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Short Communication

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Changes in physical properties of some proprietary safflower (*Carthamus tinctorius* L.) cultivars after film coating application

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Abstract

Safflower is one of the economically important oil plants. There are some studies on safflower, but none on its seed properties. This study was carried out in the Biosystem Engineering laboratories of the Faculty of Agriculture of Bingöl University in 2021. The seeds of four different proprietary safflower cultivars were randomly sampled, and some of their physical properties were examined under two separate groups, that is, control and film-coated. The film coating material was applied in a single layer, and its effects on the seed size were compared between the study groups. The coating dose should be at a level that will not adversely affect the germination and emergence performance of the seed. As a result of the study, it was found that the safflower seeds were long and oval in shape. This study is important in that its results will help the researchers carry out mechanization and breeding studies on safflower.

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Introduction

Safflower (*Carthamus tinctorius* L.), a valuable oil plant with an annual herbaceous structure, has been cultivated for about 3000 years (Koç *et al.* 2017; Culpan and Arslan, 2018; Baydar and Erbaş, 2020). It has a high tolerance to conditions such as drought and low temperature, thanks to its behaviour in the consumption of water and nutrients in the soil depending on its root structure. Due to these features, safflower is important in making use of fallow lands, controlling erosion control, and expanding cultivation areas (Baydar and Erbaş, 2020; Esendal, 1981; Bayraktar, 1991; Geçit *et al.* 2018; Köse *et al.* 2021). Safflower is sown in two seasons, summer and winter. Depending on the irrigation conditions, it can be thorny or thornless and has yellow, white, red, and orange flowers with a height of 50-150 cm. Its seeds can be white, brown, striped white, and rarely black (Culpan and Arslan, 2018; Nacar *et al.* 2016; Toprak and Tunçtürk, 2018). The flowers and seeds of the safflower plant are used in many sectors. Safflower oil is used in biodiesel production as well as in the food, medicine, textile, and paint industries (Kırıcı, 1998; Yılmaz and Tunçtürk, 2018). It is also used as animal feed and ornamental, medicinal, and aromatic plant (Koç and Güneş, 2021). The unsaturated fatty acids (oleic acid and linoleic acid) account for about 90% of the total fatty acid content of the safflower seed. It contains 32-34% carbohydrate, 14-15% protein, 5-8% moisture, and 2-7% ash (Weiss, 2000; Çoşge *et al.* 2007; Kalafat *et al.* 2009).

Since safflower is economically valuable and durable, mechanization trials and breeding studies have been carried out to expand its cultivation areas. In these studies, it was aimed to place the seeds in the soil with the least product loss by choosing the appropriate tools, machines, and systems for the physical properties of the seeds. In addition, in breeding studies, the characteristics of seeds are important in the development of new varieties.

Seed technologies are used to increase the resistance of seeds to ecological conditions and increasing planting opportunities.

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Researches are being carried out to increase seed quality through methods such as the use of plant nutrients, film coating, and pelleting.

In this study, the seeds of different safflower cultivars were examined separately under two groups, control and film-coated, and some physical properties of the seeds were determined.

Material and method

This study was carried out in the laboratories of the departments of Biosystem Engineering and Field Crops, Faculty of Agriculture, Bingöl University in 2021. In this study, the seeds of four different Safflower cultivars (Balcı, Dinçer, Yektay, and Yenice) were used as plant material. The safflower seeds were obtained from the Transitional Zone Agricultural Research Institute, Ministry of Agriculture and Forestry, Republic of Türkiye. The seeds were examined in two groups, control group and the film-coated group. SPSS v.22 statistical packages was used to analyze the data, and the TUKEY test was used to determine the differences. The statistical significance was set at $p<0.05$.

In the study, a water-based polymeric material from a commercially sold brand in the market was used in the film coating application. The safflower seeds were film coated (single layer) by spraying and then dried at room temperature (approximately 24°C) in a moisture-free, dry, and dark environment for 24 hours (ISTA, 2007).

The length (mm), width (mm), and surface area (mm^2) of the seeds were measured using a stereo microscope (Nikon SMZ 745T) (Dumanoğlu and Geren, 2020; Dumanoğlu *et al.* 2021). The obtained data were evaluated according to the seed classification criteria specified in Table I. The mean arithmetic diameter of the seeds (mm) (), their mean geometric diameter (mm) () and sphericity () [L: Seed length (mm) W: Seed width (mm)] were calculated using the data (Mohsenin, 1970; Alayunt, 2000; Kara, 2012). In addition, 1000-grain weight was measured in triplicate randomly for both groups (Dumanoğlu and Öztürk, 2021).

