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DIYARBAKIR

Edited By

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12. 09. 2021	10: 00 – 12:00
Meeting ID: 846 6861 1169	Passcode: 12092021
HALL: 1 SESSION: 1	MODERATOR: DOÇ. DR. İBRAHİM ÇÜTCÜ
DR. MELİH DİNÇER	Nelson Mandela'nın İdealist Dış Politikası
ERKAN TAMTÜRK	İki Darbe Arası Ara Dönem: 12 Mart 1971 Muhtırası
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İBRAHİM FURKAN ALABAŞ	Temsili Demokrasinin Uygulamadan Kaynaklanan Sorunlarına Bir Çözüm Önerisi Olarak Sivil Toplum Kuruluşları

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12. 09. 2021 10: 00 – 12:00 Meeting ID: 846 6861 1169 Passcode: 12092021	
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ASST. PROF. DR SELCUK SELİMLİ	Investigation Of The Effect Of Koflo Blade Mixer Blade Crossing Inclination Angle On Laminar Flow Heat Transfer Performance By A CFD Study
MOUSTAFA OSMAN MOHAMMED	Air Dispersion Model for Prediction Fugitive Landfill Gaseous Emission Impact in Ambient Atmosphere
BIRGUL DIKMETAS LOLAV RAJAB HASAN BEKIR EROL AK IBRAHIM HALIL HATIPOGLU	Contaminations In Plant Tissue Culture And Some Solutions
ARY TAHER RASUL BEKIR EROL AK İBRAHIM HALIL HATİPOĞLU	Some Bougainvillea Species And Characteristics And Reproduction Techniques
MS. UZMA AYAZ	Genetic Variability, Association And Diversity Study Among The Sunflower Genotypes At Seedling Stage Based On Different Morpho-Physiological Parameters Under Polyethylene Glycol Induced Stress
ZİRAAT MÜHENDİSİTARA TAHİR AMİN ZİRAAT YÜKSEK MÜHENDİSİ.MİZGİN AY ZİRAAT YÜKSEK MÜHENDİSİ.ZELİHA ÇİFTÇİ DOÇ. DR. EBRU SAKAR	Kuzey Irak Bölgesinde Yetiştirilen Yerel Nar Çeşitlerinin (Punica granatum L.) Bazı Pomolojık Özelliklerinin Belirlenmesi

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CHENG-SHIUNG WU	A Study of the Relationship of PSI and LMX to Service Providers' CS in Hospitality Industry
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CONTENT

PEYZAJ UYGULAMALARINDA KULLANIM OLANAKLARI AÇISINDAN SİLLE TAŞI

ZEHRA TUĞÇE ÖKSÜZ[1*], PINAR BOLLUKCU[2]

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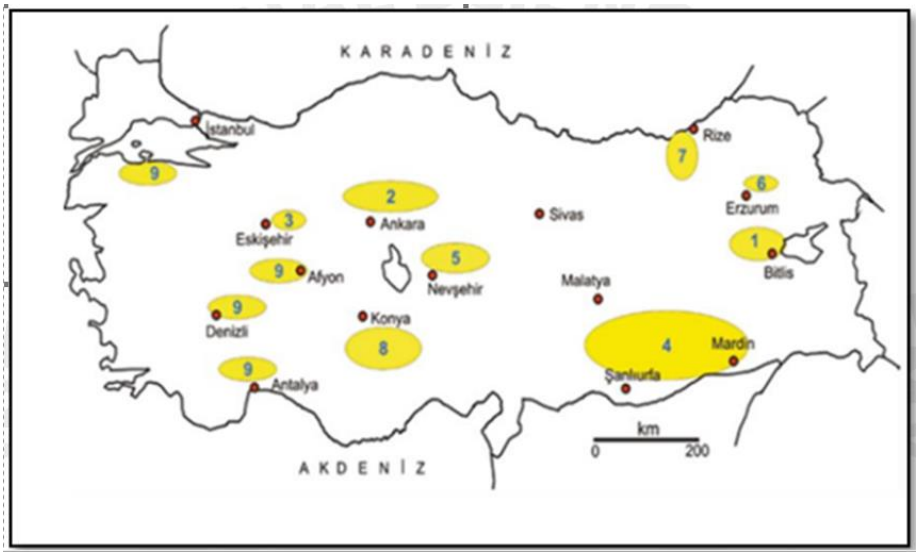
ÖZET

Dünyanın oluşumuyla birlikte var olan taş, insanlığın gelişim sürecinde de en etkili doğal materyallerden biri olmuştur. Çağlara adını veren taşı ilk insanlar; korunmak, avlanmak, pişirmek, barınmak ve sanat için kullanmış, şekillendirmiştir. Devirler değiştikçe, insanların ihtiyaçları ve kullandıkları teknikler değişmiş, taşın kullanım alanları da genişlemiştir. Mimarlık ve Peyzaj Mimarlığı gibi yapı ve çevresi ile ilgilenen meslek alanlarının iç ve dış mekân uygulamalarında; dayanıklılığı, geçirgenliği ve estetik özellikleri dikkate alınarak birçok farklı doğal taştan yararlanılmaktadır. Doğal taşlar aynı zamanda bulunduğu coğrafya için bir miras niteliği taşımakta ve kültürel peyzajın şekillenmesinde etkili unsurlardan biri olmaktadır. Çalışma alanı olarak seçilen Sille, Konya ili Selçuklu ilçesinde yer alan, kültürel peyzaj özellikleriyle dikkat çeken, arkeolojik sit ve kentsel sit alanı olarak ilan edilmiş eski bir yerleşmedir. Farklı kültürlere ev sahipliği yapan sosyolojik yapısı, ekonomik hayatı şekillendiren geleneksel el sanatları, sivil mimari yapıları ve bölgedeki taş ocaklarından çıkarılan sille taşı ile tanınmaktadır. Sille taşı, mimari yapılarda yapı taşı ve dekoratif amaçlı olarak kullanılmaktadır. Bu çalışmada sille taşının peyzaj mimarlığı dış mekân uygulamalarında kullanım olanaklarının araştırılması hedeflenmektedir. Bu bağlamda sille taşı; duvarlar, yollar, yüzey kaplamaları, su ögeleri, kaya bahçeleri ve sanatsal objelerde kullanım olanakları açısından değerlendirilmiş ve öneriler sunulmuştur. Çalışma sonuçlarının; Sille kültürel kimliğinin korunması konusunda farkındalık sağlamasının yanı sıra tasarımcı ve uygulayıcılara malzeme bilgisi konusunda katkı sunması beklenmektedir.

Anahtar Kelimeler: Peyzaj Mimarlığı, Peyzaj Tasarımı, Kültürel Peyzaj, Sille Taşı, Konya.

1. GİRİŞ

İnsanlık tarihi boyunca hayatın içerisinde olan doğal taşlar endüstriyel bir ürün olmayıp; doğada milyonlarca yılda şekillenen benzersiz materyallerdir **[1]**. Yokedildiğinde yeniden yapılamayan doğal taşlar **[2]**, sonsuz rezerve de sahip değildir **[3; 4].** Doğal taşların geçmişten beri özellikle yapı elemanı olarak kullanıldığı bilinmektedir **[5]**. İnsanoğlunun kullandığı ilk inşaat malzemesi olarak değerlendirilen doğal taşlar, ocakta üretimi yapıldıktan sonra doğal taş veya boyutlanmış taş olarak adlandırılmaktadır **[6]**. Fiziksel özellikleri ile atmosfer etkilerine uygun, dayanıklı, sağlam ve her türlü işlevselliğe sahip bir malzeme türüdür **[1]**. Günümüzde yapı elemanı olmasının yanı sıra, iç ve dış mekânlarda yüzey kaplama, döşeme ve dekorasyon gibi farklı amaçlarla kullanılan doğal taşlar, yaşamın vazgeçilmez bir parçasıdır. Doğal taş varlığı ve çeşitliliği açısından öne çıkan ülkeler arasında yer alan Türkiye, hem rezerv hem de çeşitlilik yönünden büyük bir potansiyele sahiptir **[7]**.

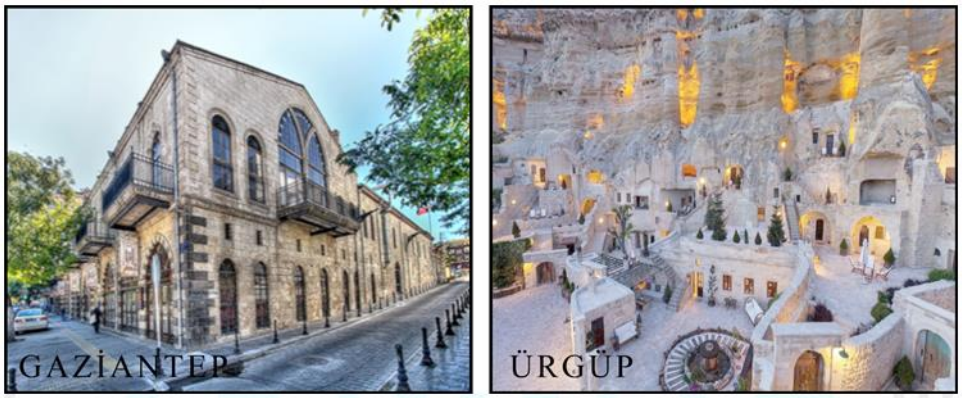


Görsel 1. Türkiye'nin Doğal Taş Varlığı [3].

Görsel 1'de verilen 1 numaralı taş Ahlat taşı, 2 numaralı taş Ankara taşı, 3 numaralı taş Lüle taşı, 4 numaralı taş Midyat taşı, 5 numaralı taş Nevşehir taşı, 6 numaralı taş Erzurum Oltu taşı, 7 numaralı taş Pileki taşı ve 8 numaralı taş Sille taşıdır. 9 numarada ise Traverten ve Mermer yatakları bulunmaktadır **[3]**.

Doğal taşlar, bulundukları coğrafyayı şekillendiren, ona kimlik kazandıran, geçmişi geleceğe taşıyan önemli kültürel bir simgedir. Ülkemizin sahip olduğu ve antik dönemlerden beri farklı amaçlarla kullanılan doğal taşların birçoğu jeolojik miras niteliği taşımaktadır **[3].** Kültürel mirasın temsilcisi olan doğal taşlar; antik kent kalıntıları, geleneksel sivil mimari yapıları ve sanat eserleri ile karşımıza çıkmaktadır. Yörede çıkarılan doğal taşları yapı malzemesi olarak kullanan ve mekânsal düzende birliğin sağlandığı, yapı taşının kente kimlik kazandırdığı örneklere ülkemizde rastlamak mümkündür (Görsel 2, 3).

Görsel 2. Mardin ve Kars Yörelerinin Sivil Mimari Yapısı [8; 9].



Görsel 3. Gaziantep ve Ürgüp Yörelerinin Sivil Mimari Yapısı [10; 11].

Peyzaj mimarlığı uygulamalarında doğal taşların tercih edilmesinde dayanıklı, işlevsel ve estetik olmaları etkendir. Doğal taşlar sağlam ve kullanışlı olmalarının yanı sıra tekstür ve renk açısından da çeşitlilik sunmaktadır. Gelişmiş ülkeler, yapay malzemeler yerine, doğal malzemeleri daha çok kullanmaktadır. Peyzaj uygulamalarında da doğal taşları yaygın olarak kullandıkları görülmektedir **[12]**.

2. MATERYAL VE YÖNTEM

2.1. Materyal

Çalışmanın ana materyalini, Konya ili Selçuklu ilçesine bağlı Sille mahallesinden ve bu yöreye ait taş ocaklarından çıkarılan Sille taşı oluşturmaktadır. Sille taşının peyzaj mimarlığı uygulamalarında kullanımına yönelik araştırmalarda, konu ile ilgili daha önce yapılmış çalışmalardan, jeolojik araştırmalardan, kamu kurumlarının verilerinden ve yerinde gözlemlerden yararlanılmıştır.

2.2. Yöntem

Çalışmanın yöntemi, alana ve konuya ilişkin literatür araştırmaları ve yerinde gözlemlerden oluşan veri toplama aşaması; Sille taşının peyzaj mimarlığında kullanım olanaklarının saptandığı analiz aşaması ve önerilerin sunulduğu sentez aşamasından oluşmaktadır.

3. SONUÇLAR VE DEĞERLENDİRME

3.1. Çalışma Alanı Doğal ve Kültürel Peyzaj Özellikleri

Çalışmanın yürütüldüğü Sille, Selçuklu ilçesine 1989 yılında iki mahalle olarak bağlanmıştır. 1995 yılında Konya Kültür ve Tabiat Varlıklarını Koruma Kurulu tarafından kilise, manastır ve

mezarlıkların bulunduğu güney yamaçları, birinci derecede arkeolojik sit alanı, esas yerleşme alanı ise kentsel sit alanı olarak ilan edilmiştir. Bugün Sille, Konya'nın önemli bir kültür ve turizm merkezidir **[13]**. Çalışma alanı ve çevresinin konumu Görsel 4'te verilmiştir.

Görsel 4. Çalışma Alanı ve Yakın Çevresinin Konumu [14].

Jeolojik açıdan Sille ve yakın çevresinde araziyi oluşturan en eski ve temele ait formasyonlar, Paleozoik döneme aittir **[15]**. Araştırma alanında jeolojik oluşum olarak Dilekçi Formasyonu bulunmaktadır **[16]**. Sille, Konya kent merkezine 8 km. uzaklıkta olup; kuzeybatısında, Takkeli Dağ (Küçük Gevele) ve Karabuğa Dağları arasındaki Sille deresinin açmış olduğu vadide konumlanmaktadır. Sille'nin Batı ve Kuzeyinde Tepeköy, Yükselen; Güneybatısında da Kızılören, Güneydoğusunda da Konya-Selçuklu ilçesi bulunmaktadır **[17]**. Sille'de en önemli akarsu kaynağı Giret Deresi ve Sille Deresi'dir. Ayrıca, Sille Deresi üzerine taşkın önleme ve sulama amacıyla Himmet Ölçmen Barajı inşa edilmiştir **[16]**.

Konya'da İç Anadolu Bölgesi'nin karasal iklim özellikleri görülmektedir **[18]**. Yazları kurak ve sıcak, kışları ise kar yağışlı ve sert geçmektedir **[13]**. Konya'da hâkim rüzgâr yönü kuzey olup; en hızlı esen rüzgârlar Güney-Güneybatı yönlüdür **[16]**. Sille'de İran-Turan floristik türleri ile Anadolu'nun endemik türlerinin oluşturduğu step vejetasyonu hâkimdir ve Sille ile Konya Havzası flora açısından aynı özellikleri taşımaktadır **[19]**. Doğal bitki örtüsünü otsu bitkiler, çalılar ve seyrek ağaçlar oluşturmaktadır. Sille'de Rhamnaceae familyasından *Rhamnus petiolaris* Boiss. &Balansa ve *Rhamnus tinctoria* L. (cehri) türleri doğal olarak yetişmektedir **[20]**.

