Clean cultivation of (*Vicia faba* L) using household waste

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Abstract: Agriculture has been practiced for thousands of years without the use of any chemicals, and the use of these agricultural chemicals not only causes degradation of arable land, but also causes soil pollution. To overcome this situation, organic agriculture is the only solution that only involves natural resources such as organic materials, plant and animal waste, and microbes. This is what helped increase the importance of research, as a pot experiment was carried out in Tartous Governorate for the 2021-2022 season to study the effect of some household waste, such as (Rice water and ground egg shells) in the growth and development of bean plants. In addition to the evidence, water only, as natural fertilizers free of chemical compounds. The experiment was conducted in a completely randomized block design.

The results showed that there were significant differences between the studied treatments compared to the control, and the rice water treatment achieved significant superiority in morphological traits (plant height, number of leaves, number of branches), while the eggshell treatment excelled in productive traits (number of flowers, number of pods, seed weight, productivity per hectare).

Keywords: Vicia faba, eggshells, rice water, morphological characteristics, household waste.

الزراعة النظيفة لنبات الفول Vicia faba L باستخدام المخلفات المنزلية

الملخص: كانت الزراعة تمارس لآلاف السنين دون استخدام أي مواد كيميائية، واستخدام هذه الكيماويات الزراعية لا يسبب تدهور الأراضي الصالحة للزراعة فحسب، بل يتسبب أيضا في تلوث التربة. وللتغلب على هذا الوضع، فإن الزراعة العضوية هي الحل الوحيد الذي لا ينطوي إلا على الموارد الطبيعية مثل المواد العضوية والنفايات النباتية والحيوانية والميكروبات، وهذا ما ساعد في زيادة أهمية البحث حيث نفذت تجربة أصص في محافظة طرطوس للموسم 2021– 2022 لدراسة تأثير بعض المخلفات المنزلية مثل (ماء الأرز ومطحون قشور البيض) في نمو وتطور نبات الفول إضافة للشاهد ماء فقط، كمخصبات طبيعية خالية من المركبات الكيميائية . حيث تمت التجربة بتصميم القطع العشوائية الكاملة. بينت النتائج وجود فروق معنوية بين المعاملات المدروسة مقارنة بالشاهد وحققت معاملة ماء الأرز تفوقا معنوياً بالنسبة للصفات المورفولوجية (ارتفاع النبات، عدد الأوراق، عدد الأفرع) في حين تفوقت معاملة قشر البيض بالصفات الإنتاجية (عدد الأزهار، عدد القرون، وزن البذور، إنتاجية الهكتار).

1. Introduction

Faba bean (*Vicia faba*) is a potential, versatileleguminous crop of Fabacee family which can begrown in varied climatic conditions throughout theworld (Arya *et al*., 2018 & 2022). The crop, if usedin rotation or as intercrop (Köpke and Nemecek, 2010;Arya *et al*., 2019) with other cereal crops, providesagronomic, economic and, environmental benefits tothe farmers in the form of reducing the requirementof inorganic fertilizers for next crops (Aschi *et al*.,2017; Arya et al., 2020), by increasing the plant yields(Xiao *et al*., 2018) and by breaking the vicious cycleof disease and pests (Zhang *et al*., 2019). Faba beanalso known as many names such as Field bean, Broadbean, Windsor bean, Horse bean, Tick bean, Longpodbean and Kaka Matar (Mínguez *et al*., 2021). It hasbeen produced in Mediterranean region (Jensen et al.,2010) China, Africa, Europe, Middle East, Asia whereit is most common crop for human and animalconsumption. Faba bean (kernel as well as maturedry seed) with well-balance d aminoacid profile(Martineau *et al*., 2022) is a rich source of protein,(Multari *et al*., 2015) carbohydrates, minerals (Rahateet al., 2020), vitamins (Oomah *et al*., 2011); and otherbioactive phytochemica ls along with some anti-nutritional compounds (Mattila *et al*., 2018).

