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Allelopathic Activity of *Ficus carica* and *Punica granatum* Leaves on Germination and Seedling Growth of *Vicia faba L.*

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Keywords: Allelopathy, Growth, Germination, Tree**,** *Vicia faba*.

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Abstract:

The pot experiments were conducted in winter 2024-2025 at the Department of Biology green house, College of Science in the University of Mosul. Treatments were done alongside the pure leaf of (*Ficus carica* and *Punica granatum*) by adding soil to the pots with the rate of 10 g/kg soil. All the parameters applied in the experiments were randomly allocated in accordance with absolutely randomization of the design (CRD) to know their influence on the *Vicia. faba* L. seed germination and growth. The results indicated that leaves at 10% for *P. granatum* had a significant stimulatory in shoot length 37.5cm, root length at an average of 20.7 cm and its fresh weight 14.8 g. while *F.carica* had a significant increased growth parameters (germination 96% , shoot length and its fresh weight ,39.4 cm and 25.9 g) respectively, root length and its fresh weight(18.2 cm,13.6 g), as well as the number of nodes and flowers, compared to the control. The findings of this research suggest the potential of applying fresh leaf of *F. carica* and *P. granatum* as a bio stimulant for *V. faba* plants' germination and development.

Keywords: Allelopathy, Growth, Germination, Tree**,** *Vicia faba*.

(Immediately after the abstract, provide 5-7 keywords and arrange them alphabetically, using American spelling and avoiding general and plural terms and multiple concepts (avoid, for example, 'and', 'of'). Be sparing with abbreviations: only abbreviations firmly established in the field may be eligible. These keywords will be used for indexing purposes).

التأثير الأليلوباثي لأوراق *Ficus carica* و*Punica granatum* على إنبات ونمو نبات *Vicia faba L*

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الخلاصة:

أُجريت تجارب ألاصص خلال موسم شتاء 2024–2025 في البيت الزجاجي التابع لقسم علوم الحياة، كلية العلوم، جامعة الموصل. طُبقت المعاملات بإضافة الأوراق الطرية لـ (*Ficus carica* و *Punica granatum*) إلى تربة الأصص بمعدل 10 غ/كغم تربة. وُزِّعت جميع المعاملات المستخدمة في التجارب عشوائيًا وفقًا لتصميم عشوائي كامل (CRD) بثلاث مكررات، وذلك لتحديد تأثيرها على إنبات بذور *Vicia faba* ونموها. أشارت النتائج إلى أن أوراق الأشجار بنسبة 10% من *P. granatum* سببت زيادة معنوية في طول المجموع الخضري بمعدل 37.5 سم وطول الجذر بمتوسط 20.7 سم و وزنه الطري 14.8 غم. بينما أظهرت *F.carica* زيادة معنوية في معايير النمو (نسبة الإنبات 96%، طول المجموع الخضري ووزنه الطري 39.4 سم و 25.9 غم على التوالي و طول الجذر ووزنه الطري 18.2 سم و 13.6غم)، وكذلك عدد العقد والأزهار، مقارنة بمعاملة السيطرة. تشير نتائج البحث الحالي إلى إمكانية تطبيق الاوراق الطرية لـ *F. carica* و *P. granatum* كمحفز حيوي لإنبات وتطور نباتات *V. faba*.

الكلمات المفتاحية: التضاد الاحيائي، النمو ، الانبات، الاشجار، الباقلاء

1.Introduction:

Allelopathy is an ecological phenomenon associated with the effect of chemicals substances released from a particular plant on the growth and development of other plants by promoting or inhibiting its growth[1] Allelopathic plants achieve the said allelopathic effect on the host plants by volatilization of stems and stem leaves, leaching of allelopathic substances, root exudations or release of allelopathic substances into the environment in the degradation of plant remains [2]. Allelochemicals are affected by a variety of biotic and abiotic variables, among others. pH, organic matter, nutrients, and moisture content in the soil are examples of

abiotic variables, age of the donor plant also affects the amount of released allelochemicals in the rhizosphere [3]. *V. faba (faba bean)* is the most important legume in most parts of the world especially in developing countries. It produces protein as a source of food. It contains a lot of some of the vitamins, minerals and dietary fiber as well. *Ficus genus* comprises approximately 850 species of woody trees, shrubs, vines, epiphytes, and hemi epiphytes belonging to the Moraceae family, results of phytochemical studies of *Ficus,* dry leaf extracts shown the presence of active substances, phenols, flavonoids, glycosides and tannins in aqueous extracts [4] Pomegranate, scientifically known as *Punica granatum* L., belongs to the intriguing Punicaceae family, renowned for its diverse applications, ranging from medicinal uses to various industrial endeavors [5]. In a series of intriguing germination tests involving common commercial seeds like lettuce (*Lactuca sativa*), tomato (*Solanum lycopersicum*), and pepper (*Capsicum baccatum*), it was observed that extracts from pomegranate (*Punica granatum*) exhibited fascinating allelopathic effects, influencing not only their germination but also impacting their growth in remarkable ways [6]. The effects of allelopathic compounds might be directly on the germination and growth of plants but they might also indirectly interfere with the root- soil interaction of plants i.e., the interaction of plants with mycorrhizal fungi They include a number of diverse chemical compounds although majority of them are phenolic compounds which were identified to help seed germination of most of the plants [7]. Additionally, the options of phenolic allelopathic compounds manipulate several biochemical and physiological activities in plants like photosynthesis, cell division, enzyme reactions, plant water affinity, and nutrients transportation [8]. Due to the significance of the allelopathic occurrence in the agricultural domain and since researchers want to profit from this phenomenon present in nature as herbicides, insecticides or natural growth promoters and to avoid employing chemical ones because of their adverse impacts on the environment and to maintain clean agriculture devoid of chemicals. Therefore, the study aimed to use the tender leaves of *F. carica*, and *P. granatum* to study their effect on the germination and development of *V. faba*.

2. Material and methods:

2.1. Sample Collection

Samples of *F. carica* and *P. granatum* were collected from Mosul city and washed with distilled water and preserved for use in experiment.

2.2. Pot Experiment:

The study included an experiment in the Department of Biology, College of Science, University of Mosul, in 2024-2025 to study of allelopathic effects of fresh leaves of, *F. carica* and *P. granatum* in seed germination and growth of *V. faba* L., Thoroughly mix the fresh leaves of *F. carica* and *P. granatum* with the prepared sterilized soil in a pot containing 10 g of leaves / 3kg of loamy soil per pot. Three replicates were performed for each treatment, in addition to distilled water as a control treatment. 10 *V. faba* L seeds per pot were sown in the soil for two monthsand irrigated as needed [9] (The seeds of the plant used in this study were collected from the department examination and certification of seeds in Tikrit, Salah Aldeen, Iraq, Viable and healthy seeds, free from visible infections, and of uniform size were selected). Evaluate the germination percentage after 14 daysby used equation [10].

Germination % = seeds germinated/total seeds x 100

2.3. Characteristics of the Study

Following 60 days after planting, certain growth indicators were assessed, including shoot length (cm), root length (cm), fresh weight of shoot (g) and fresh weight of root, number of flowers per plant, number of branches per plant, and number of nodes per plant [11].

Statistical Analysis: The research study was conducted with the plan of Random Complete Design and conducted a statistical analysis of data according to the SAS program. Duncan Multiple Range test was used at a 5% probability of differentiation between the average of transactions.

3. Results and Discussion

3.1. Characterization of of *V. faba*

3.1.1 Germination and Growth

Data present in **Table (1)** indicate a significant stimulation in the germination, lengths of shoot and roots and their fresh weights of *Vicia faba* L., with the highest stimulating effect observed in the *F. carica* leaf treatment, where the readings were germination 96%, shoot length and its fresh weight, 39.4cm and 25.9g, respectively,

while the highest value of root length 20.7cm and fresh weight 14.8 gm was in *P. granatum* treatment, compared to the control treatment without addition.