Büyük toprak gruplarından kireçsiz kahverengi topraklar ve kolüvyal toprakların yer aldığı **[16]** Sille ve civarında, dalgalı bir topografya hâkimdir. Dağlık bir arazide kurulu olan yerleşimin çevresinde birçok dağ ve tepe yer almaktadır **[21]**. Sille taşı, Sille'de bulunan taş ocaklarından çıkarılmaktadır. Yüzlerce aile 1990'lı yılların sonuna kadar Sille'nin ekonomisinde önemli bir yere sahip olan bu taş ocaklarından geçimini sağlamıştır **[23]**. Günümüzde yeterli istihdam alanı olmadığı için halkın büyük bir kısmı Sille'de yaşamakta ancak Konya'da çalışmaktadır **[16]**. Çizelge 1'de Sille'nin turistik, kültürel ve ekonomik yapısının önemli bileşenleri; Çizelge 2'de ise başlıca kültürel varlıkları verilmiştir.

Çizelge 1. Sille'nin Turistik, Kültürel ve Ekonomik Yapısına İlişkin Bileşenler [24; 25].

Turistik Yapıya Ait Bileşenler	Kültürel ve Ekonomik Yapıya Ait Bileşenler
Kale	Halıcılık
Camiler	Mumculuk
Manastır ve Kiliseler	Testicilik-Çömlekçilik
Hamamlar ve Çeşmeler	Taş İşçiliği
Köprüler	Toprak İşlemeciliği
Mesire Alanları	Bağcılık
Konaklama Alanları	Tarım ve Hayvancılık

Çizelge 2. Sille'nin Başlıca Kültürel Varlıkları [26].

Kültürel Varlıklar
Aya Elenia Kilisesi
Ak Manastır
Tepe Şapeli (Süt Kilisesi)
Hacı Ali Ağa Hamamı
Hükümet Konağı
Ak Cami, Çay Cami, Mormi Cami, Orta Cami, Mezaryaka Cami, Subaşı Cami, Karataş Cami.

3.2. Sille Taşına İlişkin Bulgular

Sille taşı, yörede bulunan taş ocaklarından çıkarılmaktadır **[3; 22]**. Sille ve çevresinde yaygın olarak kireçtaşı ve Sille taşı görülmektedir. Sille'nin güney doğusundan başlayarak güney batısına kadar uzanan dağlar, sille taşlarından meydana gelmektedir. Sille taşı özellikle; Karakaya, Gevele, Karabuğa, Delikli Kaya civarlarında bulunmaktadır. Bu taşların çıkarıldığı ve işlendiği yerler taş ocağı (kân) olarak adlandırılmaktadır **[22]**. Sille taşı, andezit blokları ve andezit tüflerin karışık bulunduğu **[3]**, magmatik kayaçlardan olan trakitler grubunda yer almakta ve ocaklardan bloklar halinde çıkarılmaktadır **[16; 7]**. Sille taşında camsı doku (porfirik) hâkim olup içinde az miktarda biotit, hornblen ve proksen gibi mefik minerallerin kristalleri bulunmaktadır. Ayrıca, camsı (porfirik) yapı hâkim olduğu için parlatılamamaktadır **[23]**. Taşın yapısından kaynaklı olarak, makinelerde işlenememekte olup; yalnızca elde işlenebilmektedir **[27]**.

Gözenekli yapıya sahip olan Sille taşı, kolay işlenebilir özelliktedir. Su emme kat sayısı (2,6 – 2,9 kg/m².h) kireç taşlarına göre yüksek olmasına rağmen kolay işlenmesi, ekonomik olması ve iyi bir ısı yalıtım malzemesi olması nedeniyle yapı taşı olarak tercih edilmektedir **[28; 3; 29]**. 2000°C'lik ısıya karşı dayanıklı olması nedeniyle tuğla fabrikaları, kireç ocakları, yöreye özgü etli ekmek fırınları, pide ve taş ekmek fırınlarının tabanlarında kullanılmakta, restorasyon ve dekorasyon amaçlı olarak kullanılmakla birlikte; kaydırmazlık özelliğinden dolayı yüzme havuzu kenarlarında da kullanılabilmektedir **[23]**. Sille taşının hurdası da iyi sıkışması ve ekonomik olması nedeniyle, yollarda zemin dolgu malzemesi olarak kullanılmaktadır **[22]**. Sille yöresinde, Sille taşından yapılmış çok sayıda kilise, çeşme, cami, hamam, mezar taşı ve tarihi yapılar mevcuttur (Görsel 5, 6, 7 8). Bunlardan bazıları; Mezeryaka Cami, Karataş Cami, Tepe Şapeli (Süt Kilisesi), Subaşı Hamamı, Sille Müzesi, Sille Evleri, Ak Manastır, Aya Elenia Kilisesi ve Hacı Ali Ağa Hamamı'dır **[30]**.

Görsel 5. Sille Taşının Kullanımına İlişkin Örnekler [13].

Görsel 6. Sille Taşının Kullanımına İlişkin Örnekler [Orijinal, 2021].

Görsel 7. Sille Taşının Kullanımına İlişkin Örnekler [Orijinal, 2021].

Görsel 8. Sille Taşının Kullanımına İlişkin Örnekler [Orijinal, 2021].

4. GENEL DEĞERLENDİRME VE SONUÇLAR

Sille taşının, çalışma alanı ve yakın çevresinde yer alan sivil mimari örneklerinde sıklıkla kullanılan bir yapı taşı olduğu tespit edilmiştir. Peyzaj mimarlığı uygulamalarında da yer bulan Sille taşının, "duvarlar, yollar, yüzey kaplamaları, su ögeleri, kaya bahçeleri ve sanatsal objelerde" kullanım olanaklarına ilişkin değerlendirmeler aşağıda sırasıyla açıklanmıştır.

Duvarlar: Mimaride en bilinen sınır elemanları olarak kullanılan duvarlar, mekânı kuşatan aynı zamanda iç ve dış kısım arasında bir arayüz oluşturan yapılardır **[31].** Plan üzerinde varlığı net hissedilemeyen duvarlar, uygulama sonrasında alanın en baskın konstrüksiyon unsurları haline gelebilmektedir. Farklı yüksekliklerde uygulanabilen duvarların düşeyde kapladığı alan hesaplandığında, harcanan malzeme miktarı ve işgücünün fazlalığı da ortaya çıkmaktadır. Duvarların diğer sınır elemanlarıyla temel farkı, geçirimsizliği ve dirençli olmasıdır. Sille taşı, duvarda temel yapı taşı olarak kullanılabildiği gibi, kaplama materyali olarak da kullanılabilmektedir. Görsel 9'da çalışma alanında tespit edilen duvar kullanımlarına ilişkin örnekler verilmiştir.

Görsel 9. Sille Taşının Duvarlarda Kullanımına İlişkin Örnekler [Orijinal, 2021].

Sille taşı sağlamlığı nedeniyle duvar inşaasında tek materyal olarak kullanılabileceği gibi, farklı materyallerle birlikte de kullanılabilir. Harçlı duvar yapımına uygundur. Geleneksel dokuda

duvar yükseklikleri göz seviyesini geçmemekte, yüksek engeller genellikle duvar üstü geçirgen sınırlarla sağlanmaktadır. Sille taşı, renk özellikleri bakımından da dikkat çekmekte, özellikle ahşap doku ile uyum sağlamaktadır. Yüzeyinin pürüzlü olması iç ve dış mekânda doğallık hissini artırmaktadır. Gerek estetik görünümler elde edebilmek, gerekse fonksiyonel kullanımlar oluşturabilmek amacıyla Sille taşının elde işlenebilme özelliğinden yararlanılabilir. Sille'de geleneksel mimari anlayışın sürdürülebilirliği ve kent kimliğine katkı sunması bakımından Sille taşının, konut bahçeleri ve kentsel kamusal alanların kuşatılmasında kullanılması önerilmektedir. Park ve bahçelerde yaygın kullanımlar olan oturma duvarları ve amfitiyatroların yapımında da kullanılabilecek niteliktedir.

Yürüyüş Yolları: Mekânsal kullanımlar arasındaki bağlantıları oluşturan yollar, peyzaj tasarım projelerinin iskeletini oluşturan yapısal ögelerdir. Etkisi plan üzerinde de hissedilen yollar, uygulama sonrasında mekânda en çok kullanılan yapısal unsurlar olmaktadır. Görsel 10'da çalışma alanında tespit edilen Sille taşı ile yapılmış yol uygulamalarına ilişkin örnekler verilmiştir.

Görsel 10. Sille Taşının Yürüyüş Yollarında Kullanımına İlişkin Örnekler [Orijinal, 2021].

Yol uygulamalarında kullanılan materyalin sağlam, geçirgen, güvenli, ekolojik ve estetik olması aynı zamanda proje maliyeti bakımından da ekonomik olması beklenmektedir. Gözenekli bir yapıya sahip olan Sille taşı geçirgen olması nedeniyle yağış sularını kolay drene edebilmekte, kayganlaşmamakta ve kullanıcı için güvenli yürüyüş imkânı sağlayabilmektedir. Doğaltaşlarda geçirgenlik özelliği, taşın dayanımını azaltan bir etkendir. Sille taşı için ölçülen değer bazı yapıtaşlarına göre yüksek olmakla birlikte; betonun geçirgenlik değerinden daha düşüktür **[3].** Sille taşının yapı taşı olarak kullanıldığı, geçmişten günümüze kadar ayakta kalan mimari örnekler de dayanıklılığını kanıtlamaktadır. Tasarım konseptine bağlı olarak yollar, formal veya informal şekilde uygulanabilir. Derzli veya derzsiz olarak kullanılabilen taşın, özellikle konut bahçesi dışındaki mekânsal uygulamalarda, kullanıcı yoğunluğundan dolayı derzli kullanımı önerilmektedir. Proje konseptine bağlı olarak bordürlü veya bordürsüz olarak

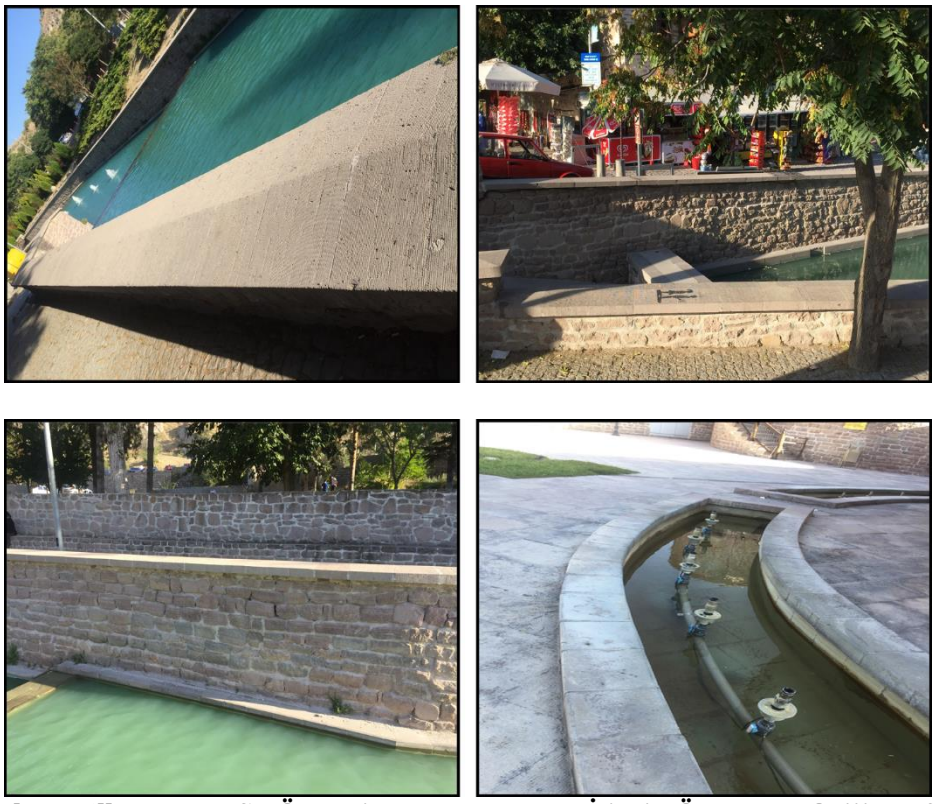
uygulanabilir. Renk ve doku özellikleri ile taş duvarlar ve ahşap yüzeyler ile estetik kompozisyonlar oluşturmaya olanak sağlamaktadır.

Yüzey Kaplamaları: Sille taşının çalışma alanında yatay ve düşey yüzeylerde birçok alanda kullanılabildiği görülmektedir. Görsel 11'de yüzey kaplamalarında kullanımına ilişkin örnekler verilmiştir.

Görsel 11. Sille Taşının Yüzey Kaplamalarında Kullanımına İlişkin Örnekler [Orijinal, 2021].

Sille taşı özellikle, yapıların dış cephe kaplamalarında, bahçe duvarı kaplamalarında ve iç cephe kaplamalarında kullanılmaktadır. Kentsel kamusal alanda estetik görüntüler elde edebilmek amacıyla trafo vb. unsurların cephe giydirmelerinde kullanılması önerilmektedir. Yatay yüzeylerde ise zemin kaplama materyali olarak kullanılabilir. Trafiğe kapalı yollar ve meydanlarda, yalnızca yaya dolaşımına açık oturma ve dinlenme alanlarında zemin döşeme materyali olarak kullanılabilir.

Su Ögeleri: Peyzaj tasarımında su; görsel, işitsel, psikolojik, fonksiyonel, ve rekreatif amaçlarla kullanılmaktadır **[32].** Tasarım konsepti, mekânın büyüklüğü, kulanıcı türü, kullanıcı yoğunluğu ve talepler gibi faktörler, peyzaj projesinde yer verilecek su ögelerinin türünü belirlemektedir. Görsel 12 ve 13'te Sille taşının su ögeleri ve çevresinde kullanımına ilişkin örnekler verilmiştir.



Görsel 12. Sille Taşının Su Ögelerinde Kullanımına İlişkin Örnekler [Orijinal, 2021].

Görsel 13. Sille Taşının Su Ögelerinde Kullanımına İlişkin Örnekler [Orijinal, 2021].

Sille taşının yüzeyinin geçirgen ve pürüzlü olması nedeniyle, su çevresinde güvenli ortam oluşturmaktadır. Yüzme havuzlarının yakın çevresinde, güneşlenme teraslarında, su ögeleri üzerinde oluşturulan köprülerde, fıskiyeli su ögelerinde, kaskatllı havuzlarda, kanal ve gölet çevreleri ile nilüfer havuzlarında kullanılabilir. Kullanımı ülkemizde de giderek yaygınlaşan; görsel, işitsel ve dokunsal duyulara hitap eden kuru havuz uygulamaları, çalışma alanının iklim koşulları da dikkate alındığında, yöre için cazip kullanımlardan biri olarak önerilebilir. Sille taşının kaydırmazlığı nedeniyle kuru havuzlarda kullanımı önerilmektedir. Bu kullanımların dışında; kuyu, çeşme, kuş havuzu vb. su ögelerinin yapımında da Sille taşı, cazip bir materyal olarak değerlendirilebilir.

