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Effect of Baker's Yeast (Saccharomyces cerevisiae) as a Bio-fertilizer on the Germination and Growth of Fenugreek seeds

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تأثير خميرة الخباز (*Saccharomyces cerevisiae*) كسماد حيوي على إنبات ونمو بذور الحلبة

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Abstract:
The aim of this research was to investigate how yeast impacts fenugreek seed vegetative growth. Twenty days after planting, the plants were treated with yeast solutions at concentrations of 10, 20, and 30 g/L via foliar spraying, root-zone injection, or both, with repeat applications performed 30 and 40 days after planting. The results indicated a positive effect of the yeast solution, as a clear increase was observed in plant height, fresh and dry weight, germination percentage, and seedling vigor index of fenugreek seeds, compared to those not treated with the yeast solution. The results also showed that the greatest plant height (15 cm) was recorded when the plants were treated with a combination of foliar spraying and root-zone injection at a concentration of 20 g/L. Regarding fresh and dry plant weights, values of 0.15 g and 0.13 g were recorded, respectively, while the germination percentage and seedling vigor index for the fenugreek seeds reached 100% and 1500, respectively. In this study, we concluded that yeast serves as a good fertilizer for plants and that the best irrigation method is a combination of foliar spraying and root-zone injection, followed by foliar spraying alone. The yeast solution concentration of 20 g/L was among the best concentrations used compared to the control group.

Keywords: Saccharomyces cerevisiae, Spraying, Foliar injection, Fenugreek

الملخص
هدفت هذه الدراسة إلى بحث تأثير الخميرة على النمو الخضري لبذور الحلبة. بعد عشرين يومًا من الزراعة، عُولجت النباتات بمحاليل الخميرة بتراكيز 10 و20 و30 غ/لتر عن طريق الرش الورقي أو الحقن في منطقة الجذور أو كليهما، مع تكرار المعالجة بعد 30 و40 يومًا من الزراعة. أشارت النتائج إلى تأثير إيجابي لمحلول الخميرة، حيث لوحظت زيادة واضحة في طول النبات، والوزن الطازج والجاف، ونسبة الإنبات، ومؤشر حيوية الشتلات لبذور الحلبة، مقارنةً بالنباتات غير المعالجة بمحلول الخميرة. كما أظهرت النتائج أن أعلى طول للنبات (15 سم) سُجّل عند معالجة النباتات بمزيج من الرش الورقي والحقن في منطقة الجذور بتركيز 20 غ/لتر. فيما يتعلق بوزن النبات الطازج والجاف، سُجّلت قيم 0.15 غرام و0.13 غرام على التوالي، بينما بلغت نسبة إنبات بذور الحلبة 100% ومؤشر حيوية الشتلات 1500. خلصت هذه الدراسة إلى أن الخميرة تُعدّ سمادًا جيدًا للنباتات، وأن أفضل طريقة للري هي الجمع بين الرش الورقي والحقن في منطقة الجذور، يليه الرش الورقي وحده. وكان تركيز محلول الخميرة 20 غرام/لتر من بين أفضل التركيزات المستخدمة مقارنةً بمجموعة المقارنة.

الكلمات المفتاحية: خميرة الخباز، الرش، الحقن الورقي، الحلبة.

Introduction

The *Apiaceae* family includes the annual fenugreek (*Trigonella foenum graecum)*, which is usually found in the Mediterranean region. Fenugreek is thought to be the world's ancient medical plant used to treat a variety of ailments; historically, it was cultivated as a forage crop for livestock, whereas in recent times, its leaves and seeds are mostly used as a spice in cooking (Acharya *et al.*, 2008 and Acharya *et al.*, 2010).

Trigonella foenum-graceum L. It is a significant medicinal plant with diabetic, cancer-fighting, and antimicrobial effects, and it also lowers cholesterol (Nagananda *et al.*, 2010). The fiber from the diet element, which has potential therapeutic nutritional properties, is mainly responsible for these positive physiological effects (Srinivasan, 2006). Fenugreek seeds have cellulose, starch, calcium, iron, beta- carotene, 20% protein, 50% carbs, 5% fat, and 25% dietary fiber (USDA, 2001). It has also been discovered include diosgenin, potassium, niacin, and vitamin C. alkaloids (including lysine and L-tryptophan) and saponins are additional active ingredients in fenugreek (Acharya *et al.*, 2007a and b). Furthermore, fresh fenugreek is a great way for people to get iron (Fe) (Chhibba *et al.*, 2000).

