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Research Article

CHANGES ON ACREAGE, PRODUCTION, AND SEED YIELD OAT (*Avena sativa* L.) IN TURKIYE

Murat Olgun[1]

[1]Osmangazi University, Faculty of Agriculture, Field Crop Department, Eskişehir

Abstract

In this study, the changes (increases/decreases) on acreage, production and seed yield in oat in Turkey after the 1930s was examined by using statistical analysis. In the analysis of oat agriculture made over many years and in twenty-year periods, it was revealed that oat agriculture in Turkey should be examined in two distinct periods. These two distinct periods can be examined as before the 1970s and after the 1970s. While oat production increased before the 1970s, it entered a decline after the 1970s. On the other hand, grain yield has consistently increased. Until the 1970s, which was the first period, production increase was possible with the expansion in acreages. Already in this period, acreages have reached their marginal limits. After this period, production decreased along with a contraction in cultivated areas. However, this decrease rate was less than in the first period. Although not at the desired level, the use of high-yielding registered varieties and the increasing use of modern cultivation techniques have led to a significant increase in grain yield per unit area. This situation also reduced the rate of decrease in efficiency. Oat production in Turkey is not at the desired level. Increasing the production amount of oats, which is increasingly important in terms of animal feed needs and human nutrition in Turkey, is only possible by increasing the use of high-yielding varieties. Additionally, oat breeding programs need to be expanded and activated.

Key Words: Oat (*Avena sativa* L.), acreage, production, seed yield, increase, decrease, stability, Principal component and biplot analysis

INTRODUCTION

Oat (*Avena sativa* L.) is a plant located in the *Aveneae* tribe of the *Grammineae* family and has the highest oil, fiber and β-glucan content among the cool climate grains [1], it has been used in animal nutrition since ancient times [2]. Nowadays, its importance in human nutrition as well as in animal husbandry is increasing day by day [3]. The oat yield (seed yield 2,42 ton/ha), produced in 24 million tons in about 10 million hectares acreage in the world. The acreage, production and seed yield in Turkey is approximately 100 thousand hectares, It is 250 thousand tons and 2.43 ton/ha [4]. Oats have an important place in human and animal nutrition due to the nutrients they contain. Both green grass and stalks, straw and husks have high feed value. It is an important raw material in the industry. Oat straw is superior to wheat and barley straw because its stalks are soft, have abundant leaves, and are rich in organic and mineral substances [2, 5]. Compared to other cereals, it is higher in unsaturated fatty acids. It is used in animal nutrition. Oats have an important place in human and animal nutrition due to the nutrients they contain. It is an important raw material in the feed industry due to the high feed value of both green grass, stalks, straw and husks. Oat straw is superior to wheat and barley straw, because, its stalks are soft, have abundant leaves, and are rich in organic and mineral substances [5, 6].

In addition, since oats are hulled, they are preferred by cattle, sheep and poultry [7, 8]. Oats are the only grain that contains avenin, a substance that strengthens the growth of young organisms in it. Due to these properties, it has an important place

in animal nutrition, especially in the nutrition of running horses, and is a valuable feed raw material. In recent years, oats have been increasingly used by the food industry in baby food, biscuit and bread making, and as breakfast cereals, biscuits, etc. due to new eating habits. However, due to the problem in processing technology, the use of oats remains limited [9, 10]. Although oats are the gene centre of Anatolia, the lack of winter varieties has caused spring crops to be planted in the inner regions, which are the main production areas, for years. As a natural result of not being able to benefit sufficiently from winter precipitation in spring planting [8, 10, 11, 12].

Although the importance of oats, which has been cultivated since ancient times, has increased during the Republic period, its production is far from the desired level. Oats are grown in winter in our coastal regions, and in our inner regions where the continental climate prevails, summer oats are cultivated and the yield is quite low. The main reasons why oats are not included enough in agriculture in Turkey are; Harvest and threshing difficulties in oat cultivation, not giving enough space to oats in the crop rotation, low oat yield, being more sensitive to diseases and pests, biotic and abiotic stresses than other cool climate grains, and insufficient consumption can be listed as reasons. The development campaign in agriculture was initiated from the first years of the Republic and has continued until today. Especially after the 1930s, agronomy and breeding studies in grains were initiated and significant progress was made in these matters. This has been achieved to a significant extent in wheat and barley, and many barley and wheat varieties have been registered and made available to producers. Until recent years, oats have not made as much progress in breeding and agronomics as in wheat and barley, and have remained lagging behind. Breeding studies and the emergence of new varieties of oats have only been possible in the last twenty or thirty years. In this study, the changes (increases/decreases) on acreage, production and seed yield in oat in Turkey after the 1930s was examined by using statistical analysis.

