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ARAŞTIRMA MAKALESİ **RESEARCH ARTICLE**

The Effect of Grass Juices on The Agricultural Properties of Legumes Grown in Different Root Media

Farklı Kök Ortamlarında Yetiştirilen Baklagillerin Tarımsal Özellikleri Üzerine Çimsularının Etkisi

Banu KADIOĞLU[1*]

Abstract

The consumption of grass juices obtained from cereals for health purposes is increasing day by day. For this purpose, research on different plant solutions has gained momentum. In our study, barley (*Hordeum vulgare* L.) and oat (*Avena sativa* L.) grass juices grown in hydroponic conditions were used. Obtained grass juices were applied to pea and lupine seeds in 100% soil (control), 100% pumice, 100% perlite, 100% tea waste and 100% cocopeat substrate. Germination percentage, germination rate, average daily germination, peak value, germination value, root dry and fresh weight, stem dry and fresh weight, root and stem length, plant yield, grass yield, plant yield seed rate, macro and micro (N, P, K, Ca, Mg, Fe, Cu, Zn and Mn) mineral substance contents were investigated pea and lupine. Grass juices were obtained by mowing barley and oat seeds sown in 30 × 50 × 7 cm plastic tubs in ten days and passing them through a juicer. Pea and lupine 25 seeds, which were placed in each pot, were grown in different root media (100% soil, 100% cocopeat, 100% pumice, 100% perlite, and 100% tea waste) under in vitro conditions. 150 ml of water (control), barley grass juice, oat grass juice and barley + oat grass juice were applied to the seeds according to their subjects. The experiment was carried out in 400 pots with 10 replications x 2 species x 4 treatments x 5 media, according to the factorial fully randomised design. As a result of the research, germination physiology (germination percentage, germination rate, average daily germination, peak value and germination value), mineral substance content (N, P, K, Ca, Mg, Fe, Cu, Zn and Mn), growth and yield parameters at (root dry and wet weight, stem dry and wet weight, root and stem length, plant yield, grass yield, plant yield seed rate) barley grass juice application was found to be more effective than other applications after control. In all parameters examined in the research, it was determined that the five different medias used as growing media followed the order of soil>cocopeat>pumice>perlite>tea waste, and after the control and the best growing medium was cocopeat.

Keywords: Germination, *Hordeum vulgare* L. and *Avena sativa* L. juice, Hydroponic, Cocopeat, Perlite, Yield

[1]***Sorumlu Yazar/Corresponding Author:** Banu Kadıoğlu, Eastern Anatolia Agricultural Research Institute Management Soil and Water Resources Campus, Erzurum, Türkiye. E-mail: banu250@hotmail.com OrcID: 0000-0002-9041-5992
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Öz

Sağlık amaçlı olarak tahıllardan elde edilen çim sularının tüketimi günümüzde giderek artmaktadır. Bu amaçla farklı bitki çözeltileri üzerine yapılan araştırmalar hız kazanmıştır. Yürüttüğümüz çalışmada hidroponik ortamda yetiştirilen arpa (*Hordeum vulgare* L.) ve yulaf (*Avena sativa* L.) çim suyunun, %100 toprak (kontrol), %100 pomza, %100 perlit, %100 çay atığı ve %100 hindistan cevizi torfu sustratlarında bezelye ve acıbakla'da çimlenme oranı, çimlenme hızı, ortalama günlük çimlenme, pik değeri, çimlenme değeri, kök kuru ve yaş ağırığı, gövde kuru ve yaş ağırlığı, kök ve gövde uzunluğu, bitki verimi, çim verimi, bitki verimi tohum oranı, makro ve mikro (N, P, K, Ca, Mg, Fe, Cu, Zn ve Mn) minerel madde içerikleri üzerine etkisi araştırılmıştır. Çim suları 30 x 50 x 7 cm boyutunda plastik küvetlere ekilen arpa ve yulaf tohumlarının on günde biçilerek katı meyve suyu sıkacağında geçirilmesi ile elde edilmiştir. Her saksıya 25 adet konan bezelye ve acıbakla tohumları invitro şartlarda farklı ortamlarda (%100 toprak, %100 cocopeat, %100 pomza, %100 perlit, ve %100 çay atığı) yetiştirilmiştir. Tohumlara konularına göre 150ml su (kontrol), arpa çim suyu, yulaf çim suyu ve arpa+yulaf çim suyu uygulanmıştır. Deneme 10 tekerrür x 2 tür x 4 uygulama x 5 ortam olacak şekilde 400 saksıda tesadüf parselleri faktöriyel deneme desenine göre yürütülmüştür. Araştırma sonucunda, çimlenme fizyolojisi (çimlenme oranı, çimlenme hızı, ortalama günlük çimlenme, pik değeri ve çimlenme değeri), mineral madde içerikleri (N, P, K, Ca, Mg, Fe, Cu, Zn ve Mn), büyüme ve verim parametrelerinde (kök kuru ve yaş ağırlığı, gövde kuru ve yaş ağırlığı, kök ve gövde uzunluğu, bitki verimi, çim verimi, bitki verimi tohum oranı) arpa çim suyu uygulaması kontrolden sonra diğer uygulamalara göre daha etkili bulunmuştur. Araştırmada incelenen tüm parametrelerde yetiştirme ortamı olarak kullanılan beş farklı ortamın toprak>cocopeat>pomza>perlit>çay atığı sıralamasını takip ettiği ve kontrolden sonra en iyi yetiştirme ortamının cocopeat ortamı olduğu belirlenmiştir.

