

COMPERATIVE SEED ANATOMY OF SELECTED ELEVEN COMMERCIAL *Triticum aestivum* L. VARIETIES (Poaceae) FROM CENTRAL ANATOLIA-TURKEY USING SEM AND LIGHT MICROSCOPY

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ABSTRACT. In this study anatomical study is surveyed on 11 varieties of commercial *Triticum aestivum* L. Seed anatomy in the Poaceae family is one of the important taxonomic characters used recently. Anatomical studies of wheat have provided some important diagnostic features in coastal and coastal areas. Caryopsis seed of *Triticum aestivum* is a food source rich in starch. The seeds of 11 varieties were studied, measured and photographed, discussed and interpreted. Parts of the kernel; pericarp layer, testa layer, aleurone cell, endosperm layer, fold depth and gap width. According to the data obtained from this study; different measurements have been made in varieties, and it is thought that the dimensions of cells, layers and other structures can be used in the differentiation of varieties in some respects. According to the data obtained from this study; Different measurements have been made in varieties, and it is thought that the dimensions of cells, layers and other structures can be used in the differentiation of varieties in some respects. With this study, seed micromorphology of 11 different wheat varieties used commercially for the first time was determined.

Keywords: *Triticum aestivum*, wheat, Poaceae, kernel, caryopsis, anatomy

INTRODUCTION

Wheat (*Triticum aestivum* L.) is a basic crop and plays a vital role in the world. Wheat are very important group of plants not only to human beings but also to animals [1]. Wheat species are most of the world's major food crops. It is estimated that the demand for wheat consumption will increase by 50 percent [2]. It will also be edible and important staple food for billions of people. With the rapid growth of the world population, the increasing needs in food consumption are becoming a problem [1,3]. To solve the problems, change the genetic structure of plant breeding studies with higher quality, higher yield, resistant to diseases and pests and high adaptability, to obtain the cultivars studied. Breeding programs should be based on the determination of the morphological, physiological, phenotypic and quality characteristics of the varieties and the determination of the morphological characteristics of the varieties allows pure crop production [1, 2, 3, 4]. Many investigators have reported the micromorphological properties of grass leaves. Some of the researchers worked on the morphology and micromorphology of wheat species. Caryopses morphology and anatomical variations have not been studied much. Besides this micromorphological study, it is also very important systematic perspective [5].

The surface of each plant organ is part of the overall body structure and has its own unique characteristics. The seeds provide numerous morphological characters and can be used for taxonomic purposes. It is known that the use of seed characters in taxa can be reliable and stable. Grass seed morphological features and surface patterns have been used in many studies to identify and compare taxa and species [6]. External characteristics of seeds and small fruits tend to be neglected in anatomic and even detailed taxonomic studies; this is surprising for the stability and high systematic value of the external characters [4].

Surface structure of plant seeds, including formations such as micro-extensions, cells, folds that directly represent the topography. The surface cell walls of cereal hulls are primarily a structural unit that responds to the action of cellulase-based water and biocatalyst solutions [7, 8]. The cell walls of cereals are presented by non-starch polysaccharides consisting mainly of arabinoxylan, cellulase and β -glucan. These polysaccharides are related to the strength of the grain shells above the crosslinks in the matrix structure of the cell wall. The outer pericarp surrounding the outer layers of the grain is a thin and weak texture attached to the intermediate layer [8]. An intermediate layer consisting of various tissues (nuclear epidermis and inner pericarp) has a complex and heterogeneous structure. These two structures are the fiber-rich fraction [6, 7, 8].

The caryopsis or grain of the wheat plant consists of the bran shell and the endosperm surrounding the embryo. The dandruff layer consists of three layers: pericarp, testa and aleurone. Endosperm constitutes about 80% of wheat grain [5, 7, 8]. It stores starch and protein, which are important for both plant and flour production. The embryo makes up only a small percentage of the grain but contains the root root and the shoot apex surrounded by the coleoptile. Scutellum separates the endosperm from the embryo [9].

Seed properties, especially exomorphic features, revealed by scanning electron microscopy, have been used to solve systematic problems. Micromorphological seed characters using scanning electron microscopy (SEM) are relatively consistent between plant species and can therefore be useful in distinguishing different species and grouping them under descriptive categories. (Few scanning electron microscopy studies have dealt with subtle structural differences in taxonomic and morphological characteristics of closely related species, particularly within plant groups of the same species [3, 6, 8].

It is known that three main factors of grain morphology affect the grinding performance. endosperm/dandruff ratio, endosperm vitreousness, and separability of dandruff coating with starchy endosperm. This factor of separability appears to be dependent on both tissue adhesion and tissue mechanical properties that need to be investigated independently [8].

The aim of this study is to determine the detailed seed micromorphology of eleven selected commercial wheat varieties. Thus, the similarities and differences between the seed micromorphologies of these varieties were revealed. With this study for the first time, the anatomical structures of these commercial wheat varieties were determined and compared. In this way, it has been shown that the examined wheat varieties can be distinguished from each other by considering their seed anatomical structures. Crease Depth/Cavity width, Endosperm/Pericarp, Endosperm/Testa and Pericarp/Testa ratios, which were presented for the first time in this study, were used in the definition of commercial wheat.