Sanatsal Objelerde Kullanım: Elde işlenebilir olma özelliğinden dolayı, Sille taşının sanatsal çalışmalarda kullanılabileceği düşünülmektedir. Az sayıda rastlanan örnekleri Görsel 14'te verilmiştir. Daha çok, madenden çıkarılan ve farklı bir özelliği (renk, büyüklük, doku vb.) ile ön plana çıkan doğal örnekler sergilenmektedir. Bu örneklerin kamusal alanlarda sergilenmesi, jeolojik bir miras olan Sille taşının hem yörede yaşayanlar hem de kenti ziyaret edenler

tarafından tanınmasına katkı sağlayacaktır. Taşın sergilendiği yüzeyin çim alan ya da taşın rengi ile tezat oluşturacak renklerde bir döşeme malzemesi olmasına, objenin çevresinde kullanıcıların duraklamasına olanak sağlayacak büyüklükte mekân oluşturulmasına dikkat edilmelidir.

Görsel 14. Sille Taşının Sanatsal Objelerde Kullanımına İlişkin Örnekler [Orijinal, 2021].

Kaya Bahçeleri: Peyzaj tasarım projelerinde kaya bahçeleri, otsu ve odunsu, tek yıllık veya çok yıllık birçok farklı bitki türünün bir arada sergilenebildiği, kendi içerisinde bir ekosisteme sahip kaya ve bitki kompozisyonlarıdır. İklim ve toprak koşulları bakımından uygun yer ve tür seçimi ile başarılı kaya bahçeleri oluşturmak mümkündür. İyi tasarlanmış ve uygulanmış kaya bahçeleri, kullanıcılar için ilgi çekici odaklar oluşturmaktadır. Gözenekli tüf taşları, kireçtaşları, granitler, bazalt ve kumtaşları kaya bahçelerinin yapımında kullanılan taş türlerinden bazılarıdır **[33].** Andezit tüf özelliği gösteren Sille taşı ile bölgede çıkarılan kireçtaşları, kaya bahçelerinin yapımında değerlendirilebilir. Özellikle artık olarak nitelendirilen uygun büyüklükteki parçaların kaya bahçelerinde kullanılması, farklı alanlarda faydalanılamayacak olan materyalin değerlendirilmesi bağlamında önerilmektedir.

Çalışma kapsamında araştırılan Sille taşının, farklı alanlarda birçok kullanıma olanak sağladığı görülmektedir. Sille kent silüetinde önemli bir yeri olan ve geleneksel mimaride geçmişten beri kullanılan Sille taşı, aynı zamanda ülkemizin jeolojik miraslarındandır. Sürdürülebilirliği, değerinin bilinerek doğru alanlarda kullanılmasına bağlıdır. Çalışmanın Sille taşı ve Sille kültürel kimliğinin korunması konusunda farkındalık sağlaması, tasarımcı ve uygulayıcılara malzeme bilgisi konusunda katkı sunması beklenmektedir.

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INVESTIGATION OF THE EFFECT OF KOFLO BLADE MIXER BLADE CROSSING INCLINATION ANGLE ON LAMINAR FLOW HEAT TRANSFER PERFORMANCE BY A CFD STUDY

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ABSTRACT

In this study, the effect of mixer blade crossing inclination angle (ß) on the heat transfer performance of Koflo Blade static mixer positioning into the laminar incompressible tube flow area where uniform heat flux is applied was investigated by CFD method with ANSYS Fluent software. The effect of positioning mixer models with ß values are 150°, 135°, 120°, 90°, 60°, 45° and 30° in the tube flow area on heat transfer and resistance to flow was evaluated. The static mixer positioned in the laminar flow area supports vortices in the flow and improves the convectional heat transfer. The decrease in the ß has developed this effect. The improvement in heat transfer strengthens the cooling performance of the tube and causes a decrease in tube surface temperature with mixer application and decreasing ß. An increase in Nusselt (Nu) number was observed with mixer application and a decrease in ß. Positioning of mixer models with decreasing ß cause an increase in Nu number are 30.94%, 43.86%, 50.23%, 56.5%, 66%, 70.69% and 75.69%. The friction factor increased with the mixer application and the decrease in the ß. The performance evaluation parameter increased by 20.38%, 35.14%, 62.55%, 111.17%, 145.86%, 193.15% with the mixer application and decrease in ß. The heat transfer improvement could be doubled by changing the ß.

Key Words: Koflo Blade static mixer, heat transfer, blade crossing inclination angle, performance evaluation parameter.

1. INTRODUCTION

Vortex generators are used to disorder the boundary layer and flow to improve heat transfer in heat pipes (Ali et al., 2015). Applications of swirling flow devices, rough surfaces, extended surfaces, coiled tubes, and surface coatings are popular to increase the efficiency of convective heat transfer (Kwon et al., 2019). Static mixers have found many applications, including blending, reaction, dispersion, heat, and mass transfer. They improve mixing, heat, and mass transfer efficiency compared to the plain tube (Jaffer & Wood, 1998). The common belief in the literature is that a flow inducer that causes mixing and rotation can increase heat transfer and be integrated into channels or pipes. Some examples of studies in the literature that reinforce this view are given as follows. Habchi et al. studied the heat transfer performances of perforated trapezoidal vortex generators. They assert that the heat transfer performance is enhanced from 40 to 80% regarding plain tubes (Habchi et al., 2021). Feng et al. studied the design of inline mixers and investigated hydrodynamic and heat exchange performance them. The mixing intensity simulations confirm the superior mixing performance of the designed

mixer (Feng et al., 2021). Jiang et al. concluded an enhanced heat transfer performance with different structure vortex generator fitted flow domains. They obtained an approximately 11.07% increase in Nu number (Y. Jiang et al., 2021). Regner et al. aimed to find a way to characterize and investigate the effects of flow rate and the geometry of the mixer elements on secondary flow and the mixing process in static mixers under laminar flow conditions. They concluded that the mixing process is the most efficient at low flow rates since the distribution in striation thickness is narrow, and the pressure drop is much lower than at high flow rates (Regner et al., 2006). Wang et al. studied the laminar hydrodynamics and heat transfer performance of highly viscous fluid in a Sulzer mixer. They observed an increase of Nu number by 2.2–40.6% compared with straight tubes (Wang et al., 2021). Jiang et al. investigated the effect of aspect ratio on the mixing performance of the Kenics static mixer. The results indicate that a low aspect ratio causes a shorter mixing time and mixer length (X. Jiang et al., 2021). Liang et al. studied an integral electrochemical system to treat water pollutants constituted with a static spiral mixer. They commented that the spiral mixer could efficiently enhance the heat transfer (Liang et al., 2021). Shahbazi et al. numerically studied the thermo-fluid performance of static mixers. They concluded an increase in heat transfer and pressure drop (Shahbazi et al., 2021). Abotsi et al. studied the flow and heat transfer in a pipe equipped with a Kenics mixer. They related heat transfer enhancement with the structural properties of the Kenics mixer that causes the acceleration of flow and enhanced fluid mixing (Abotsi & Kizito, 2020). Nyande et al. modified a Kenics static mixer design to enhance its hydrodynamic performance. They obtained efficient mixing and low-pressure drop (Nyande et al., 2021). This study investigates the impact of Koflo Blade static mixer blade ß value change on the thermal and hydrodynamic properties of laminar incompressible constant airflow under constant heat flux. Considering that a limited number of studies in the literature on Koflo Blade static mixers, which are widely used in the industrial field, this CFD study was carried out to contribute to the field.

1.1. Data Reduction

Applied steady heat transfer (q_{conv}) on the tube equally transferred to fluid flow body by convection. Heat relation can be equated as in Eq. (1) and Eq. (2) (Papazian et al., 2020).

$$q_{conv} = q_f \tag{1}$$

$$q_{conv} = h(T_{tw} - T_b) \tag{2}$$

h is the convective heat transfer coefficient, A_{tw} is the tube wall surface area, T_{tw} is the mean tube wall temperature, T_b is the bulk fluid temperature. The tube inner flow Nu number can be equated as in Eq. (3) (Dalkılıç et al., 2020).

$$Nu = \frac{hd_h}{k} \tag{3}$$

d_h is the hydraulic diameter of the tube, k is the thermal conductivity of the fluid. The friction factor can be calculated with Eq. (4).

$$f = \frac{2d_h\Delta P}{\rho u^2 l} \tag{4}$$

ΔP is the pressure drop through the tube length, ρ is the fluid density, u is the flow velocity, l is the tube length. While the static mixer placed in the flow area acts on the heat transfer, it may cause a pressure drop due to the resistance formed in the flow area. The proportional benefit between the positive effect on heat transfer and the negative effect on pressure can be related and evaluated with the performance evaluation parameter (η) in Eq. (5) (Fagr et al., 2020).

$$\eta = \frac{\frac{Nu}{Nu_{pt}}}{\left(\frac{f}{f_{pt}}\right)^{\frac{1}{3}}} \tag{5}$$

Nu_{pt} and f_{pt} are Nu number and friction factor of the plain tube. The conservation equations that are mass, momentum, and energy for incompressible, steady-state laminar flow under uniform heat flux can be estimated with Eq. (6), Eq. (7) and Eq. (8) (Yaïci et al., 2014; Zhang & Wang, 2017)

$$\nabla . \rho u = 0 \tag{6}$$

$$\rho(u.\nabla)u = -\nabla P + \mu\nabla^2 u \tag{7}$$

$$\rho c_p(u.\nabla)T = k\nabla^2 T \tag{8}$$

∇ is the del operator, μ is the dynamic viscosity of fluid, c_p is the specific heat constant.

2. NUMERICAL SIMULATION

In this computer-based numerical study, Koflo Blade static mixer (Koflo Corporation) models with different blade ß orientations and tube geometry were created with Solidworks 2021 software. The mixer blade ß are modeled as 30°, 45°, 60°, 90°, 120°, 135° and 150°. Variation in thermal and hydraulic properties with the placement of different blade ß mixer models into the tube has been studied with ANSYS Fluent 2020 R2 software for laminar steady incompressible tube flow under constant heat flux. Observations were made in the region where the tube flow completed both hydrodynamic and thermal development. Static mixers are placed in the fully developed region of the flow. The models were meshed using ANSYS Meshing software. The details and boundary conditions of the numerical analyses are visualized in Figure 1.

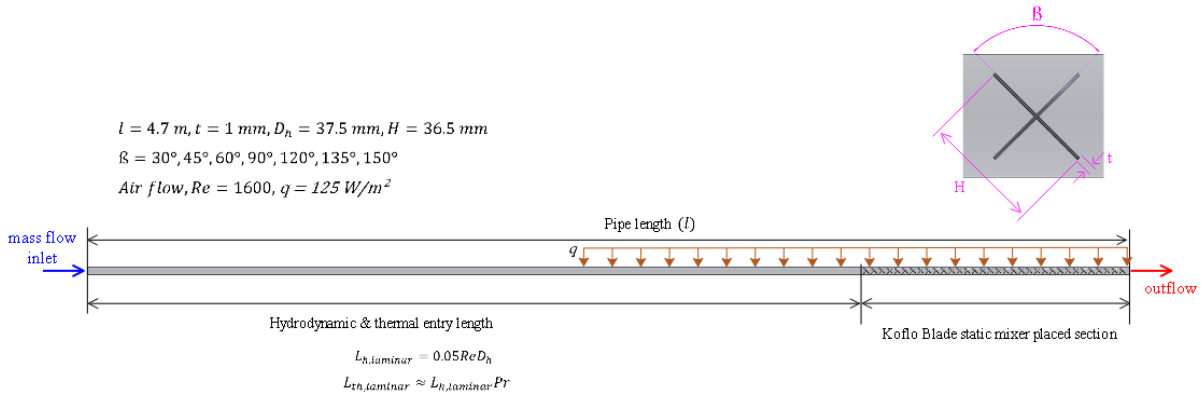

Figure 1. Analyzed model size and boundary conditions.

The no-slip condition is defined for the tube wall and mixer surfaces. A steady mass flow is defined at the inlet region. 125 W/m² uniform heat flux is exposed to the investigated part of the tube. Exit boundary is assigned outflow. The conservation relations are mass, momentum, and energy were solved iteratively with Fluent. A grid independence test was performed to ensure that the grid size did not affect the analysis results. An increasing number of grid element models were analyzed, and variations of local temperature of the plain tube were visualized in Figure 2.

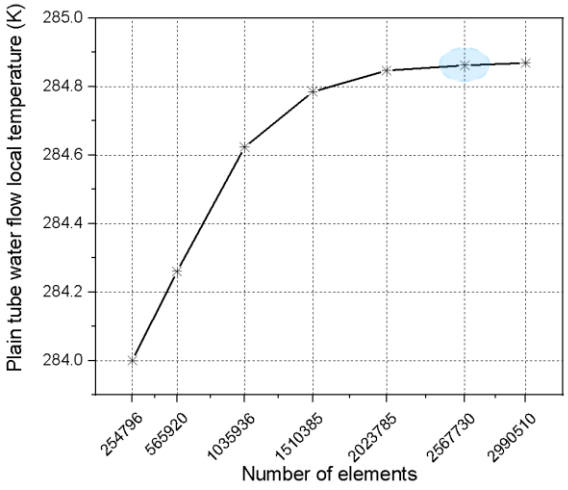

Figure 2. Grid independency.

Local temperature variation reaches a negligible level by the increase in the number of grid elements, as seen in Figure 2. The model has a 2567730 number of elements has a relative deviation lower than 0.01% due to the 2023785 number of element model. Further, an increase in the number of grid elements only increases the computational time and cost. Analyses were done with 2567730 number of grid elements model. Numerically predicted local Nu numbers through the plain tube length were also compared with similar experimental study results from the literature and presented in Figure 3.

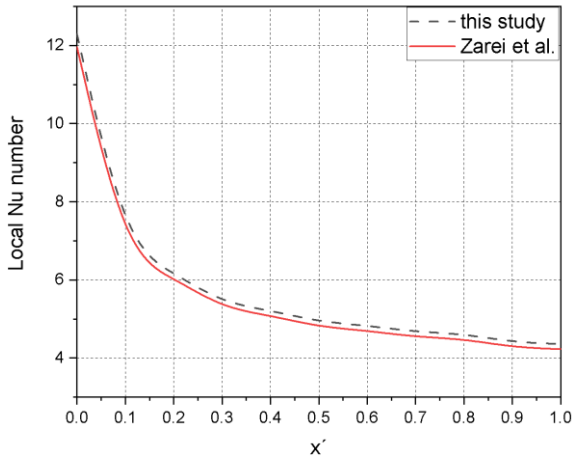

Figure 3. Validation of study by comparing the results with ref. (Zarei et al., 2021) (x' is the dimensionless length).