Anahtar Kelimeler: Çimlenme, *Hordeum vulgare* L. ve *Avena sativa* L. suyu, Hidroponik, Cocopeat, Perlit, Verim

1. Introduction

Cereal grass, which has a positive effect on human health, has been used as food for years. Laboratory studies on cereal grasses that are beneficial to human health are also increasing (Yadav et al., 2013). Cereal grass is rich in antioxidants. Young leaves are also quite healthy. For this reason, it has recently received more attention as a natural medicine (Urbonaviciute et al., 2009). Barley contains β-glucon and high amount of protein. It can also be used as barley malt and grass juice (Altuner et al., 2022). Barley grass extracts, which are an important source of antioxidants, are useful in the treatment of many diseases such as obesity, diabetes, blood circulation system disorders, anemia, arthritis, high cholesterol levels, kidney diseases and cancer (Paulickova et al., 2007). At the same time, oat grass juice is very rich in amino acids, vitamins B1, B2, B6, and B12, minerals, vitamins, antioxidants (tricin), chlorophylls and enzymes (Rexhepi and Renata, 2015). In a study using oat plant extract doses, the effects of oil plant seeds on germination and seedling growth were investigated and it was stated that the germination time of oil plants seeds was prolonged with increasing oat plant extract doses, and increasing doses of oat plant extract had a negative effect on seedling growth (Ergin and Kaya, 2020).

Soilless culture is a form of cultivation with an average of 60 years of history. Experiments on soilless aquaculture started in the 1600s. Attempts were made to determine more plant growth substances and plant compositions. It is known that the Egyptians cultivated plants in water a few centuries before Christ. Soilless culture consists of water and substrate culture. The process of growing plants using mineral nutrient solutions in water is called hydroponic system. In the study, the germination process of barley and oat seeds was provided by hydroponic system. The green parts, which can reach 20-25 cm in length in approximately seven to eight days, intertwine and take on the appearance of a carpet (Karasahin, 2015a). In hydroponic environment, water requirement is low, disease and pest control is easy, efficiency is high and environmental pollution is less (Uyeda et al., 2011). Seed type, water quality, pH, irrigation time, plant nutrient, temperature, light intensity are the factors affecting yield in hydroponic system (Dung et al., 2010; Fazaeli et al., 2012). In substrate culture, plants are grown in organic, inorganic or synthetic media. Soil (control), pumice, perlite, tea waste and cocopeat substrates were used in the study. In the study, the effects of barley, oat and barley+oat grass water treatments on pea and lupine were investigated in five different media. Water was used as control application. In the study, it was aimed to determine effect the grass water application on the mineral content of N, P, K, Ca, Mg, Fe, Cu, Zn and Mn, germination percentage, germination rate, average daily germination, peak value, germination value, root dry and wet weight, stem dry and fresh weight, root and stem length, plant yield, grass yield, plant yield seed rate.

