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Research Paper

Determination of the Yield and Cold Hardiness Characteristics of Some Bread Wheat (*Triticum aestivum* L.) Genotypes in Aqueous Conditions

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Abstract

Bread wheat is the most important plant species used in human nutrition and most of the daily protein and calorie needs of people are met from this plant. 26 advanced bread wheat lines and 4 bread wheat varieties have been compared in terms of yield and 3 different (-17, -19 and -21^{0}C) cold level parameters in this study. Durable genotypes were determined according to the LT50 value (the degree when 50% of the plants perish with cold stress). As a result of the observations, it was noted that lines 14, 16, 17, 21, and 27 were superior in terms of resistance to cold and lines 6 and 15 displayed superiority in terms of yield compared to the other varieties. It is concluded that these lines may be suitable variety candidates for wheat cultivation in the region. Furthermore, it has been concluded that it is important to include cold test studies in breeding programs in regions like the East Anatolia Region where harsh winters prevail.

Keywords: Plant breeding; Bread wheat; Cold resistance.

1. Introduction

Wheat is the leading cultivated plant that in the World as well as Turkey to counter food needs and is a strategically important cereal species [1]. Wheat, one of the most grown cereals in the world, is an important food source in human nutrition [2]. Wheat ranks second after corn in terms of total production amount [3]. Most of the daily protein and calorie requirements of humans worldwide are supplied by wheat grains [4]. In recent years, wheat demand has increased in parallel with the increase in human population. Therefore wheat production has a strategic importance in terms of world economy and food security. As a matter of fact, in 2017, 21 million tons of wheat was produced from 76 million decares of land and the average yield was 280 kg / da. Wheat has supplied approximately 20% of the calories consumed daily by the world's population as the main energy and protein source of people for thousands of years [5]. Wheat ranks first among cultivated crops in agriculture for reasons such as the range of its adaptation limit, mechanization, ease of transport, storage and processing [6]. Grain yield in wheat is genetically influenced by many cultivation techniques and climate factors as well as the yield potential of the variety. Knowledge of the relationship between the various characters in the breeding programs to increase grain yield contributes to the correct orientation of the program as well as selection [7]. In order to be effective on the foreign market, we need to increase our competitiveness by producing high quality. Bread wheat breeding works endeavor to improve quality and develop varieties with high yield, that are resistant to diseases and pests and are compatible with environmental conditions. In addition, one of the important factors that limit plant breeding is low temperature. Morphological and physiological deterioration occurs in plants that are subjected to low temperatures depending on the duration of exposure. The development of cold resistant varieties is very important as this situation causes great material losses in the agricultural sector [8;9].

Since the climate and soil factors of our country are rather variable, it is necessary to generate varieties with stable grain yield in different climate and soil conditions and whose quality characteristics are not very variable and offer them to farmers. Although the yield potential of the varieties developed in recent years is high, the yields are decreased by abiotic stress factors. Almost every year there are yield losses due to cold damage in various regions. Cold damage affects

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the yield negatively especially in Central Anatolia, East and Northeast Anatolia where wheat production is the most intense. The development of varieties resistant to stress factors will increase the yield and therefore the production. Wheat is affected by the cold and drought because it is planted mainly in winter in dry conditions. This is also the case in other regions. In winter and cold resistant varieties, the output after winter is 80-95%, while the output of susceptible varieties is down by 40-50%. Considering the strategic importance of wheat in the agriculture of our country, increasing the yield and production of this species will make a great contribution to the national economy. In order to increase yield, limiting factors must be eliminated. Drought, cold and high temperature are the most important factors limiting yield. Therefore, the development of varieties resistant to abiotic stress factors is very important in obtaining high yields. Resistance to stress factors is also associated with the period, duration, and severity of the factor [10]. The aim of this study is to develop high yield and cold resistant varieties suitable for Eastern Anatolia Region.

2. Materials and Methods

2.1. Experimental Design

This study was carried out with 3 replications according to the trial order of randomized blocks in the fields of East Anatolia Research Institute Erzurum Pasinler Location and Erzincan Garden Cultures Research Institute in the 2017-2018 production year. The trial was carried out between 1 September-1 October, which is the most suitable time for winter wheat cultivation. The seeds were planted with a 20 cm row spacing at a depth of 4 - 6 cm and 475 seeds per m^2 with a seed drill in the study [11]. Parcel dimensions were arranged as 6 m x 1,2 m =7,2 m^2. Half of the nitrogen fertilizer used in the trial was applied during planting and the other half during bolting while the Phosphor fertilizer was all applied with the planting at a rate of 6 kg N and 6 kg P per decare [11;12]. 26 advanced bread wheat lines and 4 bread wheat varieties were used in this study. The pedigrees of the varieties are given in Table 1. When the wheat reached harvest maturity, 50 cm was cut off from each parcel as edge effect and the remaining parts were harvested and blended with a parcel harvester [11;12].