It is also a good source of protein, and works to improve soil properties and increase its fertility due to its ability to stabilize atmospheric nitrogen thanks to the bacterial nodules formed on its roots (Singh *et al*., 2013). Awareness of environmental and food safety issues is responsible for the development of organic agriculture in recent years (Masarirambi *et al*.,2010).

The recent increasing interest in phytonutrients and the nutritional and health benefits of faba bean plants confirms the importance of this crop, which contains a group of biologically active phytochemicals in its mature seeds and green pods as well as leaves. These phytochemicals include phenolic compounds, flavonoids, biologically active peptides, and dietary fiber. Amino acids are mainly responsible for various biological activities and increase the importance of this plant in treating diabetes, anti-inflammatory, antihypertensive, antiviral, antibacterial, antifungal, antioxidant, antimalarial, anticancer, and cholesterol lowering (Kumae *et al*., 2022).

Recently, farmers' choice has been shifted to organic farming instead of chemical fertilizers due to their high cost and inefficiency to improve soil fertility (Oyedeji et al., 2014). Organic fertilization has become an important part of environmentally sound, sustainable agriculture. Coming from organic sources makes it more valuable for agriculture (Arora and Maini,2011).
The use of organic fertilizer has improved soil fertility and helps combat diseases. It is also an environmentally friendly way to reduce waste that accumulates in landfills (Khadem et al.,2010).
Eggshell waste can be used as plant fertilizer because eggshells contain 95% calcium carbonate (John and Paul, 2006). It helps in changing the exponent.

Very especially for P is 0,21%, K is 0,40%, Ca is 0,47% and Mg is 0,09%.The results of a study showed the effect of rice husk ash (75, 50, 25, 0) g/plant and ground egg shells (0, 15, 30) g/plant on the growth of pepper plants. The results showed that rice husk gave the best values for morphological traits at the level of 50 g/plant.

While eggshell powder achieved the best values for production characteristics at the level of (30) g/plant, as eggshell powder is considered a fertilizer that supplements organic fertilization and meets the plant’s calcium needs. Rice husk ash has mineral binding function and helps loosen the soil, so that it can help plant roots to absorb nutrients (Kurniatuti,2018).

Rice water biofertilizers depend on the chemical reaction resulting from the mixture of starch water and milk. This mixture produces lactic acid bacteria that improve soil health by decomposing organic matter and reducing unwanted pathogens associated with decomposing material. It also eliminates unpleasant odors associated with compost. The starch water allows bacteria to grow while the milk isolates the bacteria needed for the fertilizer leaving unwanted bacteria to die. These results showed that starch water biofertilizer is a good organic fertilizer for home gardens as it is easy to make and can be accessed at any time (Abba et al., 2021).

(Pervez et al., 2000) Showed in a study of the effect of organic fertilizers on the growth of potato and pea crops using different types of organic fertilizers (egg shells, wood ash, banana peels, used tea waste, and soil seedlings only), where the best values were for plant height, number of branches, leaf surface area, and productivity. Egg shell powder from the two plants, followed by banana peels, then used tea waste

A study conducted in India showed the effect of fertilizing with eggshells on the growth of the fenugreek plant and increasing soil fertility by using organic fertilizers (food scraps) such as egg and fruit shells to improve the properties of the soil. The results showed an improvement in the properties of the soil and its content of calcium carbonate and nitrogen, in addition to improving the growth, development and productivity of the fenugreek plant (Karn *et al*., 2023).

The results of a study of eggshell powder on tomato plants were achieved in two different soils, one to which eggshell powder was added and another to which the powder was not added. A difference was observed in the characteristics of the soil that contained eggshell powder and the other that did not contain it. The results also showed that eggshell powder It helped the plant to grow, as it is considered a natural, safe and healthy fertilizer for humans (Ayyub *et al*., 2012). A study of the effect of eggshells on the growth of pepper plants as an organic fertilizer showed an increase in the wet and dry weight of the plant, root length, and plant height (Anugrah *et al*.,2021).