MATERIALS AND METHODS

Voucher specimens of the eleven wheat varieties of *Triticum aestivum* used in our analyses were collected from the fields of the Faculty of Agriculture Central Anatolia-Turkey. Specimens are deposited in ESK Herbarium (Department of Botany, Faculty of Science, Eskişehir Osmangazi University, Turkey). For the study took the grain of wheat varieties Alpu 01, Altay 2000, Atay, Bezostoja, Es 26, Harmankaya, Müfitbey, Nacibey, Sönmez, Sultan, Yunus grown in the Central Anatolia in Turkey. Voucher specimens of the eleven wheat varieties of *Triticum aestivum* used in our analyses were collected from the fields of the Faculty of Agriculture Central Anatolia-Turkey. Specimens are deposited in ESK Herbarium (Department of Botany, Faculty of Science, Eskişehir Osmangazi University, Turkey). For the anatomical study; specimens of plant were fixed in 70% alcohol. From the Herbarium sample, the detailed morphological characteristics of the species were established. For the anatomical investigations, samples were taken from alcohol by hand and scalpel. Anatomical sections of the plants were taken from its seeds. The photograph dimensions were 100 µm [9, 10, 11, 12].

RESULTS AND DISCUSSION

Light and electron microscope sections of 11 commercially used *Triticum aestivum* varieties were photographed, named from the outside to the inside and measured. It explains some micromorphological properties for different varieties in observations on wheat grains using scanning electron microscopy. The data obtained from the measurements are given in tables 1 and 2, and the degree of closeness between the varieties has been revealed by evaluating. As a result of the studies carried out, numerical data have been revealed. In addition, the data of each variety has been evaluated in detail below. The aim of this study is to determine the seed micromorphologies of 11 commercially used wheat varieties and their similarities and differences.

Triticum aestivum cv *Alpu 01*

Cross section is cordate in outline, **3.346,14x 2.474,95** µm in size. The seed coat layers are well distinct and clearly divided into two parts; the outer is the pericarp or exo-tegmen and the inner is the testa or the endo-tegmen or seed coat or testa. Perikarp layer has a valuable width; 42,647 µm in thickness and Testa Layer has a valuable width **1,12** in thickness. Aleurone cells of one layer of living cells, and large, rectangular and arranged vertically and exhibit the thickness **15,08** µm. Endosperm layer thickness is **1.673,07** µm. Endosperm Layer Thickness/Testa Layer Thickness has maximum ratio, **1.493,81**. Also Perikarp Layer Thickness and Testa Layer Thickness has maximum ratio **38,08** too. Crease depth is **1.730,36** µm and Cavity width **596,15** µm. Epidermis cells in ventral side have 25,71 µm width and 122,86 µm length where as epidermis cells in dorsal side have 25,88 µm width and 72,94 µm length. It has the minimum length/width ratio, **2,81**, of epidermis cells on dorsal side (Table 1, 2, 3,4, Fig.1, 2).

Triticum aestivum cv *Atay 2000*

Cross sections measurement of wheat grains show that endosperm layer of *Triticum aestivum* cv *Atay* has 2.797,56 µm width and 1.971,50 µm height. Width/ height ratio indicate that it has cordate shape in cross section. Perikarp layer thickness is 48,321 µm and Testa layer thickness is 1.58 µm. Aleuron cell thickness 13,76 µm. Endosperm layer

has 1.398,78 μm thickness. Crease depth is 1.673,07 μm and cavity width is 711,53 μm . Epidermis cell on ventral side is 31,34x131,43 in size. Epidermis cells on dorsal side have 22,35 μm width and 80,00 μm in length (Table 1, 2, 3, 4, Fig.1, 2).

Triticum aestivum* cv *Es26

According to the cross sections, endosperm is 2.996,46 μm x 2.412,60 μm in size. Shape is obtuse-cordate. Perikarp layer thickness is 38,542 μm and testa layer thickness is 1,55 μm . Aleuron cell thickness is lowest with **11,23** μm . Endosperm layer has 1.498,23 μm thickness. Crease depth is 1.461,53 μm . Also it has lowest cavity width, **423,07** μm . Epidermis cells on ventral side have 32,35 μm width and 138,24 μm in length. Epidermis cells on dorsal side have 21,18 μm width and 101,18 μm in length (Table 1, 2, 3, 4, Fig.1, 2).

Triticum aestivum* cv *Sultan

Cross section is semitriangular-cordate in outline with 2.961,52 μm width and 2.397,79 μm height. Perikarp layer thickness is 51,069 μm and Testa layer thickness is 1,63 μm . Aleuron cell thickness 12,56 μm . Endosperm layer has 1.480,76 μm thickness. Crease depth is 1.653,84 μm and cavity width is 710,96 μm . Epidermis cells on ventral side have 34,29 μm width and 120,00 μm in length. Epidermis cells on dorsal side have 18,82 μm width and 89,41 μm in length. Ratio of Length/Width of Epidermis Cell on Ventral Side is the smallest one with **3,49** (Table 1, 2, 3, 4, Fig.1, 2).