2. Materials and Methods

The research was carried out in invitro conditions (25±1°C) in 2023. Grasses were obtained by sowing barley (*Hordeum vulgare* L.) and oat (*Avena sativa* L.) seeds in 30 × 50 × 7 cm plastic tubs in a hydroponic system. Harvesting was done with scissors ten days later. Grass juices were obtained by passing the grass through a juice extractor (Akgun et al., 2018). The research, in which pea (*Pisum sativum* L.) and lupine (*Lupinus albus* L.) seeds were used, was carried out according to the factorial fully randomised experimental design, as 2 species × 4 applications × 5 media × 10 replications in a total of 400 pots. 5% NaClO solution was used to ensure the surface sterilization of the seeds. The seeds were sterilized for 10 minutes. Sterilized seeds; 25 seeds were planted in each pot (25 × 20) in pots containing soil (control), pumice, perlite, tea waste and cocopeat. 150 ml of water (control), barley grass juice (BGJ), oat grass juice (OGJ) and barley + oat grass juice (BGJ + OGJ) were applied to each pot by tidal method (Karasahin, 2015b). Germination times of different species were determined according to the principles stated in ISTA (ISTA, 2003). After the seeds were placed in the germination medium, they were checked every day and the number of germinated ones was determined. The plants harvested after 50 days were dried at room temperature and then dried in an oven at 70°C until they reached a constant weight. The dried samples were ground to an average thickness of 2 mm in a teflon blade grinder and made ready for analysis (Kacar and İnal, 2008). The total nitrogen content of the plant samples was determined by the "Mikrokjeldahl Method" after wet burning with a mixture of H_2SO_4 (AOAC, 1990). Macro and micro mineral substance contents (P, K, Ca, Mg, Fe, Cu, Zn, Mn) were determined with Perkin Elmer (Optima 2100) Model ICP – OES device after wet burning with a mixture of $HClO_4$ (AOAC, 1990). Plant yield (g/pot) obtain by weighing the harvested plant parts with precision scales, grass yield by weighing the grass harvested from 1 cm height from the root zone on precision scales (g/pot), and plant yield by proportioning the amount of seeds used in planting after weighing the harvested plant parts on precision scales, seed rate was determined (Karasahin, 2015b). 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. Root and stem parts of plants harvested weighed on precision scales, root and stem fresh weights were determined. The root and stem dry weights of the dried plants were kept in the drying oven at 70°C until they reached a constant weight (Kadioglu 2020). In the study, germination percentage (%), germination rate (days), average daily germination (day), peak value (%), germination value (%), root dry and fresh weight (g/pot), stem dry and fresh weight (g/pot), root and stem length (cm), plant yield (g/pot) grass yield (g/pot) and plant yield seed rate (%), macro (%) and micro (ppm) mineral substance contents were investigated (Czabator, 1962; Ellis and Roberts, 1981; Matthews and Khajeh-Hosseini, 2007; Gairola et al., 2011; Akgun et al., 2018; Kadioglu, 2021). Differences between analysis of variance and mean LSD multiple comparison tests were performed in JMP 5.0.1 program.

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

n = Number of germinated seeds

Σn= Total number of seeds

Germination rate (GR): $n1/t1 + n2/t2 + \cdots \ldots$ (Eq. 2)

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

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

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

Germination value (GV): Average daily germination x peak value (Eq. 5)

