Volume 12, Issue 3, Page 139-143, 2023 https://doi.org/10.46810/tdfd.1333131 Research Article

BİNGÖL ÜNİVERSİTESİ

Türk Doğa ve Fen Dergisi
Turkish Journal of Nature and Science

www.dergipark.gov.tr/tdfd

The Effect of Grass Juice of Cereal Grown in Hydroponic Environment on the Germination of Medicinal and Aromatic Plants

Banu KADIOĞLU[1]*

[1] Eastern Anatolia Agricultural Research Institute Management Soil and Water Resources Campus, Erzurum, Türkiye
Banu KADIOĞLU ORCID No: 0000-0002-9041-5992

**Corresponding author: banu250@hotmail.com*

(Received: 26.07.2023, Accepted: 27.09.2023, Online Publication: 27.09.2023)

Keywords
Barley,
Wheat,
Oat,
Hydroponic environment,
Root and Stem length,
Grass juice

Abstract: Today, the consumption of water obtained from cereals, which is very important in human nutrition, for health purposes is becoming increasingly common. Various plant extracts are used for this purpose. Soilless farming techniques have long been used as a plant growing medium. In the substrate culture of soilless farming systems, plants are grown in organic (peat, paper, etc.), inorganic (sand, vermiculite, etc.) or synthetic (polyurethane foam, etc.) materials. In our study, The grass juices obtained from barley, wheat and oat were used to determine the effects on seed physiology of medicinal and aromatic plants grown in hydroponic conditions. Medicinal and aromatic plant seeds placed in petri dishes were germinated in vitro. 10 ml of water (control), barley grass juice, wheatgrass juice and oat grass juice were applied to the seeds. The experiment was carried out according to the randomized plots factorial design. In the experiment, the germination physiology and root and stem lengths of the seeds were determined. As a result of the research, it was determined that cereal grass juices applications negatively affected germination physiology, root and stem lengths. It was determined that coriander seeds gave better results than others, and barley grass juice was more effective on germination physiology than wheat grass juice.

Hidrofonik Ortamda Yetiştirilen Tahılların Çim Sularının Tıbbi ve Aromatik Bitkilerin Çimlenmesi Üzerine Etkileri

Anahtar Kelimeler
Arpa,
Buğday,
Yulaf,
Hidroponik ortam,
Kök ve gövde uzunluğu,
Çim suyu

Öz: Günümüzde insan beslenmesinde oldukça önemli olan tahıllardan elde edilen ekstraktların sağlık amaçlı tüketimi giderek yaygınlaşmaktadır. Bu amaçla çeşitli bitki ekstraktları kullanılmaktadır. Topraksız tarım teknikleri uzun süredir bitki yetiştirme ortamı olarak kullanılmaktadır. Topraksız tarım sistemlerinden substrat kültüründe bitkiler organik (turba, kağıt vb.), inorganik (kum, vermikülit vb.) veya sentetik (poliüretan köpük vb.) materyallerde yetiştirilmektedir. Çalışmamızda hidroponik ortamda yetiştirilen arpa, buğday ve yulaf çim sularının tıbbi ve aromatik bitkilerin tohum fizyolojisi üzerine etkileri araştırılmıştır. Petri kaplarına konulan tıbbi ve aromatik bitki tohumları in vitro koşullarda çimlendirilmiştir. Tohumlara 10 ml su (kontrol), arpa çim suyu, buğday çim suyu ve yulaf çim suyu uygulanmıştır. Deneme tesadüf parselleri faktöryel deneme desenine göre yürütülmüştür. Denemede tohumların çimlenme fizyolojisi ile kök ve gövde uzunlukları belirlenmiştir. Araştırma sonucunda çim suyu uygulamalarının çimlenme fizyolojisi ile kök ve gövde uzunluklarını olumsuz etkilediği belirlenmiştir. Kışniş tohumlarının diğerlerine göre daha iyi sonuç verdiği, arpa çim suyunun çimlenme fizyolojisi üzerine buğday çim suyuna göre daha etkili olduğu belirlenmiştir.

1. INTRODUCTION

For many years, cereal grass has been used as food due to its beneficial properties for health. In the last two decades, there has been an increasing trends in laboratory research on the human health benefits of cereal grasses [1]. The young leaves of the cereal grass, which is very rich in antioxidants, are very healthy. For this reason, it has recently received more attention as a natural medicine and scientific studies [2].