Triticum aestivum* cv *Mufitbey

Endosperm shape type is obtuse-cordate with 3.076,92 μm width and 2.910,99 μm height. Perikarp layer thickness is 44,672 μm and Testa layer thickness is 1,62 μm . Aleuron cell thickness 11,44 μm . Endosperm layer has 1.538,46 μm thickness. Crease depth is 1.673,07 μm and cavity width is 576,92 μm . Epidermis cells on ventral side have 31,43 μm width and 145,71 μm in length. Epidermis cells on dorsal side have 24,71 μm width and **123,53** μm in length. Dorsal side epidermis have longest cells. Ratio of Length/Width of Epidermis Cell on Dorsal Side is the biggest ratio with **4,99** (Table 1, 2, 3, 4, Fig.1, 2).

Triticum aestivum* cv *Bezostoja

Cross section is circular to cordate in outline with **2.771,22** μm width and 1.759,50 μm height. It has narrowest cells in endosperm cross section. It also has narrowest perikarp layer with **31,042** μm . Testa layer thickness is 1,33 μm . Aleuron cell thickness 14,22 μm . Endosperm layer has **1.385,61** μm thickness. It is the narrowest endosperm layer. Crease depth is 1.403,84 μm and cavity width is 692,30 μm . Also Crease depth/Cavity width ratio is lowest with 2.03. Epidermis cells on ventral side have **37,50** μm width and 139,58 μm in length. Epidermis has widest cells on ventral side Epidermis cells on dorsal side have 18,00 μm width and 89,00 μm in length (Table 1, 2, 3, 4, Fig.1, 2).

Triticum aestivum* cv *Harmankaya

It has circular to cordate shaped endosperm. The width of cells is 3.153,86 μm and the height of the cells is 2.329,29 μm . Perikarp layer thickness is 32,242 μm and Testa layer thickness is 2,32 μm . Aleuron cell thickness 12,36 μm . Endosperm layer has 1.576,93 μm thickness. Endosperm Layer Thickness/Perikarp Layer Thickness ratio is the biggest

ratio with **48.91**. Also Perikarp Layer Thickness/Testa Layer Thickness ratio is the lowest ratio with **13.90**. Crease depth is 1.750,04 μm and cavity width is **826,92** μm . It has the widest cavity. Epidermis cells on ventral side have 22,86 μm width and 108,57 μm in length. Epidermis cells on dorsal side have **27,06** μm width and 104,71 μm in length. Epidermis on the dorsal side have the widest cells (Table 1, 2, 3, 4, Fig.1, 2).

Triticum aestivum cv *Yunus*

Endosperm is 3.153,84 width and 1.731,27 height. The shape of endosperm is semirectangular-cordate. Perikarp layer thickness is 46,196 μm and Testa layer thickness is 2,30 μm . Aleuron cell thickness 12,02 μm . Endosperm layer has 1.576,92 μm thickness. Crease depth is **1.365,38** μm and cavity width is 519,23 μm . Epidermis cells on ventral side have 22,86 μm width and **91,43** μm in length. It is the shortest cells in ventral epidermis. Epidermis cells on dorsal side have 25,83 μm width and 89,41 μm in length (Table 1, 2, 3, 4, Fig.1, 2).

Triticum aestivum cv *Sönmez*

Cross section is semitriangular-Cordate in outline with 3.086,18 μm width and 1.955,75 μm height. Perikarp layer thickness is 47,812 μm and Testa layer thickness is 2,57 μm . Aleuron cell thickness 14,72 μm . Endosperm layer has 1.543,09 μm thickness. Crease depth is 1.673,07 μm and cavity width is 615,38 μm . Epidermis cells on ventral side have 25,74 μm width and 148,57 μm in length. Epidermis cells on dorsal side have 20,00 μm width and 94,47 μm in length (Table 1, 2, 3, 4, Fig.1, 2).

Triticum aestivum cv *Altay 2000*

Endosperm is 2.922,92 width and 2.444,80 height. The shape of endosperm is semicircular-cordate. Perikarp layer thickness is 36,724 μm and Testa layer thickness is 2,07 μm . Aleuron cell thickness 11,45 μm . Endosperm layer has 1.461,46 μm thickness. Crease depth is 1.634,62 μm and cavity width is 461,54 μm . Crease Depth/Cavity Width ratio is the biggest one with **3,54**. Epidermis cells on ventral side have **19,29** μm width and **151,43** μm in length. Although it has narrowest cells in ventral epidermis, the length of these cells have longest cells. Epidermis cells on dorsal side have 22,35 μm width and **64,70** μm in length. Also the width of dorsal epidermis cells are narrowest one. Ratio of Length/Width of Epidermis Cell on Ventral Side is biggest ratio with **7,85** (Table 1, 2, 3, 4, Fig.1, 2).

