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Potential of Trakya Region for Production of Triticale

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ABSTRACT

This study was aimed to reveal the potential of the triticale production in the Trakya Region which exists in European part of Turkey having valuable agricultural potential. The total sowing area of the Trakya region is 19.044 km² and occupies 2.43% of total land of Turkey. About 60% of the total population of this region lives in the cities and other 40% live in rural areas. The main source of income of people in this region is agriculture. 25% of the total income in the agriculture is animal production and 75% crop production. The wheat and sunflower production are predominant in the region, and it is affected by biotic factors such as diseases and pests, and abiotic factors such as drought and high temperature in almost every year. Agro chemicals are widely used for chemical disinfection against diseases and pests in the region. Therefore, new alternative products that are less affected by biotic and abiotic factors are needed in the region. In addition, 81.2% of the agricultural areas of Trakya region are in 1-4 classes. 18.8% of it is in 5-8 classes in soil properties. In the studies conducted in the region, the triticale genotypes exhibited higher values in terms of grain and herbage yield than the other alternative cereals, especially under extreme climatic and soil conditions. Moreover due to the intensive cultural animal production in the region, the triticale production in this region has a significant chance.

Keywords**:** triticale, Trakya region, production, extreme conditions

Introduction

Triticale (x *Triticosecale* Wittmack) is an annual C3 cool-season grass within the Poaceae (Graminae) family (Kavanagh and Hall 2015). Triticale is an amphiploid species stably baring the genomes of wheat (*Triticum* sp.) and rye (*Secale* sp.) (Ammar et al. 2004). Triticale is an established small grain cereal crop that combines the productivity of wheat with the hardiness of rye. Triticale may be octoploid (2N = 56; AABBDDRR) or hexaploid (2N = 42; AABBRR) depending on which wheat is crossed with rye (RR), i.e., common wheat (AABBDD) or durum wheat (AABB). The large genome of octoploid types is less stable and with the exception of Asia cultivars; most cropping triticales are of hexaploid type (Ammar et al. 2004).

Triticale is produced in order to increase the yield of marginal and infertile agricultural lands and to provide food for the increasing world population as a result of long-lasting rehabilitation studies in many countries such as USA, Poland, Canada, and Mexico. Triticale's adaptation ability to infertile and marginal lands and yield potential are inherited from durum wheat parents which have A and B genomes, and its ability to grow on cold, acidic, and salty soils comes from rye which has R genome. Triticale has high yield potential in field conditions in which wheat and barley could not provide enough yield and qualified product. Triticale is more enduring to biotic and abiotic stress conditions compared to wheat and barley. Triticale is mostly cultivated as grain product for livestock feeding, and sometimes for roughage production and pasturage.

Triticale grain is commonly used especially for poultry feeding (Belaid, 1994). The feeding quality of its grain is equal to corn, wheat, and barley (Azman, 1997).

As triticale cultivation areas in the world are analysed considering the last 10 years' data, it can be determined that while it occupied approximately 3.2 million ha in 2002, it has raised to 4.16 million ha in 2016 with 30% increase (FAOSTAT, 2017). 80% of the world's triticale cultivation area is used for winter, and 20% for summer types (Bağcı ve Ekiz, 1993). While Poland has the widest cultivation area among the countries producing triticale with 1.4 million ha, Germany follows it with 396 thousand ha, and France with 334 thousand ha (FAOSTAT, 2017). When China, Russia, Spain, Lithuania and Hungary are included, 70% of the world's triticale cultivation is provided by these countries. Especially Russia, which first started producing triticale in 2008, has accomplished to become one of the first five countries since 2012.

For the fact that the ecological conditions in our country are quite suitable for other crops and the alternative products are easily cultivated, triticale production could not reach to the desired level. In our country since 2017, triticale has been planted on 37.6 thousand ha area and 125 thousand tons of grain product has been obtained (FAOSTAT, 2017). The average grain yield of triticale (332 kg/da) in our country is higher than the average grain yield of wheat (270 kg/da), rye (263 kg/da), barley (248 kg/da) and oat (226 kg/da).