Bio-fertilizers are preparations containing beneficial microorganisms; they are used to reduce reliance on chemical fertilizers, improve soil fertility, and boost crop productivity. Baker's yeast is a kind of biological fertilizer that is usually sprayed on crops or put into soil (Abbas, 2013) Because of its abundance of nutrients and its function in the production of vital compounds like growth regulators, such as auxins and gibberellins (Fathy and Farid, 1996).

The yeast (*Saccharomyces cerevisiae*) is a promising new agent for enhancing the growth of various crops and serves as a beneficial alternative to chemical fertilizers; it can be used safely without posing risks to human or animal health or the environment (Omran, 2000). A growing body of research suggests that yeasts in the rhizosphere may either directly or indirectly promote the growth of plant roots (El-Tarabily and Sivasithamparam, 2006; Cloete *et al.*, 2009). Numerous soil yeasts has been investigated for possible applications as biological fertilizers (Gomaa and Mohamed, 2007; Eman *et al.*, 2008). *Saccharomyces cerevisiae* is a naturally biological fertilizer and biological catalyst that greatly increases the development and yield of numerous crops (Abd El-Motty *et al.*, 2010). Also, it is thought to be a naturally occurring supplier of cytokines, which promote cell differentiation and division and trigger the formation of proteins, nucleic acids and chlorophyll (Amer, 2004) Which are added whether by putting it to soil or by applying them directly to the foliage (El-Ghamring *et al.*, 1999). Along with other elements that that promote vegetative development in plants generally, it clearly and significantly contributes to boosting enzymatic efficacy and absorption of nutrients (Abbas, 2013). Concurrently, the yeast produces carbon dioxide, which helps to boost the process of photosynthesis' overall output (Khalil and Ismael, 2010).

The study's objectives were to ascertain how a yeast solution affected the fenugreek seeds' vegetative growth traits and to establish the best application technique—whether via foliar spraying, injection into the root zone, or both and to compare the results with a control in order to achieve the best outcomes regarding the studied characteristics.

2- Materials and Methods

2.1. Experiment location

A soil mixture of sand and peat moss was prepared in a 1:1 ratio and heat-sterilized. Plastic pots were filled with the mixture, and fenugreek seeds of local type were planted at a rate of four seeds per pot, with three replicates for each treatment.

Figure 1 : Planting fenugreek seeds by placing four seeds in each pot and three replicates per treatment.

Figure 2: Preparation of three concentrations 10, 20 and 30 g/l of yeast solution

2.3. Growth criteria:
Three replicates were performed for each treatment, and the germination percentage, plumule and radicle lengths, and seedling vigor index (SVI) were calculated as follows:

Seedling vigor index (SVI) = [seedling length (cm) × germination percentage] (Abdul-baki, and Anderson, 1973).

$$\text{Germination percentage} = \frac{\text{No.of germinated seeds/ pot}}{\text{No.sown seeds/ pot}} \times 100\%$$

- **Fresh weight:** Determined by weighing plant on a sensitive a delicate meter and calculating the weight rate for plant.
- **Dry weight:** After drying the fresh plant which the fresh weight of them had been previously recorded the samples were placed in an oven at 70°C for 72 hours and then weighed to determine the dry weight.

3- RESULTS
Radicle and plumule length, as well as the fresh and dry weight of the plant, were greatly affected by spraying fenugreek seeds with yeast solution at different concentrations (10, 20, and 30 g/L) according to the findings in Table (1). With foliar spraying, we observed an increase in growth parameters; however, with the root-zone injection method, only a slight increase in growth parameters was noted in contrast to the control. The findings shown in Table (1) show that the combination of root-zone injection with yeast solution and foliar spraying has a highly significant effect on fenugreek growth indicators in contrast to the control. The highest values for plant height and fresh and dry weights were recorded, particularly at a concentration of 20 g/L. When assessing seed germination percentage and the seedling vigor index, an increase in both values was observed with foliar spraying using a yeast solution; a germination rate of 75% and a vigor index of 975 were recorded at a concentration of 20 g/L, respectively. when foliar spray and injection around the roots were used together, 100% germination percentage and 1500 for seed vigor were recorded at

3.1. Yeast Solution Preparation
After dissolving 10, 20, and 30 grams in one liter of water that was warm, and adding two spoonful's of sugar to activate the yeast; the liquid was allowed to rest for a full day prior to filtering using a cloth (Dubois *et al.*, 1956). The yeast solution was sprayed, foliar injected around the roots, or applied three times at ten-day intervals beginning 20, 30, and 40 days after growing.