Triticum aestivum cv *Nacibey*

In cross sections endosperm layers have the longest layer with **1.637,36** μm height and 2.935,80 μm width. Shape of endosperm cross section is semicircular-cordate. Also perikarp layer thickness and Testa layer thickness are the thickest one. Perikarp layer thickness is **56,602** μm and Testa layer thickness is **3,29** μm . Aleuron cell thickness 12,32 μm . Endosperm layer has 1.467,90 μm thickness. Endosperm Layer Thickness/Perikarp Layer Thickness ratio is the smallest one with **25,94**. Also Endosperm Layer Thickness/Testa Layer Thickness ratio is the smallest one with **446,17**, too. Crease depth is 1.538,46 μm and cavity width is 500,24 μm . Epidermis cells on ventral side have 28,57 μm width and 122,86 μm in length. Epidermis cells on dorsal side have **17,65** μm width and 85,88 μm in length. The cells on the dorsal side are the narrowest one (Table 1, 2, 3, 4, Fig.1, 2).

Table 1. Anatomical measurements in cross section of commercial wheat grain

Sample	Perikarp Thickness (µm)	Testa Thickness (µm)	Alevron Cell Thickness (µm)	Bran Thickness (µm)	Endosperm Thickness (µm)	Endosperm Thickness /Perikarp Thickness	Endosperm Thickness /Testa Thickness	Perikarp Thickness /Testa Thickness	Endosperm Thickness /Bran Thickness
Alpu 01 (A)	42,65±4,	1,12±0,20	15,08±1,27	58,85±3,22	1.673,07±158,25	39,23	1.493,81	38,08	28,43
Altay 2000 (B)	36,72±3,	2,07±0,24	11,45±1,13	50,24±2,92	1.461,46±146,94	39,80	706,02	17,74	29,09
Atay (C)	48,32±4,	1,58±0,11	13,76±1,08	63,66±3,66	1.398,78±156,68	28,95	885,31	30,58	21,97
Bezostoja (D)	31,04±2,	1,33±0,02	14,22±1,22	46,59±4,09	1.385,61±134,72	44,63	1.041,82	23,34	29,74
Es26 (E)	38,54±4,	1,55±0,24	11,23±1,11	52,32±4,89	1.498,23±151,14	38,87	966,60	24,87	28,64
Harmankaya (F)	32,24±3,	2,32±0,28	12,36±1,23	46,92±5,01	1.576,93±153,05	34,44	949,67	27,58	33,61
Müfitbey (G)	44,67±4,	1,62±0,14	11,44±1,20	57,73±5,42	1.538,46±156,31	48,91	679,71	13,90	26,65
Nacibey (H)	56,60±5,	3,29±0,43	12,32±1,33	72,21±7,23	1.467,90±139,90	25,94	446,17	17,20	20,33
Sönmez (I)	47,81±4,	2,57±0,21	14,72±1,41	65,10±6,67	1.543,09±149,57	32,27	600,42	18,60	23,70
Sultan (J)	51,07±5,	1,63±0,19	12,56±1,13	65,26±6,88	1.480,76±141,15	29,00	908,45	31,33	22,69
Yunus (K)	46,19±4,	2,30±0,23	12,02±1,10	60,51±7,14	1.576,92±155,94	34,14	685,60	20,09	26,06

Table 2. Commercial wheat grain Crease Depth and Cavity Width measurements and its ratio

Sample	Crease Depth (µm)	Cavity Width (µm)	Crease Depth /Cavity Width
Alpu 01 (A)	1.730,36±171,37	596,15±58,13	2,92
Altay 2000 (B)	1.634,62±139,91	461,54±44,34	3,54
Atay (C)	1.673,07±145,63	711,53±68,05	2,35
Bezostoja (D)	1.403,84±156,69	692,30±67,81	2,03
Es26 (E)	1.461,53±154,88	423,07±43,66	3,45
Müfitbey (G)	1.750,04±161,76	826,92±83,17	2,90
Harmankaya (F)	1.673,07±160,14	576,92±56,71	2,12
Nacibey (H)	1.538,46±156,99	500,24±48,99	3,08
Sönmez (I)	1.673,07±157,94	615,38±61,97	2,72
Sultan (J)	1.653,84±160,76	710,96±72,85	2,33
Yunus (K)	1.365,38±159,12	519,23±50,62	2,63

Table 3. Commercial wheat grain Width and height measurements and its ratio and shape type

Sample	Wheat Grain			Shape Type
	Width (µm)	Height (µm)	Ratio	
Alpu 01 (A)	3.346,14±308,25	2.474,95±238,14	1,35	Cordate
Altay 2000 (B)	2.922,92±292,94	2.444,80±238,65	1,19	Semicircular-cordate
Atay (C)	2.797,56±306,68	1.971,50±201,25	1,42	Cordate
Bezostoja (D)	2.771,22±264,72	1.759,50±190,43	1,58	Circular to cordate
Es26 (E)	2.996,46±301,14	2.412,60±239,07	1,24	Obtuse-cordate
Harmankaya (F)	3.153,86±303,05	2.329,29±226,56	1,35	Circular to cordate
Müfitbey (G)	3.076,92±316,31	2.910,99±287,62	1,06	Obtuse-cordate
Nacibey (H)	2.935,80±278,90	1.637,36±184,32	1,79	Semicircular-cordate
Sönmez (I)	3.086,18±298,57	1.955,75±203,05	1,58	Semitriangular-cordate
Sultan (J)	2.961,52±281,15	2.397,79±241,05	1,24	Semitriangular-cordate
Yunus (K)	3.153,84±310,94	1.731,27±208,75	1,82	Semirectangular-cordate