Numerically obtained local Nu numbers agree with the experimental results from the literature, as seen in Figure 3.

3. RESULTS AND DISCUSSION

The effect of the ß of static mixer blades on the vorticity and tube wall temperature of a tube laminar airflow has been investigated. Average temperature and vorticity values were taken from the heat flux applied section of the tube and the tube wall adjacent region of the flow domain. Reached results are visualized in Figure 4.

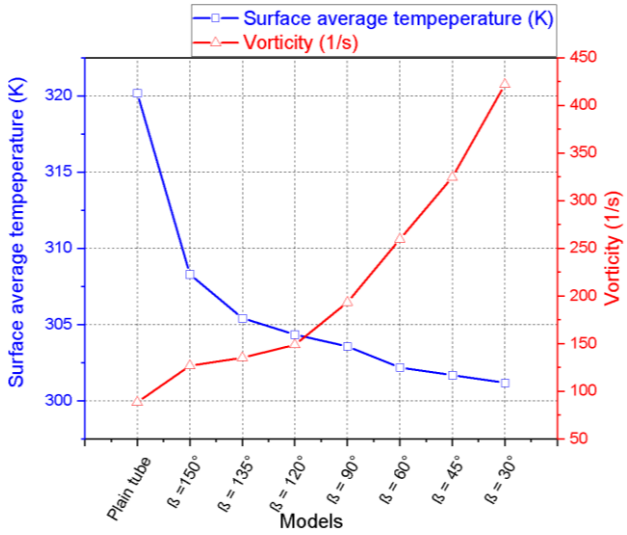

Figure 4. Average tube wall surface temperature and flow vorticity.

The change in the average vorticity values taken from the close region to the wall along the tube in Figure 4 is examined and compared for plain tube and mixer application with different blade ß. It is observed that the vorticity values increase with the decrease in the mixer blade ß. In contrast, the minimum vorticity value in plain tube flow is 88.38 1/s, the placement of static mixer increases. Reduction in ß enhance the vorticity, it reaches to 126.78 1/s at 150°, 135.15 1/s at 135°, 148.69 1/s at 120°, 193.12 1/s at 90°, 259.53 1/s at 60°, 324.37 1/s at 45° and 421.8 1/s at 30°. The proportional increase in vorticity with the static mixer and the decrease in ß was 43.43%, 52.91%, 68.22%, 118.49%, 193.62%, 266.99%, and 377.21% relative to plain tube values. The increase in vorticity means the formation of chaotic mixing. Forcing the flow from the tube center to the wall region causes an increase in flow velocity and mixing effect in the area close to the wall. This case provides the development of convection heat transfer. A similar judgment has been mentioned in the previous paper as high vorticity and circumferential velocity implies a high turbulence energy dissipation rate and thus high mixing efficiency. Vortices enhance mixing the fluid close to the wall and in the core region of the flow domain. This case causes a local heat transfer enhancement along the wall and the heat transfer from the wall to the core of the flow (Ferrouillat et al., 2006). In this context, the effect of the improvement in heat transfer on the temperature was observed by evaluating the tube surface average temperatures. The applied heat on the tube is transferred to the fluid with a minimum heat transfer rate and is removed from the tube surface slowly for the plain tube. So, the cooling performance of the plain tube is minimal, as seen in Figure 4, and the maximum tube surface temperature was determined for the plain tube as 320.17 °C. The heat transfer rate increases

with the static mixer application by convection from the surface to the tube center. This idea can be predicted by the decrease in temperature on the tube surface. In Figure 4, the decrease in tube surface temperature can be seen with the static mixer application. The decrease in the static mixer ß has created an effect that strengthens the increase in heat transfer and develops the tube wall's cooling. By the placement of static mixers which have ß are 150°, 135°, 120°, 90°, 60°, 45° and 30° into the plain tube, tube surface average temperatures are reached to 308.29 °C, 305.42 °C, 304.34°C, 303.55 °C, 302.18 °C, 301.68 °C, and 301.17 °C. When the plain tube is taken as reference, proportional decreases in temperature were observed as 3.71%, 4.6%, 4.94%, 5.19%, 5.61%, 5.77%, 5.93%. Static mixers, which are in the flow area and contribute to the improvement of heat transfer, also cause resistance to flow and pressure drop in the flow area. The variation of Nu number, which is an indicator of heat transfer performance, and the friction factor, which is an indicator of resistance to flow and therefore pressure drop, with the application of a static mixer are visualized in Figure 5. By establishing a proportional relationship between the improvement in heat transfer and the resistance against the flow, the effect of the static mixer application on the process gain can be interpreted with the performance evaluation parameter as given in Figure 5.

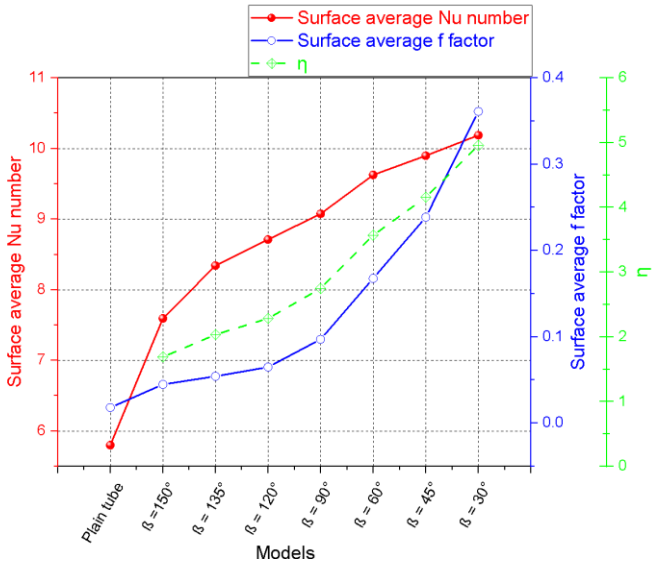

Figure 5. Nu number, friction factor, and performance evaluation parameter.

Nu number curves given in Figure 5 visualized that heat transfer can be improved with a static mixer placed in a plain tube. The geometrical decrease in the static mixer blade ß increased the chaotic mixing in the flow body, and the increase in Nu number determined the improvement in heat transfer. The placement of mixer models in the flow area at 150°, 135°, 120°, 90°, 60°, 45°, and 30° blade ß, create 30.94%, 43.86%, 50.23%, 56.5%, 66%, 70.69% and 75.69% increase in Nu number compared to plain tube. The increase in the Nu number indicates the improvement in heat transfer. It is undeniable that a mixer in the flow region will create resistance and cause a pressure drop compared to a plain tube. The increased resistance against flow due to the positioned mixer by increased friction factor is visualized in Figure 5. The decrease in Mixer blade ß supported the increase in friction factor, as seen in Figure 5. A decrease from 150° to 90° ß caused a slight increase in friction factor, while a decrease from 90° to 30° caused a significant increase in friction factor. It may be misleading to evaluate only

the Nu number or friction factor for the gain-loss evaluation of the application. This confusion was eliminated with the performance evaluation parameter that is mentioned in the literature. By the way, optimum modeling that will provide maximum thermal improvement and minimum pressure drop in the flow field is defined. The performance evaluation factor values calculated for this study are visualized in Figure 5. It is seen that the performance evaluation factor increases with the static mixer positioned in the plain tube. It is also seen that the decrease in the static mixer blade ß supports the increase in the factor. Performance evaluation parameter is increased by 20.38%, 35.14%, 62.55%, 111.17%, 145.86%, 193.15% with model applications with blade ß of 150°, 135°, 120°, 90°, 60°, 45°, and 30° compared to plain tube. It is concluded that almost twice the heat transfer performance can be achieved by placing a Koflo Blade static mixer with variable ß of blade structure in a tube.

4. CONCLUSIONS

The effect of Koflo Blade static mixer blade ß on laminar tube flow heat transfer was numerically investigated with ANSYS Fluent software on models with uniform heat flux. The mixer blade ß was evaluated as 150°, 135°, 120°, 90°, 60°, 45°, and 30°. The study was done on steady, incompressible, laminar, hydrodynamic, and thermal fully developed airflow modeling. It has been concluded that the mixer models positioned in the plain tube and the decreasing mixer blade ß support the chaotic flow in the flow area, which increases the heat transfer. Heat transfer from the tube wall to the cold fluid increased with the mixer application and the reduction of the mixer blade ß. This case was observed with the decrease in the tube surface temperature. Mixer placement in the tube and decreasing blade ß increased Nu number by 30.94%, 43.86%, 50.23%, 56.5%, 66%, 70.69% and 75.69%. The mixer application and the decrease in the mixer blade ß caused an increase in the resistance to the flow. It is determined by the observed increase in the friction factor. The improvement in heat transfer performance was achieved by calculating the performance evaluation parameter. The performance evaluation parameter was determined to increase by 20.38%, 35.14%, 62.55%, 111.17%, 145.86%, 193.15% depend on the mixer application and the decrease in the ß of the mixer blade. These values showed that the heat transfer performance could be doubled with the varied mixer blade ß.

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SOME BOUGAINVILLEA SPECIES AND CHARACTERISTICS AND REPRODUCTION TECHNIQUES

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ABSTRACT

The family *Nyctaginaceae* includes 300-400 species of trees, shrubs, and herbaceous deciduous and evergreen plants, classified into about 30 genera. *Bougainvillea* belongs to the *Nyctaginaceae* (four o'clock) plant family, with 14 species. Bougainvillea is a common tropical and subtropical ornamental plant that may be cultivated in containers in cooler climates throughout the summer.The name comes from the French navigator and military commander Louis Antoine de Bougainville (Louis Antoine de Bougainville), he was the first European to notice the Brazilian factory. Climbing plant with thorns that branch every year, it grows in a chaotic manner and may reach up to 9 m in height. The plant is utilized as a hedge, a barrier, and a slope cover. Bougainvillea is a great ground cover for vast, difficult-to-maintain regions. It may blanket an entire slope and suffocate weed growth. Use the leaves of *Bougainvillea* as medicine for a variety of gastrointestinal disorders like diarrhea and acidity. Furthermore, *B, glabra* anti-diarrheal activity has been observed to be related to the antimicrobial property. Propagation of these plants is primarily propagated by stem cuttings, but lack of competence to form adventitious roots by cuttings occur routinely and are an obstacle for the vegetative propagation. It's the best method to use to clone your plants, which means to produce plants identical to their parents. It involves methods like cutting, division, layering, grafting, budding, and tissue culture techniques. These techniques are commercially exploited mainly to produce horticulture plants.

Keywods: *Nyctaginaceae*, *Bougainvillea*, Ornamental plants, plant propagation.

1. INTRODUCTION

The concept of landscape and ornamental plants is extremely important in the planning of sustainable, holistic and identity cities. Ornamental plants are of great importance in the said landscape planning and designs. In this context, it is necessary to know the ecological demands, physiological and morphological characteristics, reproduction techniques of ornamental plants. In plant design studies; the ecological characteristics of plants, their importance in terms of landscape, the correct selection of their use, and purpose in the landscape are also of great

importance. In addition, the primary purpose of plant design is to contribute to space functionally, and thus, it can respond to the requests of the users. Plants play an important role in preventing the "urban heat island" effect (Hatipoglu and Ak, 2021).

Bougainvillea is a common tropical and subtropical ornamental plant that may be cultivated in containers in cooler climates throughout the summer. They may be overwintered in a sunny location outdoors or inside, or they can be replanted each year as an annual. (Gilman, 1999). *Bougainvillea* belongs to the *Nyctaginaceae* (four o'clock) plant family, with 14 species (Kobayashi et al.,2007). The family of *Nyctaginaceae* includes 300-400 species of trees, shrubs, and herbaceous deciduous and evergreen plants, classified into about 30 genera (Mabberley, 1987). The name comes from the French navigator and military commander Louis Antoine de Bougainville (Louis Antoine de Bougainville), he was the first European to notice the Brazilian factory in 1768. The plant is utilized as a hedge, a barrier, and a slope cover. Bougainvillea is a great ground cover for vast, difficult-to-maintain regions. It may blanket an entire slope and suffocate weed growth (Eed et al., 2015). Bougainvillea is a specimen plant that may be used in hanging baskets, containers, and bonsai (Kobayashi et al, 2007). Modernization and urbanization have increased the usage of bougainvillea since landscape horticulture is gaining popularity and demand owing to a large-scale plantation in urban areas, drought and pollution tolerance, minimal care needs in comparison to other plants, and a variety of uses. (Singh et al.,2017). *Bougainvillea* species grow best in full sun. High light intensity is required for good flowering. Low light and shady areas are not suitable, as the plants will drop their bracts. Bougainvillea does best at elevations from 10 to 2500 feet and can tolerate hot dry locations, with temperatures over 100°F. It does well in locations with a minimum of 65°F at night and 75–95°F during the day as well grows well in rich, well-drained, acidic (pH 5.5–6.0) soil. It does not thrive in soil that is constantly wet. Proper soil pH is essential because it affects the availability of mineral elements (Kobayashi et al.,2007).

Some species of Bougainvillea plants:

Bougainvillea glabra: The elliptical leaves of this climber, an evergreen member of the genus are green or variegated and have a glossy shine. The bracts of this plant occur in a variety of sizes and forms. They are usually triangular and purple or mauve in color, but white bracts are sometimes frequent. The bracts occur along the branches and at the tips of the branches. The blooms range in hue from white to cream. The thorns are short and have a curled point. The green-leaf types grow quickly, and the growth habit is spreading.

Bougainvillea spectabilis: Hairy leaves and stems distinguish this species. Large, ovate leaves with rippling around the edges and hairs on the underside. The small flowers are cream-colored, while the bracts are red, dark pink, or purple. Thorns could be large and curved. The species has a dense growth habit, and the colorful bracts appear up and down the branches.

Bougainvillea hybrids: Among Bougainvillea's horticultural hybrids, B. *glabra* x B. *peruviana* is by far the most common. This cross has its own hybrid name: *Bougainvillea x buttiana*. The leaves are large and ovate or heart-shaped with slight hairiness on both the upper and lower sides. The bracts are usually rounded, red or dark pink, and the thorns are straight and short. The small flowers are cream colored with pink tones, although the floral tube may be the same color as the bract. The growth habit is open and requires pruning to promote a

bushy appearance. B. x buttiana hybrids generally bloom several times a year (Kobayashi et al.,2007).

2. REPRODUCTION TECHNIQUES

Reproduction techniques or propagation techniques is simply multiplication or production of plants, which you can do by using your own plants! Because of the commercialization of crops, several techniques have been developed to grow plants. All techniques are designed to achieve specific goals, like uniformity in crops, increased productivity, disease-resistant plants, and plants with desired characters. Mainly these techniques are divided into two categories depending on the means of propagation: sexual means of propagation and asexual means of propagation.

