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DETERMINATION OF SOME AGRONOMIC TRAITS OF WINTER WHEAT AND SPRING WHEAT LINES OF DIFFERENT BACKCROSS GENERATIONS GROWING IN SOUTHERN MARMARA CONDITIONS

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Abstract

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This study was conducted on the testing fields of Uludag University Research and Application center. The lines belonging to the combinations of spring wheat and winter wheat examined during testing period were selected from backcross program conducted for supplying semi-tolerant to *Puccinia* spp. Some agronomic traits of lines such as plant height, spike length, spikelet per spike, seed number per spike, seed weight per spike in BC_1, BC_2 and BC_3 generations were examined. As a result of testing, the plant height, spike length, spikelet per spike, seed number per spike and seed weight per spike increased in the proceeding backcross generations of winter wheat and spring wheat lines.

Key words: backcross, yield component, wheat, recurrent
Abbreviations: BC - Backcross; R -Recurrent Parent

Introduction

It is necessary that agricultural production be increased continuously to meet the need for food of the rising population. Improving the agricultural system, educating the farmers, providing the input and marketing the product well are obligatory for that. The most important element in the improvement of the agricultural system is to develop and breed a commercial variety having a high potential of yield and genetic value.

The backcross method had been mostly used in animal breeding but not much used by plant breeders until it was mentioned by Harlan and Pope (1922). However, when the new *Tilletia* and *Puccinia* spp. emerged, the number of plant breeders using this method rose suddenly in order to increase the plant semi-tolerant to diseases. While this method was being used a breeding of semi-tolerant to diseases in the past, we observe that it is also used for transferring agronomic and quality traits from one variety into another by some researchers today. Peterson, doing one, two or three backcrossing, pointed out that the lines carrying desired characteristics could be obtained by making use of the trangressive traits in agronomic characters such as yield and adaptation (Allard, 1960).

In addition, it was reported that the rise of yield of desirable plants selected from winter wheat F_1 changed between 3.8% and 34% in comparison

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with their parents and that the rise reached 58%-81% as a result of backcrossing (Barker et al., 1989). In recent years, some agronomic traits in the lines obtained by this method such as plant height, spikelet per spike, seed number per spike. The heritage of quality characteristics such as 1000 seed weight and protein rate and the interaction between quantitative genes and their effects on plant characteristics have been searched by many scientists (Joshi et al., 1992; Dhaliwal et al., 1994; Zheng et al., 1994; Sharma et al., 1995; Gorora et al., 2002; Blanco, 2004). Today this method is being used for transferring genes providing the resistance to drought stress, salt stress, heavy metals and soft kernel texture (Nevo and Chen, 2010; Morris et al., 2011; Golabadi, 2011).

Materials and Methods

Bursa, having a coast to the Marmara Sea, is a city in the South of Marmara Region. It has a mild climate; summers are hot, winters are rainy and mild. The average rain total per yearly is 698.8 mm, the average temperature is 14.7°C and the average humidity is 69% in the city for years.19% of the total rain falls in winter months, 26% of it falls in the spring and 25% of it falls in the autumn.

The tests in Bursa of the research called 'The research of spring wheat in Turkey' conducted in different regions in the frame of a corporation of Turkish-German Universities and gathered from various regions in Turkey and the Mediterranean Countries are the basis for the source of the spring wheat in the study. The source of the winter wheat was taken from the study 'Winter Wheat Region, Variety, Yield and Adaptation' carried out by our department. The testing material after the third backcrossing, seen as hopeful, especially as a result of the selection related to the semi-tolerant to *Puccinia* ssp. consisted of backcross generations of the lines belonging to Orso* x MV-20 and Yecora* x Bezostaja-1 in winter wheat, Diyarbakir* x Erzincan, Bintepe* x Amasya and Santa* x Amasya in spring wheat.

The test established with the purpose of developing disease-semi-tolerant plants started backcrossing /crossing the parents with each other in 1993. The first backcrossing was carried out in 1994. It was repeated three times starting from F_1 without any selection to save a year. After the third backcrossing, leaving the lines self pollination for one year, a selection was made among a wide population determining the lines semi-tolerant to *Puccinia* spp. and considering the spike structure of the recurrent parent. In the study, the agronomic observations made before in the generations BC_1, BC_2 and BC_3 of these lines were evaluated.