The aim of this study is to reveal the potential of Trakya region for triticale production.

Climate and Soil Requirements of Triticale

Triticale is a cool season cereal with high yield capacity even under extreme climate and soil conditions. In our country, triticale has been better adapted to the northern transitional region, the west transitional region and Toros region, especially. It's resistance to cold and drought conditions is better than the other cool season cereals. The cultivation can be carried out in subtropical, moderately mild and moderately cold climates. Optimal temperatures are 20°C for germination, 10-24°C for optimal growth, -10°C for minimum temperature of survival and 33°C for maximum temperature of survival. Usually, the water needs of triticale range around 400-900 mm/year.

Under marginal land conditions, where abiotic stresses related to climatic (drought, extreme temperatures, etc.) and soil conditions (extreme pH levels; salinity; deficient in nutrients such as molybdenum, zinc, etc.; toxicity of trace elements such as boron, etc.) are the limiting factors for grain production, triticale has consistently shown its advantages compared to the existing cultivated cereal crops (Mergoum et al. 2004). In such problematic areas, while wheat and barley deliver 200-250 kg/da grain yield, 400 to 500 kg/da grain yield is obtained from triticale.

Climate Conditions and Soil Properties of Trakya Region

Climate conditions

Tekirdağ and Edirne provinces have sub humid climate. In Tekirdağ along the coast line, summers are hot and winters are mild, whereas Ergene Basin has continental climate. Edirne has also continental climate; summers are hot and arid, winters are too cold and harsh. However, in the southern part, in Saroz gulf and coast line, Mediterranean climate is dominant. In Kırklareli, regional characteristics determine the climate. On the northern side of the Yıldız mountains Black Sea climate is common and the temperature difference between summer and winter is low. Besides, frost is lesser than the upcountry (Anonymous, 2013).

The long-term average climate values of Trakya region provinces during triticale cultivation period are given in Table 1.

The long-term average total precipitation of Trakya region in triticale cultivation period is 547.9 mm, number of rainy days are 95, relative humidity is 71.7%, and average temperature is 13.4°C (Table 1). While the annual precipitation of Edirne (596.9 mm) and Tekirdağ (583.1 mm) is close to each other, Kırklareli's annual precipitation (463.8 mm) is lower than these two provinces (Table 1). Edirne and Kırklareli stand out as the coldest and hottest provinces in the region. In a general look, it can be said that the climate characteristics of Trakya region is quite suitable for triticale cultivation.

Soil Properties

Tekirdağ's soils which constitute the 38% of 1 million ha agricultural land of Trakya region have heavy structure. It contains more than 30% clay. Besides, in Tekirdağ, there are four kinds of soil groups which are brown forest soil group, alluvial soil group, hydromorphic alluvial soil group and limeless forest soil group (Anonymous, 2013). Among these soil groups, hydromorphic alluvial soil group is the one that does not have agricultural value.

Edirne, which has 36% of the agricultural lands of the region, generally has clayey alluvial soils. The most common soil group in Edirne is non-calcareous brown soil and non-calcareous brown forest soil (Anonymous, 2013).

Kırklareli has 26% of the agricultural lands of the region. In this province, there are 6 different soil

groups, which are limeless forest soil group, calcareous forest soil group, vertosols, brown soil group, alluvial soil group, and colluvial soil group.

As Trakya region soil characteristics are evaluated in terms of triticale cultivation, it can be said that the soil structure of the region is appropriate for triticale production.

The Importance of Triticale in Trakya Region

Besides being a gate to Europe, Trakya region has a significant place in terms of agricultural potential. The region provides the 11,82% of wheat production, 80.63% of sunflower, and 56.83% of rice production. Trakya region's sunflower, wheat and rice yield is higher than the world average, even higher than some developed countries when it is examined in terms of yield in vegetative production.