Wheat grass, which contains all nutrients, is called a whole food. It has been stated that wheat grass juice has

many benefits such as facilitating digestion, cleansing the blood, strengthening the immune system [3]. It has been reported that wheat grass juice has antioxidant and anti-carcinogenic effects and reduces the destructive effect of chemotherapy in breast cancer patients [4]. Barley, which has β-glucon content, contains a high amount of protein and is used as malt and grass juice [5]. It has been stated that barley grass extracts, which are an important source of antioxidants, are beneficial in the treatment of many diseases such as obesity, diabetes, blood circulation system disorders, anemia, joint inflammation, high cholesterol level, kidney diseases and cancer [6]. Oat grass juice is very rich in amino acids, vitamins, minerals, antioxidants and enzymes [7]. In a study in which oat grass juice was applied, it was stated that oat grass water extended the germination period of oil plant seeds and negatively affected seedling growth [8].

Hydroponic system is a method of growing plants using mineral nutrient solutions in water without using soil. In the study, the germination process of barley, wheat and oat seeds was provided by hydroponic system. The roots of the germinating plant interlock and take the appearance of a carpet. On average, the green part can reach 20-25 cm in seven days [9]. Much less water is needed in hydroponic farming therefore the contol of diseases and pests becomes easier. The hydroponic system provides high efficiency and reduces environmental pollution [10]. The yield in the hydroponic system varies depending on the type of seed used, water quality, pH, irrigation duration, presence of plant nutrients, temperature, and light intensity [11].

In the study carried out; It was aimed to determine the effect of barley, wheat and oat grass juices grown in hydroponic environment on the germination physiology and root and stem length of some medicinal and aromatic plants in hydroponic environment.

2. MATERIAL AND METHOD

The research was carried out under in vitro conditions (25±1°C) in 2023. In the study sage, fennel, coriander, linen, fenugreek, quinoa and mustard seeds were used. The study was carried out in a total of 140 petri dishes as 7 varieties x 4 applications x 5 replications according to the randomized plots factorial experimental design. To ensure surface sterilization of the seeds, the seeds were sterilized in 5% sodium hypochlorite solution for 10 minutes. Sterilized seeds; It was sown in petri dishes with a diameter of 9 cm and a height of 1.5 cm, 50 seeds in each petri dish, on 2 layers of filter paper (Whatman No: 2) placed on the bottom of the dishes. Grasses were obtained by sowing barley, wheat and oat seeds in 30x50x7 cm plastic tubs in a soilless environment. Harvesting was done with scissors ten days later. Grass juice was obtained by passing the grass through a juice extractor [12]. 10 ml of water (control), barley grass juice (bgj), wheat grass juice (wgj) and oat grass juice (ogj) were added to each petri dish [13]. In the experiment, the seeds were considered as germinated when they had 2 mm rootlets [14]. In the study, germination rate (%), germination speed (days), mean daily germination (%), peak value (%) and germination value (%) root and stem length were determined based on ISTA rules [12; 15].

Germination percentage: $n/\Sigma n \times 100$ (1)

n = Number of germinated seeds
Σn= Total number of seeds

Germination rate: $n1/t1 + n2/t2 + \ldots\ldots$ (2)

n1, n2, … number of germinated seeds t1, t2, …days

Mean daily germination: Total number of germinated seeds / total number of days (3)

Peak value: Highest seed count/highest seeding day (4)

Germination value: Mean daily germination x peak value (5)

Root and Stem Length: At the end of the germination period of the seeds, the roots and stems of the seedlings were cut with a razor blade from their junctions and their lengths were measured with the help of a millimetric ruler. The average root/stem length was calculated as cm/plant by dividing the sum of root and stem lengths in a nymph by the number of seeds.

Differences between analysis of variance and means were performed in the LSD multiple comparison test by using JMP 5.0.1 program.

3. RESULTS

3.1 Germination Rate (GP %)

In the germination rate parameter, it was determined that the species and grass juice applications (gja) were important at 1%, and the interaction of species x grass juice application was insignificant. It was determined that coriander seeds (81.11) gave better results than the others (except GJA0-Control). It was determined that the applications had a negative effect on the germination rate compared to the control, and in the species x gja interaction, coriander seed had the highest value with 93.3 in wheat grass juice application (Figure 1).