The results of the agronomic measurements in plants showing the spike characteristics of the recurrent parent are obtained by taking total 30 main stems from 10 plants in each row randomly and some agronomic traits in these plants such plant height, spike length, spikelet per spike, seed number per spike and seed weight per spike were examined.

The variance analysis of the measured traits was done with MINITAB computer package program according to the testing design and 5% and 1% significance levels were used in F_1 tests related to differences of varieties. The average values were grouped on 5% significance level according to the Lowest Significance Difference Method (LSD) using MSTATC computer package program.

Results

The first trait examined in the study is plant height. The plant height rose in the proceeding backcross generations of both winter wheat and spring wheat lines. The rise wasn't statistically different between the second and the third backcross generations but it was different between the first and the third ones. As seen from Table 1, while the plant height values of the backcross genera-

*Recurrent parent

Table 1
Statistical groups and values belonging to the some yield components of some spring wheat (*T. durum* L.) lines on different backcross generations

Combinations	Backcross generations	Plant height, cm	Spike length, cm	Spikelet number, unit	Seed number per spike, unit	Seed weight per spike, g
Diyarbakir^{R}xErzincan-13	BC_1	106.0 cd	7.7 a-e	19.3 e	38.0 bcd	1.77 ad
	BC_2	108.5 be	7.9 a-d	21.1 ae	40.6 abc	1.85 abc
	BC_3	110.8 ac	8.2 ab	22.3 ab	42.6 ab	1.98 a
Diyarbakir^{R}xErzincan-30	BC_1	102.5 d	6.8 f	20.2 cde	31.3 e	1.46 e
	BC_2	109.9 be	7.0 ef	20.3 b-e	35.3 cde	1.62 cde
	BC_3	111.0 ab	7.4 ef	21.1 a-e	35.6 cde	1.65 cde
Santa^{R}xAmasya-5	BC_1	89.6 f	7.0 ef	21.9 abc	42.0 ab	1.92 a
	BC_2	92.0 ef	7.2 def	22.0 abc	41.0 abc	1.93 a
	BC_3	94.8 e	7.3 def	22.5 ab	44.0 a	1.97 a
Bintepe^{R}-Amasya-24	BC_1	88.4 f	7.4 cf	19.4 e	35.0 de	1.63 cde
	BC_2	91.5 ef	8.3 a	19.1 e	41.6 ab	1.95 a
	BC_3	93.1 ef	8.1 abc	22.7 a	45.0 a	2.00 a
Bintepe		91.3 ef	7.0 ef	21.6 a-d	44.3 a	2.00 a
Diyarbakir		90.7 ef	7.5 b-f	22.8 a	42.3 ab	1.97 a
Santa		79.0 g	7.3 def	22.3 ab	43.8 a	1.90 ab
Erzincan		115.6 a	8.1 abc	19.6 de	35.6 cde	1.67 b-e
Amasya		102.0 d	7.1 ef	19.1 e	35.0 de	1.61 de
LSD 5%		4.86*	0.76*	2.02*	5.34*	0.24*

R: Recurrent Parent
*P< 0.005

tions of winter wheat lines were between those of the parents forming the combination, the values in spring wheat were higher than both of the parents and these values especially in the second and third backcross generations were statistically different from those of the parents.

The spike length of backcross generations of winter and spring wheat lines was examined. It was determined that the spike length in backcross generations increased in comparison with the one in the previous generation as it was in the plant height. When backcross generations were compared with their parents, they generally had values between those of their parents. Especially the second and the third backcross generations of Bintepe x Amasya-24 line had a statistically different spike length value from their parents. In addition, from the point of spike length, it was observed that some

Table 2
Statistical groups and values belonging to the some yield components of some winter wheat (*T. aestivum* L.) lines on different backcross generations