This study was conducted to determine the possibility of utilizing household waste as clean and safe household fertilizers

The importance of the research stems from the importance of the bean crop, the possibility of growing it in narrow spaces, and benefiting from household waste as clean and safe household fertilizer using the organic fertilization method and reducing the costs of chemical fertilization From the above, **the research aims to compare** the growth and development of bean plants using two types of household waste (egg shell powder and rice soak). Determine the best values resulting from treatment with these wastes.

Materials and methods:

(Location: Syria_Tartous_Safita. A home potting experiment was conducted

Varieties: The Spanish variety was obtained from the local market

Studied treatments: two types of household waste (such as biofertilizers) in addition to the control, water only. Water (see) _ egg shells _ rice water

Irrigation was treated with the previous treatments every 15 days for two months, 4 times during the plant growth stages.

How to prepare eggshell fertilizer: According to (Karn *et al*., 2023)

grams of egg shells were ground, and we obtained cup of finely ground shells ,Then we put it in a bowl and added three times as much apple cider vinegar to it (that is, three cups of apple cider vinegar are added to every cup of egg shells). Then mixing was done until the reaction stopped and no bubbles appeared. The container was closed well and placed in a dark place for (3-4) days for the reaction to occur

Then a very thin, brown layer forms. We remove the layer and then filter the mixture to get rid of the sediment

Then we take 10 ml of the mixture of egg shells and vinegar, dissolve it in a liter of water, and then use it, the rest of the mixture is stored in a cool place in a closed plastic container and we pierce it at the top.

1- Rice water.Rice water fertilizer is a natural fertilizer that is prepared at home and is the water that results from washing or soaking rice.

It contains a number of nutrients such as carbohydrates, vitamins, sugar, fibre, iron, magnesium and zinc. It also contains nitrogen, phosphorus and potassium, so it is considered a natural alternative to chemical fertilizer

But of course, the proportions of the elements are light and not concentrated, and therefore there will be no fear of harm to the plants if it is used in a concentrated form or several times. Rice fertilizer is used on all plants at all their different stages

How to prepare rice water: According to (Abba *et al*., 2021).

Put a cup of rice in a liter of warm water and leave it for (2-3) hoursWe filter the water into a suitable bowl, add 8 tablespoons of natural milk and mix it well

We cover the bowl well with a piece of cloth or gauze. Then put it in a dark place and leave it for (2-3) days.After that, we remove the gauze, examine it, and notice the formation of a thin, white layer, so we remove it. We filter the rice water, then take 10 ml of the mixture, dissolve it in a liter of water, and then use it on the plants

Store the rest of the mixture in a closed plastic container with a hole punched in the top.The treatment was carried out with irrigation and the previous components every 15 days for two months, 4 times during the plant growth stages.

The readings studied: plant height (cm) / number of branches / plant - number of leaves / plant - number of flowers / plant - number of pods / plant - weight of pods / plant (g).

Experiment design: The experiment was designed using a randomized block method, then the data was tabulated on the Excel program and a statistical analysis was performed using the Genstat 12 program to determine the least significant difference at the 5% level.

Results and discussion:

1**:The effect of household waste on the height of bean plants/cm.**

Table (1) shows the effect of treatment with household waste (control, rice soak, and ground eggshells) on plant height. The averages reached (90.44, 100.10, 90.88) cm, respectively. Comparing the averages, it was noted that there were no significant differences between the studied treatments, but the reason for soaking rice was an increase in the height of the plant, as soaking rice can help the plant roots to absorb nutrients (Kumae *et al*., 2022).

Table (1): Shows the effect of household waste on bean plant height (cm)

ground egg shells	soaked rice	water	Refined
91.00	95.33	87.33	1
97.33	101.66	89.66	2
84.33	103.33	94.33	3
90.88 [a]	100.10 [a]	90.44 [a]	Average
	11.78		L.S.D5%
	5.5		CV%

2:The effect of household waste on the number of branches/plant

Table (2) shows the effect of treatment with household waste (control, rice soak, and ground eggshells) on the number of branches/plant. The averages reached (3.33, 4.33, 3.33) branches/plant, respectively.

