, grain yield of each plot was immediately weighed. Variance analysis of grain yield at first year (based on controls) indicated that there were no significant differences among controls. The lines 2, 3, 4, 5, 11, 13, 15, 18, 19, 20, 21, 46, 47, 48, 51, 55, 63, 72, 73, 74, 76, 77, 79, 83, 86, 91, 92, 93, 98, 100, 112 and 114 (32 synthetic wheat lines altogether) had the highest grain yields at the first year. At this year, lines 2, 4, 5 and 76 with grain yields of 576.3, 549.3, 527.3 and 509.5 g/plot in respect had the highest grain yields. Higher fertile tiller no., spike length and grain no./spike seem to be the cause for higher grain yields in these lines. Fertile tiller no., spike length and grain no./spike of line 76, which was a hybrid of Elvira and Iniya were 6.18, 10.4 cm and 63.45, respectively. This line was well tolerable against yellow rust (5R) and brown rust (5R) and had spring growth type.

Table 2: Simple variance analysis of grain yield and some measured traits

Source of variantion	D.F.	M.S. Grain yield First year	Grain yield Second year	Fertile tiller no.	Spike length	Plant height	Grain no./spike	Grain weight/spike
Replication	4	8609.8	32996	5.7	0.27	5.9	72.8	0.09
Genotype	3	12955ns	37078ns	3.1ns	3.2*	139.3ns	133ns	0.27ns
Error	12	5964	19598	1.3	0.83	82.5	44.3	0.13
Variation co. (%)	-	23.38	38.71	16.46	11.98	11.59	19.10	22.43

Table 3: Mean grain yield at first year and second year and some measure traits of controls

Cultivar	Grain yield at first year (g/plot)	Grain yield at second year (g/plot)	Fertile tiller no.	Spike length (cm)	Plant height (cm)	Grain no./spike	Grain weight/spike (g)
Kaspard	360.8	375.9	7.04	7.98	83.26	36.06	1.83
MV17	384	475	6.53	8.34	80.01	41.29	1.85
Kaskojen	302.6	275.4	7.9	7.68	79.46	28.76	1.43
Saysonz	273.8	319.8	6.06	5.02	70.9	33.89	1.45
Mean	393.8	361.1	6.88	7.62	78.41	34.85	1.64

Mean plant height of the genotype 76 was 91.82 cm and was grouped in semi-dwarf synthetic wheat cultivars. Line 4 was a hybrid of Very wheat which is well adapted to most climates and their yield persistence has been proved in various places. The hybrid Veery is well resistant to widespread fungal diseases such as yellow rust and brown rust. Its plant height was 87.5 cm and its spike length was 8.57 cm in average. Fertile tiller no. of this line was 6.33. The spread of yellow rust and brown rust in this line was the minimal (O) and powdery mildew was very slight (2). Line 4 was a wheat cultivar with the growth type of facultative.

Grain Yield at Second Year: The results of variance analysis of grain yield and some traits of controls are presented in Table 3. They show that there was no significant difference in grain yield at second year among control treatments. The study of adjusted means of lines showed that 23 lines had higher grain yield than control at second year and it is necessary to study them further. These lines were 2, 3, 4, 5, 9, 10, 47, 50, 51, 52, 54, 55, 56, 77, 78, 79, 89, 90, 91, 92, 93, 94 and 95.

The lines 2, 3, 4, 5, 89, 90 with grain yields of 778.9, 721.1, 722.1, 769.6, 726.1, 710.1 g/plot in respect had the highest grain yields at second year. In these lines main spike length was the highest and it was higher than mean total spike length of lines. In addition, the lines 2, 5 and 89 with grain no./spike of 52.7, 50.16 and 57.79 were the highest.

The line 89 was a hybrid of Iniya 66 with mean plant height of 96.22 cm and mean fertile tiller no. of 4.73. The line with a spring growth type was tolerant to yellow rust and brown rust (5R) and resistant to powdery mildew.

Fertile Tiller Number: Simple variance analysis of fertile tiller no. for controls was not significant which is a proof of insignificant difference among controls regarding this trait.

The study of adjusted means of synthetic wheat genotypes indicated that the lines 31, 32, 34, 44, 78, 79, 92, 94, 95, 97, 100, 105, 107, 108 and 112 were the superior lines regarding this trait. In total, some synthetic wheat cultivars which were hybrids of Ganfrench wheat had greater fertile tiller no. and they can be used in hybridization programs for breeding and increasing the number of fertile tiller.