2.1. Sexual propagation

Propagation or multiplication of plants by seeds is known as 'sexual propagation'. Seeds are formed as a result of successful fertilisation and combination of parental gametes. It is an old and easy method and is widely used for the propagation of crops like ornamental annuals, vegetables, medicinal and fruit plants, such as papaya. The disadvantages of this technique are delayed flowering and fruiting, plants that do not produce seeds can not be propagated by this method, identical plants can not be produced, and mass production is harder to achieve.

2.2. **Asexual propagation**

Vegetative production, which is carried out by using the organs of plants such as roots, branches and leaves, allows plants to be produced as a clone. Vegetatively propagated rootstocks produce certain and identical effects on the variety (Ak et al., 2021). It's the best method to use to clone your plants, which means to produce plants identical to their parents. It involves methods like cutting, division, layering, grafting, budding, and tissue culture techniques. These techniques are commercially exploited mainly to produce horticulture plants. Because vegetative propagation is a form of asexual reproduction, plants produced through this system are genetic clones of a parent plant. This uniformity has advantages and disadvantages.

One advantage of vegetative propagation is that plants with favorable traits are repeatedly reproduced. Commercial crop growers can employ artificial vegetative propagation techniques to ensure advantageous qualities in their crops. A major disadvantage, however, of vegetative propagation is that it does not allow for any degree of genetic variation. Plants that are genetically identical are all susceptible to the same viruses and diseases and crops produced through this method are, therefore, easily wiped out. Bougainvillea plants are propagated from cuttings, by ground or air layering and budding (Singh et al., 2012).

2.3. Effect of IBA on rooting ability of cuttings

Plant growth regulators are the natural or synthetic compounds that modify the growth and development of plants by influencing their physiological processes and thereby increasing the productivity of crops (Kakimoto, 2003). Application of some plant growth retardants to improve rooting ability and survival in several plant species (Hartmann and Kester, 1975). Plant growth regulators Horticulturists utilize them to study and manage plants for specific

objectives, and they are usually applied in small quantities measured in parts per million (ppm) et al., 2014). Root initiation in cuttings is influenced by a number of factors, including plant growth regulators, plant age, growth medium, and cutting size (Husen and Pal, 2006). Plant growth regulators allow the development of adventitious roots by promoting the initiation of the root primordium and cell division expansion (Fogaca and Fett-Neto, 2005). Furthermore, this growth hormone enhances the rooting rate and percentage, root number and quality, and cutting rooting uniformity (Khoshkhooy, 2012). Indole-3-butyric acid (IBA) has been known as a manufactured auxin for a long period and is the main auxin used commercially for the adventitious root induction in stem or leaf cuttings (Srivastava, 2002).

Panwar *et al.,* (1994), reported that IBA at 2000 ppm was the best treatment, resulting in significantly more sprouting of cuttings, more roots, longer roots length, and a higher percentage of rooting of cutting of *bougainvillea cv.* Alok than the other treatments.

Ahmad *et al.,* (2002), indicated when treated hardwood stem cuttings of *Bougainvillea glabra var* with IBA at different concentrations (0, 1000, 2000, 3000, 4000, 5000) ppm that the maximum number of roots (15.00), root length (11.73 cm), root thickness (3.53 mm), number of branches (3.80) plant- 1, number of leaves (11.76) plant-1, sprouted cuttings (93.33%) was obtained from cuttings treated with 4000 mg.L-1. also, maximum Shoot length (36.33 cm), stem thickness (1.93 mm), and plant height (51.67 cm) were gained by hardwood cuttings when treated with IBA at 5000 ppm.

Gupta *et al.,* (2003), found that maximum rooting (100%) with higher number of roots (32.0) in Semi-hardwood cuttings of *Bougainvillea cv. 'Los BanosVariegata*when IBA at 1000 $mg.L^{-1}$ was used.

Siddiqui and Hussain (2007), indicated when treated stem cuttings of *Ficus hawaii* with IBA at different concentrations (0, 1000,2000, 3000, 4000, and 5000) mg.L-1.that the Maximum sprouting (43.7%) leaves per plant (63), plant height (37.46cm), shoots per plant (13), leaf area (19.33 cm2), shoot thickness (0.57 cm), root length (11.5 cm) and roots per cutting (13) were recorded in cuttings treated with 4000 ppm IBA.

Shadparvar *et al.,* (2011),mentioned that stem cutting of *Hibiscus rosa-Sinensis* increasing the percentage of rooting when treated with IBA at 2000 $mg.L^{-1}$.

Singh e*t al.,* (2011), observed that the maximum of cuttings rooted and produced a good number of roots with average root length when auxin (IBA) was used on hardwood cuttings of Torch Glory *Bougainvillea* especially 3000 $mg.L^{-1}$.

Amissah and Monney (2012), observed an increase in roots characters when auxin (IBA) was used on semi-hardwood cuttings of *Bougainvillea glabra* especially 2500 $mg.L^{-1}$.

Asl *et al.,* (2012), cleared from a study on the effect (0, 2000, 3000, and 4000) $mg.L^{-1}$ IBA on semi-hardwood cutting of *Bougainvillea flower* that 2000 $mg.L^{-1}$ IBA showed the best treatment as resulted to the number of roots (8.67 roots per plant)and highest root length (151.42 mm).

Singh (2012), The founded result that the hardwood cutting of *bougainvillea (Louise Wathen)* treated with 1000 ppm, gave 85.39% sprouting, 75.46% rooting, and 80.78% callusing.

Eed et al. (2015), observed that the highest values of rooting percentage, number of roots, and root length were obtained from the hardwood cutting stem of *Bougainvillea spectabilis* treated with 2000 ppm of IBA.

Kuldeep *et al.*, (2013), treated the hardwood stem cuttings of *bougainvillea (var. Thimma)* with IBA at different concentrations (0, 1000, 1500, 2000 ppm) $mg.L^{-1}$ noticed that the number of rooted cuttings (6.33), percentage of rooted cuttings (63.33%), length of shoots per cutting after one month (3.07 cm), length of shoots per cutting after two months (14.73 cm), number of roots per cutting (30.00), length of roots (12.85 cm) and dry weight of the roots (0.43 g) was showed from cuttings treated with 2000 $mg.L^{-1}$.

Mehraj *et al.*, (2013), revealed that when mature stem cuttings of *Bougainvillea spectabilis* treated with IBA showed significant differences in comparison with control especially 1000 $mg.L^{-1}$ which was superior over other treatments in all parameters (rooting percentage, roots number, length of longest root, leaves number per cutting, shoots number per cutting and shoot length) although both of 500 and 2000 $mg.L^{-1}$ resulted to the same rooting percentage but best rooting survival was obtained from 1000 $mg.L^{-1}$.

Shahab *et al.*, (2013), studied the influence of different concentrations of IBA (0, 5, 10, 15, and 20%) on stem cutting of *Alstonia*, the result showed regarding leaf area plant-1(26.032 cm2), sprout length (18.096 cm), stem diameter (14.44 mm), number of roots plant-1 (15.613), root diameter (3.412 mm) in cutting that treated with 10% of IBA.

Wagh *et al.*, (2013), discovered that the hardwood cuttings of *bougainvillea* variety Torch Glow observed the maximum increase of all growth parameters, with a minimum number of days for sprouting and rooting having maximum root length and number of leaves per cutting when treated with 2000 $mg.L^{-1}$ of IBA.

Roshoudi *et al.*, (2014), studied the effect of different IBA concentrations (0, 500, 1000, 1500, 2000, 2500, and 3000) ppm on rooting of hardwood cuttings of *Bougainvillea Spectabilis Willd*, showed results the highest rooting percentage, root fresh and dry weight, and root number when cuttings treated with 2000 ppm of IBA.

Seyedi *et al.*, (2014), treated stem cuttings (wood and semi hard wood) of *Bougainvillea glabra* L. with (0,2000,4000) $mg.L^{-1}$ of indole butyric acid, 4000 $mg.L^{-1}$ provided maximum rooting number and root length, root fresh weight in comparison to other treatment.

Abbas *et al.*, (2015), found that a Maximum number of roots (30.25), more number of leaves (7.5), and length of sprouting (19.16%) in stem cuttings of *Roses Cvs. Bajazzo* when IBA at 2000 mg.L-1 was used**.**

Costa *et al.*, (2015),revealed that the 2000 mg/l IBA resulted at 56 days the percentage of alive cuttings rooted and with shoots, number of shoots and roots per cutting, and the length of the longest root and highest bud were evaluated when wood cuttings of *Bougainvillea spectabilis* were used.

Ahmad *et al.*, (2016), treated stem cuttings of *Hylocereusundatus* with (0,50,75,100) ppm of IBA showed the best results in all the studied parameters with the highest root number (13.2), root length (12.7cm), root diameter (1.5mm), fresh weight (2.7g), and dry weight (0.8g) found in 100 ppm of IBA and the lowest of all these were found in control (6.3, 5.7cm, 0.9mm, 0.3g, 0.2g).

Sultana *et al.*, (2016), concluded that the use of rooting hormone (IBA) on *Bougainvillea* cuttings was a significant factor in improving rooting of cuttings in comparison with control other especially 400 $mg.L^{-1}$ which provided the highest number of root (25.38), longest root (23.53cm), and a higher percentage of success in rooting.

Babita *et al.,* (2017), noticed the 6000 ppm of IBA hormone in treating hardwood cuttings of *Bougainvillea (peruviana cv. Thimma*), gave the better rooting percentage (90.00%), length of the longest shoot (38.0 cm), shoot fresh wt./plant (22.333 g), shoot dry wt./plant (3.843 g), length of longest root/plant (18.233 cm), fresh wt. of root/plant (7.527 g) and dry wt. of root/plant (1.58 g).

Fathi *et al.,* (2017), observed when treated the stem cutting of bougainvillea *Bougainvillea spectabilis L.* with IBA different concentrations (1000, 2000, 3000, and 4000 ppm) that the highest rooting percentage, highest number of primary roots, longest primary roots, highest root fresh and dry weight was obtained from cuttings treated with 4000 ppm of IBA.

Singh (2017),discovered that hardwood cuttings of Phalsa plant (*Grewia asetica*L.) cv. Dwarf type recorded best results of rooting percentage, longest root length, roots number per cutting, roots dry weight, number of shoots, leaves number and longest shoot length when treated with 1000 $mg.L^{-1}$ of IBA.

Phuyal *et al.,* (2018), cleared from a study on the effect of both IBA and NAA at three different concentrations (2000 ppm, 3000 ppm, and 5000 ppm) on stem cuttings of *Zanthoxylum armatum* that 5000 ppm of IBA was the best treatment as resulted in the highest number of roots (6.5) and root length (11.6 cm).

Ritu and Rana (2018), found that the concentration of IBA, 8000 ppm to Stem Cutting of *Karonda (Carisa carandas L.* lead to prominent improvement in the number of sprouted cutting, number of secondary root per cutting number of sprout per cutting, percentage of rooted cuttings,the average length of root per cutting, average dry weight of root.

Pêgo *et al.,* (2019), carried out research to detect the impact of different concentrations of IBA (0,500, 1000, 2000, and 3000) mg L-1 on herbaceous cuttings of *Streptosolenjamesonii*, observed that the highest number of roots and the better root and shoots when cuttings treated with 750 to 1456 mg L-1 IBA.

Bashi (2019), evaluated influence of different concentrations of IBA (0,250,500,750,1000,2000) ppm on semi-hardwood cutting of bougainvillea glabra, showed the maximum percentage of root 100%, number of roots 24.46, length of roots 7.93, dry weight of roots, and maximum Shoot length when 1000ppm of IBA is used.

Ashok and Ravivarman (2020)**,** revealed that 3000 ppm of IBA resulted maximum number of roots per cutting (14.23) and root length (9.79 cm) are recorded when terminal stem cuttings of *Pseuderanthemumcarruthersii*var.*atropurpureum.*

Herastuti and Ek (2020), treated terminal, middle, and basal of stem cutting of *bougainvillea* with (50, 100, 150) ppm of indole butyric acid, the result showed the middle and basal types produced the best percentage cutting to life, root number, length of longest root, and root volume.

3. FACTORS INFLUENCE THE ROOTING ABILITY

3.1. Plant species

Several factors can influence the rooting ability of stem cuttings, including the species and cultivar requirements; the source, position, and kind of cutting taken; and the source, position, and type of cutting taken. juvenility and stock plant condition (Hartmann and Kester, 2002).

Stem cutting propagation is advantageous in that it is the easiest and fastest way to propagate plants as it bypasses the juvenile characteristics of certain species (Hartmann and Kester, 2002).

3.2.**Propagation media**

Different types of media serve as soil, anchoring the root system, supplying water and nutrients to the plant, and ensuring appropriate aeration in the root system. (Gruda and Schnitzler, 2006). Plant and root development are influenced by the biological and physical-chemical characteristics of growing medium. During the rooting period, a propagation medium is used to keep the cuttings in place, supply them with moisture, enable air exchange at the bottom of the cuttings, and create an opaque or dark environment by reducing light penetration to the cuttings' base (Galavi et al., 2013).

3.3. Plant growth regulators

Plant growth regulators allow the development of adventitious roots by promoting the initiation of the root primordium and cell division expansion (Fogaca and Fett-Neto, 2005). Indole-3-butyric acid (IBA) has been known as a manufactured auxin for a long period and is the main auxin used commercially for the adventitious root induction in stem or leaf cuttings (Srivastava, 2002).

4. CONCLUSION

Bougainvillea plant is an important ornamental plant for landscaping with its showy bracts, white flowers and different form. In landscape planning, plants are evaluated in two ways, aesthetically and functionally. A landscape architect should be able to use not only the concept of the measure but also all the necessary features related to the plant material in plant designs. Thus, thanks to the planting designs made, the users are satisfied both visually and functionally from the outdoors. The bougainvillea plant creates a functional effect by preventing bad images with its aesthetic appearance.

In this direction; It is extremely important to know the general characteristics of the bougainvillea plant and to apply the correct reproduction methods. Within the scope of the research, these cases were emphasized in line with the relevant literature.

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CONTAMINATIONS IN PLANT TISSUE CULTURE AND SOME SOLUTIONS

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ABSTRACT

The concept of biotechnology was first used in 1919 by forming the words "biology" and "technology". Plant biotechnology, defined as the application of technology on plants; It covers the culture, reproduction and genetic modification of plant organs, tissues and cells in sterile artificial media. It is a set of techniques consisting of plant, organ and genetic modification techniques. Plant tissue culture means the production of a new plant by growing a small piece of plant tissue in aseptic condition, usually a test tube, flask, or bottle, containing a nutrient medium and the medium we will use for may be liquid or solidified with agar. Tissue culture is the growth of tissue or cells in an artificial medium separate from the parent organism. This technique is called micropropagation. This is typically facilitated via use of a liquid, semisolid or solid growth medium, such as agar or its substitutes. A plant consists of different organs, each of which consists of different tissues made up of cells. The areas of use of *in vitro* culture vary according to the parts of the plant used, and different *in vitro* culture types emerge. In plant tissue culture, contamination may occur due to poor sterilization of the plant part, the tools and equipment used. Contamination in plant tissue cultures emerges as acute contamination caused by inadequate superficial sterilization, contamination caused by microorganisms hidden in the explant or microorganisms settled during subculture, and chronic contamination that occurs naturally after a long sterile culture period. Considering the sources of contamination as %; 75% is due to the person performing the culture process, 15% is due to poor ventilation, 5% is due to the structure of the room where the culture is made, and 5% is due to the cleaning of the tools and equipment used during the culture.