Trakya region has quite suitable characteristics considering the cool climate grain production. The average yield of the cool climate grains produced in the region is much higher than the country average. Plantation, production and yields of cool climate grains cultivated in our country and Trakya region are presented in Table 2 (FAOSTAT, 2017; TÜİK, 2018). When the average grain yield of cool climate grains cultivated in our country is examined, it is obvious that triticale has higher yield with 332 kg/da compared to other cool climate grains.

As can be seen in Table 2, in Turkey, 125 thousand tons of triticale is produced on 37.6 thousand ha area with 332 kg/da average yield. As the triticale cultivation in Trakya region is investigated, it can be observed that the highest triticale production is in Edirne with 9.573 da, and it is followed by Kırklareli with 9.203 da (Table 2). The lowest triticale production is in Tekirdağ with 4.681 da. Thus the triticale yield in Trakya region is much higher than the country average. Average grain yield in Tekirdağ is 394 kg higher than country average, Edirne's average grain yield is 99 kg higher than country average, and Kırklareli's average grain yield is 79 kg higher than country average (Table 2). The average grain yield of the region (523 kg/da) is 191 kg higher than country average (Table 2).

In the light of these data, it can be said that Trakya region is very suitable for triticale cultivation in terms of the unit area yield.

The importance of triticale for land capability classes

More than the half (1.041.351 ha) of the total land property of Trakya region (1.904.383 ha) is utilized for agricultural production (Anonymous, 2013). 96.46% of agricultural lands are reserved for field crop cultivation. The share of the agricultural lands of the region in Turkey's lands is around 3.86%. The land capability classes of Trakya region is presented in Table 3 (Cangir et al. 1996).

As it is observed in Table 3, the share of I.-II.-III.-IV. class lands in the total area of Trakya region is 81.2%, the share of V.-VIII. class lands is 18.8%. This 18.8% area (357.147 ha) which is not suitable enough for cultivation is an important potential for triticale production whose adaptability to inconvenient conditions is higher than other cool climate grains.

As the provinces of the region are analyzed in terms of land capability classes, it can be concluded that V.-VIII. class lands occupy Kırklareli in the highest extent with 31.6%, and it is followed by Edirne with 14.4%. The lowest amount of V.-VIII. class lands are in Tekirdağ (Table 3). These data show that there is an important potential for triticale production in Kırklareli.

The importance of triticale for culture animal husbandry

Culture animal husbandry has recently increased in Trakya region. A large part of animals (98.28%) in the region is culture+cross-breed. The rest of it (1.72%) is constituted by native races. Trakya region's available animal stock and number of managements are given in Table 4. As the average feed consumption of the region is examined, it can be determined that roughage consumption per management is 14.6 tons/year, silage consumption 47.1 tons/year, and mixed feed as 8.18 tons/year. The husbandry managements of the region provide some of their needs from vetch+oat, vetch+wheat or vetch+triticale mixtures. Because there are too many managements in the region, the producers have problems while supplying roughage. Thus, it can be understood that triticale which has high yield potential is a significant plant which can be an alternative feed source.

The cattle culture husbandry in the region have increased in recent years. Besides, more than 100 big managements and many small cattle producers are active in the region. While the number of cattle which is in the first place in cattle farming is around 16 million, the number of sheep is around 33.6 million (TÜİK, 2017).

The investments for cattle farming in Trakya region has significantly increased in recent years. Triticale is more advantageous than cool climate grains in providing fodder for husbandry managements in the region and in the utilization of the soils which have low agricultural qualities (declivitous, hydrophilic, crop, sandy). This is also proved by the studies conducted in the region.

Korkut et al. (2009) in their study which is conducted with 9 triticale genotypes, 3 bread wheat,

3 durum wheat, 3 barley and 1 rye over three years and 3 different locations of Trakya region, revealed that triticale genotypes have average grain yield 30 kg/da higher than bread wheat, 95 kg/da higher than barley types, 63 kg/da higher than durum wheat and 121 kg/da higher than rye. They also found out that the fodder yield of triticale genotypes is 523 and 106 kg/da higher than bread wheat, 1183 and 381 kg/da higher than durum wheat, 1749 and 409 kg/da higher than barley. In the study, triticale genotypes have green grass yield 146 kg/da lower than rye, and have fodder yield 305 kg/da lower than rye. 2021 triticale lines (620 kg/da) in terms of grain yield, Tacettinbey triticale (5132.111 kg/da) in green grass, and Tatlıcak 97 triticale (1495.333 kg/da) in fodder yield have come to the foreground.