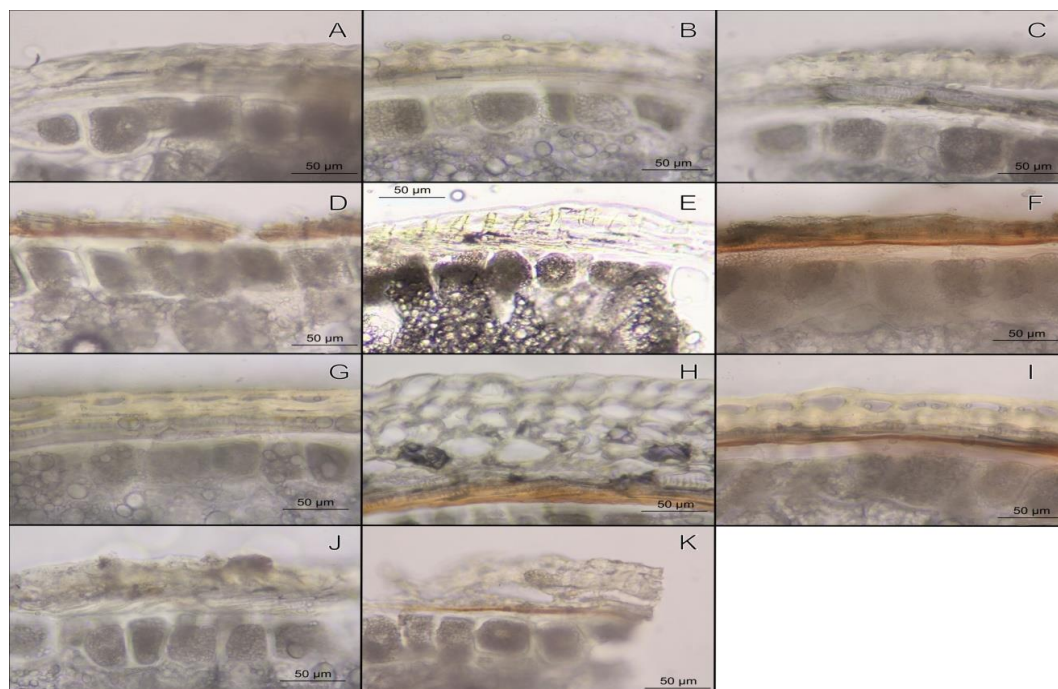


Fig. 1. Light micrographs of cross-sections of commercial wheat varieties grains; A: Alpu 01, B: Altay 2000, C Atay, D: Bezostoja, E: Es 26, F: Harmankaya, G: Müfitbey, H: Nacibey, I: Sönmez, J: Sultan, K: Yunus

In all samples of wheat grains, the superficial generally scalariform sculptural model of epidermal cells was examined. Raised anticlinal walls and usually 4-5 gonals, raised borders, straight with regular channels. The outer periclinal walls are concave with thin grooves. Prominent junction, terminal, broad, round. Rugose-scalariform sculptural model of epidermal cells [6,7,8]. Raised anticline walls and usually 4-5 gonals, raised borders, straight or curved with normal channels. The outer periclinal walls are concave with thin grooves. Striking junction point, tip, broad, round and conical. The scalariform-rugulose sculptural model of epidermal cells. Raised anticline walls and usually 4-5 gonals, raised borders, straight or curved with normal channels. Outer periclinal walls are concave. The junction is striking, tip, narrow, conical and round [5, 6, 7, 8]. All examples have apical hairs (Fig. 2, 3, 4, 5).