Table 1: Effect of *F. carica* and *P. granatum* fresh leaves on germination & growth of V. *faba*

Treatments		Seed Germination (%)	Shoot length(cm)	Fresh Shoot weight (g)	Root length (cm)	Fresh Root weight(g)
Control		86.6b	35.0c	16.2b	17.8cb	10.5c
P. granatum		76.6c	37.5b	17.4b	20.7a	14.8a
F. carica		96.0a	39.4a	25.9a	18.2b	13.6b
Average effect of trees	*P. granatum*	81.6b	36.2b	16.7b	19.3a	14.7a
	F. carica	91.3a	37.2a	21.4a	17.0b	11.5b

* Similar letters indicate that there are no differences that are significant at the 5% level Considering Duncan's Multiple Range Selection

3.1.2. Flower number

As shown in Fig. (1 and 2), the results of the effect of adding fresh leaves of *F. carica* and *P. granatum* to the soil at a concentration of (10%) on the number of flowers of *V. faba*. Plants, where the results showed an increase in the number of flowers with the effect of *F. carica* leaves, while plants grown in soils incubated with leaves of *P. granatum* were not affected.

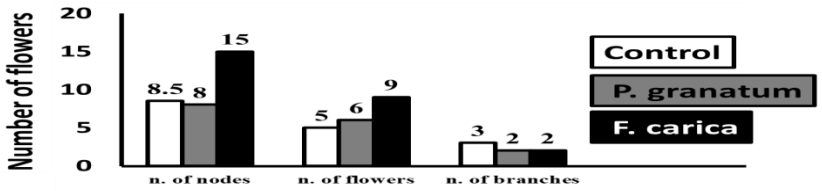

Figure 1: Effect of *F. carica* and *P.granatum* fresh leaves on flower number of *V. faba.*

Figure 2: Growth of *V.faba* L. of treatment with fresh leaves of *F. carica,* and *P. granatum.*

A*: Plants treated with F. carica* B*:* Plants treated with *P. granatum* C: Control

3.1.3. Nodes/ plant

The number of bacterial nodes in roots was increased after treating with leaves residues, shows the root nodes as a single multi-node, most of them have a blue or pink colour appearance, which in turn considered them active nodes, on the other hand, their size showed an enlarged size due to the effect of additional leaf of tree under study, and the highest increase was noticed after adding *p, granatum* leaves in Fig.3.

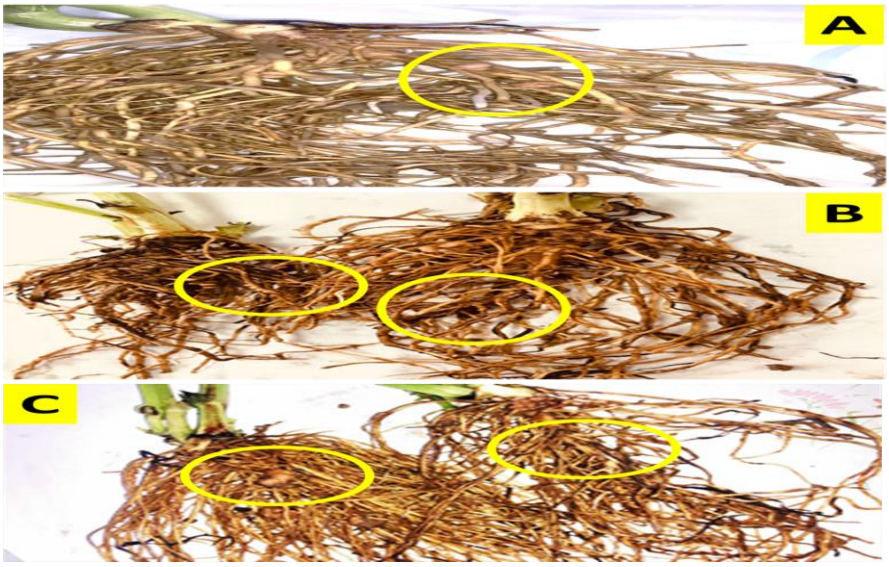

Figure 3: Nodes of *V. faba* root treated with fresh leaf of *F. carica*, and *P.granatum.*