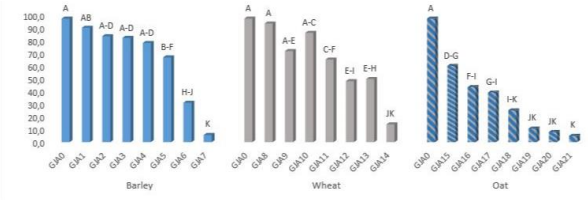

Figure 1. The effect of species x grass juice applications on GP
GJA0= control, GJA1= coriander x bgj, GJA2= fennel x bgj, GJA3= sage x bgj, GJA4= linen x bgj,GJA5= fenugreek x bgj, GJA6= quinoa x bgj, GJA7= mustard x bgj, GJA8= coriander x wgj, GJA9= fennel x wgj, GJA10= sage x wgj, GJA11= linen x wgj, GJA12= fenugreek x wgj, GJA13= quinoa x wgj, GJA14= mustard x wgj, GJA15= coriander x bgj+wgj, GJA16= fennel x bgj+wgj, GJA17= sage x bgj+wgj, GJA18= linen x bgj+wgj, GJA19= enugreek x bgj+wgj, GJA20= quinoa x bgj+wgj, GJA21 = mustard x bgj+wgj

3.2 Germination Speed (GS days)

It was determined that species, grass juice applications and species x gja interaction were important at 1% during the germination period. It has been found that mustard seeds, whose germination speed has a negative effect on the species, are more sensitive. It was determined that grass juice applications decreased GS compared to the control. It was determined that ogj application got the lowest value with 2.78. Mustard seeds were found in barley grass juice with the lowest value of 0.78 in the species x gja interaction during the germination period (Figure 2).

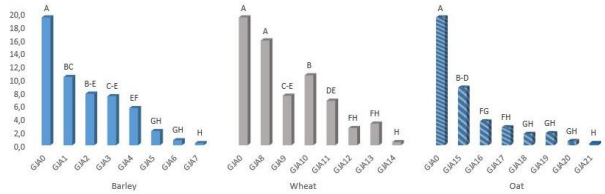

Figure 2. The effect of species x grass juice applications on GS
GJA0= control, GJA1= coriander x bgj, GJA2= fennel x bgj, GJA3= sage x bgj, GJA4= linen x bgj,GJA5= fenugreek x bgj, GJA6= quinoa x bgj, GJA7= mustard x bgj, GJA8= coriander x wgj, GJA9= fennel x wgj, GJA10= sage x wgj, GJA11= linen x wgj, GJA12= fenugreek x wgj, GJA13= quinoa x wgj, GJA14= mustard x wgj, GJA15= coriander x bgj+wgj, GJA16= fennel x bgj+wgj, GJA17= sage x bgj+wgj, GJA18= linen x bgj+wgj, GJA19= enugreek x bgj+wgj, GJA20= quinoa x bgj+wgj, GJA21 = mustard x bgj+wgj

3.3. Mean Daily Germination (MDG days)

When the mean daily germination parameter was examined, it was determined that the grass juice applications and species x gja interaction was insignificant, and it was significant in 1% of the species. Among the species, coriander seeds had the highest value with 7.04% and mustard seeds had the lowest value with 0.35. In the study, although the application of wgj (2.90) on the mean daily germination was more effective, it was not found to be statistically significant (Figure 3).

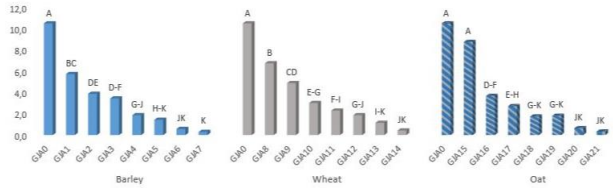

Figure 3. The effect of species x grass juice applications on MDG
GJA0= control, GJA1= coriander x bgj, GJA2= fennel x bgj, GJA3= sage x bgj, GJA4= linen x bgj,GJA5= fenugreek x bgj, GJA6= quinoa x bgj, GJA7= mustard x bgj, GJA8= coriander x wgj, GJA9= fennel x wgj, GJA10= sage x wgj, GJA11= linen x wgj, GJA12= fenugreek x wgj, GJA13= quinoa x wgj, GJA14= mustard x wgj, GJA15= coriander x bgj+wgj, GJA16= fennel x bgj+wgj, GJA17= sage x bgj+wgj, GJA18= linen x bgj+wgj, GJA19= enugreek x bgj+wgj, GJA20= quinoa x bgj+wgj, GJA21 = mustard x bgj+wgj