Key Word: Sterilization, Contamination, Tissue culture, Biotechnology

1. INTRODUCTION

The concept of biotechnology was first used by Karl Erkey in 1919 by forming the words "biology" and "technology". The definition of “it is the whole of events in which raw materials are processed and transformed into new products with the help of biological structures” is also used for biotechnology (Ozdemir, 2005).

Biotechnology is a combined application of the fields of biochemistry, microbiology and engineering in order to benefit from the technical application potential of microorganisms, cells and tissue cultures and their various parts (Surmeli and Sahin, 2009).

When biotechnology, which is a very wide application area, is separated according to the biological assets to which it is applied, one of them is to create plant biotechnology. Plant biotechnology, defined as the application of technology on plants; It covers the culture, reproduction and genetic modification of plant organs, tissues and cells in sterile artificial media. In other words, plant biotechnology; It is a set of techniques consisting of plant, organ and genetic modification techniques Plant tissue culture is aseptic conditions, in an artificial nutrient medium, new tissue from plant parts such as a whole plant, cell (meristematic cells, suspension or callus cells), tissue (various plant explants), or organ (apical meristem, root, etc.). is the production of plants or herbal products (such as metabolites). In addition, various tissue culture methods are routinely applied in the protection of endangered species and in the production of species that are difficult to reproduce (Babaoglu et al. 2001; Hatipoglu, 2005, Ak, 2018).

The first studies on plant biotechnology were made by Schwan and Schleiden in 1838; all plant cells can form a plant without attachment (totipotency) started with the theory (Ari, 2006). However, the fact that a full-fledged plant could not be obtained from a single cell in studies conducted under laboratory conditions caused this theory to not be widely accepted (Hatipoğlu, 2005). Important studies related to plant tissue culture are given in Table 1.1.

Table 1.1. Important studies on plant tissue culture

RESEARCH	LITERATURE
Culture of first isolated cells	Haberland, 1902
Culture of mature embryos	Hanning, 1904
First use of the term biotechnology	Karl Eraky, 1917
Identification of auxin	Went et al., 1920
Laboratory reproduction of root and shoot tips	Kotte and Robbins, 1922
First embryo recovery technique (corn)	Dieterich, 1924
First continuous root cultures (tomato)	White, 1934
Initial callus formation	Gautheret, 1934
Obtaining secondary metabolites from primary callus cultures	Gautheret, 1942
First plant extraction from shoot tips (apical meristem)	Ball, 1946
Determination of the structure of DNA	Watson Crick, 1953
First plant production from cell suspensions	Muir et al., 1954
Development of MS medium	Murashige and Skoog, 1962

2. PRINCIPLES OF *IN VITRO* CULTURE

When *in vitro* culture is mentioned, it is understood that plant explants or cells and protoplasts are cultured in sterile and artificial nutrient media. *In vitro* culture;

1. Reproduction of plants that cannot be easily reproduced by traditional methods
2. Establishing somaclonal resistance against plant diseases,
3. Rehabilitation studies,
4. Selection of resilient individuals,
5. Conservation of Resistant Plant Genotypes,
6. Conservation of plant gene resources,
7. To purify plants from diseases,
8. It is used to obtain biochemical products (secondary metabolites) ((Mansuroglu and Gurel 2001).

3. USAGE AREAS OF *IN VITRO* CULTURE

Intact Plant Culture: In intact plant culture, plant seeds are planted *in vitro* and the sown seeds germinate to form a new plant.

Embryo Culture: Includes *in vitro* culture of embryos isolated from testa and nutrient tissue.

Organ Culture: Forming the plant; It includes culturing organs such as leaves, shoot tips, flower buds and anthers.

Callus Culture: If an isolated tissue is differentiated and then re-cultured and allowed to differentiate again, the tissue formed is called callus tissue. This applied process is called callus culture (S´aikin-Fodulovic´ et al. 1998).

Cell Culture: It is the name given to the culture of cells obtained from tissue callus or suspension cultures by using mechanical or enzymes (Dagustu, 1996).

Protoplast Culture: It is the culture process carried out by culturing the protoplasts obtained as a result of the breakdown of the cell wall with the help of enzymes.

The advantages of rapidly growing plants *in vitro* using the plant tissue culture technique are;

Since most of the economically important vineyard, and garden plants have hybrid characteristics, it is only possible to produce these plants by preserving their own characteristics, only by vegetative way. However, the biggest disadvantage in this regard is that it can be produced vegetatively from species to species, even between varieties of a species. With *in vitro* or micro propagation, it becomes possible to reproduce the plant in large numbers in a short time. While it is very easy for viruses or other systematic diseases to be transmitted from plant to plant by vegetative propagation method, such diseases negatively affect the quality conditions of the product. With *in vitro* propagation, it is possible to produce virus and disease free from disease-free stock plants. With tissue culture, production can be made throughout the year, not only depending on the vegetation period. Plants that are in the culture stage can be easily transferred between countries (George, 1993; Burun, 2001; Ak et al., 2020).

In addition to these, the need for tools and equipment, the need for sufficient technical experience during application, the need to develop an appropriate protocol for the plant to be cultivated, the compliance of the production area with industrial standards and the expensive production stages are the negative aspects of tissue culture (*in vitro* propagation).

4. STAGES OF *IN VITRO* CULTURE

• Establishment of a suitable laboratory setup

• Selection, preparation and sterilization of plant parts and nutrient media to be used

• Creation of callus or cell suspensions

• From callus or cell suspensions; stimulation of plant regeneration directly from somatic or gametic cells

• Reproduction and lengthening of the formed shoots, formation of somatic embryos

• Rooting of elongated shoots

• Acclimatization of rooted plants (George and Sherrington 1984).

5. STERILIZATION

One of the most important features of *in vitro* culture; The culture process is carried out in an environment free from all kinds of microorganisms. In order to fulfill this requirement, the medium, culture vessels and all kinds of tools and equipment used in *in vitro* culture studies must be sterile. In plant tissue and cell culture studies, one of the most important uses is to ensure sterilization in places where microbiological and pathological studies are carried out. Proper sterilization and compliance with cleaning rules minimize the risk of contamination of microorganisms in *in vitro* culture. Sterilization methods are divided into two as physical and chemical (Hatipoglu, 2005).

Physical Methods: The sterilization process performed by physical methods is examined under three main groups.

• Heat Sterilization: Heat is mostly used in sterilization as it is easy and inexpensive to do and gives good results.

• Sterilization with Ionizing Rays: The effect of ionizing rays is used for sterilization of water and some substances used in microbiology.

• Mechanical Sterilization: It is used to sterilize various liquids that are not resistant to high temperatures. This method is based on the principle of keeping microorganisms in a liquid environment by passing them through various filters and preventing them from passing to the filtrate.

Chemical Methods: It is carried out using various chemicals. It is a process performed to control pathogenic microorganisms.

• Chemical Sterilization with Gases: The generally used gas is ethylene oxide. This gas is effective against all types of microorganisms. Ventilation is carried out by leaving the material at 50–60 °C for 8–12 hours or at room temperature for 7 days.

• Chemical Sterilization with Liquids: When used appropriately, it destroys all forms of bacteria, fungi, tuberculosis bacilli and viruses. Glutaraldehyde and formaldehyde are generally used as sterilization solutions. However, acids, alkalis, halogens, heavy metals, quaternary ammonium compounds, phenolic compounds, aldehydes, ketones, alcohols, amines and peroxides are used in explant sterilization.

6. ENSURING STERILE CONDITIONS IN *IN VITRO* CULTURES

Sterilization of Glass and Metallic Materials: In *in vitro* culture studies, glass and metallic materials can be sterilized by the application of dry heat in an oven. It is known that bacteria and especially spores are very resistant to dry heat. In the studies, it has been determined that the temperature required to destroy different species and the application time of the temperature are different even in a bacterial genus. For this reason, the tools and equipment to be sterilized with dry heat application must first be cleaned very well. Generally, tools and equipment used in *in vitro* culture are sterilized by dry heat application; It is applied at 160-180 °C for 3 hours (Babaoglu et al., 2001).

Sterilization of Media: Nutrient media are purified from microorganisms by keeping them in an autoclave at a temperature of 121 °C under high pressure (1.05kg/cm²) for a certain period of time or by filtering them into sterile containers by passing through filters with a pore width of 0.22 µ. The retention times of nutrient media in the autoclave are related to their volumes. After the sterilization process has started, 20 minutes may be sufficient for the nutrient medium in a volume of 20-50 ml, for example (Hatipoglu, 2005).

Sterilization of Temperature Sensitive Media: Some chemicals of the components in the media are not resistant to high temperatures. These substances can decompose at high temperatures. For this reason, the sterilization of vitamins, carbohydrates and growth regulators, which are not resistant to high temperatures, is done by cold filtration method. In this method, the solution to be sterilized usually passes through sterile filters with a pore diameter of 0.2 µ.

Sterilization of Plant Material to be Used in *In Vitro* Culture: One of the most important sources of infection in *in vitro* culture is the plant material used in culture. Plants grown in field conditions host a large number of microorganisms. When explants carrying these microorganisms are placed in the nutrient medium, microorganisms are contaminated with the nutrient medium and the explant loses its viability in a short time. Various chemical substances are used in the sterilization of plant material. These chemicals; 1% sodium hypochlorite solution, 7% saturated calcium hypochlorite solution, 1% brominated water solution, 70% alcohol, 0.2% mercury chloride solution, 10% hydrogen peroxide solution, 1%' silver nitrate solution.

7. CONTAMINATION

Although the plant material was well sterilized, infection may have occurred in later cultures. These;

• The plant material used may be infected internally.

• Person working may not have worked sufficiently sterile.

• The sterile cabinet is broken, not working.

• Non-sterile instruments and equipment in the sterile cabinet.

• The outer part of the containers containing the nutrient medium is not clean.

Improper cleanliness of the room where the sterile cabinet is located may cause infection of the cultures. Contamination in plant tissue cultures Acute contamination caused by ineffective superficial sterilization, contamination caused by microorganisms hidden in the explant or microorganisms settled during subculture, and chronic contamination that occurs naturally after a long sterile culture period. Considering the sources of contamination as %; 75% is caused by the person performing the culture process, 15% is due to poor ventilation, 5% is due to the structure of the room where the culture is made, and 5% is due to the cleaning of the tools and equipment used during the culture. Contaminations occurring *in vitro* are divided into two as chemical and biological.

Chemical Contamination: The source of chemical contamination is usually the medium, the uncontrolled variance of the hormones and growth factors added to the nutrient medium, and the use of the jars in which the cultured explants are placed without decontamination.

Biological Contaminations: Contamination caused by viruses, bacteria, molds, yeasts, insects and pests in the environment is called biological contamination. Viruses; They are the most difficult cell contaminants to detect in cultures due to their small size. Insects, spiders, flies, ants, cockroaches and can cause culture contaminants and a significant source of microbial contamination, often found in the laboratory. Bacterial and fungal contaminants; Contaminants that pose a major problem in plant tissue culture laboratories include: *Pseudomonas fluorescens*, *Escherichia coli*, *Proteus species*, *Micrococcus sp*, *Streptococcus pneumoniae*, *Staphylococcus aureus*, *Bacillus cereus*, *Bacillus subtilis*. Fungal contaminations; *Aspergillus niger*, *Aspergillus fumigatus*, *Penicillium sp*. Yeast, *Fusarium sp*. they contain. The most dominant of these; bacterial contaminants; *Micrococcus sp*., Staphylococcus aureus and *Bacillus cereus* Fungal contaminants; *Aspergillus sp*., *Penicillium sp*. and yeast.

Staphylococcus Spp.: Light white to light yellow colored cohesive colonies about 1-2 mm in diameter. It can enter the environment mainly through the human factor (through laboratory studies), less likely from the soil where the plant grows or from the irrigation water. They are selective anaerobic organisms. The main reasons for the presence of this bacterium in the environment; is the lack of adequate personal sterilization (wrong hand washing, dirty aprons and constantly used masks) (Babaoglu, 2005).

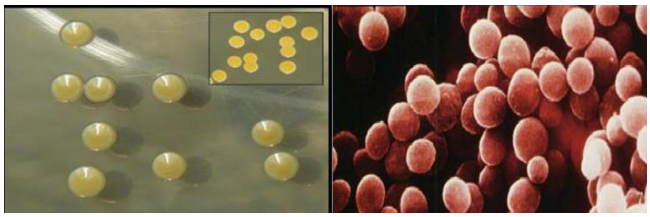

Figure 1. Image of *Staphylococcus Spp* under microscope

Bacillus subtilis: Bacteria in beige or light yellow color with rough edges. The source of the bacteria is usually the inability to sterilize the medium or the insufficient sterilization of the blotter papers and the instruments used. In addition, this bacteria, which can come from the soil, can also pass through the shoes of laboratory workers. *B. Circulans* can live in 70% alcohol (Babaoglu, 2005).

Figure 2. *Bacillus subtilis* image of under the microscope

Pseudomonas fluorescens: Gram negative bacteria. It is white in color and mucoid. The main source is; Inadequate sterilization of explants. In addition, non-compliance with laboratory procedures is another reason (Babaoglu, 2005).

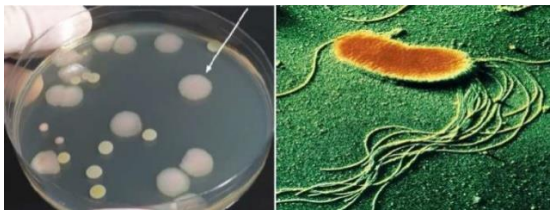

Figure 3. Image of *Pseudomonas fluorescens* under the microscope

Enterobacteriaceae Spp: Gram negative bacteria. They are large, circular and convex colonies of grayish to white color. The main source is; Inadequate sterilization of explants. In addition, non-compliance with laboratory procedures is another reason (Babaoglu, 2005).

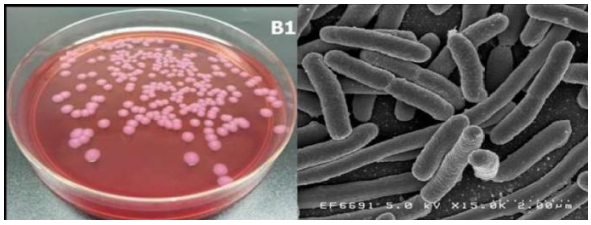

Figure 4. Image of *Enterobacteriaceae Spp* under microscope

Escherichia coli: Circular, convex, grayish/white in color, moist, smooth and opaque. It is transmitted by human origin or insufficient sterilization.