Table I. Classification of the seeds by their geometric haracteristics and shapes (23)

Geometric characteristics	Grain width/ Grain length (b/a) (mm)
Long	< 0.6
Medium	0.6 – 0.7
Short	> 0.7
Shapes	Length (a), Width (b), Thickness (c) (mm)
Round	a ≈ b ≈ c
Oval	a/3 < b ≈ c
Long	c < b < a/3

Results and discussion

We examined some physical properties of four different safflower cultivars under two separate groups (control and film-coated) and found that, in the control group, the seeds of the variety Balcı had the highest length and surface area (7.599 mm; 22.027 mm^2) and those of the variety Yenice had the lowest values (6.502 mm; 18.792 mm^2); the seeds of the variety Dinçer had the highest width (3.721 mm) and those of the variety Yektay had the lowest width (3.508 mm) (Table II)

In the control group, the seeds of the variety Balcı had the highest mean of both arithmetic (5.572 mm) and geometric (79.738 mm) diameter and sphericity (10.700) and those of the variety Yenice had the lowest (5.062 mm; 56.458 mm; 8.589). The variety Balcı was found to have the highest 1000-grain weight (40.434 g) and the variety Yenice had the lowest (34.843 g) (Table II).

As for the film-coated group of four different safflower varieties, it was found that the seeds of the variety Balcı had the highest length (7.427 mm) and those of the variety Yektay had the lowest length (6.452 mm); the seeds of the variety Yektay had the highest width (3.661 mm) and the seeds of the variety Yenice had the lowest width (3.503 mm); and the seeds of the variety Yenice had the highest surface area (21.248 mm^2) and those of the variety Yektay had the lowest surface area (18.709 mm^2).

It was found that, in the film coated safflower cultivars, the seeds of the variety Yenice had the highest mean arithmetic diameter (5.480mm) and those of the variety Yektay had the lowest (5.056 mm); the seeds of the variety Yenice had the highest mean geometric diameter (76.184 mm) and those of the variety Yenice had the lowest (55.729 mm); and the seeds of the variety Yenice had the highest sphericity (10.082) and those of the variety Yektay had the lowest (8.561). In the film-coated group, the variety Balcı was found to have the highest 1000-grain weight (40.562 g) and the variety Yenice had the lowest (35.645 g) (Table I). Based on these results, it can be asserted that all the safflower seeds in the control group and the film-coated group had a long and oval seed structure.

Table II. Some physical characteristics of the seeds of the safflower varieties

Varieties	Length (mm)	Width (mm)	Surface area (mm^2)	Avg. Arithmetic Diameter	Avg. Geometric Diameter	Sphericity	Thousand grain weight (g)
Balcı	7.599[a]	3.545[b]	22.027[a]	5.572[a]	79.738[a]	10.700[a]	40.434
Dinçer	6.767[b]	3.721[a]	20.485[bc]	5.244[b]	62.876[b]	9.209[b]	38.692
Yektay	7.460[a]	3.508[b]	21.247[ab]	5.479[a]	75.955[a]	10.072[a]	38.473
Yenice	6.502[cd]	3.622[ab]	18.792[d]	5.062[c]	56.458[cd]	8.589[c]	34.843
Avg.	7.082	3.599	20.638	5.339	68.757	9.643	38.111
Stdv.	0.531	0.094	1.382	0.231	10.928	0.931	2.348
Film coated Balcı	7.427[a]	3.536[b]	21.151[ab]	5.482[a]	75.705[a]	10.075[a]	40.562
Film coated Dinçer	6.702[bc]	3.643[ab]	19.758[cd]	5.173[bc]	60.491[bc]	8.959[bc]	39.456
Film coated Yektay	6.452[a]	3.661[b]	18.709[ab]	5.056[a]	55.729[a]	8.561[a]	38.803
Film coated Yenice	7.458[d]	3.503[ab]	21.248[d]	5.480[c]	76.184[d]	10.082[c]	35.645
Avg.	7.010	3.586	20.217	5.298	67.027	9.419	38.617
Stdv.	0.510	0.078	1.214	0.217	10.480	0.778	2.110

As a result of the measurement and calculation processes, it was found that the safflower varieties in the control and film coated groups had similar values in all parameters. This is primarily due to the application of a single layer film coating. There was not much difference between the coated and uncoated seeds in terms of size, and the film material did not cover the seed like a barrier. This is extremely important for germination and emergence performances. In addition, it should be noted that the seeds randomly selected for film coating were slightly smaller than those in the control group.

The thousand grain weights found in this study were in agreement with those reported in previous studies. Koc *et al.* (2017) examined the yield components of five safflower lines (106-2, 11-1, 77-1-d, 89-1-c, BDYAS-9) developed by selection between 2015 and 2016 in Konya and some standard safflower varieties (Göktürk, Balcı, Linas, Olas, Dinçer) and reported that the 1000-grain weights of the varieties ranged from 36.5 g to 43 g. On the other hand, in their study, Geçit *et al.* (2018) reported that the safflower varieties had a 1000-grain weight of 30-45 g. The 1000 grain weights of the safflower cultivars examined in the present study were similar to those reported in these studies..

The safflower seeds were also coated using a film coating material in order to improve their properties and quality, and the film coated seeds were compared with those in the control group. Measurement and calculation processes, which form the basis for mechanization and breeding research, were carried out in this study. Based on the results of the study, it can be asserted that the variety Balcı in the control group and the variety Yenice in the film coated group came to the fore. This study is important in that it will form a basis for future research on seeds of oil plants.

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