Table 1: Effect of different concentration levels of yeast solution on some growth parameters of fenugreek seeds.

Treatment	RL (cm)	PL (cm)	Fresh Weight g	Dry Weight g	GP	SVI
Control	4	3	0.04	0.03	75	525
Spraying (10 G/L)	6	5	0.10	0.09	75	825
Spraying (20 G/L)	6	7	0.12	0.10	75	975
Spraying (30 G/L)	5	5	0.09	0.07	25	250
Around root injecting (10 G/L)	3	5	0.08	0.05	25	200
Around root injecting (20 G/L)	4	6	0.09	0.08	50	500
Around root injecting (30 G/L)	4	3	0.06	0.04	25	175
Spraying + Injecting (10 G/L)	6	6	0.12	0.10	75	900
Spraying + Injecting (20 G/L)	10	5	0.15	0.13	100	1500
Spraying + Injecting (30 G/L)	5	5.5	0.13	0.11	50	525

RL: Radical length, PL: Plumule length, GP: germination percentage, SVI: seedling vigor index.

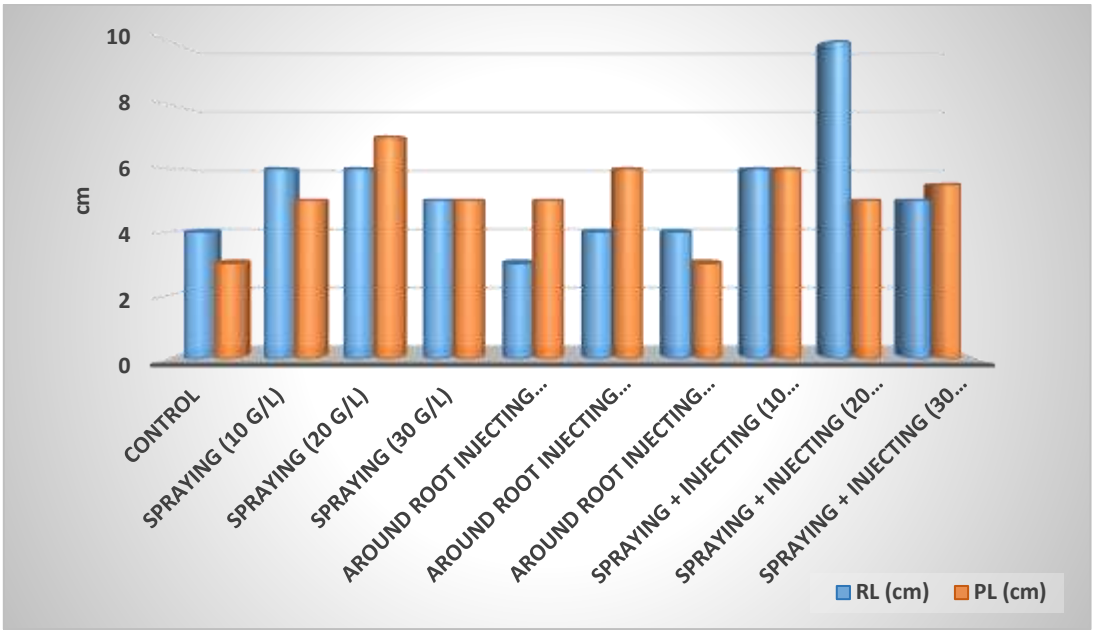

Figure 3: Effect of different concentration levels of yeast solution on radical and Plumule length of fenugreek seeds.