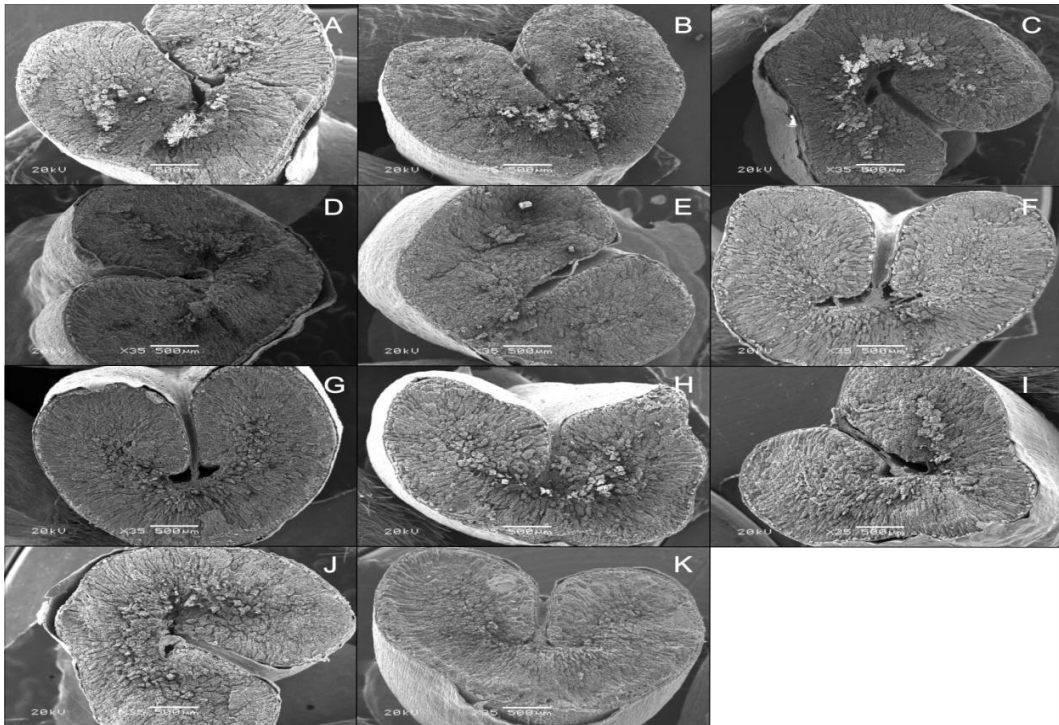


Fig. 2. Commercial wheat grains cross section cleaved kernel with pericarp and central cavities on scanning electron microscopy; A: Alpu 01, B: Altay 2000, C Atay, D: Bezostoja, E: Es 26, F: Harmankaya, G: Müfitbey, H: Nacibey, I: Sönmez, J: Sultan, K: Yunus

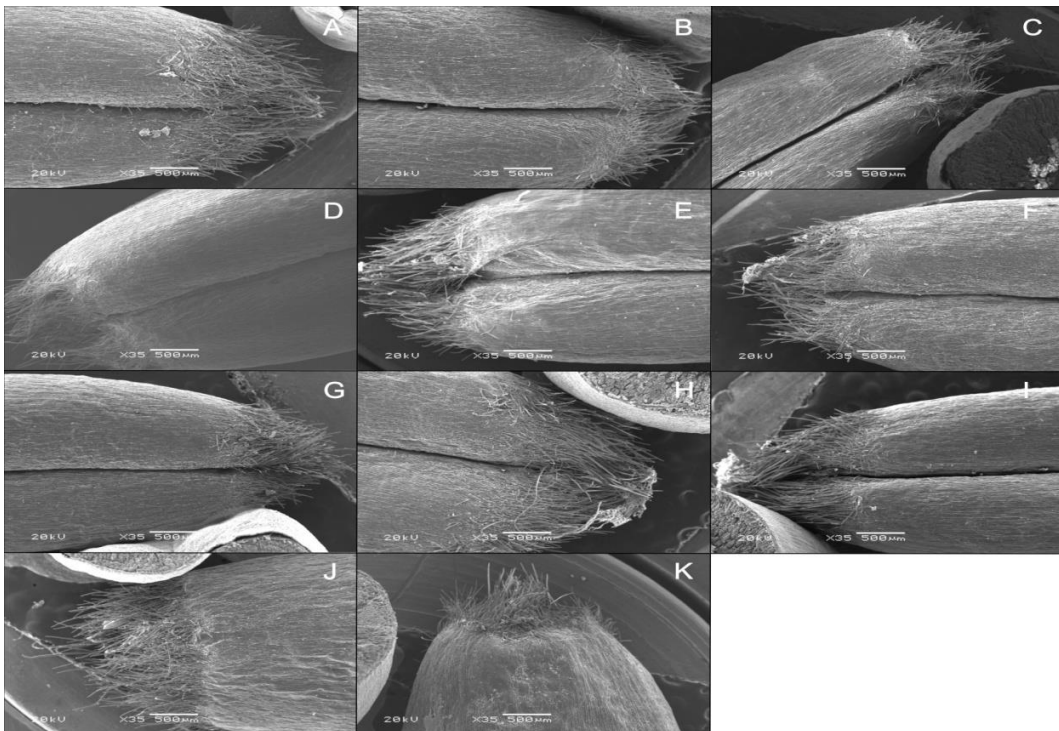


Fig. 3. Commercial wheat grain surface and apical hairs micrographs on scanning electron microscopy A: Alpu 01, B: Altay 2000, C Atay, D: Bezostoja, E: Es 26, F: Harmankaya, G: Müfitbey, H: Nacibey, I: Sönmez, J: Sultan, K: Yunus.