2.2. Observations made during the trial

Grain yield: The grain product collected from each parcel was harvested and blended and weighed after cleaning with a small selector. The grain yields obtained as a result of weighing were collected and converted to kg / da.

Cold tests: The cold tests were carried out according to the method used by [10].

3. Results and Discussion

When the variance analysis table was analyzed, it was seen that Yield and vitality rates at different cold temperatures(-17°C,-19 °C and -21°C) were found to be very important in both locations and average of locations (P <0,01). The hightes yield in Erzincan was

Table 1. Genotypes used in the trial

	Hybrids and pedigrees of varieties and lines in the study
1	KARASU 90
2	YILDIRIM
3	BEZOSTAJA
4	KONYA 2002
Line 1	GANSU-1/MEZGIT-4
Line 2	JUP/4/CLLF/3/II14.53/ODIN//CI13431/WA00477/5/GK Aron/AgSeco 7846//2180
Line 3	YUBILEINAYA75/3/AGRI/BJY//VEE/4/SAULESKU #26/PARUS
Line 4	MV C410-90/GK KALAKA//MV C410-90/FATIMA/3/RINA-6
Line 5	GUN91/MNCH*2//T-2003
Line 6	HBK0935W-24/KS84W063-9-34-3-2//KARL 92/4/SHARK/F4105W2.1
Line 7	F885K1.1/SXL/3/OMBUL/A1AMO//MV11/4/BONITO-36
Line 8	KAPKA-I.P./BILINMIYEN96.55
Line 9	SHARK/F4105W2.1//CHARA/3/MERCAN-1
Line 10	KRASOTA/ZARGANA-4
Line 11	GT 8946-57-7 DA
Line 12	YUBILEINAYA75/3/AGRI/BJY//VEE/4/SAULESKU #26/PARUS
Line 13	SERI.1B//KAUZ/HEVO/3/AMAD/4/KS93U134/MVC327-96//X921084-C-8-2/5/HBK0935-13-6/SWM7094 (128) (OAS/TRM)//VBF0589-1
Line 14	TEMPORALERAM87*2/4/HD2281/TRAP#1/3/KAUZ*2/TRAP//KAUZ/5/STEKLOVIDNAYA24/6/F10S-1//STOZHER/KARL
Line 15	SHARK/F4105W2.1//QT6258 /3/SHARK/F4105W2.1
Line 16	GUN91/4/SNI//CAR422/ANA/3/KAUZ*2/TRAP//KAUZ/5/MERCAN-1
Line 17	WEEBILL1/NALIM-3//GALLYA-ARAL1
Line 18	TJB368-251/BUC//SMUT1590-165/3/KS7866-15/ORS8425/4/NE87U119/CHAM6//1D13.1/MLT
Line 19	KRASNODAR/FRTL/6/NGDA146/4/YMH/TOB//MCD/3/LIRA/5/F130L1.12
Line 20	GUN91/MNCH*2//T-2003
Line 21	YUBILEINAYA75/3/AGRI/BJY//VEE/4/SAULESKU #26/PARUS
Line 22	ZANDER-44/DAGDAS94
Line 23	SKAUZ//AGRI/NAC/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ/5/ADMIS
Line 24	PANTHEON/BLUEGIL-2/3/F498U1-1021/BOEMA
Line 25	KVZ/HB2009/5/CNN/KHARKOV//KC66/3/SKP35/4/VEE/6/DAGDAS94
Line 26	AKULA/BONITO//F10S-1/3/F494J6.1111/BONITO

determined Line 24 (260 kg/da). Also Line 26 (257 kg/da), Line 22 (233 kg/da) ve Line 20 (233 kg/da take part in the same group with maximum yield (Table. 2). Maximum yield in Pasinler location was measured Line 15 (437 kg/da). The value was followed by Line 6 (423 kg/da) and Line 21 (397 kg/da). Acording to mean of locations, maximum yield was determined in Line 15 (321 kg/ da) and Line 6 (318 kg/da). İn a study that irrigations conditions in Aydın province made by [13], it was seen that yield changed from 299.2 to 861.5 kg/da. Also in another study has determined wheat yield as 640.5 kg/ da. [14].