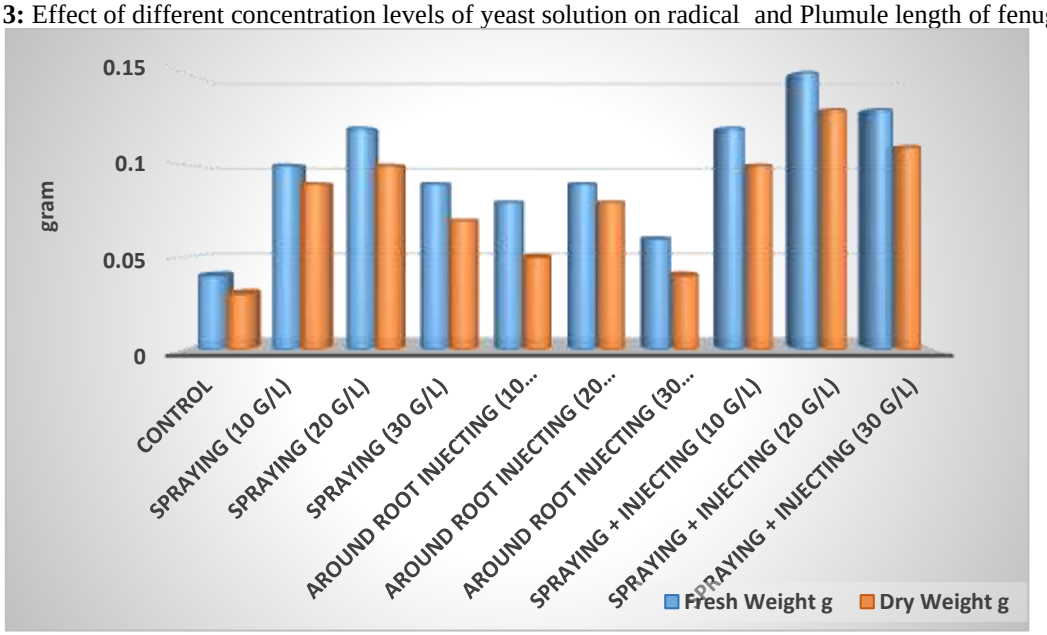

Figure 4: Effect of different concentration levels of yeast solution on fresh and dry weight of fenugreek seeds

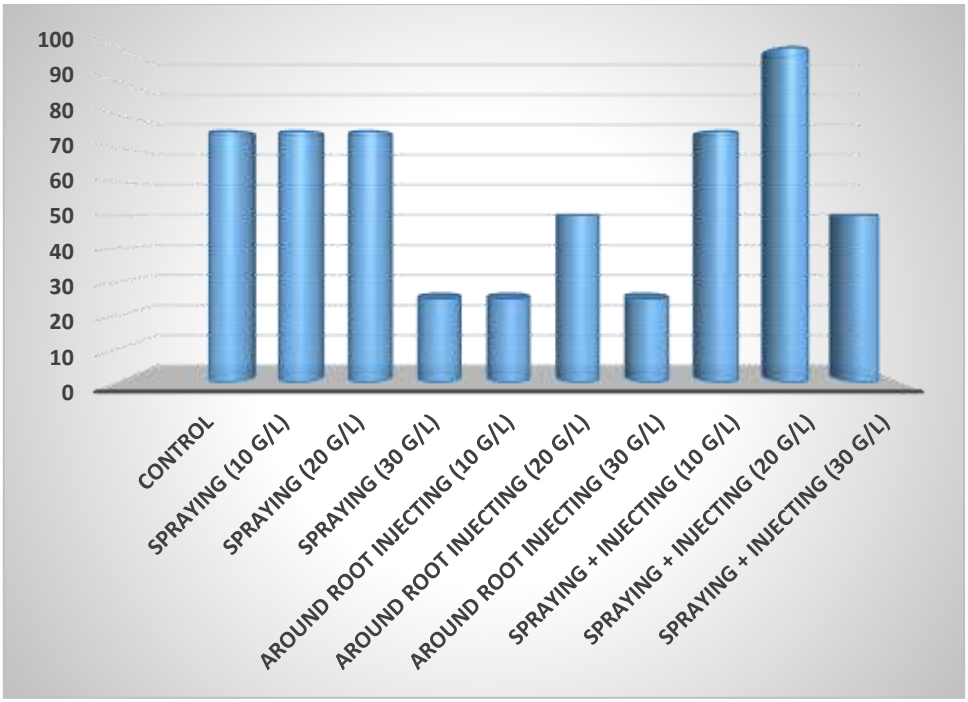

Figure 5: Effect of different concentration levels of yeast solution on germination percentage of fenugreek seeds