Figure 5. Image of *Escherichia coli* under the microscope

Micrococcus Spp.: Nutrient Agar is yellow in color and is found in soil, dust, water, and human skin flora.

Figure 6. *Micrococcus Spp*. image of under the microscope

Aspergillus niger: It is initially white in color, then quickly turns black. The underside is light yellow. It can form radial cracks on agar. It is commonly found in soil, seeds, air, plant rhizospheres, dried fruits and nuts. It is one of the most common fungi found in foods. Air and water are the main sources of entry for *Aspergillus Spp* in our laboratory.

Figure 7. *Aspergillus niger* image of under the microscope

Penicillium Spp: It is seen in green/khaki color, brush-like structure and in cluster form. Greenish colonies are in brush-like clusters. According to the literature; It is stated that it is observed in building materials, dust on walls and indoor air depending on these. High air filtration and regular wall cleaning should be done.

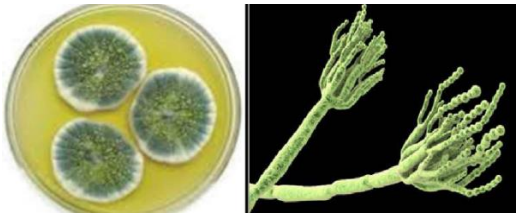

Figure 8. *Penicillium Spp.* image of under the microscope

Fusarium Spp: It can be seen in various colors from white to yellow, pink, red and purple. Colonies, usually pink in color and surrounded by a white ring, were observed. It occurs when the laboratory is heavily polluted by air and sanitation.

Figure 9. *Fusarium Spp.* image of under the microscope

Yeast: They are creamy white colonies. Yeast is also found on the skin surface. It is spread by growth chamber mite and insect infestation. The presence of yeast in our cultures indicates improper hygiene; yeast spreads through the skin and breathing.

Cladosporium: It is an olive green or dark brown colored mold with a suede-like texture. It is usually found on the surface of the fiberglass duct liner on the inside of the supply ducts. Since spores of this fungus are very common in the outdoor air, it is observed with insufficient protection of the laboratory atmosphere from contamination by outside air. Positive laboratory air pressure and double-door inlets significantly reduce contamination from Cladosporium.

Figure 10. *Cladosporium* image of under the microscope

8.GENERAL CONSIDERATIONS TO AVOID CONTAMINATION

Use a magnifying glass, if necessary, a microscope to examine all tissue culture jars. All infected culture jars are removed to a suitable place for decontamination. To prevent contamination from spreading from one jar to the next, 10% sodium hypochlorite (20 minutes) is used for the contamination jar. Wipe the outside of all non-infected bottles with 70% Isopropyl Alcohol (IPA). The lab coat and lab coat are autoclaved 2 times a week and washed once a week. After sterilization of media, all sterilized media jar, top, bottom and lid parts should be wiped with freshly sterilized hand towel or absorbent cotton. Make sure the cotton or freshly sterilized hand towel is sprayed with alcohol so that the wiping materials do not contaminate the media jar.

Care should be taken with indexing explants and cultures for contaminants. Identifying the source of these pollutants, identifying and characterizing the pollutants should be done. It is necessary to remove contaminants with advanced cultural practices, antibiotics or other chemicals. Periodic checks of HEPA filters should be made at the LAF. Daily sterilization of dissecting instruments, papers, cotton, use of alcohol to wipe off LAF in each culture, flasks subcultures, steam sterilization indicator strip should be used to check the quality of the autoclave for correct sterilization. Always record the pressure and time during the autoclave for

cross-checking of the autoclave. If there is further contamination in the laboratory, fumigate once a week. Apply the microbial open plate method before and after fumigation to control the effect of fumigation and contamination. Follow the SOP (standard operating procedure) for explant sterilization. Employees (technicians, students, etc.) using the room should be made aware of sterilization. Wear gloves and a lab coat and keep your long hair tied back. Be as organized as possible and label everything.

Inspect all equipment and the environment for visible contamination prior to use. If you need to completely remove a cap from a tube, dish or bottle, close the cap with the open side up and insert it inside. Otherwise, keep tubes, dishes or bottles closed as much as possible. Do not run your hands/arms over any open bottles, dishes or tubes.

When finished, do the following: Record the subculture date, the number of culture bottles used, the culture stage used, new culture bottles produced, media used, stage produced, multiply rate, and operator code number and LAF number for tracking. Remove everything, properly dispose of materials, wipe work surfaces with 70% alcohol, and turn on the UV lamp in the laminar flow hood for 10-15 minutes to sterilize the area. Check out the hand wash solution, which should ideally have a combination of phenolic compounds and a surfactant (alcohol with chlorhexidine, 2% or 4% chlorlheximide, 7.5% povidone iodine, or 1% triclosan, etc.). Inspection/cleaning of air conditioning ducts should be done every 3 months. In the case of a positive pressure unit in your laboratory, a filter integrity test should be performed on the HEPA filter. Only what must be strictly in the clean room (breeding hall and plant growing room) should be allowed. Preserve as much in and out movement as possible. Laboratory waste, especially used media, waste cultures, pp caps, etc. Take care to remove it from the area and autoclave the equipment.

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GENETIC VARIABILITY, ASSOCIATION AND DIVERSITY STUDY AMONG THE SUNFLOWER GENOTYPES AT SEEDLING STAGE BASED ON DIFFERENT MORPHO-PHYSIOLOGICAL PARAMETERS UNDER POLYETHYLENE GLYCOL INDUCED STRESS

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Abstract

Drought stress directly affects growth along with productivity of plants by altering plant water status. Sunflower (*Helianthus annuus* L.) an oilseed crop, is adversely affected by a biotic stresses. The present study was carried out to study the genetic variability and diversity among the sunflower genotypes at seedling stage based on different morpho-physiological parameters under Polyethylene Glycol (PEG) induced stress. A total of twenty seven genotypes including two hybrids, eight advanced lines and seventeen accessions of sunflower (*Helianthus annuus* L.) were tested at germination and seedling stages in Polyethylene Glycol. Correlation and principle component analysis confirmed that germination percentage, root length, proline content, shoot length, chlorophyll content, Stomatal frequency and survival percentage are positively correlated with each other hence; these traits were responsible for most of variation among genotypes. The cluster analysis results showed that genotypes Ausun, line-2, line-8, 17559, 17578, Hysun-33, 17555, and 17587 as more diverse among all the genotypes. These most divergent genotypes could be utilized in the development of inbreed which could be subsequently used in the heterosis breeding.

Key words: Sunflower, drought, stress, polyethylene glycol

KUZEY IRAK BÖLGESİNDE YETİŞTİRİLEN YEREL NAR ÇEŞİTLERİNİN (Punica granatum L.) BAZI POMOLOJIK ÖZELLİKLERİNİN BELİRLENMESİ

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Özet

Bu çalışmada Kuzey Irak'ın Halepçe ilinin Hawraman ilçesinde doğal olarak yetişen ve bölgeye iyi adapte olmuş yerel nar genotiplerine ait meyvelerin, bazı pomolojik özelliklerinin belirlenmesi amaçlanmıştır. Araştırmada bölgede yetişen Laswara , Salaxani , Meyhoş ve Kawa Hanar çeşitler ait meyve örnekleri alınarak Türkiye'ye getirilmiş ve bazı pomolojık değerleri belirlenmiştir. Araştırmada meyve ağırlıklarının 206-266 gr, meyve uzunluklarının 64.13-70.73 mm, meyve enlerinin 75.92-81.18 mm, Kaliks yarıçapı 11.02-12.42, kaliks uzunluklarının 14.35-17.21 mm, odacık sayısı 6-7 adet, Ph 2.71-3.54 , SÇKM %11.8-15.5 arasında değiştiği belirlenmiştir.

Anahtar Kelime: nar, pomolojı, kuzey Irak .

Abstract

In this study, it was aimed to determine some pomological characteristics of the fruits belonging to the local pomegranate genotypes, which grow naturally in the Hawraman district of Halabja province in Northern Iraq and are well adapted to the region. In the research, fruit samples of Laswara, Salaxani, Meyhoş and Kawa Hanar varieties grown in the region were taken and brought to Turkey and some pomological values were determined. In the research, fruit weight is 206-266 gr, fruit length is 64.13-70.73 mm, fruit width is 75.92-81.18 mm, calyx radius is 11.02-12.42, calyx length is 14.35-17.21 mm, number of chambers is 6-7, Ph 2.71-3.54 , SÇKM 11.8% It was determined that it varies between -15.5.

Key Words: pomegranate, pomology,northem Irag

1.Giriş

Nar bilinen en eski meyve türlerinden biri olup anavatanları Güney Kafkasya, iran, Afganistan, Güney Asya, Batı Asya, Anadolu ve Akdeniz arasındaki bölgeleri kapsamaktadır. Anavatanların yanında Avrupa ve Afrika'nın Akdeniz sahil bölgelerinde, Çin, Hindistan, Afganistan, iran, Arabistan, şili, Arjantin, Kaliforniya, Arizona ve Kuzey Meksika'da yetiştiriciliği yapılmaktadır (Özbek, 1977; Dokuzoğuz ve Mendilcioğlu, 1978; Onur, 1983). Asırlardan beri narın meyvesi, şekli, yapısı ve bazı özellikleri nedeniyle nar çeşitli sanat dallarında konu edinilmiş meyve, kök, gövde, yaprak ve çiçekleri sık sık kullanılmıştır.

Kutsal kitapların çoğunda, Mısır, Yunan ve Roma efsanelerinde bu meyveden bahsedilmektedir. Değişik inançlara göre danelerin bolluğu, bazen bir toplumu, bazen bereketi simgelemiş, kırmızı rengi kan ve vahşeti temsil etmiştir (Dokuzoğuz ve Mendilcioğlu, 1978).

Nar bitkisi genellikle uzun ömürlüdür. 200-300 yıl yaşayabilir. Nar gerçek bir çalı olduğu için bir kök gövdesine (ksilopodyum) sahiptir. Bu organ besin maddelerini depolayan ve vejetatif çoğalmayı sağlayan toprak altındaki odunsu gövdedir. Kök gövdesinin varlığı, narın zorlu tabiat şartlarına dayanımı açısından son derece önemlidir (Yılmaz, 2007).

Bazı nar çeşitlerinin pomolojik özelliklerinin belirlenmesinde, 2002 ve 2006 yıllarını kapsayan dönemde Dörtyol'da yapılan bir çalışmada ―Hicaz, Katırbaşı, Çekirdeksiz ve Kara Mehmet‖ nar çeşitleri kullanılmıştır. Bu nar çeşitlerinde, dört yıl boyunca alınan ortalamalara göre; meyve ağırlığı 241.1-319.8 g, meyve uzunluğu 67.5-78.7 mm, meyve eni 75.2-85.3 mm, kabuk kalınlığı 2.9-4.0 mm, dane randımanı %57.7-64.1 arasında değiştiği belirlenmiştir. Buna ilaveten, SÇKM %14.3-16.6, pH 2.97-3.20 ve asitlik %0.39-1.59 arasında belirlenmiştir. Bu nar çeşitlerinin kabuk alt zemin rengi yeşil ve sarı, kabuk üst zemin rengi kırmızı ve pembe, çekirdek sertliği yumuşak, orta sert ve sert olarak belirlenmiştir. Bu çalışma sonucunda Dörtyol ekolojik koşullarına göre ―Hicaz‖ ve ―Katırbaşı‖ çeşitleri bölge için ümitvar çeşitler olarak belirlenmiştir (Polat ve ark., 2002).

Ak ve ark. (2009), Akdeniz Bölgesi, Ege Bölgesi ve Güneydoğu Anadolu Bölgesi'nden seçilen bazı nar çeşitlerinin Şanlıurfa koşullarında pomolojik özelliklerini belirlemiş oldukları çalışmada; Akdeniz Bölgesi'nden seçilen narlarda meyve ağırlığının 189.9-430.9 g, 100 dane ağırlığının 26.6-46.3 g, dane randımanının %42.6-63.4, suda çözünür kuru madde miktarının %13.8-16.2 ve titre edilebilir asit miktarının %0.2-2.2; Ege Bölgesi'nden seçilen narlarda meyve ağırlığının 194.6-312.4 g, 100 dane ağırlığının 24.0-35.4 g, dane randımanının %35.4-61.2, suda çözünür kuru madde miktarının %14.4-16.2 ve titre edilebilir asit miktarının %0.4-0.7; Güneydoğu Anadolu Bölgesi'nden seçilen narlarda da meyve ağırlığının 157.4-402.3 g, 100 dane ağırlığının 19.2-39.2 g, dane randımanının %51.8-67.6, suda çözünür kuru madde miktarının %13.7-14.8 ve titre edilebilir asit miktarının %0.2-2.2 arasında değişiklik gösterdiğini bildirmişlerdir.

Tehranifar ve ark. (2010), 20 İran nar çeşidinin fizikokimyasal özelliklerinin belirlendiği çalışmada; meyve ağırlığının 196.89-315.28 g, meyve eninin 64.98- 86.88 mm, meyve boyunun 69.49-81.56 mm, dane randımanının %37.59-65, suda çözünür kuru madde miktarının %11.37-15.07 ve titre edilebilir asit miktarının %0.33-2.44 arasında değişiklik gösterdiğini bildirmişlerdir

Ferrara ve ark. (2011), italya'nın güneydoğusunda, Apulia bölgesinde yetiştirilen (Sour Triggiano, Sour Molfetta, Sour Ninetta Ostuni, Sour S. Giorgio, Common Triggiano, Modugno Triggiano, Common Molfetta, A Denta S. Giorgio) sekiz nar genotipinin morfo-pomolojikal özelliklerini belirlemişlerdir. Çalışma sonunda meyve ağırlıklarının 168.9±36.1 ile 574.9±18.8 (g) arasında, meyve boyunun 55.9±6.0 ile 91.2±4.4 8 (mm), meyve çapının 69.1±4.8 ile 106.3±2.6 (mm), dane ağırlığının 435.1±75.6 ile 519.1±65.8 (mg), dane uzunluğunun 8.9±0.9 ile 11.0±0.6 (mm), dane çapının 6.1±0.8 ile 8.0±0.9 (mm) arasında değiştiğini tespit etmişlerdir

İkinci ve Kılıç (2016), Şanlıurfa'nın Siverek ilçesinde doğal olarak yetişen ve yöre iklimine iyi adapte olmuş 15 yerel nar genotipi üzerinde yapmış oldukları çalışmada; meyve ağırlığının 267.72-650.56 g, meyve eninin 80.12-109.61 mm, meyve boyunun 69.60-92.72 mm, şekil indeksinin 0.833-0.914, kaliks boyunun 13.47-22.49 mm, kaliks çapının 10.19-17.03 mm, dane ağırlığının 141.33-361.33 g, meyve suyu hacminin 81-98 ml, suda çözünür kuru madde miktarının %12.64-16.68 ve titre edilebilir asit miktarının %0.55-2.99 arasında değişiklik gösterdiğini bildirmişlerdir.