A: Plants treated with *F.carica* B:Plants treated with *P.granatum* C:Control

The results showed a significant increase in the growth characteristics of the of *V. faba* plant due to the addition of *F.caria* and *P. granatum* tree leaves to the soil, *F. carica* leaves had the highest germination percentage of 96%, while *P. granatum* at the same concentration reached 76.6% compared to the control 86.6% This may be due to increased osmotic pressure in plant cells, which increases the cells' ability to absorb water It may also be that trace inorganic ions the activity of respiratory enzymes of *V. faba* cells stimulates the activity of respiratory enzymes and enhances the capacity of the plants to produce nutrients and consequently enhance germination of *V. faba* seeds [12]. Plant secondary products Allelochemicals are commonly termed as the secondary metabolic product. In the intricate world of plant metabolism, a significant portion of compounds is synthesized through the fascinating shikimic acid and acetate pathways. These pathways weave together in a complex

movement, shaping the very essence of how plants thrive and interact with their environment., are usually water-soluble and widely present in most plants, and in many tissues Allelochemicals in a dose that retard growth of one species can literally stimulate the same or another species at different concentration [13]. It was proposed that since allelochemicals exist in the leaves of *F.caria* and *P. granatum*, there is a possibility of their release into the soil that can promote growth of beans directly or indirectly[14]. [15] Other plant allelochemicals enhance the cultivation of the recipient plant by altering the proportion and the level of the hormones present in them. To some extent, other allelopathic substances in the leaf of the *F.caria* and *P. granatum* trees may also promote the growth of the *V. faba* in other ways. Allelopathic chemicals can alter the composition of microbial community within the soil and favor the growth of other plants and other allelopathic chemicals that are present in the tree leaves may stimulate colonization by mycorrhizal fungi and this facilitates the growth of the *V. faba* [16]. According to research results, reached similar results in a study conducted [17] the effect of aqueous extract of *F. caria* e leaves was most effective in growth promotion on mint (*Mentha haplocalyx Briq*.) in medium and low concentration. In other research [18] Phytochemical exploration into the extracts of *F. caria*, mulberry, and eucalyptus leaves revealed a treasure trove of active compounds. Within these aqueous extracts, one can find a vivid array of phenols, flavonoids, glycosides, and tannins. Each of these chemicals dances with potential, promising fascinating insights into their roles and benefits. The effect of these extracts on maize seed germination was very remarkable at different concentration rates. Aqueous extracts of leaves of the plants under the investigation produced better morphological growth and germination rates at low levels, whereas higher concentrations revealed marked toxicity to maize plants. Our research findings are consistent with [19] *Vitis vinifera* L. leaves contain essential elements for plant growth like calcium, magnesium, phosphorus, and iron, which favorably affected the morphological traits of the *V.faba* plant.

4. Conclusions

The results showed that adding fresh *F. carica*, and *P.granatum* leaves to the soil at a concentration of 10% has allelopathic effects that stimulate the germination and growth of the *V. faba* plant growing in it. However, *F. carica* leaves showed a significant increase over *P.granatum* leaves for most growth traits of *V. faba*. However, there are some limitations, the experiment took place in a controlled pot experiment hence it might not appear accurately in the field environments where type of soil, moisture content, and pests contribute to the allelopathic aspect of the plant. Moreover, the concentrations applied cannot be perfectly

reflective of the ones occurring in natural settings, which propagates towards the insufficient generalizability of the findings. Additional studies dealing with the field experiments to confirm these findings under the varying environmental conditions and the influences on other varieties of *V. faba* should be undertaken in the future.

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