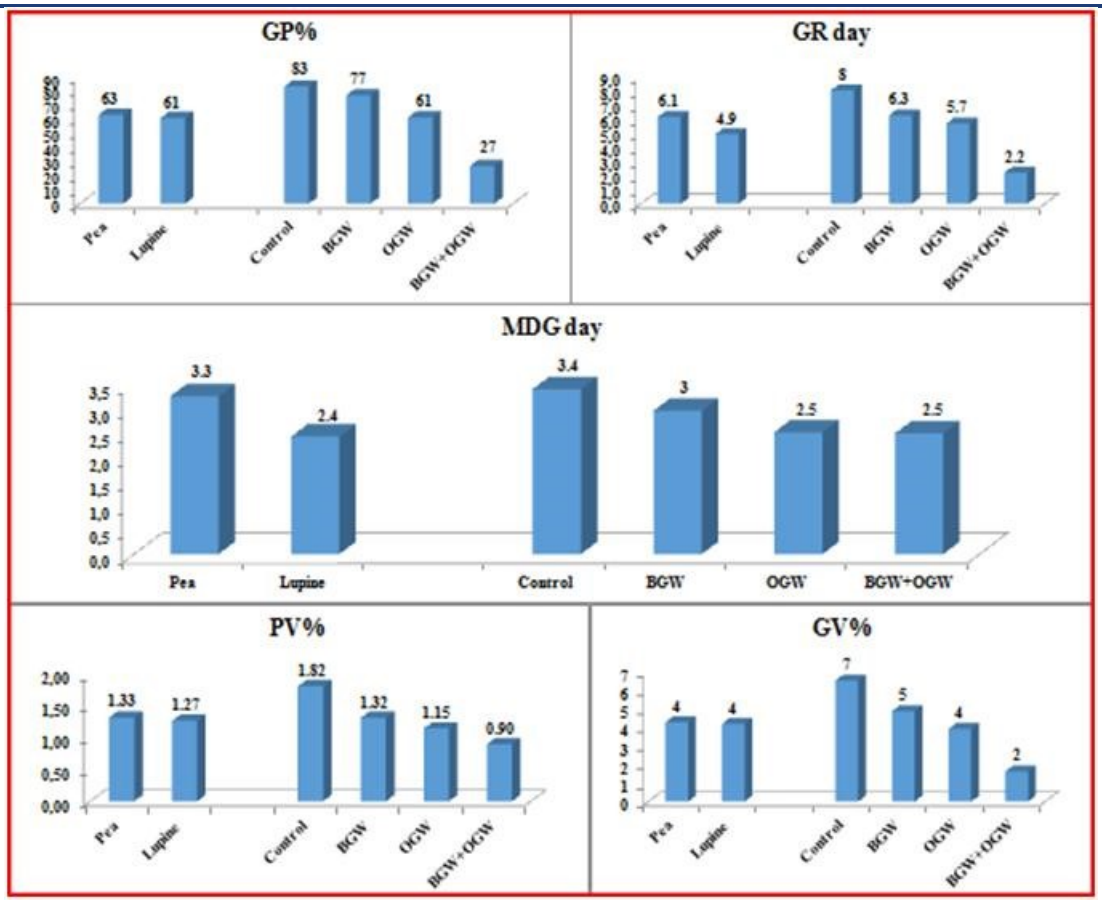
The average root/stem length was calculated as cm/plant by dividing the sum of root and stem lengths in a petri dish by the number of seeds.

3. Results and Discussion

The germination percentage, germination rate, average daily germination, peak value, germination value, root dry and wet weight, stem dry and wet weight, root and stem length, plant yield, grass yield, total yield, mineral content of N, P, K, Ca, Mg, Fe, Cu, Zn and Mn of pea (*Pisum sativum* L.) and lupine (*Lupinus albus* L.) grown using soilless farming techniques in vitro were determined in the study. The parameters were analyzed according to the factorial fully randomised design. It was determined that the control took the highest values in all parameters examined in applications and substrates.

3.1. Germination parameters

Compared to the control, the treatments had a negative effect on the germination parameters. There are significant differences between species. Lupine is more sensitive to applications. Cocopeat medium has better values in germination parameters. Germination parameters (GP%, GR day, MDG day, PV% and GV%) in cocopeat media were 76.5%, 7.48 days, 3.93 days, 1.35% and 4.92%, respectively. Barley grass juice is more effective on GP%, GR day, MDG day, PV% and GV% parameters. Species × media, species × application, media × application and species × media × application interactions got the lowest values from lupine × tea waste, lupine × BGJ + OGJ, tea waste × BGJ + OGJ, and lupine × tea waste × BGJ + OGJ applications (*Figure 1*).



Column shows germination parameters (GP%, GR day, MDG day, PV%, GV%) and bar shows plants (%/day) and applications (%/day)

Figure 1. Germination parameters for both plants and applications

3.2. Growth parameters

Growth parameters including root and stem dry weight, root and stem fresh weight, root and stem length were investigated in our research in which we investigated the effect of grass juices on pea and lupine on different substrates. The examined parameters had the lowest values in lupine with 0.32 g plant, 2.73 g plant, 0.94 g plant, 6.90 g plant, 16.54 cm and 62.39 cm, respectively. The growth parameters are in the order soil (control) > cocopeat > pumice > perlite > tea waste. BGJ + OGJ had the lowest values in all the parameters examined in the applications. Control application and control environment gave the highest values in the growth parameters examined in the interactions. Pea were found to be more effective in interactions (*Table 1*).