3.4. Peak Value (PV %)

When the peak value was examined, it was determined that the species and grass juice applications were important at 1%. Species x gja interaction was determined to be significant at 5%. In the study, it was determined that there were differences between the species, and sage seeds had the highest peak value with 1.67. It was determined that it was followed by fennel seeds with 1.55, coriander with 1.45, linen seeds with 1.42, fenugreek with 0.76, quinoa with 0.61 and mustard seeds with 0.35, respectively. In the grass juice application, the ogj application got the lowest value with 0.91. Coriander seeds had the highest value with 2.4 in the species x gja interaction in barley grass juice. It was determined that grass juice applications affected the investigated parameter negatively (Figure 4).

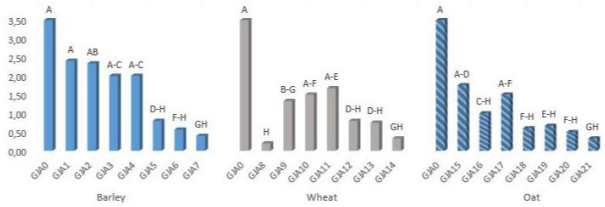

Figure 4. The effect of species x grass juice applications on PV
GJA0= control, GJA1= coriander x bgj, GJA2= fennel x bgj, GJA3= sage x bgj, GJA4= linen x bgj,GJA5= fenugreek x bgj, GJA6= quinoa x bgj, GJA7= mustard x bgj, GJA8= coriander x wgj, GJA9= fennel x wgj, GJA10= sage x wgj, GJA11= linen x wgj, GJA12= fenugreek x wgj, GJA13= quinoa x wgj, GJA14= mustard x wgj, GJA15= coriander x bgj+wgj, GJA16= fennel x bgj+wgj, GJA17= sage x bgj+wgj, GJA18= linen x bgj+wgj, GJA19= enugreek x bgj+wgj, GJA20= quinoa x bgj+wgj, GJA21 = mustard x bgj+wgj

3.5 Germination Value (GV %)

In the GV value, the species, gja and species x gja interaction was found to be significant at 1%. Among the species, coriander (7.52) had the best values barley grass juice with 4.98 compared to control in grass juice applications. It was determined that the coriander x barley grass juice interaction gave the best result with 13.71 in the species x gja interaction (Figure 5).

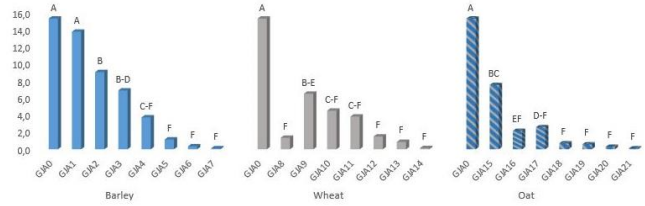

Figure 5. The effect of species x grass juice applications on GV
GJA0= control, GJA1= coriander x bgj, GJA2= fennel x bgj, GJA3= sage x bgj, GJA4= linen x bgj,GJA5= fenugreek x bgj, GJA6= quinoa x bgj, GJA7= mustard x bgj, GJA8= coriander x wgj, GJA9= fennel x wgj, GJA10= sage x wgj, GJA11= linen x wgj, GJA12= fenugreek x wgj, GJA13= quinoa x wgj, GJA14= mustard x wgj, GJA15= coriander x bgj+wgj, GJA16= fennel x bgj+wgj, GJA17= sage x bgj+wgj, GJA18= linen x bgj+wgj, GJA19= enugreek x bgj+wgj, GJA20= quinoa x bgj+wgj, GJA21 = mustard x bgj+wgj

3.6 Root and Stem Length (cm/plant)

In our study, in which we investigated the effect of grass juices on sage, fennel, coriander, linen, fenugreek, quinoa and mustard seeds, it was determined that the species, gja and species x gja interaction in root length was significant at 1%. In stem length, while the species and species x gja interaction was significant at 1%, grass juice applications were found to be insignificant. Fenugreek (0.61) got the best value in root length parameter. The barley grass juice with 0.51 and fenugreek x bgj interaction with 1.31 had the best values

compared to the control (Figure 6a). When we examine the stem length, mustard has the lowest value with 1.93. It was determined that quinoa x barley grass juice had the highest value with 3.33 in the species x gja interaction (Figure 6b).