Table 2. Yield and vitality rates at different cold temperatures

	Yield (kg/da)			Cold temperatures (%)		
	Erzincan	Pasinler	Mean	-17°C	-19°C	-21°C
KARASU 90	199 c-h	167 l-n	183 g-j	93 ab	87 ab	50 b-f
YILDIRIM	146 j-m	361 b-d	254 bc	80 a-e	50 f-j	37 f-h
BEZOSTAJA	173 d-k	124 no	148 j-l	87 a-d	57 d-j	47 c-f
KONYA 2002	159 fl	80 op	119 l	67 d-f	67 b-g	47 c-f
Line 1	188 c-j	177 k-n	183 g-j	73 b-f	43 h-j	20 j-k
Line 2	139 k-m	251 g-j	195 f-h	63 ef	60 c-h	40 e-h
Line 3	160 e-l	278 e-h	219 c-g	77 a-f	63 c-h	40 e-h
Line 4	104 m	143 m-o	124 j-l	77 a-f	53 e-j	20 jk
Line 5	155 g-l	329 de	242 b-e	77 a-f	57 d-j	20 jk
Line 6	213 b-d	423 ab	318 a	90 a-c	77 a-d	53 b-e
Line 7	190 c-j	336 c-e	263 b	67 d-f	37 jk	0 l
Line 8	113 l-m	154 l-n	134 j-l	70 c-f	47 g-j	10 kl
Line	170 d-k	201 j-m	186 g-j	83 a-e	67 b-g	17 jk
Line 10	184 c-k	256 f-j	220 c-g	83 a-e	77 a-d	73 a
Line 11	194 c-j	164 l-n	179 g-j	93 ab	80 a-c	50 b-f
Line 12	113 -lm	312 d-g	212 c-g	90 a-c	73 a-e	57 b-d
Line 13	209 c-e	199 j-m	204 e-h	93 ab	90 a	63 ab
Line 14	206 c-f	335 c-e	271 b	70 c-f	23 k	0 l
Line 15	205 c-g	437 a	321 a	80 a-e	63 c-h	43 d-g
Line 16	196 c-h	224 h-l	210 c-g	67 d-f	23 k	0 l
Line 17	166 d-k	199 j-m	182 g-j	93 ab	90 a	60 bc
Line 18	151 h-l	146 m-o	148 j-l	77 a-f	53 e-j	30 g-j
Line 19	203 c-g	47 p	125 j-l	87 a-d	70 a-f	3 l
Line 20	223 a-c	160 l-n	191 gh	87 a-d	67 b-g	40 e-h
Line 21	153 h-l	397 a-c	275 b	97 a	63 c-h	40 e-h
Line 22	233 a-c	239 h-k	236 b-f	87 a-d	53 e-j	40 e-h
Line 23	103 m	320 d-f	211 c-g	97 a	87 ab	60 bc
Line 24	260 a	238 h-k	249 b-d	57 f	50 hj	27 hj
Line 25	202 c-g	126 no	164 hk	93 ab	77 a-d	50 b-f
Line 26	257 ab	236 h-k	246 b-d	83 a-e	60 c-h	50 b-f
Mean	179**	235**	207**	81**	62**	36**

According to the Duncan test, the averages shown with the same letter are not important in their group (p<0,01)

At the hightes cold test application -17 ° C in the study, all lines and varieties showed more than 50% viability and the highest viability rate was determined in Line 23 (97%) and Line 21 (97%) lines. Line-17 (90%) and Line-13 (90%) lines stand out in the -19 ° C application. Line Line 10 (73%) and Line 13 (63%) had the highest viability at -21 ° C, which was the coldest temperature in the study. Line 23 and Line 17 followed these lines with a viability of 60%. Küçüközdemir et al. emphasized that there were significant differences in cold resistance between the lines in the cold resistance test study on Trtitikale and that it was important to include cold tests in breeding programs in regions such as East Anatolia Region where winters were cold [15]. In a study of 90 local genotypes and 6 registered bread wheat varieties under controlled conditions, they reported that registered varieties exhibited higher resistance than local genotypes and emphasized that the most resistant genotype was Alparslan [14].

4. Conclusions

In this study, 26 advanced bread wheat lines and 4 bread wheat varieties have been compared in terms of yield and 3 different (-17, -19 and -210C) cold level parameters. As a result of the observations, it was noted that lines 14, 16, 17, 21, and 27 were superior in terms of resistance to cold and lines 6 and 15 displayed superiority in terms of yield compared to the other varieties. These lines are promising for the region and can be used as a parent in the breeding program.

Eastern Anatolia Region is a region where winters are hard and snowy. In order to obtain high efficiency in this region, the varieties used must be cold resistant varieties. Deaths occur in plants due to severe cold in winter, so it is very important to use cold-resistant varieties. For this reason, determination of cold resistance levels of plants under controlled conditions is very important for breeding programs.

Conflict of Interest

The authors declare no conflict of interest.

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