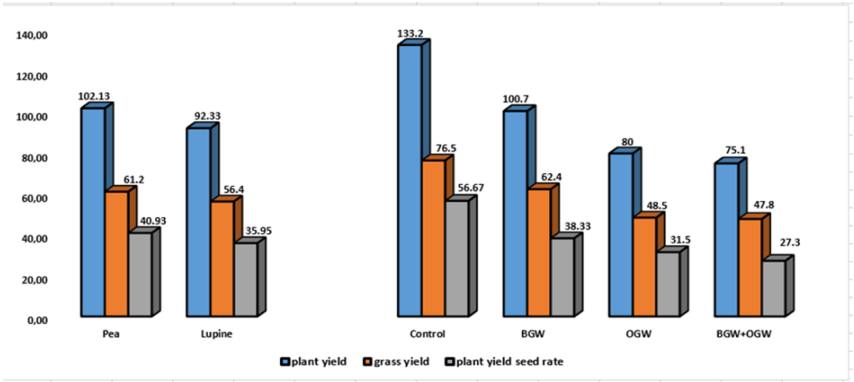
3.3. Yield parameters

In the study, plant, grass and plant yield seed rate of pea and lupine were examined. Grass juice applications (GJA) have a negative effect on yield parameters. Grass juice applications were effective between the environment and the species. It was determined that plant, grass and plant yield seed rate of pea had the highest values with 102.13 g/pot, 61.20 g/pot and 40.93%, respectively. Plant, grass and plant yield seed rate in the environments were 99.92 g/pot, 59.83 g/pot, 39.5% in cocopeat substrate. It was determined that the control got the highest efficiency values (133 g/pot, 76.5 g/pot, 57%) in the applications. It was determined that the control application was followed by barley grass juice (100.7g/pot, 62.4 g/pot, 38.33%), oat grass juice (80 g/pot, 48.5 g/pot, 31.50%) and BGJ + OGJ (75.1 g/pot, 47.8 g/pot, 27.27%) applications, respectively. In the interactions, the lowest values were obtained by lupine × teawaste, lupine × BGJ + OGJ, lupine × BGJ + OGJ, lupine × tea waste × BGJ + OGJ (*Figure 2*).

Table 1. Effect of S ×M × A of interaction on the growth parameters

Species	Media	Application	Root dry weight (g plant)	Stem dry weight (g plant)	Root fresh weight (g plant)	Stem fresh weight (g plant)	Root length (cm)	Stem length (cm)
Pea	Soil	Control	1.36	3.47	2.04	13.0	28.42	84.44
		BGJ	0.41	3.38	1.06	9.47	23.60	74.33
		OGJ	0.36	3.04	1.51	8.07	20.41	70.89
		BGJ + OGJ	0.32	2.84	1.09	7.01	18.56	64.44
	Cocopeat	Control	1.17	3.13	1.38	13.0	26.59	84.44
		BGJ	0.23	3.00	1.04	9.46	22.66	74.11
		OGJ	0.22	2.92	0.91	7.83	20.33	69.67
		BGJ + OGJ	0.17	2.37	0.88	7.01	17.78	63.56
	Pumice	Control	0.81	3.04	1.31	11.4	25.20	80.67
		BGJ	0.21	2.96	0.91	9.46	22.31	73.56
		OGJ	0.16	2.68	0.81	7.61	20.24	65.33
		BGJ + OGJ	0.13	2.26	0.62	6.99	17.76	63.33
	Perlite	Control	0.68	3.02	1.05	11.3	25.20	80.67
		BGJ	0.15	2.69	0.72	9.09	20.83	73.11
		OGJ	0.13	2.26	0.55	7.48	20.24	65.22
		BGJ + OGJ	0.13	2.10	0.48	6.99	17.62	63.33
	Tea waste	Control	0.46	2.93	0.76	9.79	24.37	77.00
		BGJ	0.13	2.31	0.72	8.44	20.80	71.00
		OGJ	0.13	2.12	0.51	7.24	18.97	64.44
		BGJ + OGJ	0.12	2.10	0.47	6.97	17.59	61.89
Lupine	Soil	Control	1.28	3.38	1.86	6.94	17.19	61.11
		BGJ	0.38	3.37	1.67	6.64	16.48	55.00
		OGJ	0.36	3.00	1.15	5.42	15.81	52.22
		BGJ + OGJ	0.17	2.82	1.13	3.74	14.91	51.00
	Cocopeat	Control	0.81	3.01	1.46	6.94	16.93	59.44
		BGJ	0.36	3.00	1.02	6.61	16.32	55.00
		OGJ	0.20	2.96	1.00	4.83	15.70	52.00
		BGJ + OGJ	0.16	2.71	0.91	3.27	14.26	50.22
	Pumice	Control	0.81	2.96	1.31	6.87	16.93	59.22
		BGJ	0.22	2.96	1.00	6.45	16.18	53.22
		OGJ	0.16	2.71	1.00	4.52	15.64	51.56
		BGJ + OGJ	0.15	2.69	0.89	3.26	13.43	49.89
	Perlite	Control	0.56	2.71	1.02	6.84	16.81	58.78
		BGJ	0.21	2.71	0.81	6.31	16.03	52.78
		OGJ	0.16	2.49	0.72	4.40	15.52	51.33
		BGJ + OGJ	0.14	2.40	0.47	2.79	3.37	49.56
	Tea waste	Control	0.46	2.65	0.76	6.71	16.61	57.78
		BGJ	0.15	2.36	0.61	6.29	16.00	52.33
		OGJ	0.15	2.10	0.55	4.06	15.26	51.00
		BGJ + OGJ	0.13	2.07	0.32	2.00	2.88	49.44
Species			***	ns	***	ns	***	ns
Media			***	***	***	***	***	***
Application			***	***	***	***	***	***
S * M			ns	***	ns	***	***	***
S * A			***	ns	***	ns	ns	***
M * A			***	***	***	***	***	***
S * M * A			***	***	***	***	ns	***