MATERIALS AND METHODS

In this study, the acreage, production and seed yield [13] in bread wheat between 1938-2020 in Türkiye were examined and the changes occurred were discussed statistically. The changes on data in twenty-year periods were examined by Principal Component Analyse [14, 15, 16]. This analyse was made in Minitab 17 software program.

RESULT AND DISCUSSION

Due to its structural situation, the agricultural sector has weak competitiveness with other industrial sectors. The main goal of agriculture is to feed the ever-increasing world population by preserving the efficiency and continuity of existing natural resources. Studies have shown that while the population increases geometrically, food production increases arithmetically, and even has a tendency to decrease in recent years. It has been demonstrated that countries should use their agricultural resources regularly in response to the rapidly increasing population [17, 18]. Although our country has been mentioned as one of the few self-sufficient countries in the world in terms of grain production for many years, the rate of agricultural production meeting the increasing population has been decreasing in the last decade due to reasons such as uncontrolled urbanization of agricultural areas, erosion, and abandonment of agricultural production due to migration to cities [19, 20, 21, 22].

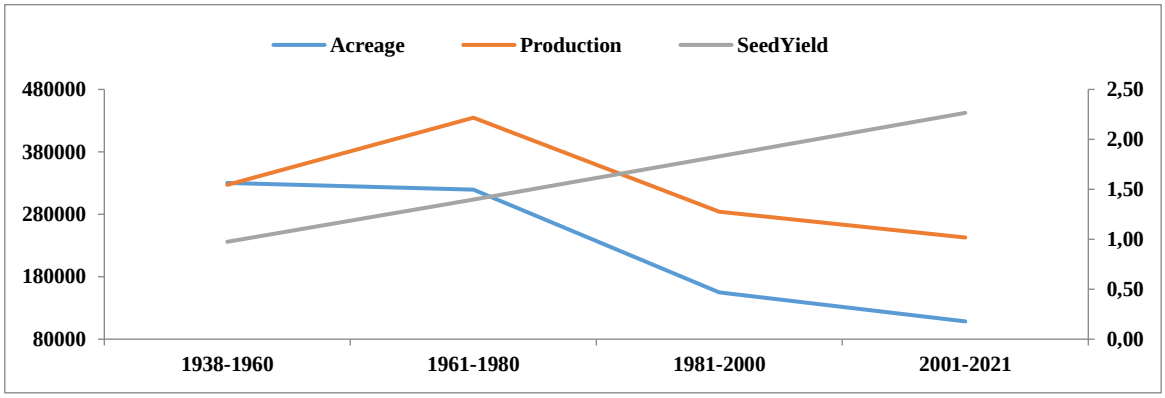
Oat, a grain that has long been grown for its grain and herb, has begun to be used extensively in human nutrition in recent years, as its nutritional value has been understood. In addition, the demand for oats is increasing day by day with its increasing importance in the cosmetics and pharmaceutical industries [23, 24, 25]. Beta glucan, found in oats, helps strengthen the immune system and reduce cholesterol levels in humans [26, 27]. As seen in Table 1, there was a significant increase in acreage and production until the 1970s, and a rapid decline occurred after the 1980s. After the 2000s, the decline continued, but to a lesser extent. By the 1970s, the limit of acreages had been reached. There was a significant increase in efficiency.

As it is known, until the 1970s, the increase in production increased due to the growth in acreages. There has been a sustained and significant increase in grain yield. This increase in grain yield resulted from the increase in production due to the increase in cultivated areas until the 1970s. In 1970, the cultivation phases came to an end. Especially after the 1980s, there was an increase in grain yield due to the use of registered varieties, albeit a small number, an increase in the use of agronomic practices such as fertilization and irrigation, and the improvement of agricultural mechanization.