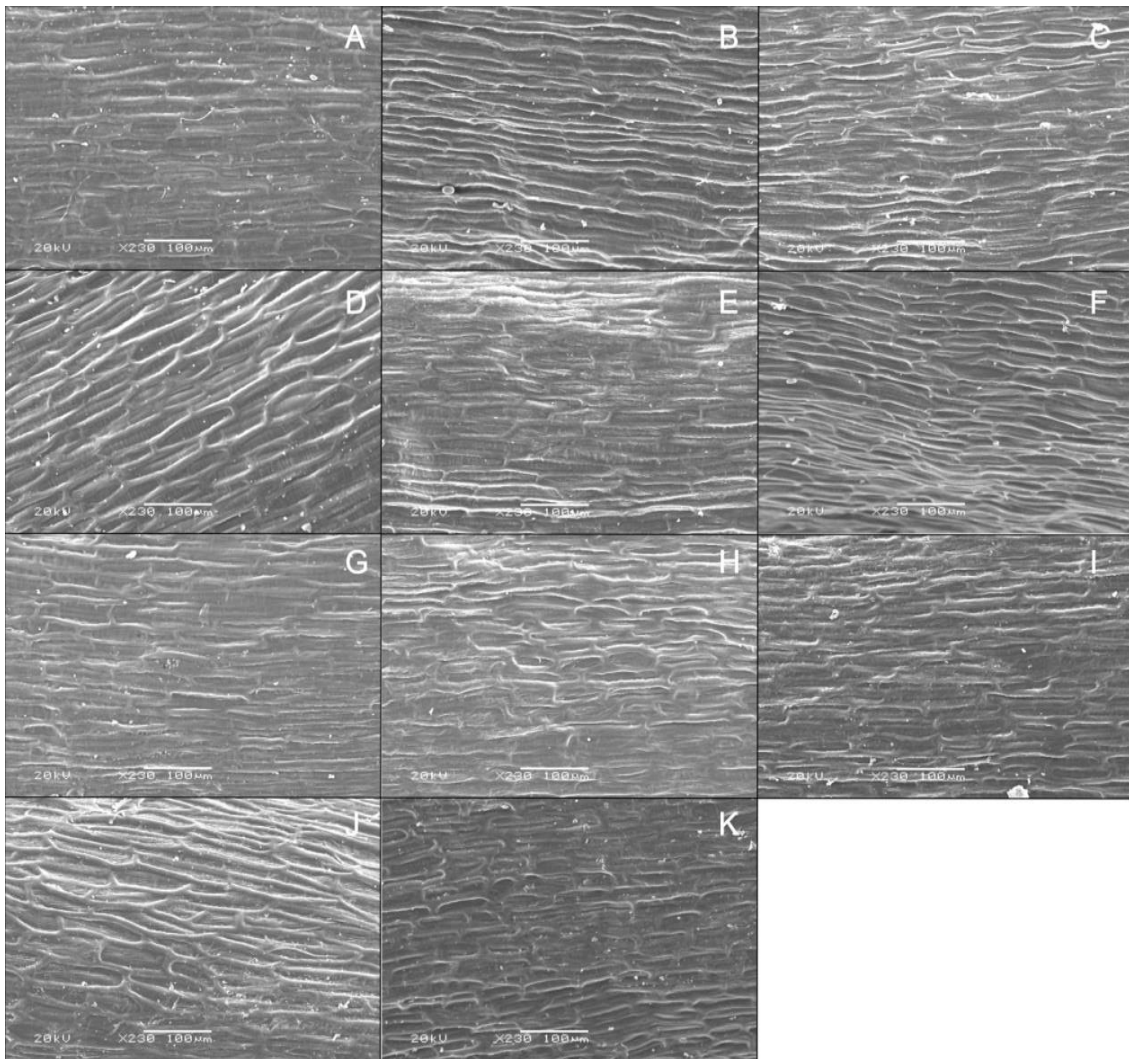


Fig. 4. Commercial wheat grain surface on ventral side on scanning electron microscopy; A: Alpu 01, B: Altay 2000, C Atay, D: Bezostoja, E: Es 26, F: Harmankaya, G: Müfitbey, H: Nacibey, I: Sönmez, J: Sultan, K: Yunus

Transversely divided grains revealed textural patterns of pericarp, aleurone layer, endosperm, and fold. Apart from the clearly differentiable aleurone cells, the grain consists of compressed cells belonging to the wheat grain shell, the seed coat (testa) and the nuclear epidermis. All these tissues are of maternal origin and their largest component is the outermost part of the fruit shell (pericarp). This is a combination of layers of cells that form the outer and inner pericarp. These data are similar to previous studies [5, 6, 7, 8].

Caryopses are single-seeded fruits in which testa (seed coat) is fused with a thin pericarp (fruit peel). Cereal grains have highly developed embryos and are composed of triploid endosperm, starchy endosperm (dead storage tissue) and aleuron layer (living cells) in cereal grains. Wheat grain is usually full and compact. The aleurone cells show a regular and granular structure. Endosperm cells and Aleuron cells are tightly packed and full (Fig. 2) [6, 7, 8]. In our study, according to the SEM and light microscope photos; *Triticum aestivum* cv *nacibey* has the thickest perikarp layer from other varieties (Fig. 4, 5).