Statistically significant differences at ***p ≤ 0.001; ns: indicate the non-significant difference. GJA: Grass juice applications; Control: Water; BGJ: Barley grass juice; OGJ: oat grass juice; BGJ + OGJ: Barley + Oat grass juice

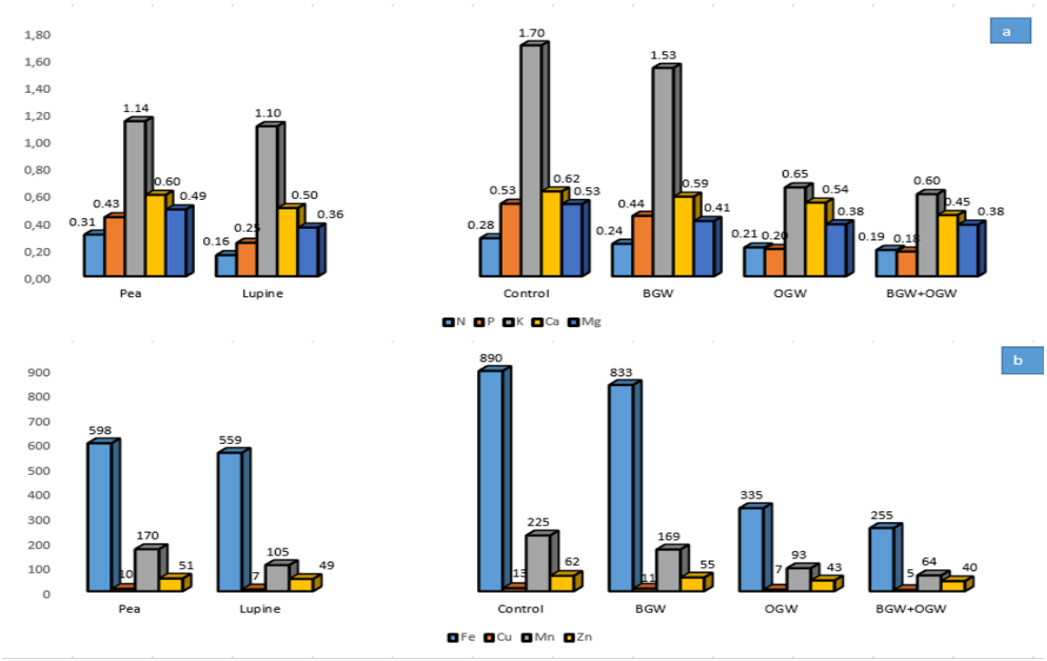


Column shows yield parameters (plant yield, grass yield g/pots and plant yield seed rate %) and bar shows plants (g/pots, %) and applications (g/pots, /%)