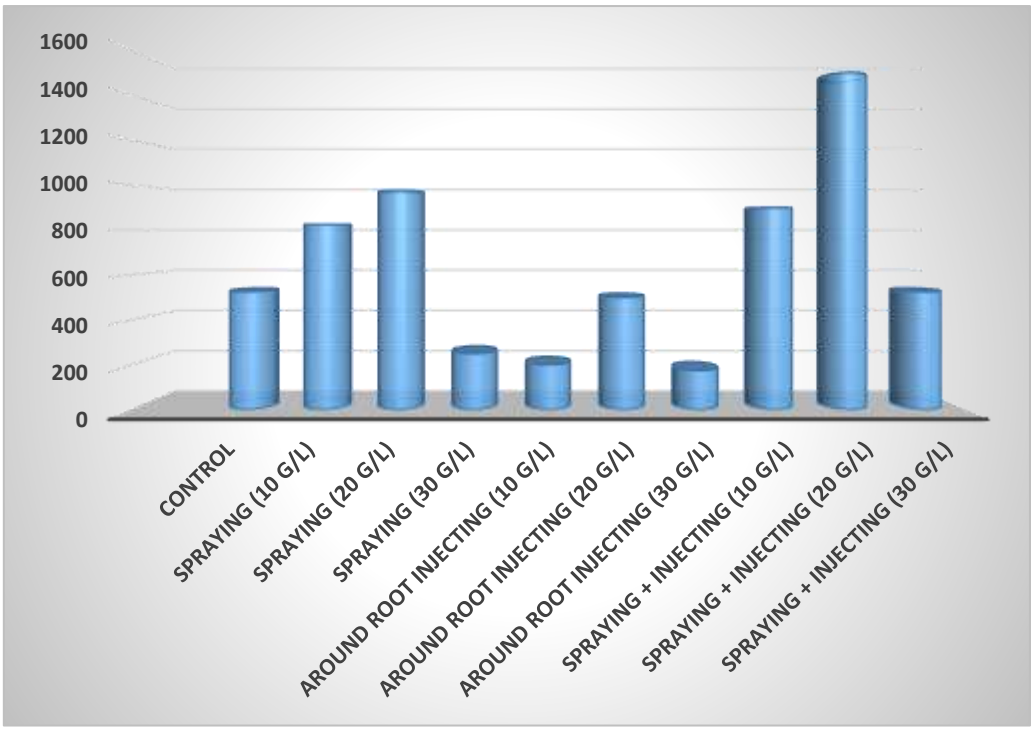

Figure 6: Effect of different concentration levels of yeast solution on seedling vigor index of fenugreek seeds

Figure 7: Effect of different concentration levels of yeast solution on fenugreek seeds

4- DISCUSSION

The ability of yeast to increases the production of plant growth promoters, particularly auxins, cytokinins, and gibberellins, which improve plant cell division and growth, may be the reason for its usage as an efficient plant fertilizer (Amer, 2004). More significantly, vital physiological functions like respiration and photosynthesis depend on micronutrients (Marschner, 1995). Micronutrient foliar spraying was found to enhance every growth indicator and biochemical activity examined in fenugreek plants (Ibrahim and Faryal, 2014). According to a study by Amal (2015), fenugreek plants in the Wadi El-Rayan region of Fayoum Governorate, Egypt, may benefit from

foliar spraying with baker's yeast at a rate of 400 liters per feddan to improve their productivity and nutritional condition.

Because tryptophan is a precursor for auxin synthesis, studies and research on yeast solution have shown that it has a positive influence on vegetative growth and internal nutrient content (Moor, 1979). In comparison to the untreated control, Mustafa and Abu Raya (2003) discovered that adding a yeast solution to the soil enhanced all examined growth characteristics of the Grand Nain banana plant. Mady also discovered in 2009 that applying yeast extract topically to fava bean plants (*Vicia faba*) significantly increased a number of growth factors, including leaf area, leaf chlorophyll concentration, number of leaves, and dry weight of leaves and stems. All growth markers in pea plants, including the stem, leaves, and internal nutritional content, were increased by yeast extract (Saleh and Issa 2014). According to a study by Jackson (1958), foliar spraying olive trees (*Olea europaea* L.) with a 1% yeast extract solution significantly increased the quantities of important mineral components including protein, phosphorus, and nitrogen in their leaves. Based to research (Chapman and Pratt, 1982) on bean plants (*Phaseolus vulgaris* L.) spraying the plants with a 4% yeast extract solution greatly enhanced in the dry weight of the treated plants. In comparison to untreated plants, the Batheena *et al.,* 2019 study found that applying a dry yeast solution at doses of 10 and 20 g/L via foliar spraying and root-zone injection improved the majority of vegetative growth traits and the internal nutritional content of treated plants. in particular, the treatment that combined root-zone injection and foliar spraying at a dosage of 10 g/L produced the highest rates of internal nutritional content and vegetative development.

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