The annual changes in oat acreage, production and grain yield between 1938 and 2021, and the maximum, minimum and average values are given in Table 1.

Table 1. Annual changes on maximum, minimum and average values, acreage, production and grain yield in oat between 1938-2021.

	1938-1960			1961-1980		
Variable	**Mean**	**Minimum**	**Maximum**	**Mean**	**Minimum**	**Maximum**
Acreage	330263±11200	248080	430000	319600±16851	197000	412000
Production	326927±21953	121546	530000	434700±13761	355000	550000
SeedYield	0,974±0,045	0,470	1,300	1,399±0,044	1,060	1,800
	1981-2000			**2001-2021**		
Variable	**Mean**	**Minimum**	**Maximum**	**Mean**	**Minimum**	**Maximum**
Acreage	154980±3464	132000	180000	108442±4391	85862	155000
Production	284050±7933	216000	330000	242849±7535	189099	314528
SeedYield	1,830±0,027	1,540	2,040	2,265±0,054	1,770	2,780



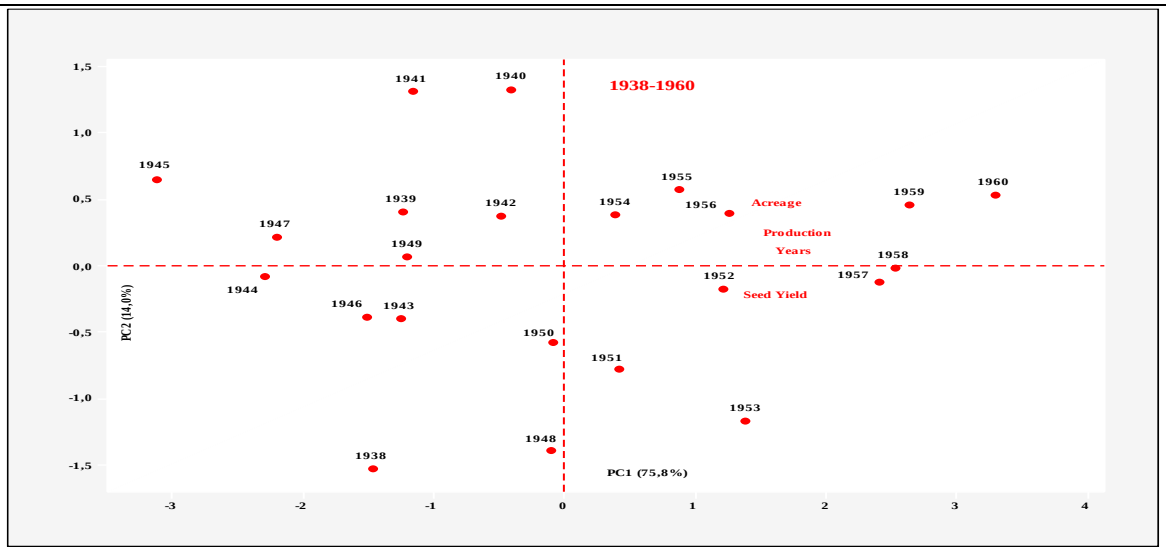
The decline in production after the 1980s was less severe than the decline starting in the 1970s. The reason for this was more effectively used registered varieties, agronomic practices and agricultural mechanization. The changes in oat

acreage, production and grain yield were examined in twenty-year periods and the changes were expressed. Principal component and biplot analysis of the changes in acreage, production and grain yield between 1938 and 1960 are given in Table 2.

As seen from the table, major changes and variations could be explained at the PC_1 and PC_2 levels (PC_1 75.8%, PC_2 14.0% and cumulative 89.8%). While it was observed that there was a significant variation in acreage and production depending on the change in years, no significant variation was observed in grain yield. It can be said here that acreage and production play an effective role in total production. Since acreage has a higher coefficient than production, the most effective factor in total production can be expressed as the expansion in acreages.

Table 2. Principal component and biplot analysis, the changes in acreage, production and seed yield between 1938-1960.