Figure 2. Yield parameters for both plants and applications

3.4. Mineral substance contents

The effects of grass juices on macro and micro mineral substances in pea and lupine seeds were investigated; Among the macro elements N (0.31%), P (0.43%), K (1.14%), Ca (0.60%) and Mg (0.49%), pea had the highest values. Substrates used in macro elements are listed as soil > cocopeat > pumice > perlite > tea waste. Barley grass juice application in N, P, K Ca and Mg elements took the values of 0.24%, 0.44%, 1.53%, 0.59% and 0.41%, respectively. In the macro elements species × media, species × application, media × application interactions, pea × cocopeat, pea × BGJ, cocopeat × BGJ applications gave the highest values (*Table 1*). Micro elements as well; Fe (559 ppm), Cu (7.39 ppm), Mn (105 ppm) and Zn (49.37 ppm) had the lowest values in lupine. Fe (521 ppm), Cu (7.05 ppm), Mn (129 ppm) and Zn (45 ppm) had the lowest values in the tea waste substrate. In applications, BGJ + OGJ had the lowest values as 255 ppm, 4.61 ppm, 64 ppm and 40 ppm, respectively. In the interactions of species × media, species × application, and media × application, pea × cocopeat, pea × BGJ, cocopeat × BGJ applications were more effective than other applications (*Figure 3*).



Column shows macro (a) and micro (b) element contents (%/ppm) and bar shows plants (%/ppm) and applications (%/ppm)

Figure 3. Macro (a) and micro (b) element contents for both plants and applications

Interest in grass waters prepared using different plant components; Grass juice variety is increasing day by day due to the fact that there is no side effects, it strengthens the immune system, and it can be used in diets. The consumption of plants for health purposes has increased in recent years. Cereals and cereal products are consumed for health purposes. For this purpose, more grass juices are consumed. There are studies on grass juices, which are very rich in plant nutrients and vitamins (Akgun et al., 2018). Water (control) application had the highest values in all parameters examined in our study, followed by BGJ, OGJ and BGJ + OGJ applications. At the same time, the order of soil (control) > cocopeat > pumice > perlite > tea waste was realized in terms of substrates. It has been determined that the GJAs differ in the substrates used. As a result of our study in which we applied BGJ, OGJ and BGJ+OGJ on pea (*Pisum sativum* L.) and lupine (*Lupinus albus* L.) on different substrates, the reason why the control application was more effective than the grass juice application may be the allelopathic effect. Allelopathy is defined as the inhibitory effect of one plant on another plant with its chemical secretions. Chemicals secreted by plants are also called allelochemicals (Rice, 1984; Khalid and Shad, 1991; Callaway, 2002). Allelochemicals that affect metabolic events can affect plant growth. This situation may vary depending on the type and density of the allelochemical substance (Jose and Gillespie, 1998). In allelopathy, one plant may have a direct or indirect detrimental effect on another plant (Zeng et al., 2008). It was stated that the extracts used in the study, which determined the allelopathic effects of different weed extracts, had a negative effect on seed germination in vegetables compared to the control (Kadioglu et al., 2005). In another study, it was reported that extracts obtained