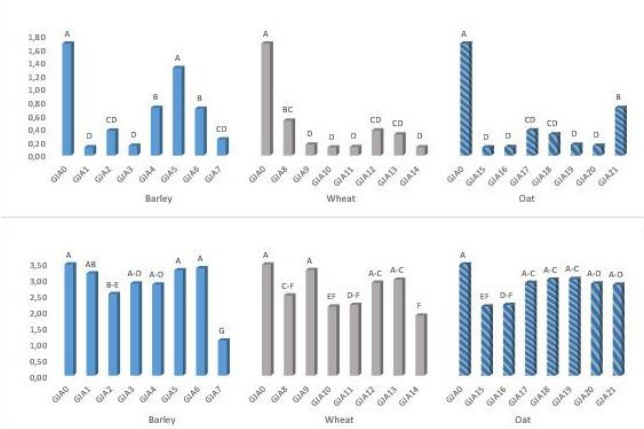

Figure 6. The effect of species x grass juice applications on root and stem length
GJA0= control, GJA1= coriander x bgj, GJA2= fennel x bgj, GJA3= sage x bgj, GJA4= linen x bgj,GJA5= fenugreek x bgj, GJA6= quinoa x bgj, GJA7= mustard x bgj, GJA8= coriander x wgj, GJA9= fennel x wgj, GJA10= sage x wgj, GJA11= linen x wgj, GJA12= fenugreek x wgj, GJA13= quinoa x wgj, GJA14= mustard x wgj, GJA15= coriander x bgj+wgj, GJA16= fennel x bgj+wgj, GJA17= sage x bgj+wgj, GJA18= linen x bgj+wgj, GJA19= enugreek x bgj+wgj, GJA20= quinoa x bgj+wgj, GJA21 = mustard x bgj+wgj