Plant Height: Variance analysis of plant height did not show any significant differences among controls (Table 3). Mean plant height of controls was 78.5 cm while the lines 1, 41, 42, 47, 49 and 50 with plant heights of 102.4, 110, 100.7, 108.9, 103.6 and 101.4 were tall lines and their plant heights exceeded 1 m. These lines constituted 6% of all genotypes. The difference in plant heights of lines was because synthetic wheat lines used in the study originated from different hybrids. Plant height of lines 33 and 118 was 58.47 and 51.63 cm which were the most dwarf lines. The plant height of 22% of genotypes was 50-75 cm, so they were grouped in dwarf lines. Lower plant height or dwarfness of lines in plants infected by lodging or sensitive to fungal diseases can minimize the spread of lodging and fungal diseases. Nearly 72% of study lines had plant heights of 75-100 cm which could be categorized as semi-dwarf synthetic wheat cultivars.

Spike Length: Statistical analysis results showed significant difference among controls regarding spike length at probability level of 5% (Table 3). The cultivars MV17 and Kaspard with spike length of 8.33 and 7.98 cm had the highest spike length among controls. The lines 8, 28, 34, 41, 65, 89, 94, 95, 109, 113 and 114 with spike lengths of 11.9, 11.87, 11.86, 11.6, 12.15, 11.84, 11.64, 11.74, 12.03, 13.15 and 11.83 cm had higher spike length. In lines which had higher fertile tiller number, the spike length was lower perhaps because of the decrease in auxiliary tiller no. and consequently higher spike length on main tiller.

Spike length is one of main yield components. In some lines, the major reason of grain yield fall supposedly was the decrease in one yield component such as spike length.

Grain Number/Spike: Simple variance analysis of the trait showed that controls did not exhibit any significant differences regarding grain no./spike (Table 3). Grain no./spike in lines 9, 28, 34, 39, 46, 47, 49, 51, 65, 67, 72, 74, 76, 84, 89, 92, 98, 101, 104, 113, 114 and 116 (55.71, 57.62, 80.95, 58.12, 86.22, 65.42, 59.19, 63.79, 70.39, 69.39, 56.36, 57.04, 63.45, 86.79, 57.79, 59.54, 64.29, 71.04, 68.96, 96.69, 64.89 and 64.04, respectively) was higher and in lines 22, 23, 26, 27 and 31 (16.16, 16.51, 16.98, 11.87 and 12.92) was lower.

In fact, the difference of grain no./spike among lines was due to the difference of spike length and fertile spike no. In some lines with the lowest fertile tiller no, grain no./spike was higher, seemingly due to the decrease in auxiliary tiller no. and as a result, the increase in grain no./main spike.

Grain Weight/spike: Statistical results of grain weight showed that there was no significant difference among controls regarding this trait (Table 3). Wheat lines 9, 14, 34, 51, 65, 67, 84, 89, 102, 101, 113, 114 and 116 (with grain weights/spike of 3.13, 3.71, 3.78, 3.63, 4.13, 3.73, 7.6, 3.9, 3.94, 3.82, 4.29, 3.69 and 3.52 g) had the highest grain weight/spike. Most of these lines had higher grain no./spike, too.

Response to Yellow Rust: The response of genotypes to yellow rust indicated that controls were immune or resistant and/or semi-resistant to the disease. In total, field studies showed that 24% of synthetic wheat genotypes were immune (O), 55% were resistant (R), 19% were semi-resistant (MR) and 2% were semi-sensitive (MS). The lines 67 and 94 with 10 MS response were semi-sensitive to yellow rust.

Response to Brown Rust: The study of the response of genotypes to brown rust showed that all synthetic wheat lines were immune, resistant or semi-resistant to this fungal infection. However, control cultivars of Saysonz and MV17 exhibited a semi-sensitive response to the disease in some plots (10MS).

Response to Powdery Mildew: Field studies of powdery mildew showed that most genotypes were well-resistant to this disease.

Growth Type of Genotypes: The study of growth type showed that 56% had spring growth type, 25% had autumn growth type and 19% had an intermediate growth type.

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