Comparing the averages, it was noted that there were no significant differences between the studied treatments, but the reason for the rice soaking was an increase in the number of branches, as the rice soaking can help the plant roots to absorb the nutrients that caused an increase in the number of branches. The height of the plant, and this in turn was reflected in the number of branches/plant (Kumae *et al*., 2022).

Table (2): shows the effect of household waste on the number of branches of bean plants

ground egg shells	soaked rice	water	Refined
4.00	4.00	3.00	1
3.00	5.00	3.00	2
3.00	4.00	4.00	3
3.33 [a]	4.33 [a]	3.33 [a]	Average
	1.31		I.S.D5%
	15.7		CV%

3:The effect of household waste on the number of leaves/plant

Table (3) shows the effect of treatment with household waste (control, rice soak, and ground eggshells) on the number of branches/plant. The averages reached (37.00, 46.00, 41.00), leaf/plant, respectively.

Comparing the averages, significant differences were found between the studied treatments, where soaked rice achieved significant superiority over the other treatment and the control, and achieved the best value (46.00) leaf/plant, and in turn, ground was superior. Eggshells on the control that gave the lowest value (37.00) leaf/plant. This may be attributed to the role of both types of fertilizers used (egg shells and rice water) and the role of organic extracts in germination and increasing the overall productivity of the plant, and this is what the rice soaking achieved(Arora and Maini,2011).

Table (3): shows the effect of household waste on the number of leaves of bean plants

ground egg shells	soaked rice	water	Refined
46.00	51.00	42.00	1
40.00	46.00	35.00	2
36.00	42.00	34.00	3
41.00 [b]	46.00 [a]	37.00 [c]	Average
	2.07		L.S.D.5%
	2.2		CV%

4:The effect of household waste on the number of flowers/plant

Table (4) shows the effect of treatment with household waste (control, rice soak, and ground eggshells) on the number of flowers/plant. The averages reached (15.00, 17.00, 21.00) flower/plant, respectively. Comparing the averages, significant differences were found between the studied treatments, where ground eggshell achieved significant superiority over the other treatment and the control and achieved the best value (21.00) leaf/plant, and in turn, ground Egg shells were the control that gave the lowest value (37.00) flower/plant, followed by soaked rice, superior to the control that gave the lowest value (15.00) flower/plant. The increase in the number of flowers is due to the eggshells containing 95% calcium carbonate. It helps in changing the pH of acidic soil and thus helps in increasing the absorption of nutrients for the plant (Singh *et al*., 2013).

Table (4): shows the effect of household waste on the number of flowers/bean plants

ground egg shells	soaked rice	water	Refined
23.00	21.00	17.00	1
18.00	14.00	12.00	2
21.00	16.00	16.00	3
21.00 [a]	17.00 [b]	15.00 [c]	Average
	2.07		L.S.D5%
	2.2		CV%

5:The effect of household waste on the number of pods/plant

Table (5) shows the effect of treatment with household waste (control, rice soak, and ground eggshells) on the number of pods/plant. The averages reached (6.66, 10.33, 13.66), pods/plant, respectively.

Comparing the averages, significant differences were found between the studied treatments, where the ground eggshell had a significant superiority over the other treatment and the control, and achieved the best value (13.66) pods/plant, and in turn was superior to Soaked rice was the control that gave the lowest value (6.66) pod/plant. Eggshells contain trace elements of magnesium, sodium, calcium, zinc, manganese, and copper, at a rate of 0.3%. Magnesium (Mg) plays an important role in transporting phosphate in plants, and therefore the phosphate content in plants can be increased by adding magnesium through eggshells, and this in turn is reflected in increasing the number of pods on the plant (Khadem et al.,2010).