4. DISCUSSION AND CONCLUSION

Today, the consumption of plants for health purposes is increasing and cereals and cereal products are also consumed for this purpose. More grass juices are consumed for health purposes. Grass juices are very rich in terms of nutrients and vitamins [12]. Different studies are carried out such as the nutritional values of grass juices, their effects on health and other plants. In the study in which different doses (25, 50, 75 and 100%) of oat grass juice were applied, the germination of barley, wheat, oats, beans, lentils, sugar beet, sunflower, Italian grass, red clover, clover, cockscomb and wild mustard seeds rate, germination index, average germination time, shoot and root length were examined and it was stated that the effects of oat grass juice application and grass juice doses on germination and seedling development were negative [16]. In the study in which wheat grass juice was applied, barley (*Hordeum vulgare*), corn (*Zea mays*), wheat (*Tritucum aestivum*), beans (*Phaseolus vulgaris*), clover (*Medicago sativa*), perennial grass (*Lolium perene*), sheep's ball (*Festuca ovina*) and the germination index, germination rate, and root and stem length of sugar beet (*Beta vulgaris*) seeds were examined and it was stated that wheat grass juice reduced the investigated properties [12]. According to the results we obtained from our research in parallel, it was determined that barley, wheat and oat grass juice applications had a negative effect on germination physiology, root and stem development. Grain juice contains alkaloid, saponin, gum, mucilage, protein and amino acid [17]. Because it contains these substances, it is thought to have an allelopathic effect on the germination and development of other plant species. The allelopathic effect can affect plant growth by affecting metabolic events such as photosynthesis, respiration and ion uptake mechanisms in plants [18]. In the study where the effects of different doses of carbon dioxide applications on turf water yield and nutritional values in hydroponic wheat (*Triticum aestivum* L.) grass juice production were determined, three different carbon dioxide doses (Control; 0, D1; 750, D2; 1500 and D3; 2000 ppm) were applied to the growing medium. The effects on plant yield, seed rate, plant and grass yield, grass juice yield and pH, plant height and root length were investigated. It was stated that the highest plant, grass and grass juice yields and plant height values were obtained from D1 application, while the highest root length values were obtained from D1 and D3 applications [19]. In our study, the highest root and plant length were obtained from the barley grass juice application, and the lowest values were obtained from the wheat grass juice application. In another study conducted in hydroponic environment, the yield and nutritional values of barley, wheat and corn grass juice were examined, plant height and root length were examined and it was determined that the highest root length belonged to the corn plant [20]. Karaman et al. [21] investigated the effects of essential oil doses obtained from lavender plant on culture and foreign plants and reported that with the increase of lavender oil doses, germination and seedling properties decreased. In a study examining the effects of 6% plant extract doses (20, 40, 80 and 100%) of vinegar weed on germination and abnormal grass formation characteristics of rapeseed seeds, it was stated that 100% vinegar plant extract caused the lowest germination and the highest abnormal seedling percentage [22]. In our study, it has been determined that the mustard species, in which the responses of plant species to grass juice are different, are more sensitive to grass juice applications. In the study in which the effect of plant extracts on the germination and seedling growth of pepper was determined, it was stated that the inhibition effect and rate of plant extracts changed depending on the species and doses [23]. In a study in which the plant extract doses obtained from radish species and turnip plants were applied to cockscomb, barren wild oats, purslane, wild mustard, it was reported that there was a significant decrease in germination and shoot and root lengths in parallel with increasing doses [24]. In another study, it was determined that the sap obtained from squash shoots applied to cockscomb and vinegar weed seeds inhibited germination [25]. In another study, it was reported that the extract obtained from the leaves of salvia and celery plant had a negative effect on lentil seed germination and seedling growth, and inhibited root development [26].
The young leaves of cereal grass juices are very beneficial for human health, as they are rich in antioxidants. There has been an increasing interest in the use of grain juices, which contain all nutrients, as a natural medicine. Plant growing technique without using soil is called soilless farming technique. Media and water culture are used in soilless agriculture. In the study used in two cultures, it was determined that medicinal and aromatic plant seeds using barley, wheat and oat grass juices grown in hydroponic conditions have a negative effect on germination physiology and root and stem lengths. It was determined that coriander seeds

gave better results than others, and barley grass juice was more effective on germination physiology than wheat grass juice. The effects of different plant extracts on different plants should be determined in the future studies.

REFERENCES

[1] Yadav M, Sethi J, Dahyia K, Sood S, Gupta V, Singh V, et al. Effect of *Triticum aestivium* on physiological and biochemical parameters in high fat diet fed rabbits. JK Practitioner. (2013); 18 (3-4): 39-42.

[2] Urbonaviciute A, Samuoliene G, Brazaityte A, Duchovskisukauskas A. The effect of variety and lighting qualityon wheatgrass antioxidant properties. Zemdirbyste-Agriculture. (2009); 96 (3): 119-128.

[3] Anonymous [Internet]. Miracle superfood: wheatgrass benefits; 2022 [cited 2022 May 25]. Available from: https://www.fhi.no/nettpub/utbruddsveiledere n/

[4] Ashish S, Shilpa K, Singh RR, Sanjav K, Rajendran N. Wheatgrass: an alternative household nutritional food security. International Research Journal of Pharmacy. (2012); 3 (7): 246-250.

[5] Altuner F, Oral E, Ülker M. Determination of yield and quality components of some barley (*Hordeum vulgare* L.) cultivars. Journal of Bahri Dagdas Crop Research. (2018); 7 (2): 11-22.

[6] Paulickova I, Ehrenbergerova J, Fiedlerova V, Gabrovska D, Havlova P, Holasova M, et al. Evaluation of barley grass as a potential source of some nutritional substances. Czech Journal of Food Science. (2007); 25: 65–72.

[7] Rexhepi-Hasani A, Renata K. Consumer acceptance and readiness to pay for green juices containing grain grass juices in Kosovo. Journal of the Association-Institute for English Language and American Studies. (2015); 4 (6): 49-57.

[8] Ergin N, Kaya MD. Bazı yağ bitkileri tohumlarının çimlenme ve fide gelişimi üzerine iki yulaf çeşidinin allelopatik etkileri. Iğdır Üniversitesi Fen Bilimleri Enstitüsü Dergisi. (2020); 10 (2): 1419-1428.