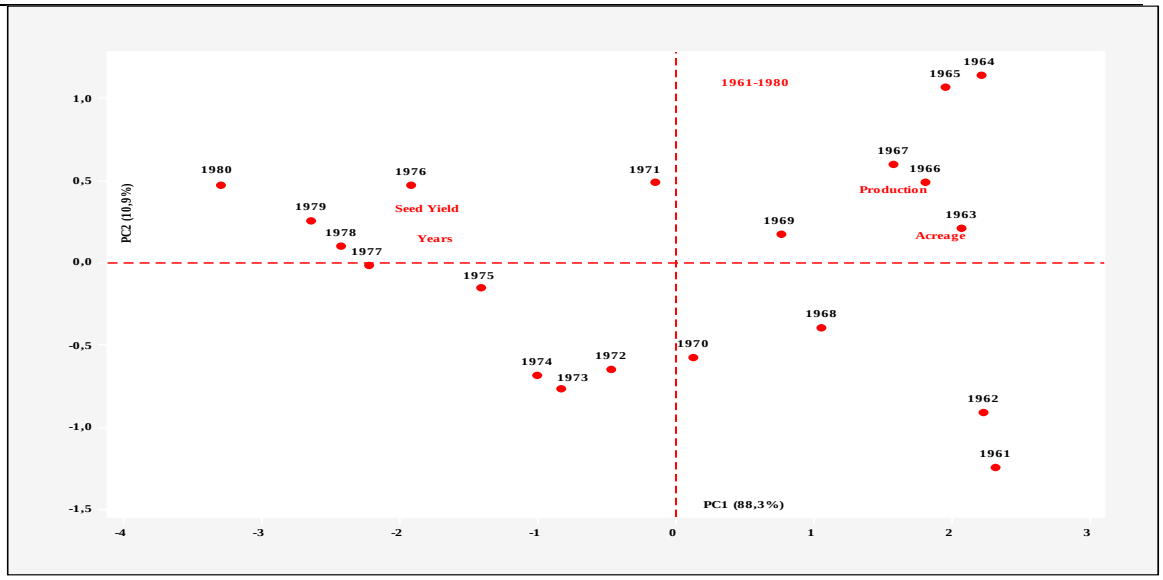
Eigenanalysis of the Correlation Matrix			Variable	PC_1	PC_2
1938-1960	**PC_1**	**PC_2**	**Years**	0,477	-0,001
Eigenvalue	3,032	0,561	**Acreage**	0,064	0,746
Proportion	0,758	0,140	**Production**	0,467	-0,042
Cumulative	0,758	0,898	**Seed Yield**	0,485	-0,664



The change and increase in acreage and production in the 1950s was higher than between 1938 and 1950. Principal component and biplot analysis of the changes in acreage, production and grain yield between 1961 and 1980 are given in Table 3.

Table 3. Principal component and biplot analysis, the changes in acreage, production and seed yield between 1961-1980.