Özden ve ark. (2017), Şanlıurfa'da 3 nar çeşidi üzerinde yapmış oldukları çalışmada; meyve ağırlığının 330.22-633.75 g, 100 dane ağırlığının 32.33-61.20 g, suda çözünür kuru madde miktarının %15.16-17.50 ve titre edilebilir asit miktarının %1.30-2.91arasında değişiklik gösterdiğini bildirmişlerdir.

2.Materyal ve Metot

2.1.Bitki Materyali

Bu çalışma Kuzey Irak'ın Halepçe ilinin Hawraman ilçesinde bulunan kapama nar bahçelerinde yapılmıştır. Bölgede doğal olarak yetişen, Laswra, Salaxani, Kawa Hanar ve Meyhoş çeşitlerine ait narlar kullanılmıştır. Araştırmada kullanılan nar ağaçlarının verim çağında, hastalık ve zararlılar yönünden sağlıklı ve gelişme yönünden homojen ağaçlar olmasına dikkat edilerek seçilecektir. Her nar çeşidi için 3'er tekerrür olmak üzere 3'er ağaç kullanılacaktır. Pomolojik özellikler işaretli ağaçlarda yapılarak bu ağaçlardan meyve örnekleri her bir ağaçtan 6 adet alınacaktır Hasat olgunluğuna (11.10.2020) ulaşan meyveler hasat edilerek soğuk ortamda muhafaza edilerek Harran Üniversitesi Hübtam Laboratuvarlarında analiz edilmiştir.

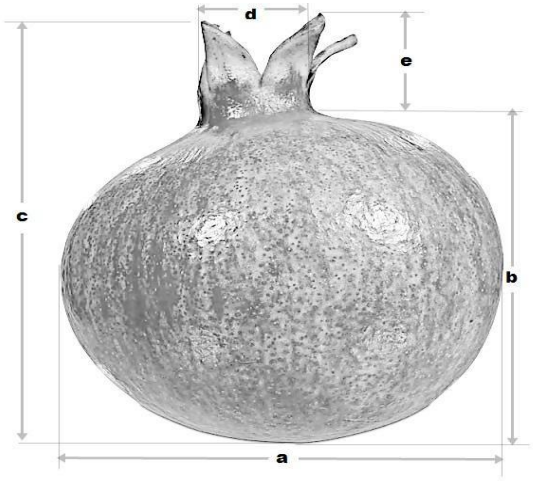
2.2. Pomolojik Ölçümler :

2.2.1. Meyve Ağırlıkları (g)

Labaratuvara getirilen meyvelerden tesadüfi olarak alınan 6 adet meyve 0.01 g'a duyarlı terazi ile tek tek tartılarak ortalama meyve ağırlığı belirlenmiştir.

2.2.2.Meyve boyutları (mm)

Meyvelerin eni, ekvator bölgesinin çapları ve meyvelerin boyu şekil 1 'de gösterildiği şekilde meyvelerin sap kısmı ile kaliksin alt kısmı (kaliks boyu hariç) arasındaki mesafe 0.01 mm'ye duyarlı dijital kumpasla ölçülerek, ortalama değerler tespit edilmiştir.



Şekil 1. Meyve ve kaliks boyutları; a: meyve eni, c-b: meyve yüksekliği, d: kaliks çapı, e: kaliks uzunluğu

2.2.3. Kaliks boyutları

Meyvenin kaliks boy ve kaliks yarıçapı 0.01mm‘ ye duyarlı kumpasla ölçülerek, ortalama olarak belirlenmiştir.

2.2.4. Odacık sayıları

Meyvelerdeki odacıklar ayrı ayrı sayılarak tespit edilmiştir. Bu değerlerin ortalaması alınmıştır

2.3.Meyvelerdeki kimyasal özellikler

Meyvelerin kimyasal analizleri Harran Üniversitesi Ziraat Fakültesi Bahçe Bitkileri Bölüm laboratuarında yapılmıştır.

2.3.1. Suda çözünür kuru madde (S.Ç.K.M)

Suda çözünür kuru madde oranı; tesadüfü olarak alınan meyvelerin suları karıştırıldıktan sonra el refraktometresi (Master-M, Atago, Japonya) yardımıyla ölçülmüş, sonuçlar ―%‖ olarak ifade edilmiştir.

2.3.2. Titrasyon asitliğinin tayini

Meyve suyundan 10 ml alınarak, saf su ile 100 ml‘ye tamamlanmış, 2 damla fenolftalein indikatörü damlatılarak karıştırılmıştır. 0.1 N NaOH ile pH 8.1 olana kadar titre edilerek, sonuç aşağıdaki formül yardımı ile susuz sitrik asit cinsinden hesaplanmıştır (Altan, 1992).

$$\text{Titrasyon asitliği (g/100 ml)} = \frac{S \times N \times me \times F}{\text{(örnek miktarı)}} \times 100$$

S ; NaOH sarfiyatı
N ; NaOH‘ ın normalitesi
me; Sitrik asitin milieşdeğer ağırlığı
Sitrik asit sabiti: 0.0064 g F ; kullanılan NaOH faktörü

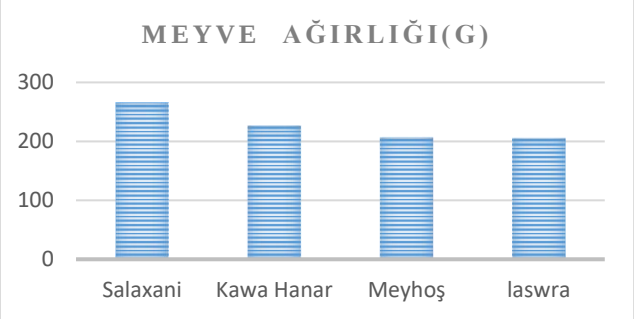
2.3.3. Ph tayini

Meyve suyunun pH değerleri Hanna Marka dijital pH metre ile ölçülerek tayin edilmiştir.

3.Araştırma Bulguları ve Tartışma

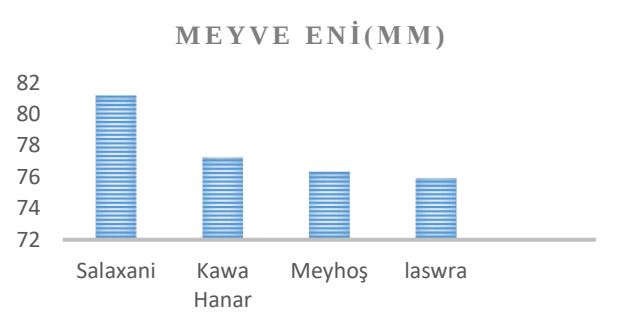
3.1. Meyve ağırlığı:

Labaratuvara getirilen meyvelerden tesadüfi olarak alınan 6 adet meyve 0.01 g'a duyarlı terazi ile tek tek tartılarak ortalama meyve ağırlığı belirlenmiştir.Meyve ağırlığı en yüksek 266 g ile Salaxani çeşidinde en düşük değer 206 g ile Laswra nar çeşidinde bulunmuştur.



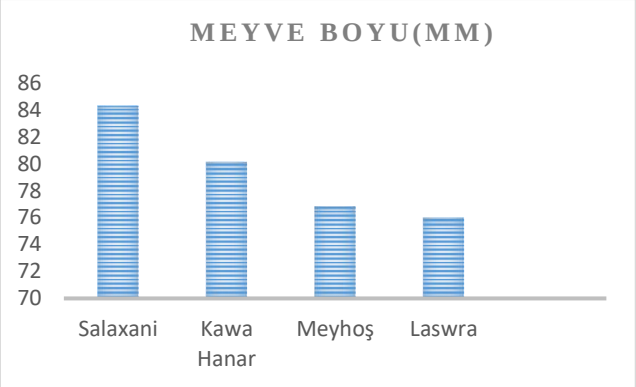
3.2. Meyve eni:

Meyveler, ekvator bölgesinin çapları0.01 mm'ye duyarlı dijital kumpasla ölçülerek, ortalama değerler tespit edilmiştir



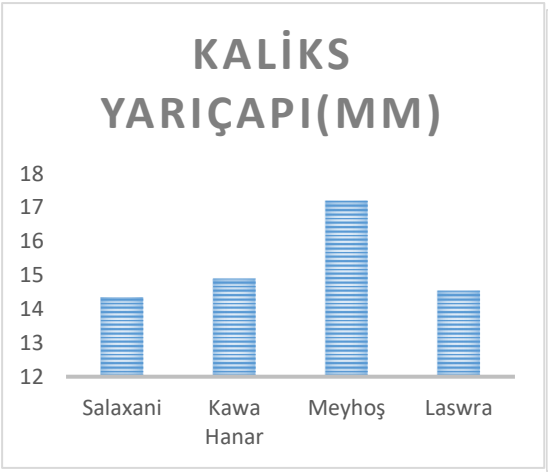
3.3. Meyve boyu:

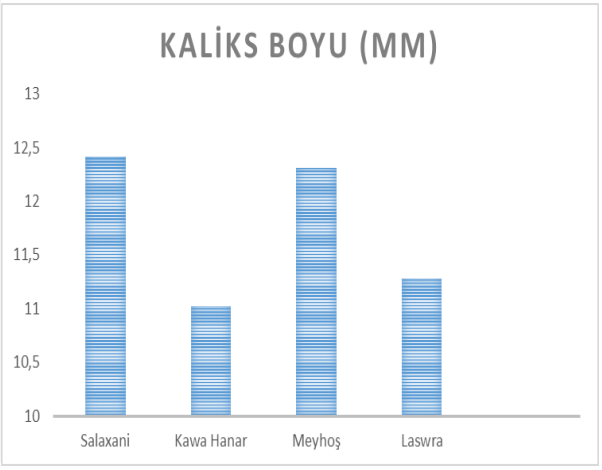
Meyvelerin sap kısmı ile kaliksin alt kısmı (kaliks boyu hariç) arasındaki mesafe 0.01 mm'ye duyarlı dijital kumpasla ölçülerek, ortalama değerler tespit edilmiştir.



3.4. Kaliks boyutları

Meyvenin kaliks boy ve kaliks yarıçapı 0.01mm'ye duyarlı kumpasla ölçülerek, ortalama olarak belirlenmiştir. Kaliks boyu sırasıyla 12.42 mm Salaxani,12.31 mm Meyhoş, 11.28 Laswra ve 11.02 mm Kawa Hanar nar çeşidinde bulunmuştur. Kaliks yarıçapı 17.21 mm Meyhoş,14.90 mm Kawa Hanar, 14.54 mm Laswra ve 14.35 mm Salaxani nar çeşidinde çeşidinde bulunmuştur.





3.5. Odacık sayıları

Meyvelerdeki odacıklar ayrı ayrı sayılarak tespit edilmiştir. Kawa Hanar ve Meyhoş nar çeşidinde odacık sayısı 6 bulunmuştur. Salaxani ve Laswra nar çeşitlerinde odacık sayısı 7 bulunmuştur.

3.6.Meyvelerdeki kimyasal özellikler

3.6.1Suda çözünür kuru madde (S.Ç.K.M)

Suda çözünür kuru madde oranı; tesadüfü olarak alınan meyvelerin suları karışt.ırıldıktan sonra el refraktometresi (Master-M, Atago, Japonya) yardımıyla ölçülmüş, sonuçlar —%‖

olarak ifade edilmiştir. S.Ç.K.M değeri en yüksek % 15.8 Salaxani çeşidinde bulunmuş olup bunu sırasıyla %15.5 Laswra , %14 Meyhoş izlemiş olup en düşük değer %11.8 Kawa Hanarda bulunmuştur

3.6.2. Titrasyon asitliğinin tayini

Meyve suyundan 10 ml alınarak, saf su ile 100 ml'ye tamamlanmış, 2 damla fenolftalein indikatörü damlatılarak karıştırılmıştır. 0.1 N NaOH ile pH 8.1 olana kadar titre edilerek bulunmuştur. Salaxani çeşidende 1.38 bulunmuş olup bunu sırasıyla 2.05 Meyhoş, 2.68 Laswra ve 2.73 Kawa Hanar çeşidi izlemiştir.

3.6.3. Ph tayini

Meyve suyunun pH değerleri Salaxani 3.54, Meyhoş 3.32 Laswra 3.20 ve Kawa Hanar 2.71 bulunmuştur.

SONUÇ

Kuzey Irak 'ta yapılan bu çalışmada bölgede yetişen yerel nar çeşitlerinin pomolojik analizleri yapılmıştır. Analizler sonucunda en ağır meyve 266 g ile Salaxani çeşidinde en hafif meyve 206 g Laswra çeşidinde bulunmuştur. Titre edilebilir asit değeri en yüksek 2.73 Kawa Hanar çeşidinde, en düşük değer1.38 Salaxani çeşidinde bulunmuştur Bölgenin yerel nar çeşitlerine bakıldığında Salaxani çeşidi ağırlık, irilik, SÇKM ve titre edilebilir asit değerlerine bakıldığında en iyi meyve çeşidi olarak belirlenmiştir.

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AIR DISPERSION MODEL FOR PREDICTION FUGITIVE LANDFILL GASEOUS EMISSION IMPACT IN AMBIENT ATMOSPHERE

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Abstract:

This paper will explore formation of HCl aerosol at atmospheric boundary layers and encourages the uptake of environmental modeling systems (EMSs) as a practice evaluation of gaseous emissions ("framework measures") from small and medium-sized enterprises (SMEs). The conceptual model predicts greenhouse gas emissions to ecological points beyond landfill site operations. It focuses on incorporation traditional knowledge into baseline information for both measurement data and the mathematical results, regarding parameters influence model variable inputs. The paper has simplified parameters of aerosol processes based on the more complex aerosol process computations. The simple model can be implemented to both Gaussian and Eulerian rural dispersion models. Aerosol processes considered in this study were (i) the coagulation of particles, (ii) the condensation and evaporation of organic vapors, and (iii) dry deposition. The chemical transformation of gas-phase compounds is taken into account photochemical formulation with exposure effects according to HCl concentrations as starting point of risk assessment. The discussion set out distinctly aspect of sustainability in reflection inputs, outputs, and modes of impact on the environment. Thereby, models incorporate abiotic and biotic species to broaden the scope of integration for both quantification impact and assessment risks. The later environmental obligations suggest either a recommendation or a decision of what is a legislative should be achieved for mitigation measures of landfill gas (LFG) ultimately.

Keywords: Air dispersion model, landfill management, spatial analysis, environmental impact and risk assessment.