Combinations	Backcross generations	Plant height, cm	Spike length, cm	Spikelet number, unit	Seed number per spike, unit	Seed weight per spike, g
Orso^R x MV-20-7	BC_1	102.8 d	7.8 d	17.3 f	39.9 h	138 g
	BC_2	109.8 ab	8.0 cd	17.6 ef	43.1 gh	1.74 ef
	BC_3	110.0 ab	8.1 bcd	18.1 c-f	44.1 fg	1.77 de
Orso^R x MV-20-19	BC_1	107.1 bcd	8.1 bcd	17.7 def	47.0 def	1.92 bcd
	BC_2	112.2 a	8.2 a-d	18.3 b-f	47.2 c-f	1.96 abc
	BC_3	112.4 a	8.2 a-d	18.2 b-f	48.4 c-e	1.97 abc
Yecora^R x Bezostaja-1-16	BC_1	108.1 abc	8.3 abc	19.0 bcd	49.6 cd	1.85 cde
	BC_2	110.5 ab	8.4 abc	19.2 abc	49.0 cde	1.87 b-e
	BC_3	110.1 ab	8.6 a	20.4 a	50.3 bc	1.89 b-e
Yecora^R x Bezostaja-1-47	BC_1	107.3 bc	8.3 abc	17.2 f	53.3 ab	2.01 abc
	BC_2	109.6 ab	8.3 abc	18.0 c-f	53.6 a	2.02 ab
	BC_3	112.3 a	8.4 abc	18.4 b-f	56.0 a	2.11 a
Orso		90.0 e	8.6 a	18.7 be	53.0 ab	2.00 abc
Morthonvashari-20(MV-20)		107.5 be	8.2 a-d	18.1 cf	45.8 e-g	1.60 f
Yecora		105.0 cd	8.5 ab	18.2 bf	55.0 a	2.00 abc
Bezostaja-1		105.0 cd	8.3 abc	19.5 abc	54.0 a	2.00 abc
LSD 5%		4.41*	4.44*	1.38*	3.28*	0.2*

R: Recurrent Parent
*P< 0.005

backcross generations had repeated values while some had the values similar to those of donor parents (Table 1).

Spikelet per spike increased in the proceeding backcross generations of winter wheat and spring wheat lines. Generally, it was observed that spikelet per spike of backcross generations was between the values of the parents forming the combination and these values in winter wheat were similar to those in recurrent parent (Table 1).

Another trait examined in the study is seed number per spike. Seed number per spike indicated an increase in backcross generations of lines belonging to both winter and spring wheat combinations. When backcross generations were compared with the parents, only the values of the backcross generations of Yecora x Bezostaja-1-16 line were statistically different and lower than both of the parents (Table 1).

The last trait examined in the study was seed weight per spike. From the point of this trait, there was an increase in both winter wheat and spring wheat backcross generations (Table 2). The increases –except for Diyarbakır x Erzincan 30 and

Orso x MV-20-7 lines- were similar to those of the recurrent parent.

Discussion

In a study on backcrossed wheat, it was reported that the plant height of backcross lines was near the tall parent in backcross studies the tall parent used (Alderov, 1984). This was observed in most backcross generations studied in this research. It was determined in another research that there was no statistical difference between the plant heights of the lines of the third and the fourth backcross generations (Sandukhadze et al., 1989). In this study, the fourth backcross generation wasn't obtained but no statistically significant difference was seen between the second and the third backcross generations.

It was found in a study that the spike length increased backcrossed wheat (Zihirov and Ternovskaya, 1988). This result was parallel with the one found in the research only in backcross generations of Bintepe x Amasya-24 line.

It was reported in one study that spikelet per spike decreased in plants obtained by backcrossing (Zihirov and Ternovskaya, 1988). However, this result wasn't parallel with the ones determined in this study.

While some researchers reported that the increase in seed number per spike of backcross generations wasn't significant in comparison with the parents (Barker et al., 1989), some researchers observed an increase in spike per seed (Reedy et al., 1995). In this study, backcross lines indicated an increase in proceeding generations in comparison with the previous generation but this increase wasn't more than the values of the parents and some backcross generations having lower values than their parents were observed.

Conclusions

It was reported that the variety obtained by backcross method didn't need to be used in yield studies again because the variety as a genotype looked like the recurrent parent mostly, and that the genes coming from the donor parent were also added to these traits (Briggs and Allard, 1953). In this study, under the lights of output obtained as a result of the third backcrossing, it was concluded that an increasing backcross number increased the plant's semi-tolerant to diseases and from the point of some agronomic traits such as spike length, spikelet per spike, seed number per spike and seed weight per spike except for plant height, the lines.

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