from the leaves and roots of *Chromolaena odorata* (christmas bush) (0.1% and 10%) adversely affect the seed germination and seedling growth of some herbaceous plants (Hu and Zhang, 2013). In the study, different doses of oat grass juice and oat grass juice (25%, 50%, 75% and 100%) were applied to leguminous seeds such as oats, barley, beans, wheat, and lentils; germination 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 water doses on germination and seedling development were negative (Karaman et al., 2021). In another study, wheat grass juice applied barley (*Hordeum vulgare*), corn (*Zea mays*), wheat (*Triticum aestivum*), bean (*Phaseolus vulgaris*), clover (*Medicago sativa*), perennial grass (*Lolium perenne*), sheep's ball (*Festuca ovina*) and sugar beet (*Beta vulgaris*) seeds, germination index, germination rate and root and stem length were examined and it was stated that wheat grass juice reduced the investigated parameters (Akgun et al., 2018). In our study, average germination parameters in pea (*Pisum sativum* L.) were determined as GP: 63.26%, GR: 6.14 day, MDG: 3.26 day, PV: 1.33%, GV: 4.29%. Root dry, stem dry, root wet, stem wet, root length and stem length parameters were 0.36 g/plant, 2.83 g/plant, 0.90 g/plant, 7.68 g/plant, 18.09 cm and 65.61 cm in barley grass juice application, respectively. It has been determined that the results of our research are in parallel with the other studies, and that barley, oat and BGJ + OGJ applications have a negative effect on germination physiology and plant growth compared to the control. Grain juices contain substances such as alkaloids, saponins, and gums (Ashok, 2011). Since cereal grass juices contain 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 (Jose and Gillespie, 1998; Terzi, 2007). In the study in which the effects of different doses of oat plant extract on the germination and seedling development of oil plants seeds were determined, it was determined that the germination time of oil plants seeds was prolonged with increasing oat plant extract doses, and increasing doses of oat plant extract had a negative effect on seedling growth (Ergin and Kaya, 2020). It has been stated by the researchers that increasing doses of oat plant extract inhibit the growth of wheat and oat seedlings. Hydroxamic acid, scopoletin, L-tryptophan substances cause allelopathic effects in oat plant (Gürsoy et al., 2013). In a different study, it was reported that the extract obtained from the leaves of salvia and celery plant had a negative effect on the germination and seedling growth of lentil seeds and inhibited root development (Stratu et al., 2012). Macro and micro plant nutrients affect plant growth by changing plant morphology, anatomy and chemical composition. At the same time, they affect the resistance/tolerance of plants against diseases and pests positively or negatively (Yıldız, 2012), making them more beneficial for human health. Plants have a limited ability to selectively take in essential plant nutrients for their growth and development. In various studies using plants or plant parts (herbs, roots, fruits, etc.), it has been reported that plant extracts have a large amount of antioxidant compounds and their use reduces or encourages plant growth (Lin, 2004; Joseph et al., 2007; Pan et al., 2009). In our study, it was determined that the GJA application for macro and micro plant nutrients got the high values after the control, while the control application gave the highest values for the plant, grass and total yield parameters, followed by the BGJ > OGJ > BGJ + OGJ interaction. The data obtained in our study show parallelism with the results of other studies. In a study examining the effect of wheat (*Triticum aestivum* L.) and oat (*Avena sativa* L.) grass juices on the yield and nutrient content of some medicinal and aromatic plants in soilless medium, it was determined that grass water applications had a negative effect on yield and plant nutrient content (Kadıoğlu, 2022). 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 (Karaşahin, 2015a). In another study, the effect of plant extracts on the germination and seedling growth of pepper was examined and it was stated that the inhibition effect and ratio of plant extracts changed depending on the species and doses (Özbay, 2018). The alleopathic effect varies from plant to plant. In our study, it was determined that the response of plant species to grass waters was different, and pea species were more resistant to grass water applications in all parameters examined.

4. Conclusions

As a result, seed germination physiology, plant growth parameters, mineral substance contents and yield of pea (*Pisum sativum* L.) and lupine (*Lupinus albus* L.) grown in soil, perlite, pumice, tea waste and cocopeat substrates of barley and oat grass juices obtained by hydroponic system. It was determined that except control medium, the other growing media had a negative effect on the parameters. Pea (*Pisum sativum* L.) germination percentage, germination rate, average daily germination, peak value, germination value, root dry and fresh weight, stem dry

and fresh weight, root and stem length, plant yield, grass yield, plant yield seed rate, N, P, K, Ca, Mg, Fe, Cu, Zn and Mn values were found to be better than lupine (*Lupinus albus* L.) values. It was determined that GJA application and cocopeat substrate gave better results than other applications and substrates in the examined parameters. In addition, it was determined that the interaction of barley grass juice × pea × cocopeat was determined to be more effective in general, and the allelopathic effect different between plant species. Based on the data obtained from the results of the conducted study; It is suggested that barley grass water application can be applied in cocopeat medium to improve the agricultural characteristics of pea.

Ethical Statement

There is no need to obtain permission from the ethics committee for this study.

Conflicts of Interest

There is no conflict of interest.

Authorship Contribution Statement

Concept; Design; Data Collection or Processing; Statistical Analyses; Literature Search; Writing, Review and Editing: BK.

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