Duğan (2010), in their study which is conducted with 7 triticale genotypes, 3 bread wheat, 2 barley and 1 rye over two years and 4 different locations of Trakya region having different soil characteristics (sloping infertile and fertile soil condition) revealed that triticale genotypes grow better than other in barren and hydrophilic soils. In base soil conditions triticale is in the same statistical group with bread wheat and some triticale (Presto-2000 and Karma 2000) have higher yield than bread wheat. As a result of the study, it is revealed that triticale genotypes have grain yield 51 kg/da higher than bread wheat, 142 kg/da higher than barley, 248 kg/da higher than oat and 177 kg/da higher than rye . In terms of green grass yield, triticale genotypes' yield is 1.11 tons/da higher than bread wheat, 1.02 tons/da higher than barley, 0.11 tons/da higher than oat, and 1.01 tons/da higher than rye. The researcher also found out that triticale genotypes' forage yield is 90 kg/da higher than bread wheat, 120 kg/da higher than barley, 140 kg/da higher than oat, whereas it is 50 kg/dalower than rye.

The data from the studies conducted in Trakya region reveal that triticale has an important potential in the region. However, triticale cultivation in this region has not reached a desired level yet. The most important reason is that triticale has not been introduced to the local producers efficiently.

Results

High amounts of pesticides against agricultural diseases and pests are applied every year in Trakya region. Extensive or wrong pesticide applications and climate change have caused new types of diseases to appear in the region. In recent years, it has been observed that there is a significant increase in diseases and pests in grains.

There is also a significant increase in diseases such as yellow rust, septoria, barley yellow dwarf, besides brown rust. The most important pest of the region is sunn bug and root rot and every year it causes significant losses of wheat. These diseases are commonly seen because of the low durability of the cultivated plants in the region, and to prevent this, pesticides are being applied intensively.

Triticale is the most important candidate plant against both biotic stress factors such as disease and pests, and abiotic stress factors such as draught, high temperature and cold.

As a result, the reasons of the fact that the expected increase in triticale production in Trakya region has not come true are:

1. The local producers do not have enough information about the durability of triticale against biotic and abiotic stress factors,
2. It is not known that triticale has higher green and fodder yield compared to other grains in the region's ecological conditions,
3. The marketing price of triticale is lower than other grains,
4. Inadequate seed supply in triticale,
5. The low preference of triticale by animals as it is used in feed mixes because of its cellulose amount in its stem,
6. Marketing problems and
7. Inadequate special encouragement for low agricultural quality soils.

Table 1. The long term average climate values of Trakya region.