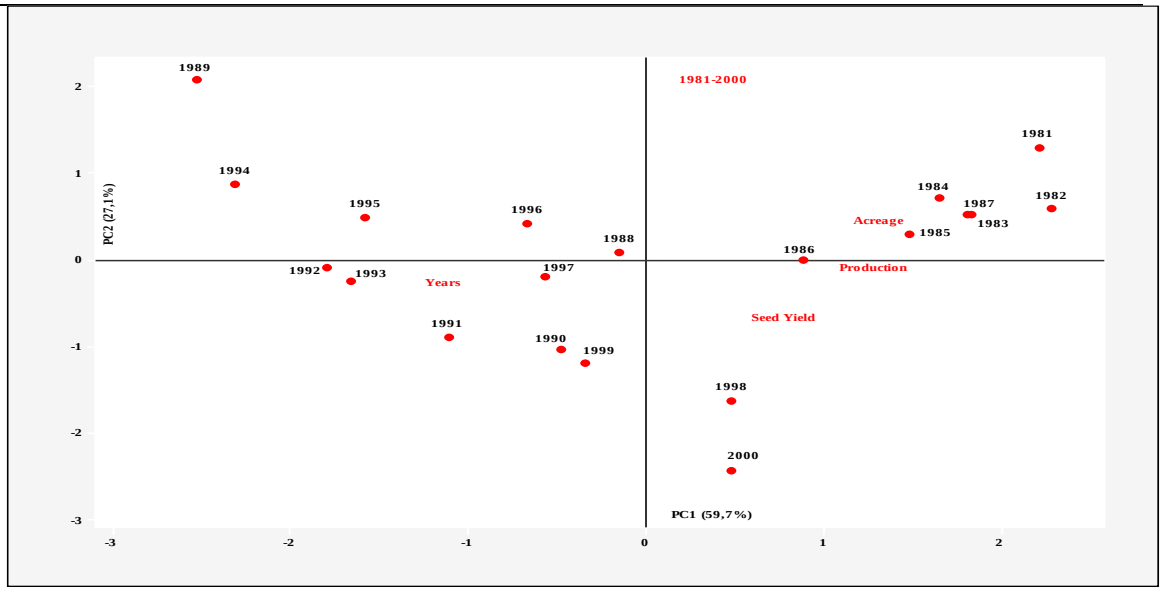
Eigenanalysis of the Correlation Matrix			Variable	PC_1	PC_2
1961-1980	**PC_1**	**PC_2**	**Years**	-0,526	0,116
Eigenvalue	3,531	0,435	**Acreage**	0,331	0,048
Proportion	0,883	0,109	**Production**	0,761	0,070
Cumulative	0,883	0,992	**SeedYield**	-0,078	0,549



Changes and variations at the PC_1 and PC_2 levels (PC_1 88.3%, PC_2 10.9% and cumulative 99.2%) could be explained. Depending on the change in years, significant variation has occurred in the acreage and production grain yield. There was no increase in the cultivated area and production, on the contrary, there was a significant decrease. Grain yield continued to increase. The increase in grain yield was mostly due to the increase in cultivation techniques. Despite this, there was a decrease in production. Although higher grain yield per unit area caused a partial increase in production, production decreased compared to the previous period. The variation that occurred in the 1960s, the increase in grain yield, the decrease in planted area and production was higher than in the 1970s. Cultivated areas did not increase further, on the contrary, they decreased and showed a more stable situation. Principal component and biplot analysis of the changes in acreage, production and grain yield between 1981 and 2000 are given in Table 4.

Table 4. Principal component and biplot analysis, the changes in acreage, production and seed yield between 1981-2000.

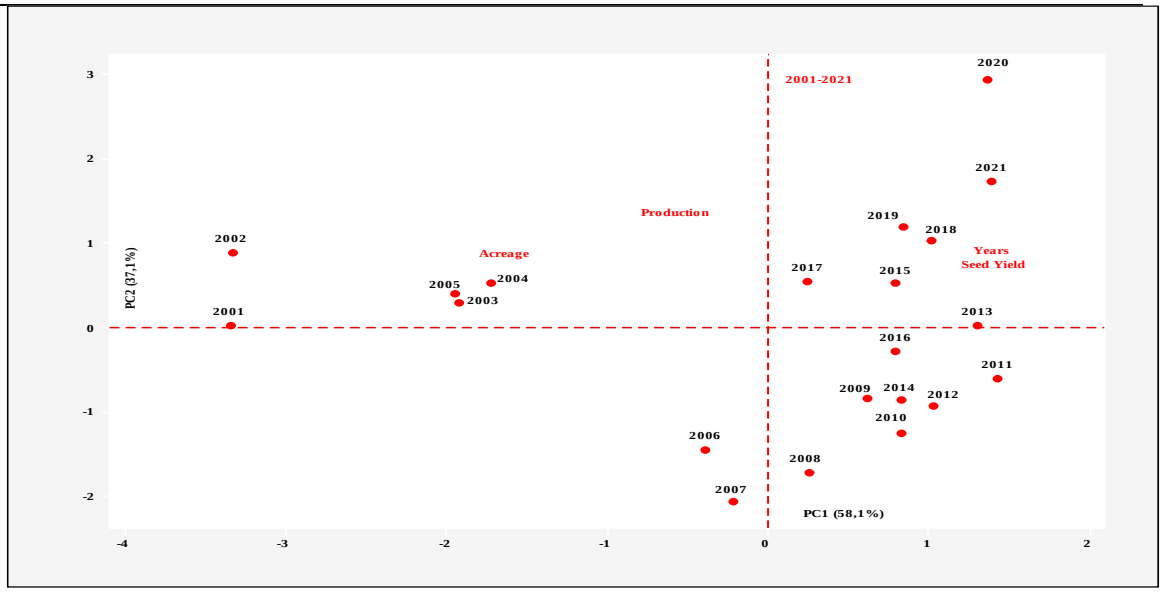
Eigenanalysis of the Correlation Matrix			Variable	PC_1	PC_2
1981-2000	PC_1	PC_2	**Years**	-0,386	-0,594
Eigenvalue	2,390	1,083	**Acreage**	0,576	0,246
Proportion	0,597	0,271	**Production**	0,629	-0,172
Cumulative	0,597	0,868	**SeedYield**	0,352	-0,746