Table (5): shows the effect of household waste on the number of pods/bean plant

ground egg shells	soaked rice	water	Refined
14.00	12.00	8.00	1
13.00	9.00	5.00	2
14.00	10.00	7.00	3
13.66 [a]	10.33 [b]	6.66 [c]	Average
	1.51		L.S.D.%
	6.5		CV%

6:The effect of household waste on the weight of pods/plant

Table (6) shows that there was a significant increase in the weight of the pods between the studied treatments (water, soaked rice, ground eggshells), where the averages reached (257.46, 167.83, 85.44) g/plant, respectively, where the ground eggshells achieved significant superiority over the treatments. studied and gave the highest value (257.46) g/plant, followed by soaked rice and then water, which gave the lowest value (85.44) g/plant. The reason may be because eggshells contain up to 0.3% phosphorus and trace elements (magnesium, sodium, potassium, zinc, manganese, copper) contain 0.3%. Phosphorus plays a role in energy transfer in plant cells, such as ADP and ATP. Phosphorus (P) for plants is beneficial in stimulating root growth. In addition, phosphorus acts as a raw material for photosynthesis and respiration. It accelerates flowering, the appearance of fruits, and increases their weight (Arora and Maini, 2011).

Table (6): shows the effect of household waste on the weight of pods/bean plants

ground egg shells	soaked rice	water	Refined
272.46	191.66	102.83	1
247.53	143.83	64.83	2
252.46	168.00	88.66	3
257.46 [a]	167.83 [b]	85.44 [c]	Average
	15.38		L.S.D5%
	4.0		CV%

7:The effect of household waste on the weight of seeds/plant (g)

Table (7) shows that there was a significant increase in seed weight among the studied treatments (water, soaked rice, ground eggshells), where the averages reached (214.61, 133.58, 63.04) g/plant, respectively, where ground eggshells achieved significant superiority over the treatments. studied and gave the highest value (214.61) g/plant, followed by soaked rice and then water, which gave the lowest value (63.04) g/plant. The reason may be because eggshells contain up to 0.3% phosphorus, as phosphorus plays a role in energy transfer in plant cells, such as ADP and ATP. In addition, phosphorus acts as a building block for nucleic acids (DNA and RNA), lipids and proteins (John and Paul,2006).

Table (7): shows the effect of household waste on the weight of seeds/bean plants (g)

ground egg shells	soaked rice	water	Refined
228.00	151.90	76.43	1
206.57	114.90	48.50	2
209.26	133.96	64.19	3
214.61 [a]	133.58 [b]	63.04 [c]	Average
	11.28		L.S.D5%
	3.6		CV%

8:The effect of household waste on the weight of seeds/plant (g)

Table (8) shows that there was a significant increase in productivity among the studied treatments (water, soaked rice, ground eggshells), where the averages reached (94.56, 200.38 (321.92 g/plant). Comparing the averages, significant differences were found between the studied treatments, and the ground eggshells achieved it was significantly superior to the second treatment and the control and gave the highest value (321.92) g/plant, followed by rice water, then water. This may be attributed to the fact that ground eggshell contains up to 0.3% of phosphorus and contains trace elements (magnesium, sodium, potassium, zinc, manganese, and copper) at a rate of 0.3. %. Phosphorus acts as a raw material that helps photosynthesis and respiration. Accelerates flowering and the appearance of fruits. Moreover, calcium has an important role in maintaining the quality of the fruit, maintaining the integrity of the cells, and the growth of the fruits and increasing their weight (Kumae *et al*., 2022).

Table (8): shows the effect of household waste on productivity per hectare, kg/ha

ground egg shells	soaked rice	water	Refined
342.00	227.85	114.65	1
309.86	172.35	72.75	2
313.89	200.94	96.29	3
321.92 [a]	200.38 [b]	94.56 [c]	Average
	16.85		L.S.D5%
	3.6		CV%

Conclusions:

•The treatment is superior to the rice soak in terms of the number of leaves, the number of branches, and the length of the plant

•Eggshell ground treatments were superior in terms of number of pods, number of flowers, seed weight, and productivity.

Suggestions:

Use these household wastes because they are natural, inexpensive, economical, and do not stress the soil. They help improve the properties of the soil and are not harmful to the environment

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