Months	Provinces	Total monthly precipitation (mm)	Number of rainy days	Monthly relative humidity (%)	Temperature		
					Minimum	Maximum	Avarage
October	Edirne	56,7	7,9	72	-3,3	34,1	14,2
	Kırklareli	48,4	-	72	-3,4	35,0	13,5
	Tekirdağ	55,2	7,2	76	-0,2	32,0	15,2
November	Edirne	68,8	11,3	80	-11,2	25,1	9,3
	Kırklareli	71,2	-	78	-4,3	23,3	8,9
	Tekirdağ	81,3	9,3	81	-6,9	27,9	11,4
December	Edirne	75,2	13,2	82	-17,1	20,8	4,5
	Kırklareli	76,1	-	81	-10,0	18,8	5,1
	Tekirdağ	86,2	12,0	82	-10,9	21,6	7,2
January	Edirne	62,9	13,0	81	-22,2	20,0	2,0
	Kırklareli	63,3	-	80	-15,8	18,0	2,6
	Tekirdağ	69,9	12,6	82	-13,5	21,5	4,4
February	Edirne	50,8	10,6	77	-18,9	21,1	5,2
	Kırklareli	49,7	-	78	-15,0	21,0	3,9
	Tekirdağ	54,7	10,3	80	-13,5	22,2	5,3
March	Edirne	46,2	9,7	73	-13,5	28,0	7,1
	Kırklareli	46,4	-	74	-11,8	25,7	6,7
	Tekirdağ	55,6	10,3	79	-9,0	28,1	6,8
April	Edirne	49,9	9,9	68	-2,3	33,5	12,7
	Kırklareli	44,3	-	69	-2,5	29,4	12,0
	Tekirdağ	42,9	8,9	76	-1,0	34,3	11,5
May	Edirne	49,2	10,8	67	0,6	37,1	17,9
	Kırklareli	45,8	-	66	1,8	36,0	17,0
	Tekirdağ	37,6	7,6	75	2,7	33,8	16,6
June	Edirne	48,9	8,8	62	6,7	39,3	22,0
	Kırklareli	49,7	-	62	5,8	37,0	21,2
	Tekirdağ	37,8	6,3	71	9,2	34,0	28,9
July	Edirne	32,1	5,7	56	8,0	41,5	24,4
	Kırklareli	25,2	-	59	9,0	41,6	21,3
	Tekirdağ	19,4	3,4	67	12,6	37,6	23,3
Annual	Edirne	596,9	109,4	70	-22,2	41,5	13,6
	Kırklareli	463,8	81,5	69	-20,3	40,4	12,2
	Tekirdağ	583,1	94,1	76	-13,5	37,6	14,5
Region Average		*547,9*	*95,0*	*71,7*	*-18,7*	*39,8*	*13,4*

Table 2. Plantation, production and yields of cool climate grains in Turkey and Trakya region in 2017.

Products		Turkey	Trakya region		
			Tekirdağ	Edirne	Kırklareli
Wheat	Plantation	7.6 million/ha	1.922.560 da	1.396.181 da	1.264.579 da
	Production	20.6 million/ton	882.674 tons	505.460 tons	552.431 tons
	Yield	271 kg/da	459 kg/da	362 kg/da	437 kg/da
Barley	Plantation	2.7 million/ha	130.549 da	50.067 da	45.302 da
	Production	6.7 million/ton	71.575 tons	23.821 tons	21.624 tons
	Yield	248 kg/da	548 kg/da	475 kg/da	477 kg/da
Oat	Plantation	113 thousand/ha	5.594 da	2.082 da	8.151 da
	Production	250 thousand/ton	1.908 tons	697 tons	2.523 tons
	Yield	222 kg/da	347 kg/da	335 kg/da	310 kg/da
Rye	Plantation	114 thousand/ha	1.375 da	2.226 da	1.583 da
	Production	300 thousand/ton	833 tons	1.170 tons	772 tons
	Yield	263 kg/da	606 kg/da	525 kg/da	488 kg/da
Triticale	Plantation	37.6 thousand/ha	4.681 da	9.573 da	9.203 da
	Production	125 thousand/ton	3.401 tons	4.125 tons	3.783 tons
	Yield	332 kg/da		726 kg/da	431 kg/da

Table 3. The land capability classes of Trakya region and provinces.

Provinces	Total Area (ha)	Land capability classes	
		I.-II.-III.-IV classes	V.-VIII. classes
Tekirdağ	621.788	558.589 (89.8%)	63.199 (10.2%)
Kırklareli	655.036	451.297 (68.4%)	203.739 (31.6%)
Edirne	627.595	537.386 (85.6%)	90.209 (14.4%)
Trakya region	1.904.419	1.547.272 (81.2%)	357.147 (18.8%)

Table 4. Number of cattle, sheep and managements in Trakya region

	Tekirdağ	Edirne	Kırklareli
Cattle	156.000	154.000	142.000
Sheep	320.000	275.000	259.000
Management	15.000	14.500	13.200

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