At the PC_1 and PC_2 levels (PC_1 59.7%, PC_2 27.1% and cumulative 86.8%), an explanation level of approximately 87% was achieved. While the decrease in acreage and production continued to a lesser degree, the increase in grain yield continued. After the 1980s, there was a decrease in the acreage and production. Positive improvement in cultivation techniques and a partial increase in the use of high-yield and high-quality registered varieties were effective in this. On the other hand, stability was evident in grain yield, planting area and production. This means that the increase in grain yield and the decrease in planting area and production in the 1980s were greater than in the 1990s. Therefore, the higher performance increase seen in the 1980-2000 period compared to the previous period is due to the performance in the 1980s. The principal component and biplot analysis of the changes in acreage, production and grain yield between 2001 and 2021 are given in Table 5.

Table 5. Principal component and biplot analysis, the changes in acreage, production and seed yield between 2001-2021.

Eigenanalysis of the Correlation Matrix			Variable	PC_1	PC_2
2001-2021	**PC_1**	**PC_2**	**Years**	0,546	0,369
Eigenvalue	2,324	1,485	**Acreage**	-0,572	0,395
Proportion	0,581	0,371	**Production**	-0,204	0,768
Cumulative	0,581	0,952	**SeedYield**	0,570	0,145



In the PCA analysis, the sum of the solution degree of the two PC levels (PC_1 58.1%, PC_2 37.1% and cumulative 95.2%) was approximately 95%. The rapid decline in acreage and production, which started in the 1960s, continued after the 1980s, although its severity decreased. The decrease in intensity continued its course after the 2000s. Meanwhile, high PC coefficients in production and grain yield reveal a closer relationship of production with grain yield. Therefore, the increasing use of registered varieties, more effective use of modern cultivation techniques and the expansion of their use have led to an increase in the grain yield obtained per unit area. This situation reduced the rate of decline in production. Changes in production and grain yield were stronger in the 2010s, and production and seed yield were more stable in these roads. In other words, the positive effect in the years after 2010 was much greater than in the 2000-2010 period.

CONCLUSION

In the analysis of oat agriculture made over many years and in twenty-year periods, it was revealed that oat agriculture in Turkey should be examined in two distinct periods. These two distinct periods can be examined as before the 1970s and after the 1970s. While oat production increased before the 1970s, it entered a decline after the 1970s. On the other hand, grain yield has consistently increased. Until the 1970s, which was the first period, production increase was possible with the expansion in acreages. Already in this period, acreages have reached their marginal limits. After this period, production decreased along with a contraction in cultivated areas. However, this decrease rate was less than in the first period. Although not at the desired level, the use of high-yielding registered varieties and the increasing use of modern cultivation techniques have led to a significant increase in grain yield per unit area. This situation also reduced the rate of

decrease in efficiency. Due to the different usage areas of oats, from livestock to human nutrition, the demand for oats is increasing. However, the number and use of registered varieties to meet the needs are not sufficient. For this reason, oat production in Turkey is not at the desired level. Increasing the production amount of oats, which is increasingly important in terms of animal feed needs and human nutrition in Turkey, is only possible by increasing the use of high-yielding varieties. Additionally, oat breeding programs need to be expanded and activated.

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