[9] Karasahin M. Green fodder production in hydroponic medium. Harman Time Magazine. (2014); 12: 2-4.

[10] Uyeda J, Cox LJ, Radovich TJ. An Economic comparison of commercially available organic and inorganic fertilizers for hydroponic lettuce production. Sustainable Agriculture. (2011); 5: 1-4.

[11] Fazaeli H, Golmohammadi HA, Tabatabayee SN, Asgari-Tabrizi M. Productivity and nutritive value of barley gren fodder yield in hydroponic system. World Applied Science Journal. (2012); 16 (4): 531-539.

[12] Akgun İ, Ayata R, Karaman R. Effect of wheat grass (*Triticum aestivum* l.) juice on seed germination. Academia Journal of Engineering and Applied Sciences. (2018); 1 (4): 19-24.

[13] Prodo FE, Boero C, Gallardo M, Gon-zalez JA. Effect of NaCl on germination growth and soluble sugar content in che-nopodium quinoa (Wild) seeds. Bot. Bull. Acad. Sin. (2000); 41: 27-34.

[14] ISTA. The Rules: International Rules for Seed Testing, ISTA, Zürih, Switzerland; 1996.

[15] Kadioglu B. Effect of different bacterial strains on the germination forage pea (*Pisum sativum* ssp. arvense L.) under salt stress. Legume Research. (2021); 44 (11): 1333-1337.

[16] Karaman R, Turkay C, Akgun İ. Effects of oat grass juice on germination and seedling characteristics of certain weeds and cultivated plants. Journal of Tekirdag Agricultural Faculty. (2021); 18 (2): 312-321.

[17] Ashok AS. Phytohemıcal and pharmacologıal screenıng of wheatgrass juice (*Triticum aestivum* L.). International Journal of Pharmaceutical Sciences. (2011); 9(1): 159-164.

[18] Terzi İ. Effects of walnut fruıt hull extracts on muskmelon seed germınatıon, seedlıngs elongatıon and dry weıghts. Anadolu Unıversıty Journal of Scıence and Technology. (2007); 8 (2): 355-360.

[19] Karasahin M. Grass juice yield and nutritional values of some cereals ın soilless culture. Iğdır Univ. J. Inst. Sci. &Tech. (2015); 5 (4): 57-64.

[20] Karasahin M. The effects of different carbon dioxide doses on yield and nutritional values of hydroponic wheat (*Triticum aestivum* L.) grass juice. International Journal of Agriculture and Wildlife Science (IJAWS). (2015a); 1 (2): 78 – 84.

[21] Karaman R, Erbaş S, Baydar H, Kaya M. Allelopathic effect of lavandin (Lavandula x intermedia Emeric ex Loisel. var. Super A) oil on germination and seedling development of some weed and field crops. Harran Journal of Agricultural and Food Sciences. (2014); 18 (4): 35-41.

[22] Ghiyasi M, Ozdemir FA, Amirnia R, Tajbakhsh M, Rahimi A. Allelopathic effect of chenopodium album l. on germination and abnormal seedling of canola (*Brassica napus* L.). BEU Journal of Science. (2016); 5 (2): 225-228.

[23] Ozbay N. Allelopathic Effects of some Herbs and Medicinal Plants' Extracts on Seed Germination and Seedling Growth of Pepper. Turkısh Journal of Agrıcultural and Natural Scıences. (2018); 5 (1): 81-85.

[24] Ozdemir S. Investıgatıons of bıo herbıcıdal potentıal of plant extracts obtaıned from some crops in brassıcaceae famıly for weed control. [Master's Thesis]. Antakya: Mustafa Kemal University Institute of Science and Technology; 2007.

[25] Qasem LR, Issa NN. Allelopathic effects of squash (*Cucurbita pepo* L. Cv. Scarlette) on ceratain common weed species in Jordan. Proceedings of the 4th World Congress on Allelopathy, "Establishing the Scientific Base", Wagga Wagga, New South Wales, Australia: 2005. p. 258-262.

[26] Stratu A, Toma D, Costica N. The effect of extracts from Apium graveolens L. and Evisticum officinale koch leaves on the germination of certain dicotyledons species. An. Stiint. Univ. Al. I. Cuza Iasi, Sect. II a. Biol. Veget. (2012); 58 (2): 73-79.