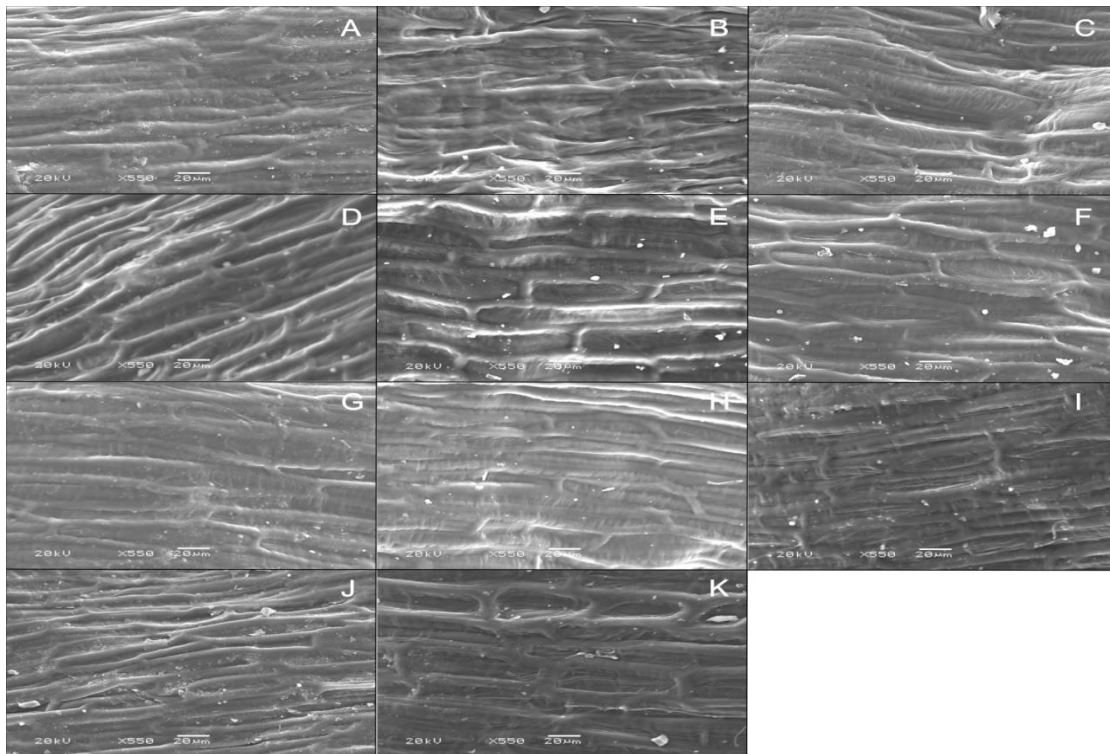


Fig. 5. Commercial wheat grain surface on dorsal side on scanning electron microscopy; A: Alpu 01, B: Altay 2000, C Atay, D: Bezostoja, E: Es 26, F: Harmankaya, G: Müfitbey, H: Nacibey, I: Sönmez, J: Sultan, K: Yunus

Table 4. Commercial wheat grain Epidermis Cell on Ventral Side and Dorsal Side measurements and its ratio

Samples	Epidermis Cell on Ventral Side			Epidermis Cell on Dorsal Side		
	Width (µm)	Length (µm)	Ratio	Width (µm)	Length (µm)	Ratio
Alpu 01 (A)	25,71±2,15	122,86±11,10	4,78	25,88±23,10	72,94±7,56	2,81
Altay 2000 (B)	19,29±1,12	151,43±14,07	7,85	22,35±22,45	64,70±5,78	2,89
Atay (C)	31,34±2,89	131,43±13,15	4,19	22,35±21,67	80,00±8,15	3,57
Bezostoja (D)	37,50±3,18	139,58±14,10	3,72	18,00±19,41	89,00±9,10	4,94
Es26 (E)	32,35±3,13	138,24±14,23	4,27	21,18±21,32	101,18±11,12	4,77
Harmankaya (F)	22,86±2,19	108,57±11,24	4,74	27,06±27,54	104,71±10,78	3,86
Müfitbey (G)	31,43±3,14	145,71±13,89	4,63	24,71±23,23	123,53±13,24	4,99
Nacibey (H)	28,57±3,10	122,86±12,78	4,30	17,65±18,44	85,88±8,17	4,86
Sönmez (I)	25,74±2,80	148,57±13,80	5,77	20,00±23,12	94,47±9,88	4,72
Sultan (J)	34,29±3,23	120,00±12,16	3,49	18,82±19,17	89,41±9,16	4,75
Yunus (K)	22,86±2,17	91,43±10,03	3,99	25,83±24,15	89,41±9,10	3,46

In this study, commercially cultivated in Turkey 11 commercial wheat seed micromorphology of varieties were examined in detail. Both light microscopy and scanning electron microscope made detailed investigations in agriculture in Turkey in commercially made 11 varieties of grain wheat Micromorphological properties have been demonstrated for the first time.

CONCLUSION

11 commercial wheat cultivar grown in Turkey, for the first time, the survey revealed some micromorphological features such as; grain shape type and size, seed coat layers, perikarp layer, testa layer, endosperm layer, endosperm layer thickness/testa layer thickness, length/width ratio, aleurone cells, features, crease depth and cavity width. The micromorphological characteristics of 11 wheat varieties examined in this study were compared with similar studies and discussed. According to this; It was determined that the data obtained were compatible with the literature information. It is thought that this will contribute to the relevant scientific studies to be carried out later. In addition, the features determined for the first time with this research are valuable information for the literature. Thanks to the authors who have carried out similar studies on commercial wheat.

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